Using Digital Tools for Information Management in Higher Education

Naghmeh Aghaee
Lund University, Lund, Sweden

nam.aghaee@ics.lu.se

Abstract: In recent years, Knowledge Management (KM) has gained significant attention within the Information Systems (IS) community. The economic importance of data and information, often likened to "data as the new oil," underscores the critical role of data/information/knowledge management. KM is crucial in both educational and organizational contexts. Despite growing interest, research in KM in Higher Education (HE) remains fragmented, especially with the rapid evolution of digital tools and Artificial Intelligence (AI). This paper explores the intersection of KM and HE, emphasizing the use of digital tools and platforms for knowledge acquisition among university students. An open survey conducted in Sweden among bachelor students enrolled in a digitalisation course revealed that digital tools are used frequently for knowledge acquisition and communication. The study highlights the benefits, challenges, and suggestions about how to use digital tools in KM in HE and the need for structured educational training to facilitate KM processes. It also advocates for new research avenues emphasizing the role of digital tools in HE and provides guidance for integrating technology into KM principles in HE.

Keywords: Higher Education, Digital Tools, Knowledge Management, Information Management, Generative Artificial intelligence

1. Introduction

Knowledge Management (KM) has recently received considerable attention in the information systems community and is continuously gaining interest by industry and academia (Quarchioni, et al., 2022; De Bem Machado, 2022). The increasing importance of information/knowledge (defined differently by Zins, 2007) play a fundamental role towards the success of gathering, using and transforming information, in an organizational perspective, especially in educational settings (Metaxiotis & Psarras, 2003). Previous articles outline the basic concepts within KM (Metaxiotis & Psarras, 2003; De Bem Machado, 2022) and specifically KM in Higher Education (HE) (Quarchioni, et al., 2022; Brewer & Brewer, 2010) as a concept for an ever-changing environment (Katz et al., 2022; Laal, 2011). KM is a systematic process by which knowledge needed for an organization to succeed in creating, capturing, sharing and leveraging (Laal, 2011).

There are numerous definitions of data, information, and knowledge, with no universally agreed-upon definitions (Zins, 2007). In this study, "information" is defined as data that is communicated, contextualized, and has a purpose or effect, while "knowledge" refers to the cognitive framework that enables individuals to understand and utilize the information (Beynon-Davies, 2019; Bellinger, Castro & Mills, 2004; Davis & Olson, 1984). Since information gathering is part of the knowledge management process, the terms "information management" and "knowledge management" may be used interchangeably in this study. Furthermore, although differentiating between explicit, tacit, and implicit knowledge is important in KM, this study focuses on tools for general knowledge acquisition and communication.

The rapid evolution and emergence of digital tools like Learning Management Systems (LMS), social media, and Generative Artificial Intelligence (GAI) have revolutionized productivity in KM in education (Aljawarneh, 2020; Dhamdhere, 2015; Eloundou et al., 2023; Hamid, 2020; Kurtz et al., 2024; Ouyang et al., 2022; Ritala et al., 2023; Shawar & Al-Sadi, 2010; Thorne, 2024). The impact of these digital tools, especially GAI, on higher education and knowledge acquisition is significant and inevitable (Aljawarneh, 2020; Bahrini et al., 2023; Eloundou et al., 2023; Ritala et al., 2023). While GAI tools promise increased accuracy, efficiency, and productivity, their potential for misinformation and hallucinations underscores the need for cautious use, as Large Language Models (LLMs) struggle with comprehensive problem-solving and input uncertainty, may lead to inaccuracies (Thorne, 2024). The unclear mechanisms behind AI-generated responses affect the validation and reliability of answers, raising concerns about trustworthiness and biases (Bahrini et al., 2023).

The literature (e.g., Brewer & Brewer, 2010; De Bem Machado, 2022) covers the importance of KM, the challenges organizations face, and the key activities necessary for effective knowledge acquisition and communication. Despite growing interest in KM within higher education (HE) and its critical role in organizations and academia (Quarchioni et al., 2022; Brewer & Brewer, 2010), research on integrating new digital tools into KM in HE remains limited. There is a noticeable gap in studies addressing the structured use of digital tools in

HE, and it is unclear if universities have recognized or addressed the sources of students' acquired knowledge. Additionally, it is uncertain whether educational programs adequately facilitate access to reliable resources or teach essential soft skills such as critical thinking and problem-solving (Aghaee & Karunaratne, 2023). Therefore, higher education institutions must ensure that they prepare students for emerging job profiles and professional success by providing appropriate educational environments (Williamson, 2021).

Although many digital tools are available and their uses are extensively analysed, this study considers the tools focused by the respondents. This study examines what digital tools students use to facilitate their knowledge acquirement and communication in courses and what are their needs to make this use more structured and academic. To address the above-mentioned gap to use digital tools in KM in HE, this study seeks to answer the following research questions: *What digital tools and platforms are used for knowledge management in higher education? How can digital tools be used effectively in knowledge acquisition?*

2. Digital Tools in Educational Information Management

Digital tools and platforms are essential for knowledge management (KM) in higher education (HE), helping to compile, store, and disseminate information generated by academic institutions (Hamid, 2020; Dhamdhere, 2015). In the modern educational environment, the use of digital tools for creating, capturing, sharing and leveraging knowledge has become ubiquitous (Di Vaio et al., 2021; Aljawarneh, 2020; Laal, 2011; Brewer & Brewer, 2010). They leverage advancements in computing and Internet usage deliver knowledge and make education accessible (Shawar & Al-Sadi, 2010; Aljawarneh, 2020) as well as facilitate sharing educational materials, such as file and information sharing (Whalen, 2008). Digital and online tools for obtaining information and facilitating communication enable the exchange of knowledge and experiences, and sharing information and documents among students and faculty, thus improving teaching quality and learning outcomes (Hamid, 2020; Aljawarneh, 2020; Di Vaio et al., 2021; Whalen, 2008).

Learning Management System (LMS) (discussed by Shawar & Al-Sadi, 2010; Kung et al., 2012) and social media have been identified as effective tools for facilitating the distribution and management of knowledge in educational settings (Hamid, 2020). The effective utilization of digital tools and social media in KM ensures that valuable knowledge is accessible anytime and anywhere (Hamid, 2020; Dhamdhere, 2015; Thorne, 2024). These digital tools play an important role in KM by providing a centralized knowledge base system for knowledge acquisition, management, sharing, mapping, and collaboration (Dhamdhere, 2015; Di Vaio et al., 2021; Hamid, 2020). Platforms such as LMSs (e.g., Moodle or Canvas) develop a collaborative academic environment and support academic interactions and activities, as students increasingly rely on them for continuous access to academic information about courses (Aljawarneh, 2020; Hamid, 2020; Bahrini et al., 2023; Shawar & Al-Sadi, 2010).

In the era of KM, global impact spans various domains, including education, which has transitioned from traditional face-to-face approaches to online knowledge attainment and management. The structure and efficacy of KM in HE is enhanced by digital tools and ubiquitous learning environments that provide seamless and context-aware learning experiences (Hamid, 2020; Dhamdhere, 2015; Di Vaio et al., 2021). These digital and Web-based platforms and tools like LMSs for information sharing and communication, enhance personalized learning and facilitate the integration of both authentic and digital resources (Aljawarneh, 2020; Shawar & Al-Sadi, 2010; Kung, et al., 2012). However, studies on which digital tools and media are used as part of formal education in courses and how they are perceived to be utilized are still quite limited.

Recent advancements in Natural Language Processing (NLP) have led to the development of Large Language Models (LLMs) and Generative Artificial Intelligence (GAI) such as GPTs (Generative Pre-training Transformer), significantly enhancing KM in different areas such as education by providing extensive relevant information (Hu et al., 2023; Taticchi et al., 2009; Kurtz et al., 2024; Jin et al., 2024). Digital tools like ChatGPT, Midjourney, Copilot, and Gemini promise to revolutionize society and transform education by reshaping learning and teaching practices (Kurtz et al., 2024; Bahrini et al., 2023). While GAI and GPTs may enable students to acquire targeted knowledge, the quality of this information depends on the used methods and tools, which may vary based on students' digital skills (Bahrini et al., 2023; Jin et al., 2024; Thorne, 2024; Mohamed Hashim et al., 2022; Bergdahl et al., 2020; Katz et al., 2022). Integrating unconfirmed tools in HE settings presents challenges such as inaccuracy, bias, overreliance on technology, and unequal access to resources (Taticchi et al., 2009; Kurtz et al., 2024; Thorne, 2024). Therefore, HE institutions must ensure the quality and relevance of the acquired knowledge while addressing these challenges.

Academic library services in HE have recently been enhanced by digital tools for incorporating KM principles and to improve the use of organizational information for effective learning (Mavodza, 2010). KM practices involve capturing, retaining, organizing, disseminating, and reusing knowledge, using digital libraries and scientific databases to access resources for educational purposes. Such resources are referred to as research tools, including Google Scholar, JSTOR, and university library websites, which provide support for academic research. In addition, research tools include reference management tools, like Mendeley, EndNote, RefWorks, and Zotero, as discussed by Butros and Taylor (2010). These tools help students access academic papers, conduct literature reviews, and manage references easier and more effective (Mavodza, 2010).

Productivity tools, such as Google Workspace (Tamayo & Mosquera, 2024) and Microsoft 365 (Mahliyo, 2024), support various educational activities like writing assignments, project management, and resource sharing, while also facilitating document creation, task management, and group collaboration. Their integration into course tasks and projects makes them important for regular academic operations (Tamayo & Mosquera, 2024; Mahliyo, 2024; Zhakota et al., 2024; Aljawarneh, 2020). Despite existing studies on their functionalities, these tools are often used with minimal teacher oversight, and university authorities are typically unaware of the usage for such tools. Students often do not officially learn to use these tools as a structured academic context (Zhakota et al., 2024).

1. Methodological Approach

To achieve the objective of this study, an exploratory survey approach was utilized, measuring the frequency of using digital tool and including open-ended questions to gain deeper insights into students' perceptions and use of technology. As students' digital skills, understanding, and use of digital tools can vary among Gen Z (Katz et al., 2022), especially across different disciplines (Mohamed Hashim et al., 2022; Bergdahl et al., 2020), the selected case study focused on a digitalization bachelor course at a university in Sweden, covering students from international business, economics, and informatics programs, participating in the course. The case was conveniently chosen, and the data was collected during the course, in spring term of 2024.

A semi-structured survey was used to collect anonymous data, reducing potential respondent bias. The study examined students' general views and use of digital tools in education. To improve transferability, a representative sample was drawn based on Bryman's (2006) guidelines. Open-ended questions aimed to capture students' perspectives in their own words (Creswell, 1999), investigated students' experiences with digital tools, including benefits, challenges, and suggestions for better use of digital tools in HE. The study received a total of 72 responses (n = 72 out of N = 91), achieving an 80% response rate for most closed-ended questions. Response rates for open-ended questions however ranged from 54% to 76%, and the final two questions were excluded due to insufficient responses.

The questionnaire covered three main segments of 1) digital tools used for information gathering and knowledge acquisition, 2) digital tools for communication and information/document sharing, and 3) suggestions for facilitating effective use of tools. The structured questions assessed the frequency of using digital tools or platforms (in different categories) on a Likert scale with five levels: from 'less than once a week' (level 1) to 'several times a day' (level 5). Students were asked to honestly answer to the questions and a consent form was presented before students participate in the survey. The respondents were given the option to terminate participation or skip any questions, if they did not wish to answer or continue. In this course, the library services and even some lectures were provided by the experts to show students how to use the academic research tools and even included the reference criticism aspects and introduced the reference management systems. The questionnaire did not gather any sensitive or personal data.

Both closed- and open-ended responses were analyzed qualitatively. Digital tools categories were developed based on the available literature and the intended use of them in coursework, knowledge acquisition, and group work and communications. The themes and sub-themes from the open-ended responses, summarized in Table 1, were developed to complement the developed categories.

2. Results and Discussion

Digital tools were categorized into five different categories to cover the information acquisition, communicating information and sharing files. The categories reflect students' insights into the tools students use for academic pursuits, knowledge acquisition, communication, and information sharing.

2.1 Categories of Digital Tools Used for KM in HE

Based on the result of this study, the first identified category is Learning Management System (LMS), a Moodle-based platform, specifically Canvas that is commonly used in Swedish universities in modern education to support KM and academic communication. This digital tool facilitates knowledge sharing and communication among different students and faculty staff (as also discussed by Shawar & Al-Sadi, 2010; Kung, et al., 2012). LMS adoption has surged in most Swedish higher education institutions. As discussed by earlier studies (Shawar and Al-Sadi, 2010; Kung, et al., 2012), the result shows that students use LMS platforms primarily to access course materials, submit assignments, and participate in discussion forums. However, this platform is not rated as an often used for communications in the courses. The daily use of LMS reflects the essential role of such platform in managing coursework and staying updated with academic requirements and gaining knowledge about the course and from the available materials. It also provides students to share their knowledge through forums or ask questions or add reflections. LMS platform: average scale of daily use due to their integral role in coursework.

The second category is social media and communication tools, which have become indispensable, especially for virtual learning and knowledge acquisition and sharing (as also discussed by Hamid, 2020). The result shows that these platforms enable students to join group meetings and interact with instructors during the online sessions. The indicated frequent use of social media including Zoom, Microsoft Teams, Messenger, Google Meet, highlights the importance of such tools as a complement to the physical meetings, in maintaining knowledge management and communication. While these tools are primarily used for interactions, students seem to use these tools often for sharing knowledge and resources, following educational content, and learning in their formal learning through discussion forums such as Discord and WhatsApp. The common use of such social media and communication tools for educational purposes indicates their important role in the academic toolkit and knowledge management. Communication through social media and different tools varied much with a result from several times a day to less consistently used for educational purposes. This is in confirmation of previous studies claiming the use of digital tools may vary based on students' digital skills, understanding, generation, and disciplines (Katz et al., 2022; Mohamed Hashim et al., 2022; Bergdahl et al., 2020).

The third category is Generative AI-based tools, which are increasingly being adopted by students in HE (Bahrini et al., 2023; Jin et al., 2024; Thorne, 2024). Based on the results of this study, this category of tools has quite high frequency use for various academic purposes. The result shows that AI-based tools or GAIs such as ChatGPT and Gemini, assist students for instance in generating ideas, drafting essays, and providing explanations for complex topics. The use of ChatGPT and similar AI tools shows the growing importance of AI in supporting students' learning processes both in the closed- and open-ended questions in this study and the frequency of mentioning GAI tools in the survey was noteworthy (in line with the studies such as Bahrini et al., 2023; Jin et al., 2024; Thorne, 2024). The result shows that GAI Tools are regularly used (toward a daily use), as some respondents mentioned especially during writing-intensive tasks.

The final two categories in this study address productivity tools and research tools. Results indicate that productivity tools, such as Google Workspace (Tamayo & Mosquera, 2024) and Microsoft 365 (Mahliyo, 2024), are frequently used for document creation, task management, and group collaboration, with usage varying according to project needs and deadlines. In contrast, research tools like Google Scholar, scientific databases and university library websites (Mavodza, 2010) are used periodically for academic research, assisting in research, accessing academic papers, and managing references with tools such as Mendeley (Butros & Taylor, 2010). As confirmed by earlier studies (Mavodza, 2010; Butros & Taylor, 2010; Tamayo & Mosquera, 2024; Mahliyo, 2024; Zhakota et al., 2024; Aljawarneh, 2020), the result also confirms the importance and use of both productivity and research tools for tasks like writing research reports and accessing course materials and scientific references. However, while productivity tools are used daily (quite frequently), research tools are indicated by lower frequency use in Figure 1, compared to all other categories of tools.

Figure 1 shows the frequency of use for each category mentioned above. The name of the categories in the survey, as shown in Figure 1, were simplified to enhance student understanding and were later modified based on data analysis and the results of open-ended questions. Category 1, "Learning Management System (LMS)," was "Online learning platform (e.g., Canvas)." Category 2, "Social media and communication tools," was "Scientific search platforms like Google Scholar and library websites." Category 3, "Generative AI-based tools," was "GPT or any AI-based system to obtain information and clarifications (such as ChatGPT, MS-Copilot)." Category 4, "Productivity tools," was "Online platforms for sharing files (e.g., Google Docs)." Category 5, "Research tools," was "Online forum for peer discussion/chat (Discord, WhatsApp)". Figure 2 displays the most frequently mentioned digital tools as a word cloud, based on 156 words provided by respondents. Although the

word cloud is frequency-based, the focus is not on quantitative analysis; instead, the text size indicates the prominence of specific digital tools.

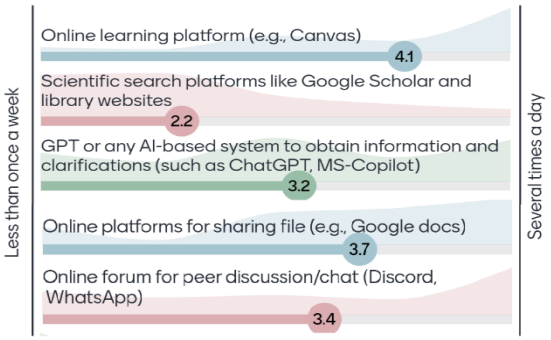


Figure 1: Frequency of the use of digital tools

Figure 2: The most frequently used digital tools

2.2 Themes and sub-themes Presenting the Purpose of Using Digital Tools

Based on the thematic analysis of qualitative data obtained from open-ended questions, the following primary themes, each with associated sub-themes, were developed. A summary of these themes and sub-themes is presented in Table 1. However, these themes and sub-themes are not mutually exclusive and may have some degree of overlap. This thematic framework provides a structured summary of students' perceptions regarding the benefits and challenges of digital tools and summarizes students' suggestions for enhancing the effective utilization of digital tools in higher education.

Table 1: Themes and subthemes to present the purpose of using digital tools

Theme	Sub-theme	Study result and respondents' reflections	Relevant literatures
Benefits of digital tools in KM in HE	Course Management	Accessing Canvas LMS for managing course information: essentially used for tracking course materials, submitting assignments, and checking grades. This tool helps students stay organized and meet academic deadlines.	Williamson, 2021; Shawar & Al-Sadi, 2010; Laal, 2011; Kung, et al., 2012
	Accessing Academic information	Research tools like Google Scholar and library databases provide access to trusted and reliable scholarly source of information and academic contents; crucial for academic learning, conducting research and gathering information for the assignments.	Quarchioni, et al., 2022; Mohamed Hashim et al., 2022; Brewer & Brewer, 2010; Mavodza,2010
	Resource use and information management	Access sources of information anywhere/anytime, both academic resources and AI-based generated information. Use of reference management and online documents enable students to share information and resources (such as reference management tools); essential for maintaining academic flexibility, integrity, and collaboration producing good quality work.	Hamid, 2020; Whalen, et al., 2008; Metaxiotis & Psarras, 2003; Dhamdhere, 2015; Thorne, 2024; Laal, 2011
	Virtual learning and real-time interactions	Social media such as Discord and even messenger facilitate live online discussion, collaboration, and getting clarifications. Other platforms such as Zoom and Microsoft Teams provides supports for real-time meetings and discussions among group members, which enhance collaborative learning and even online supervisions and getting guidelines.	Di Vaio et al., 2021; De Bem Machado, 2022; Aljawarneh, 2020; Tamayo & Mosquera, 2024; Mahliyo, 2024; Zhakota, et al., 2024;
	Project coordination	Managing group tasks and collaborating on common documents and streamlining project coordination. Tools like Google Workspace are part of the project coordination and knowledge management and sharing in group assignments.	Whalen, et al., 2008; Metaxiotis & Psarras, 2003; Dhamdhere, 2015; Butros and Taylor, 2010

Theme	Sub-theme	Study result and respondents' reflections	Relevant literatures
	AI-based information resources	Generative AI tools like ChatGPT and Gemini assist in knowledge acquisition, getting quick reply, access to responses and knowledge developed by GAI anywhere/anytime. GAI tools support brainstorming and drafting, which may increase efficiency and productivity.	Taticchi, et al., 2009; Ritala et al., 2023; Kurtz et al., 2024; Jin, et al., 2024; Hu et al., 2023
Challenges of digital tools in KM in HE	Negatively influence on students' soft skills	Influencing negatively on students' soft skills such as problem-solving and innovative thinking due to overreliance. Enabling a seamless transition to use GAI as a virtual learning environment more than using the assigned academic or scientific resources.	Kurtz et al., 2024; Eloundou et al., 2023; Bahrini et al., 2023
	Reliability of resources and unproved resources for knowledge acquisition	Digital tools which are not certified by academia or teachers may mislead students due to potential inaccuracies and the lack of reliable sources and references to the answers they provide. Assistance with complex problem-solving and the explanation of questions can negatively impact students' development of soft skills, particularly those related to knowledge management skills.	Thorne, 2024; Jin, et al., 2024; Bahrini et al., 2023; Kurtz et al., 2024; Taticchi, et al., 2009; Aghaee & Karunaratne, 2023
	Technical Issues	Students reported problems with internet connectivity and software glitches, hindering their ability to utilize digital tools fully, which is also connected to varies digital skills.	Katz et al., 2022; Laal, 2011; Zins, 2007.
	Learning Curve	Adapting to new tools and platforms without academic and clear instructions would pose difficulties for some students and create barriers to efficient usage and productivity.	Bergdahl et al., 2020; Katz et al., 2022
Suggestions for Improvement	Guidelines for Reliable Resources	Providing guidelines to use existing tools and reliable resources can lead students to formal learning channels and prevent reliance on unproven knowledge.	Hu et al., 2023; Zhakota et al., 2024
	Better Training	More training and tutorials, such as workshops or additional lectures about the use of tools to help students utilize digital tools effectively; enhancing ability to navigate and critically learn from using such tools and maximize these technologies' potential.	Aljawarneh, 2020; Bergdahl et al., 2020: Zhakota et al., 2024
	Integration of Tools	Better integration between digital tools in different categories of tools and academic courses to streamline the learning process, reduce the complexity of managing multiple tools, and improve efficiency. Integrate using tools such as ChatGPT as an educational help and explain the benefits and risks, to make students understand how to use them pedagogically in courses.	Hu et al., 2023; Bahrini et al., 2023

2.3 Benefits and Challenges of Using Digital Tools

Building on prior research (Hamid, 2020; Bahrini et al., 2023; Jin et al., 2024; Thorne, 2024; Tamayo & Mosquera, 2024; Mahliyo, 2024; Zhakota et al., 2024; Aljawarneh, 2020), the result of this study emphasizes the critical role of digital tools in knowledge acquisition and communication in higher education. As previous studies reflect on the positive impact of digital tools on education (Mohamed Hashim et al., 2022; Bergdahl et al., 2020; Williamson, 2021; Quarchioni et al., 2022), this study confirms that most students frequently use technology and digital tools, even for on-campus courses. This extensive use of digital tools underscores the importance of their integration into educational activities and the need of clarifying their role for an effective learning environment.

The results indicate that digital tools like Canvas LMS are primarily used for effective course administration and knowledge management, confirming prior research (by Williamson, 2021; Shawar & Al-Sadi, 2010; Laal, 2011; Kung et al., 2012). Canvas enhances student organization and adherence to course deadlines and tasks by facilitating access to academic resources, managing course materials, facilitating assignment submissions, and enabling grade tracking. This underscores the importance of linking LMSs to other digital productivity and research tools, such as Google Scholar and library databases, to instruct students on how to access and use scholarly resources for academic knowledge.

In line with earlier studies (Di Vaio et al., 2021; Whalen et al., 2008; Metaxiotis & Psarras, 2003; Dhamdhere, 2015; De Bem Machado, 2022; Aljawarneh, 2020), this study highlights the role of social media and communication tools in virtual learning environments and project coordination. Platforms like Zoom, Microsoft

Teams, Google Meet, and messaging apps like Discord, WhatsApp, and Messenger facilitate live discussions, collaborations, and interactions among students and instructors. Tools like Google Workspace streamline group tasks and project management, promoting knowledge sharing within group assignments and adhering real-time communication and collaborative learning

As in previous studies (e.g., Ritala et al., 2023; Kurtz et al., 2024; Jin et al., 2024; Hu et al., 2023; Zins, 2007), the results of this study indicate that GAI tools facilitate rapid information acquisition, by providing quick responses and easy information access. Tools such as ChatGPT and Gemini were frequently used by respondents, despite their relatively recent emergence. Respondents reported using these tools for brainstorming and report drafting, potentially enhancing their productivity (also noted by Taticchi et al., 2009; Ritala et al., 2023; Kurtz et al., 2024). However, the uncertainties and risks associated with the use of GAI-based tools, including the potential to diminish students' soft skills such as critical thinking and independent problem-solving, which are already underemphasized in higher education (discussed also by Aghaee & Karunaratne, 2023).

2.4 Research Contributions

The study results reveal an overreliance on social media and GAI tools, with a higher frequency of use compared to research tools (Figure 1: 3.2 vs. 2.2). Figure 2 highlights ChatGPT, Google Docs, and Google as the most frequently mentioned tools, comparable to the official LMS platform (Canvas), while fewer students mention the use of scientific resources like Google Scholar and library databases, which are crucial for higher education (as indicated by Mavodza, 2010; Butros & Taylor, 2010; Tamayo & Mosquera, 2024; Zhakota et al., 2024). This underscores a cautionary note as social media and GAI tools, which may lack academic certification and reliable references, are more frequently used for formal learning and educators need to provide guidelines on using these tools pedagogically.

Consistent with other research (Kurtz et al., 2024; Taticchi et al., 2009; Thorne, 2024; Jin et al., 2024; Bahrini et al., 2023), the integration of GAI tools must be carefully considered to avoid negative impacts on skill development and ensure information credibility. The lack of systematic integration into academic workflows is a concern. As summarized in Table 1, while GAI tools assist with complex problem-solving and question explanations, their use may hinder the development of crucial knowledge management skills (as indicated by Kurtz et al., 2024; Eloundou et al., 2023; Bahrini et al., 2023), affecting students' ability to independently manage and evaluate information.

The study's findings emphasize the need for instructional academic sessions to teach students the how to use digital tools effectively and academically. Katz et al. (2022) noted the variation of digital proficiency within Gen Z, and respondents in this study highlighted the role of digital skills in today's educational landscape. Therefore, integrating education and training on digital tools into academic curricula can streamline learning processes, simplify tool management, enhance efficiency, and bridge the gap in digital proficiency.

3. Concluding Remarks

This study has explored the landscape of digital tools for knowledge management (KM), shedding light on the use of various tools and applications in higher education (HE). To answer the first research question, the findings highlighted the important role of digital tools often used daily by students in five main categories: Learning Management Systems (LMS), social media and communication tools, generative AI-based tools, productivity tools, and research tools. These tools facilitate knowledge acquisition and sharing, interactions among students and faculty, enhancing accessibility to educational resources and developing the collaborative learning while exceeds physical boundaries.

In addition, to answer to the second research question, the study reveals the benefits and challenges associated with the integration of digital tools. The challenges include issues of knowledge reliability, overreliance on technology, and the need for comprehensive training to optimize the digital tools' pedagogical impacts. There is a clear imperative for HE institutions to strategically integrate digital tools into their curricula while addressing these challenges. This integration should be accompanied by training programs, workshops and educational sessions, to empower students to use these tools pedagogically for academic purposes.

Moreover, educators must ensure that digital tools supplement, rather than replace, traditional methods of knowledge acquisition, thereby facilitating the development of soft skills such as critical thinking and independent problem-solving as well as motivating students to use reliable scientific and peer reviewed references which are more evidence-based. By doing so, KM in HE can employ the full potential of digital tools

to prepare students for the complexities of modern workplaces and cultivate lifelong learners capable of navigating the evolving landscape of knowledge management.

This study contributes to the ongoing discourse on digital transformation in education, highlighting both the opportunities and responsibilities associated with leveraging digital tools for educational purposes. As educational settings continue to evolve, adopting digital tools in a purposeful and balanced manner will be essential for enhancing learning outcomes and preparing students for success in a knowledge-driven society. Further studies would be valuable to explore student's experiences and perception of using digital tools in-depth.

References

Aghaee, N. and Karunaratne, T. (2023) Soft Skills Demand and Supply Through the Lens of Higher Education Students. *In 22nd European Conference on e-Learning (ECEL 2023)*, Vol. 22, No. 1, pp 1-10. Academic Conferences and Publishing International Limited.

Aljawarneh, S.A. (2020) Reviewing and exploring innovative ubiquitous learning tools in higher education. *Journal of computing in higher education*, Vol 32, No. 1, pp 57-73.

Bahrini, A., Khamoshifar, M., Abbasimehr, H., Riggs, R.J., Esmaeili, M., Majdabadkohne, R.M. and Pasehvar, M. (2023) ChatGPT: Applications, opportunities, and threats. In *2023 Systems and Information Engineering Design Symposium (SIEDS)*, pp 274-279. IEEE.

Bellinger, G., Castro D., & Mills, A. (2004) *Data, Information, Knowledge, and Wisdom.* Available at: www.systems-thinking.org/dikw/dikw.htm (accessed: July 2024).

Bergdahl, N., Nouri, J. and Fors, U. (2020) Disengagement, engagement and digital skills in technology-enhanced learning. *Education and information technologies,* Vol 25, No. 2, pp 957-983.

Beynon-Davies, P. (2019) *Business information systems*. England: Bloomsbury Publishing.

Brewer, P.D. and Brewer, K.L. (2010) Knowledge management, human resource management, and higher education: A theoretical model. *Journal of Education for Business*, Vol 85, No. 6, pp 330-335.

Bryman, A. (2006) Integrating quantitative and qualitative research: How is it done? *Qualitative Research*, Vol 6, No. 1, pp 97–113.

Butros, A., & Taylor, S. (2010) Managing information: evaluating and selecting citation management software, a look at EndNote, RefWorks, Mendeley and Zotero. In *Netting knowledge: two hemispheres/one world: proceedings of the 36th IAMSLIC Annual Conference* (pp 17-21). USA: IAMSLIC.

Davis, G. B., & Olson, M. H. (1984) *Management information systems: Conceptual foundations, structure, and development*. McGraw-Hill, Inc.

De Bem Machado, A., Secinaro, S., Calandra, D. and Lanzalonga, F. (2022) Knowledge management and digital transformation for Industry 4.0: a structured literature review. *Knowledge Management Research & Practice,* Vol 20, No. 2, pp 320-338.

Dhamdhere, S.N. (2015) Importance of knowledge management in the higher educational institutes. *Turkish Online Journal of Distance Education*, Vol 16, No. 1, pp 162-183.

Di Vaio, A., Palladino, R., Pezzi, A. and Kalisz, D.E. (2021) The role of digital innovation in knowledge management systems: A systematic literature review. *Journal of business research*, Vol 123, pp 220-231.

Eloundou, T., Manning, S., Mishkin, P., & Rock, D. (2023) *GPTs are GPTs: An Early Look at the Labor Market Impact Potential of Large Language Models*. Available http://arxiv.org/abs/2303.10130 (accessed: July 2024).

Hamid, S.A. (2020) Knowledge management using social media tools in higher education institution. *Recent Trends in Information Technology and its Application*, Vol 3, No. 1, pp 2020.

Hu, X., Tian, Y., Nagato, K., Nakao, M. and Liu, A. (2023) Opportunities and challenges of ChatGPT for design knowledge management. *Procedia CIRP*, Vol 119, pp 21-28.

Jin, Y., Yan, L., Echeverria, V., Gašević, D. and Martinez-Maldonado, R. (2024) Generative AI in Higher Education: A Global Perspective of Institutional Adoption Policies and Guidelines. *arXiv preprint arXiv:2405.11800*.

Katz, R., Ogilvie, S., Shaw, J. and Woodhead, L. (2022) *Gen Z, explained: The art of living in a digital age*. University of Chicago Press.

Kung, S.M., Mat Yamin, F. and Wan Ishak, W.H. (2012) *Design, purpose of usage and the impact of LMS on student learning: A preliminary findings*. In: Knowledge Management International Conference (KMICe) 2012, Johor Bahru, Malaysia.

Kurtz, G., Amzalag, M., Shaked, N., Zaguri, Y., Kohen-Vacs, D., Gal, E., Zailer, G. and Barak-Medina, E. (2024) Strategies for Integrating Generative AI into Higher Education: Navigating Challenges and Leveraging Opportunities. *Education Sciences*, Vol 14, No. 5, pp 503.

Laal, M. (2011) Knowledge management in higher education. *Procedia computer science*, Vol 3, pp 544.

Mahliyo, T. (2024) OFFICE PROGRAMS AND THEIR NEW CAPABILITIES. *MASTERS*, Vol 2, No. 3, pp 49-51.

Metaxiotis, K. and Psarras, J (2003) Applying knowledge management in higher education: the creation of a learning organisation. *Journal of Information & Knowledge Management*, Vol 2, No. 04, pp 353.

Mohamed Hashim, M.A., Tlemsani, I. and Matthews, R. (2022) Higher education strategy in digital transformation. *Education and Information Technologies,* Vol 27, No. 3, pp 3171-3195.

Mavodza, J. (2010) *Knowledge management practices and the role of an academic library in a changing information environment: the case of the metropolitan college of New York*. Doctoral dissertation, University of South Africa.

Quarchioni, S., Paternostro, S. and Trovarelli, F. (2022). Knowledge management in higher education: a literature review and further research avenues. *Knowledge Management Research & Practice*, *20*(2), pp.304-319.

Ritala, P., Ruokonen, M. and Ramaul, L. (2023). Transforming boundaries: how does ChatGPT change knowledge work?. *Journal of Business Strategy*, (ahead-of-print).

Shawar, B.A. and Al-Sadi, J. (2010) Learning management systems: are they knowledge management tools?. *International Journal of Emerging Technologies in Learning (iJET)*, Vol 5, No. 1, pp 4-10.

Tamayo, B.M.C. & Mosquera, S.W.E (2024) *Peer-review through online tools and the writing skill.* Bachelor's thesis, Universidad Técnica de Ambato-Facultad de Ciencias Humanas y de la Educación-Carrera de Pedagogía de los Idiomas Nacionales y extranjeros.

Taticchi, P., Tonelli, F., Hernandez, E. and Cagnazzo, L. (2009) Implementation of a Knowledge Management Tool within a Virtual Organization: the GPT Case Study. *innovation*, Vol 13, pp 14.

Thorne, S. (2024) Understanding the Interplay between Trust, Reliability, and Human Factors in the Age of Generative AI. *International Journal of Simulation--Systems, Science & Technology*, Vol 25, No. 1.

Williamson, B. (2021) Making markets through digital platforms: Pearson, edu-business, and the valuation of higher education. *Critical Studies in Education,* Vol 62, No. 1, pp 50-66.

Whalen, T., Toms, E. and Blustein, J. (2008) File sharing and group information management. *Personal Information Management:* PIM, 2008.

Zhakota, D., Kushch, D., Mnichovich, M., Malyugin, N., & Donchenko, N. (2024) Student research group: how to organize the management of a distributed team?. *Authorea Preprints*.

Zins, C. (2007) Conceptual approaches for defining data, information, and knowledge. *Journal of the American society for information science and technology,* Vol 58, No. 4, pp 479-493.

Knowledge Exchange in the Context of Remote Work: Generation Z Perspective

Anna Albrychiewicz-Słocińska
Department of Applied Sociology and Human Resource Management, Faculty of Management, Częstochowa University of Technology, Poland

a.albrychiewicz-slocinska@pcz.pl

Abstract: The key element of knowledge management is that all knowledge, both explicit and tacit, accumulated by an organization becomes easily accessible to each of its members. This is important for decision-making processes and allows the organization to become more agile. In the literature there is an increasingly common attitude that more attention should be paid not only to the technological but also to the human aspect of knowledge management. The processes of knowledge exchange among employees have been subject to extensive research and studies, yet the recent years have added another thread to the discussion about the matter, i.e. a significant proportion of employees switching to the online work model. The aim of this article is to demonstrate how issues of knowledge exchange and learning influence preferences in choosing the form of work in the future. Based on the findings of the studies conducted on a group of employees representing Generation Z, the Principal Component Analysis (PCA) technique and was applied to organize the factors with the highest relevance for the respondents in online work. Cluster analysis was used for segmentation purposes. PCA demonstrated that the components recognized as most important were those relating to knowledge transfer and their impact on employee efficiency, and on the other hand employee relations as a factor that supports the learning processes. Cluster analysis proved that learning and knowledge exchange opinions have an impact on the form of work preferences.

Keywords: Learning, Knowledge Exchange, Remote Work, Generation Z

1. Introduction

The knowledge resources of the organization and its members constitute the heart of the organization's functioning. However, this potential can be used and used up to build a competitive advantage only when it is diagnosed, located, developed and multiplied through permanent exchange. Knowledge is currently treated as a type of enterprise resources and therefore an element that is subject to management rules to the same extent as other organizational resources. The characteristic features of knowledge according to G. Probst, S. Raub, K. Romhardt (2004, p.26) are that it is: ordered, complex, context-dependent, dependent on the person using it and is reflected in behavior models. However, this division does not take into account the remaining basic universal principles of knowledge, namely:

- knowledge is born and located in the minds of people;
- sharing knowledge is based on trust;
- new technologies create new knowledge exchange behaviors;
- knowledge sharing must be supported and rewarded by the organization;
- knowledge exchange initiatives must be implemented in a planned manner, with quantitative and qualitative evaluation metrics defined;
- knowledge and innovation are the result of creativity, which should be encouraged and developed in many unusual and unconventional ways.

There are two basic knowledge management strategies: a strategy based on codification and personalization. The first one assumes the use of computer techniques as a basic tool for acquiring, processing and storing knowledge. This approach is characterized by a high level of centralization of knowledge management. The second type of knowledge management strategy is based on the assumption that knowledge is closely related to the person who possesses, processes and shares it. The main goal of this strategy is to create an appropriate organizational climate that favors direct contacts between organization members.

The aim of this article is to demonstrate how issues of knowledge exchange and learning influence preferences in choosing the form of work in the future.

2. Theoretical Foundations of the Issue

According to the concept of I. Nonaka, R. Toyoma (2007), people do not acquire knowledge passively; they interpret it and adapt it to their own situation and perspective. Referring to the personalization strategy in the field of knowledge transfers (which will be the research assumption of this study), we focus on individual

employees, their characteristics and mutual relations that favor or limit knowledge flows (social capital, human capital, intellectual capital) and on intra-organizational factors (tangible and intangible) that support these processes (i.e. IT systems, physical work environment, human resources management, project management, etc.).

The basic division of knowledge that can be found in the literature on the subject (Akhmadi & Tsakalerou, 2022; Bloodgood & Chen, 2021; González-Ramos et al., 2023) is the division into explicit and hidden, as well as declarative and procedural knowledge. Declarative knowledge, most often in an explicit form, is knowledge of the "I know what" type, while knowledge of a procedural and tacit nature is knowledge of the "I know how" type. Explicit and declarative knowledge, due to its verbalized nature, has existed in organizations for a long time and is subject to management processes. Tacit and procedural knowledge and methods of its transformation towards explicit and declarative knowledge are currently attracting greater attention of researchers.

Therefore, one of the key elements of knowledge exchange is the transformation of unnamed knowledge (which is "owned" by each employee) into named knowledge. This is a necessary process so that tacit knowledge can be passed on. It is in the process of transforming tacit knowledge into accessible and back into tacit knowledge that organizational knowledge is created. In this approach (identified with the Japanese approach (Nonaka & Takeuchi, 1995)), we treat the organization as a living organism - knowledge "must be felt", it must be experienced, it cannot be acquired only through education and training. Western companies believe that the organization is a machine serving only for processing information and knowledge and not for generating knowledge. The result of this approach is the assumption that only available knowledge is important, which is communicable, ordered and formalized in the form of hard data, scientific formulas and universal principles. According to the Japanese approach, knowledge should be treated differently. It is believed that knowledge expressed in numbers and words is just the tip of the iceberg. The most important is hidden knowledge, difficult to notice and verbalize. This is individual knowledge, difficult to formalize, based on the subjective participation of intuition and premonitions. It results from individual action and experience and is deeply hidden in individual ideals, values and emotions. Tacit knowledge can be understood in two dimensions (Hau et al., 2013):

- technical - know-how (often people who have it cannot express it based on scientific and technical principles) and
- cognitive – composed of patterns, mental models, beliefs and perceptions that are so deeply rooted that they are taken for granted.

Taking into account the above, knowledge exchange in the context of remote work can be understood in two ways. Adopting a codification approach, this form of work does not pose major obstacles to locating, storing or even creating knowledge, information processes and learning. However, if we analyze the problems of knowledge exchange from the perspective of the personalization approach (and this is the approach shared by the author of the study), remote work creates numerous obstacles to the exchange of knowledge between employees, their development and, consequently, effective work.

These regularities are confirmed in the publications of Kucharczyk (2023) based on "The Economist". Many publications, especially those created during the pandemic and earlier, raised the advantages of remote work, basing their conclusions on the publication by Emanuel & Harrington (2020), which emphasized the increase in productivity and efficiency among employees working remotely compared to stationary employees. These opinions expanded their circles of popularity even in the face of the fact that the same authors, in their subsequent publications based on more accurate and detailed data (Emanuel & Harrington, 2023b, 2023a), revised their views, pointing to opposite conclusions, which was also confirmed by research (Atkin et al., 2023;Gibbs et al., 2022). The cited research results emphasize, among other things, that remote communication is not conducive to solving everyday matters at work, and teleconferences are only an imitation of office meetings (Szombathelyi et al., 2023). In remote work, the coordination of many processes takes longer, becomes more complicated, formalized and therefore less effective. Remote work causes stagnation in development, both professional and social (Yarbrough & Ramos Salazar, 2023). According to Emanuel et al., (2024), people working on-site acquire the skills needed to effectively perform their duties more quickly.

The discussed issues gain additional value if employees representing the youngest generation of employees are taken as a reference point. For representatives of this generation, communication tools used in remote work dominate over the form of direct communication (Zeer et al., 2021). Through them, young employees build relationships, learn, acquire knowledge and share it. It should be noted, however, that for representatives of Generation Z, knowledge is sometimes identified with the category of information (Szymkowiak et al., 2021). Interestingly, for this generation, knowledge is not a competitive good (Albrychiewicz-Słocińska, 2022;

Bloodgood & Chen, 2021). However, the research results draw attention to the fact that in relation to Generation Z, there may be problems related to the exchange of knowledge understood as learning and teaching others (Sekala et al., 2023), which may result from different generational characteristics, including the values they profess, attitude towards work and expectations towards it, and adaptability to the work environment (Maloni et al., 2019; Cresnar and Nedelko, 2020; Chillakuri, 2020; Barhate and Dirani, 2021; Snieska et al., 2020). Noteworthy are the lack of competences in naming and expressing knowledge, which is tacit knowledge and often not realized by the employee himself, i.e. deficiencies in social and communication skills (Hegade & Shettar, 2022; Steyn et al., 2020). The above-mentioned competence deficiencies undoubtedly disturb their efforts to acquire professional experience early, engage in various types of activities, including volunteering, and believe in the need to build social capital, i.e. a network of contacts (Sidor-Rządkowska, 2023, p. 31).

3. Methodology

The research results presented in the study are part of a quantitative survey on "Managerial aspects of remote work management", carried out among young people working remotely, representing Generation Z. The most popular division in the literature assumes that Generation Z includes people born after 1995, although some researchers sometimes include among its representatives those born in 1990, and in others only those who were born in 2000 and later (Dreyer & Stojanová, 2022; Skýpalová et al., 2023; Urick et al., 2017) .

Due to the fact that there is no statistical data on the number of people representing Generation Z, the size of the population of people working in Poland in the age range of interest to researchers (15-34 years of age) was established at 4,802,000 people (GUS, 2022). For the population estimated in this way, with the following statistical assumptions: fraction size: 0.5; confidence level: 95%; maximum error: 5%, the size of the research sample was set at 384 people.

The study was carried out using quantitative research methods, using the CATI (Computer Assisted Telephone Interview - 50% of respondents) and CAWI (Computer Assisted Web Interview - 50% of respondents) techniques in December 2022. The study covered young people from Generation Z whose experience of remote work lasted at least year 2022.

The research tool used is a standardized questionnaire consisting of 57 closed statements and 8 questions regarding the socio-demographic characteristics of the respondents. A Likert scale was used for the responses (Kaczmarek, 2013), which allows determining the relative intensity of different responses (Babbie, 2004, p.192). The research tool (questionnaire) is original and was prepared by members of the research team - employees of the Department of Applied Sociology and Human Resources Management, Faculty of Management, Częstochowa University of Technology.

In the process of developing the research results, the principal component analysis (PCA) method was used, which is one of the most popular statistical techniques used as part of factor analysis, used in the area of analyzing respondents' behavior and attitudes (Pupelis & Šeinauskienė, 2023). The analytical procedure in the principal components method is described in the literature on the subject, especially in the field of psychological and social research methodology (Capecchi et al., 2023; Lloyd et al., 2023; Okóń, 1968). The use of principal components analysis requires variables measured on an interval scale, but it can also be used for measurements carried out on five- and seven-point ordinal scales (Sagan 2004, p. 89).

Cluster analysis was used for segmentation purposes. The cluster analysis method, also called feature and object segmentation, is an example of an analysis consisting in searching for and extracting clusters from data, i.e. groups of similar objects. Correctly performed cluster analysis allows for dividing the data set into groups in order to better understand the information contained therein and to determine the properties of groups of similar objects and their synthetic characteristics. (Korzeniewski, 2012, p. 5). However, the idea of cluster analysis (Zakrzewska, 1994, p. 21) is to divide a set of objects or variables into classes without a pre-existing external criterion. Both statistical methods were implemented using the STATISTICA program.

4. Research Results

According to the principal components analysis algorithm presented earlier, 57 variables were analyzed. The scale used in the responses was as follows: 1 - I completely disagree, and 5 - I completely agree. Four questionnaire validity procedures have been used: content (Rossiter 2008), face (Czakon 2014), construct (Cronbach and Meehl 1955) and nomological (Czakon 2014) ones. The scale reliability was validated using Cronbach's alpha that is a measure of internal consistency (α = .970019). The correlation analysis was preceded

by an assessment of the values of the obtained descriptive statistics, in particular the standard deviation. In both conducted measurements, standard deviation values other than zero were obtained for all variables. Based on the correlation analysis, two low-correlated items were eliminated from the set of 57 statements: "remote work leads to a feeling of isolation" and "remote work places emphasis on written communication (e-mails, text messages, etc.)". There were few statistically significant correlations for these variables. The obtained values of the KMO index = 0.968 (Kaiser-Meyer-Olkin) and the Barlett's Test of Sphericity (result close to zero) for 55 variables allowed a positive decision to be made regarding the possibility of using principal components analysis to explain the structure of the correlation matrix.

After performing the scree test and using the Kaiser's eigenvalue criterion, 7 factors (components) were isolated, which explain a total of 72.23% of the variance (Table 1).

The analysis of the main components allows us to conclude that the opinions on remote work expressed by Generation Z employees, in relation to the conducted study, can be reduced to seven dimensions, the first two of which: (1) "knowledge, information and efficiency" and (2) "relationships and learning" refer to the issue of knowledge exchange in the context of efficiency and the social work environment. The first factor explains as much as 45.54% of the variance and the next factor 11.71% of the variance. The substantive construction of factors in terms of scale test items took into account both variable contributions, based on correlations, and common variable resources, based on correlations.

The remaining isolated factors, which do not provide such important information, are: (3) formal/task communication, (4) work-life in the context of time commitment, (5) work comfort and feedback communication, (6) stress-producing/disruptive elements and (7) professional development and work-life elements.

Table 1: Eigenvalues

Factor No	**Eigenvalues (correlations), related statistics**			
	Eigenvalues	% of total Variance.	Cumulative Eigenvalues	Cumulative %
1	25,05095	**45,54719**	25,05095	45,5472
2	6,44129	**11,71143**	31,49224	57,2586
3	2,63789	4,79617	34,13013	62,0548
4	1,74604	3,17462	35,87617	65,2294
5	1,50683	2,73969	37,383	67,9691
6	1,30544	2,37353	38,68844	70,3426
7	1,03688	1,88524	39,72533	**72,2279**
…	…	…	…	…
55	0,07432	0,13513	55	100

Source: own work

Chart 1 shows factor loadings, i.e. correlations between primary variables and principal components. The correlation coefficients have values in the range [-1;1] and are distributed within the so-called unit circle, also called correlation circle (Stanisz, 2007, p.192-193). The further a given point is from the center of the circle, the higher the correlation of a given variable with a given principal component. As can be seen from the presented graph, most of the variables are negatively correlated with the first component, in the case of the second component, some of the variables are positively correlated, some negatively. The angles between the vectors representing the studied variables indicate that these variables are correlated, acute angles (vectors located close to each other) indicate a positive correlation, a right angle (perpendicular vectors) indicates a lack of correlation, and obtuse angles (vectors on opposite sides of the center of the correlation circle) indicate a negative correlation. Analysis of the correlation circle reveals high correlation of variables.

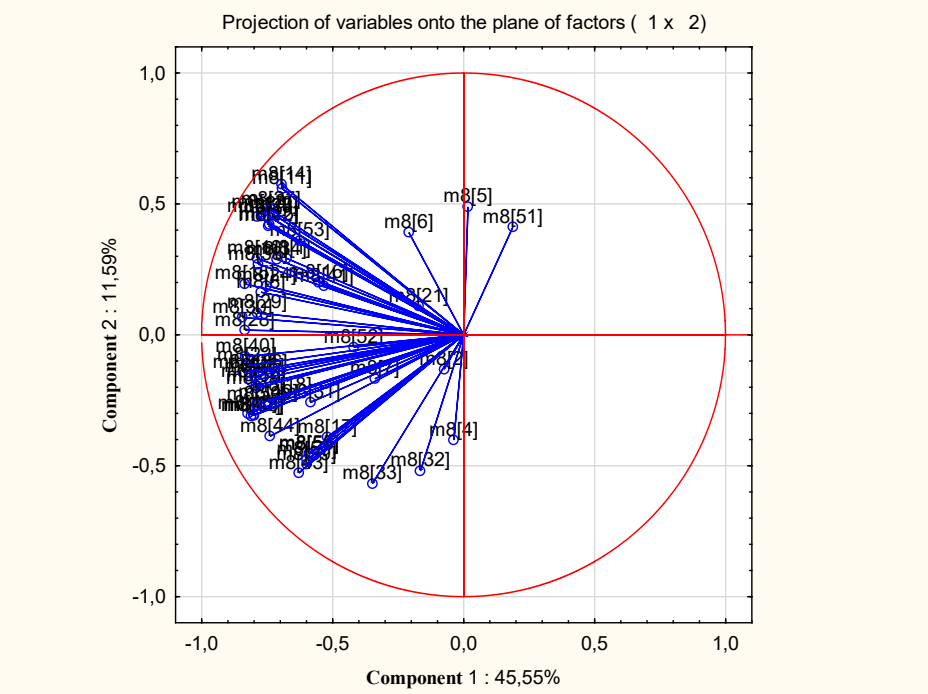


Figure 1: Correlation circle for components 1 and 2.

Source: own work

In the next step of the statistical analysis, representative variables were selected for individual components based on the highest values of factor loadings, i.e. the variables that had the greatest impact on individual components were selected. In relation to these variables, the cluster analysis method was used to diagnose how the respondents' attitude to individual dimensions of remote work influenced their preferences in choosing the form of work in the future. The cluster analysis carried out using the Ward method using percentage inconsistency as a distance measure led to the identification of three clusters of respondents with the characteristics presented in Table 2.

Table 2: Respondents profile.

Claster	Form of Work* %	Components** %						
		1	2	3	4	5	6	7
1	34,4 H 25,8 R 39,8 S	98,9 (4)+(5)	74,2 (4)+(5)	89,3 (4)+(5)	63,4 (4)+(5)	89,2 (4)+(5)	67,7 (4)+(5)	84,9 (4)+(5)
2	63,2 S 22,1 H	27,9 (3) 50,0 (1)+(2)	83,1 (1)+(2)	87,5 (5)	43,4 (1)+(2)	70,6 (4)+(5)	72,8 (1)+(2)	44,9 (4)+(5) 36,8 (1)+(2)
3	55,1 S 29,7 H	58,9 (3)	48,0 (3)	26,0 (3) 63,9 (4)+(5)	47,5 (3)	28,5 (3) 42,4 (4) 26,6 (2)	44,3 (3)	49,4 (3)

*H- hybrid, R-remote, S- stationary

** Scale: I fully disagree (1), I rather disagree (2), Neither (3), I rather agree (4), I fully agree (5)

Source: own work

Group 1 - in this group, as the only one, almost 26% of respondents reveal that the preferred form of work in the future is remote work, although the remaining respondents distributed their declarations in similar proportions in relation to hybrid and stationary work. Interestingly, this group is the only one with such a high percentage expressing positive opinions on the issue of access to knowledge and information, shaping employee relations and learning, similarly to the other components.

Group 2 - in this group, the vast majority of respondents declare their willingness to provide work in the future in a stationary form, and 22% - in a hybrid form. Respondents from this group mostly represent a negative

attitude towards the opportunities offered by remote work in terms of the flow of knowledge and information and their impact on efficiency and the possibility of shaping employee relations and learning.

Group 3 - this is a group that, similarly to group 2, declares to undertake full-time and hybrid work in the future, with a slightly greater share of the latter. This group is characterized by an ambivalent attitude towards most of the defined dimensions, including components 1 and 2.

5. Discussion

The survey results reveal that among employees with experience of remote work, this type of work is not the most frequently mentioned form of work in the future. This debunks the myth regarding Generation Z employees, for whom the use of modern technologies at work seems natural and obvious, and that they are much better suited to remote work (Albrychiewicz-Słocińska, 2022). It seems that the dominant preferences of young respondents in terms of stationary and hybrid forms of work should be associated with the importance of organizational learning (i.e. exchange of knowledge, information and learning) and employee relations presented in the study.

Table 3: Kendal's tau correlation index

Variable	Kendall's tau correlation p <,001 for components						
	1	2	3	4	5	6	7
Form of work	**-0,201751**	**-0,223657**	0,067872	0,023048	0,011060	**-0,149418**	**-0,136288**

Source: own work

An element that brings additional interpretive value to the results of the conducted analyzes is Kendall's tau correlation coefficient (an indicator recommended for examining the relationships between variables expressed on a Likert scale, the value is between -1 and 1 (Błażejczyk-Majka, 2018)), which shows numerous connections between components, however with a raised p (for p<.001) provides insight into strong relationships only between selected components (Table 3). The areas of knowledge, information and efficiency and relationships and learning have the strongest influence on the preferred form of work in the future. However, the minus sign next to all correlation coefficients draws attention to the direction of the correlation, according to which it should be interpreted that the worse the respondents rated individual dimensions of remote work, the more often they moved towards stationary or hybrid work.

These principal components analysis factors explain 57% of the total variance. This is confirmed by research (Dreyer & Stojanová, 2022; Hegade & Shettar, 2022) which emphasizes the importance of personal contacts and direct communication along with the related skills (Hans et al., 2023).

The importance of organizational knowledge exchange is also confirmed by the results of cluster analysis. It seems that the respondents from the first group, who were the only ones who indicated potential interest in remote work, based their preferences primarily on positive opinions regarding the exchange of knowledge, information and learning. In the remaining groups where these opinions were neutral or negative, remote work did not appear as a preferred form of work in the future. Therefore, organizations should particularly analyze the processes of organizational learning in relation to Generation Z employees, so that they meet the expectations of these employees.

6. Conclusions

The conclusions drawn by the author of the study from the analysis of the research results are positive. The analyzed group of young people with experience in remote work, not forced due to the pandemic, but chosen consciously and voluntarily, appreciates the importance of knowledge and information in the context of increasing their own effectiveness and learning in connection with building personal relationships. Therefore, even representatives of the youngest generation of employees understand how important direct contact with other people and their knowledge is. Such transfer of knowledge allows for a faster learning process, adaptation of knowledge to the requirements of organizational practice and verification of the acquired information without leading to information overload. The presented attitude of young employees towards the issue of knowledge and learning creates a platform for intergenerational knowledge transfer, which should undoubtedly be of interest to both researchers and practitioners, with particular emphasis on HR department employees.

References

Akhmadi, S. and Mariza T. (2022), 'Knowledge Acquisition, Elicitation, and Management in Innovative Firms'. *Procedia Computer Science* 200:91–100. doi: 10.1016/j.procs.2022.01.208.

Albrychiewicz-Słocińska, A. (2022), *Remote work and Knowledge Exchange Strategies in the Opinions of Generation Z*. European Conference on Know.ledge Management, 23(1), Article 1. doi.org/10.34190/eckm.23.1.622

Atkin, D., Schoar, A., and Shinde, S. (2023), 'Working from Home, Worker Sorting and Development' (Working Paper 31515). *National Bureau of Economic Research*. doi.org/10.3386/w31515

Babbie, E. (2004), *Badania społeczne w praktyce*, PWN, Warszawa.

Barhate, B., and Dirani, K. M. (2021), 'Career aspirations of generation Z: a systematic literature review'. *European Journal of Training and Development* [Epub. ahead-of-print]. doi: 10.1108/EJTD-07-2020-0124.

Błażejczak-Majka L. (2018). *Zastosowanie analizy skupień w przypadku zmiennych wyrażonych na skali porządkowej*, BazaWiedzaSukces.pl, StatSoftPolska. Retrieved from: https://www.bing.com/ck/a?!&&p=2d282e3800e2ccfcJmltdHM9MTcwNjQ4NjQwMCZpZ3VpZD0yYzNjNjFhOS05NGM0LTZiZWUtMzVhOS03M2NlOTViYzZhMmEmaW5zaWQ9NTIxMg&ptn=3&ver=2&hsh=3&fclid=2c3c61a9-94c4-6bee-35a9-73ce95bc6a2a&psq=Zastosowanie+analizy+skupie%c5%84+w+przypadku+zmienych+wyrazonych+na+skali&u=a1aHR0cHM6Ly93d3cuc3RhdHNvZnQucGwvd3AtY29udGVudC91cGxvYWRzLzIwMTgvMTEvc2VtX25hdWtfemFzdG9zb3dhbmllX2FuYWxpenlfc2t1cGllbi5wZGY&ntb=1, 07.02.2024.

Bloodgood, J. M., and Chen, A. N. K. (2021), 'Preventing organizational knowledge leakage: The influence of knowledge seekers' awareness, motivation and capability'. *Journal of Knowledge Management*, 26(9), 2145–2176. https://doi.org/10.1108/JKM-12-2020-0894.

Capecchi, S., Cappelli, C., Curtarelli, M., and Di Iorio, F. (2023), 'Synthetic indicators to analyze work-related physical and psychosocial risk factors: Evidence from the European Working Conditions Survey'. *Quality and Quantity*, 57(6), 5713–5735. doi.org/10.1007/s11135-023-01617-8.

Chillakuri, B. (2020), 'Understanding generation Z expectations for effective onboarding'. *Journal of Organizational Change Management*. 33, 1277–1296. doi: 10.1108/JOCM-02-2020-0058.

Cresnar, R., and Nedelko, Z. (2020), 'Understanding future leaders: how are personal values of generations Y and Z tailored to leadership in industry 4.0?' *Sustainability* 12:4417. doi: 10.3390/su12114417.

Cronbach, L.J. and Meehl, P.E. (1955), 'Construct Validity in Psychological Tests', *Psychological Bulletin*, Vol. 52, No. 4, pp 281–302.

Czakon, W. (2014), 'Kryteria oceny rygoru metodologiczne go badań w naukach o zarządzaniu', *Organizacja i Kierowanie*, Vol. 1, Nr 161, pp 51–62.

Dreyer, C., and Stojanová, H. (2022), 'How entrepreneurial is German Generation Z vs. Generation Y? A Literature Review'. *Procedia Computer Science* 217, 155–164. doi.org/10.1016/j.procs.2022.12.211.

Emanuel N., Harrington E. (2020), 'The Payoffs Of Higher Pay: Elasticities Of Productivity And Labor Supply With Respect To Wages, Job Market Paper', https://scholar.harvard.edu/files/nataliaemanuel/files/emanuel_jmp.pdf, (access date: 07.02.2024)

Emanuel, N., & Harrington, E. (2023a), 'Is Work-from-Home Working?' (SSRN Scholarly Paper 4486370). https://papers.ssrn.com/abstract=4486370.

Emanuel, N., & Harrington, E. (2023b), 'Working Remotely? Selection, Treatment, and the Market for Remote Work' (SSRN Scholarly Paper 4466130). doi.org/10.2139/ssrn.4466130.

Emanuel, N., Harrington, E., and Pallais, A. (2024), 'The Power of Proximity to Coworkers: Training for Tomorrow or Productivity Today?' https://scholar.harvard.edu/pallais/publications/power-proximity-coworkers-training-tomorrow-or-productivity-today.

Gibbs, M., Mengel, F., and Siemroth, C. (2022), 'Work from Home and Productivity: Evidence from Personnel and Analytics Data on Information Technology Professionals' (SSRN Scholarly Paper 3841457). https://doi.org/10.2139/ssrn.3841457.

González-Ramos, M. I., Guadamillas, F., and Donate, M. J. (2023), 'The relationship between knowledge management strategies and corporate social responsibility: Effects on innovation capabilities'. *Technological Forecasting and Social Change*, 188, 122287. doi.org/10.1016/j.techfore.2022.122287.

Górniak J. (1998), 'Analiza czynnikowa i analiza głównych składowych', *Ask: Research and Methods*, Vol 7, p. 83-102.

GUS (2022)Główny Urząd Statystyczny / Obszary tematyczne / Roczniki statystyczne / Roczniki Statystyczne / Rocznik Demograficzny 2022, https://stat.gov.pl/.

Hans, S., Nayeem, A. M., Mikkilineni, S., and Gupta, R. (2023), 'Exploring the relationship between generational diversity and knowledge sharing: The moderating role of workplace intergenerational climate, boundary-spanning leadership and respect'. *Employee Relations*, 45(6), 1437–1454. doi.org/10.1108/ER-11-2022-0507.

Hau, Y. S., Kim, B., Lee, H., and Kim, Y.-G. (2013), 'The effects of individual motivations and social capital on employees' tacit and explicit knowledge sharing intentions'. *International Journal of Information Management*, 33(2), 356–366. doi.org/10.1016/j.ijinfomgt.2012.10.009.

Hegade, P., and Shettar, A. (2022), 'Elevate-Z: A Model to Create Learning Spaces for Generation Z Students'. *Journal of Engineering Education Transformations*, 35(Special Issue 1), 175–180.

Kaczmarek, M. (2013), 'Problemy stosowania skali Likerta w pomiarze jakości użytkowej serwisów internetowych'. *Zeszyty Naukowe Uniwersytetu Ekonomicznego w Krakowie*, 916, Article 916.

Kaczmarek, M. (2016), 'Zastosowanie analizy głównych składowych w ewaluacji skali pomiaru użyteczności serwisu internetowego'. *Studia Oeconomica Posnaniensia*, 4, 128–141. doi.org/10.18559/SOEP.2016.1.9.

Korzeniewski, J. (2012), *Metody selekcji zmiennych w analizie skupień*. Łódź: Wydawnictwo Uniwersytetu Łódzkiego. doi: dx.doi.org/10.18778/7525-695-6.

Kucharczyk M. (2023), "The Economist": Upadł wielki mit dotyczący pracy zdalnej. Iluzja nie trwała długo', https://wydarzenia.interia.pl/raport-media-zagraniczne/news-the-economist-upadl-wielki-mit-dotyczacy-pracy-zdalnej-iluzj,nId,6955266#parametr=temat_wiecej#utm_source=paste&utm_medium=paste&utm_campaign=chrome (access date: 07.02.2024).

Lloyd, M., Sugden, N., Thomas, M., McGrath, A., and Skilbeck, C. (2023), 'The structure of the Hospital Anxiety and Depression Scale: Theoretical and methodological considerations'. *British Journal of Psychology*, 114(2), 457–475. doi.org/10.1111/bjop.12637.

Maloni, M., Hiatt, M. S., and Campbell, S. (2019), 'Understanding the work values of gen Z business students'. The International Journal of Management Education 17:100320. doi: 10.1016/j.ijme.2019.100320.

Nonaka I. and Takeuchi H. (1995), *The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation*. Oxford University Press, New York.

Nonaka I. and Toyoma R. (2007), 'Why do firms differ? The theory of knowledge-creating firm', in : Ichijo, K., Nonaka, I. (Eds.) *Knowledge creation and management. New challenges for managers*, Oxford University Press, Oxford.

Okóń, J. (1968), *Analiza czynnikowa w psychologii*, Wydawnictwo Naukowe PWN, Warszawa.

Probst G., Raub S., Romhardt K. (2004), *Zarządzanie wiedzą w organizacji*, Oficyna Ekonomiczna, Kraków.

Pupelis, L., and Šeinauskienė, B. (2023), 'Effect of consumer self-discrepancy on materialism and impulse buying: The role of subjective well-being'. *Central European Management Journal*, 31(2), 222–240. doi.org/10.1108/CEMJ-12-2021-0154.

Rossiter, J.R. (2008), 'Content Validity of Measures of Abstract Constructs in Management and Organizational Research', *British Journal of Management* Vol. 19, No. 4, pp 380–388.

Sagan, A. (2004), *Badania marketingowe. Podstawowe kierunki*, Wydawnictwo Akademii Ekonomicznej w Krakowie, Kraków.

Sekala, A., Schultz, O., Foit, K., and Blaszczyk, T. (2023), 'Technical Education for Industry 4.0: Generation Z's motivation to study technical subjects - a comparative study of selected universities in Denmark and Poland'. EAEEIE 2023 - Proceedings of the 2023 32nd Annual Conference of the European Association for Education in Electrical and Information Engineering. doi.org/10.23919/EAEEIE55804.2023.10181671.

Sidor-Rządkowska M. (2023), *Kształtowanie przestrzeni pracy*, Warszawa: Wolters Kluwert .

Skýpalová, R., Stojanová, H., Troger, H., and Caha, Z. (2023), 'Human Resource Management across Generations within the Context of World of Work 4.0'. *Emerging Science Journal*, 7(3), 843–853. doi.org/10.28991/ESJ-2023-07-03-013.

Snieska, V., Navickas, V., Grencikova, A., Safrankova, J. M., and Sikyr, M. (2020), 'Fundamental human resource management practices aimed at dealing with new challenges in the labour market'. Transformations in Business & Economics 19, 38–51.

Stanisz, A. (2006), *Przystępny kurs statystyki z zastosowaniem STATISTICA PL na przykładach z medycyny*, Tom 1, StatSoft, Kraków.

Steyn, A. A., de Villiers, C., Jordaan, J., and Pitso, T. (2020), 'Connecting generation Z information systems students to technology through the task-technology fit theory'. *Communications in Computer and Information Science*, 1136 CCIS, 197–210. doi.org/10.1007/978-3-030-35629-3_13.

Szombathelyi, M. K., Borgulya, Á., and Balogh, G. (2023), 'Home-Based Telework: Aspects of Communication. Evidence From Hungary'. *Economics and Sociology*, 16(3), 178–197. doi.org/10.14254/2071-789X.2023/16-3/10.

Sztemberg-Lewandowska, M. (2017), *Analiza niezależnych głównych składowych*. Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu. Taksonomia (28), 468, 222–229. doi.org/10.15611/pn.2017.468.23.

Szymkowiak, A., Melović, B., Dabić, M., Jeganathan, K., and Kundi, G. S. (2021), 'Information technology and Gen Z: The role of teachers, the internet, and technology in the education of young people'. *Technology in Society*, 65. doi.org/10.1016/j.techsoc.2021.101565.

Urick, M. J., PhD, Hollensbe, E. C., PhD, and Fairhurst, G. T., PhD. (2017), 'Differences in Understanding Generation in the Workforce'. *Journal of Intergenerational Relationships*, 15(3), 221–240. doi.org/10.1080/15350770.2017.1329583.

Walesiak, M. (2006), *Przegląd podstawowych zastosowań metod statystycznej analizy wielowymiarowej w badaniach marketingowych*. https://depot.ceon.pl/handle/123456789/2025.

Yarbrough, J. W., and Ramos Salazar, L. (2023), 'Virtual onboarding and socialization, an exploration of employee discussions and experiences'. *Corporate Communications*, 28(5), 707–723. doi.org/10.1108/CCIJ-12-2022-0158.

Zakrzewska, M. (1994), *Analiza czynnikowa w budowaniu i sprawdzaniu modeli psychologicznych* (Tom Seria Psychologia i Pedagogika nr 95). Poznań: Wydawnictwo Naukowe Uniwersytetu im. Adama Mickiewicza.

Zeer, E. F., Tserkovnikova, N. G., and Tretyakova, V. S. (2021), 'Digital Generation in the Context of Predicting the Professional Future'. *Obrazovanie i Nauka*, 23(6), 153–184. doi.org/10.17853/1994-5639-2021-6-153-184.

Assessing the Impact of Science and Technology Parks on Firm Profitability: A Comparative Study of On-Cluster and Off-Cluster Dynamics

Mousa Al-kfairy
College of Technological Innovation, Zayed University, Abu Dhabi, UAE

Mousa.al-kfairy@zu.ac.ae

Abstract: Science and Technology Parks (STPs) are pivotal in driving regional development, primarily through fostering innovation and enhancing regional wealth. However, the impact of STPs on regional development remains a contentious topic with inconclusive findings. This study digs into the contribution of STPs to the profitability of firms by conducting a comparative analysis of profitability and salary data between firms located within these parks (on-cluster) and those outside them (off-cluster). The research adopts a two-pronged approach: initially, it examines firm profitability and employee salaries at an aggregate level to understand the overall economic impact of STPs. Following this, it models the various factors that influence firm profitability, offering a nuanced understanding of the dynamics at play. The findings are revealing – being located within an STP (on-cluster) appears to significantly boost a firm's profitability, but only up to a certain size of the cluster. This suggests that the benefits of being in an STP diminish beyond a certain scale. At a more granular, micro level, the study finds that a firm's previous innovation output has a positive impact on its profitability. This underscores the importance of continuous innovation for sustained economic success within these clusters. Conversely, a larger firm size seems to negatively impact profitability within STPs, indicating a potential strategy for growing firms to relocate off-cluster to mitigate this effect. For firms operating outside STPs (off-cluster), the scenario differs. Here, innovation plays a partial role in influencing profitability, and interestingly, the size of the firm does not significantly impact its profitability. This distinction between on- and off-cluster firms highlights the unique economic ecosystems fostered by STPs and their varied effects on firm performance. Overall, this study contributes to the ongoing debate on the role of STPs in regional development, offering new insights into how these entities affect firm profitability and suggesting potential strategies for firms operating within and outside these parks.

Keywords: Science and Technology Parks (STPs); Firm Profitability; Innovation Output; Cluster Dynamics; Knowledge Management

1. Introduction

The foundational Resource-Based View (RBV) of firms stems from an industrial organization approach, positing that businesses operate within a tangible reality. Managers can collect and process information within this reality to make informed decisions and implement strategies (Wernerfelt, 1984). However, when it comes to fundamental innovation and change, the RBV stumbles, struggling to grasp these pivotal concepts. In contrast, the Knowledge-Based View (KBV) centres around a firm's dynamic capability to innovate and adapt, an area ripe with debate and exploration for knowledge management theorists (Grant, 2002).

Industrial clusters, specifically, have undergone a fascinating evolution over the last 40 years. Once primarily spontaneous and grassroots ("bottom-up"), clusters have increasingly become focal points of scholarly and governmental attention for spurring innovation and regional development, particularly since Porter highlighted their competitive advantage. These clusters, such as Science and Technology Parks (STPs), now often materialize through planned ("top-down") initiatives, sometimes fuelled by taxpayer investment, with firms choosing whether to join these hubs or remain independent (Mondal et al., 2024; Mondal et al., 2023; Porter, 2003).

There are generally three acknowledged types of industrial clusters. First, "pure agglomeration industrial districts" are characterized by proximity-based firm networks that facilitate free labour movement and knowledge sharing. Second, the "industrial complex model" is distinguished by supply-demand relationships between co-located firms, aiming to minimize transportation costs but at times risking inflexibility. Finally, "social network clusters" thrive on trust-building through formal or informal networks, fostering cooperative work and potentially reshaping the cluster's organizational structure through shared investments (Gordon and McCann, 2000; Kolehmainen, 2002; McCann et al., 2002).

Historically, clusters aimed to reduce transaction and transportation costs by streamlining the flow of information and knowledge. They also served to minimize the hurdles in knowledge transformation and cost savings, such as infrastructure and specialized labour availability, which in turn fostered an environment conducive to knowledge sharing and cooperation (Barkley and Henry, 1997; Cojocaru and Ionescu, 2016).

At a regional level, clusters are lauded for their potential to enhance wealth by supporting entrepreneurship, attracting multinational corporations, and boosting employment. However, such initiatives also carry risks and potential downsides, such as the possibility of economic "lock-in," space constraints, and the misallocation of financial resources (Barkley and Henry, 1997; Sunley and Martin, 2010; Breschi and Malerba, 2001; Tallman et al., 2004).

Regarding financial returns, the examination of Science and Technology Parks (STPs) across Europe, which employ significant numbers and represent a considerable investment, has been a major focus of scholarly inquiry (EU Commission, 2018). Studies have scrutinized various performance indicators, including employment growth and innovation outputs, to gauge the success and influence of clusters on regional economic vitality (Al-kfairy et al., 2017; Temouri, 2012; Porter, 2003).

This study seeks to illuminate the factors influencing the profitability of on-cluster firms by analysing financial data at both the aggregate and micro-levels. It endeavours to understand the interplay between innovation and profitability within clustered environments. By employing panel data analysis and contrasting on-cluster with off-cluster firms, the study aims to extract nuanced insights into the drivers of firm success within these unique ecosystems.

2. Related Work

Innovation expenditure and output significantly influence firm profitability, and their impact is often moderated by the firm’s location within or outside of industrial clusters such as Science and Technology Parks (STPs). This section explores how these factors interplay to shape financial outcomes for firms, emphasizing the distinctive effects of being situated on-cluster (within STPs) versus off-cluster (outside STPs).

Innovation expenditure, encompassing R&D spending, technology acquisition, and related investments, is a critical determinant of a firm's capability to develop new products and processes, which can lead to a sustainable competitive advantage (ÖZKAN, 2022). However, the immediate impact of such expenditures on profitability can be complex. Initially, high innovation expenditures might not translate into immediate profits due to the time lag between spending and the realization of benefits through commercialization (Schäper et al., 2023). This delay can be attributed to the development cycles required to innovate and subsequently market the innovations effectively. Previous studies have highlighted that while R&D intensity is a strong predictor of future revenue growth and market valuation, its direct impact on short-term profitability is often negative or neutral, as these investments take time to yield returns (Tung and Hoang, 2024).

Innovation output, typically measured by metrics such as patents, licenses, and product launches, directly correlates with enhanced firm performance, especially in technology-oriented sectors. Firms that successfully commercialize their innovations can secure substantial profits and market share. The effect of innovation output on profitability is more pronounced when these outputs are successfully aligned with market needs and are adequately protected through patents or copyrights, which prevent competitors from eroding the innovator’s market position. Empirical studies suggest a positive correlation between patent outputs and firm profitability, emphasizing that firms with higher patent counts tend to exhibit better financial performance, assuming these patents are of high quality and market relevance (Song et al., 2024).

Being located within an STP (on-cluster) can significantly affect a firm's profitability. STPs are designed to foster an environment conducive to innovation and business growth by providing infrastructure, networking opportunities, and access to knowledge and resources. Firms located on-cluster benefit from proximity to other innovative companies and research institutions, which facilitates knowledge spillovers and collaborative opportunities. These interactions can enhance the firms' innovation output and, consequently, their profitability (Aydemir, 2024).

Moreover, firms in STPs often have better access to funding sources, including venture capital and government grants, which can enhance their ability to invest in innovation. However, the benefits of being on-cluster might diminish as the cluster grows and becomes congested, potentially leading to increased competition for the same resources and talent, which might initially decrease profitability for some firms. This dynamic underscore the importance of managing growth within STPs to maintain an environment that continues to support each firm's profitability (Mondal et al., 2023).

In summary, both innovation expenditure and output play crucial roles in determining firm profitability, with these effects significantly influenced by the firm’s location within industrial clusters. The strategic benefits of on-cluster location can provide firms with competitive advantages through enhanced innovation capabilities and

access to collaborative networks and funding. Understanding these dynamics is essential for firms deciding on their location strategy and for policymakers aiming to foster successful innovation ecosystems within STPs.

3. Methodology

Using the dataset obtained from the Swedish database (Ratsit) for industrial code 62X, we collected firms' financial data for 2007-2015. The data includes on- and off-cluster firms for Linkoping Science Park (Mjardevi). Using porter's definition of business clusters, firms were either identified as on-cluster if they are either:

- Located inside the business cluster postcode area.
- Or is part of the STP organisations.
- Otherwise, they are considered off-cluster.

Then, we categorise the data every year and sum up the firms' profit using the following formulas:

$$Profit_y = \sum_{i=1}^{n} Profit_i \text{ , y is the year and } i \text{ is the firm.}$$

Equation 1

After that, the average profit-per-Employee and the average salary-per-employee, as well as the Average Patent and License income per-employee and Average R&D investments per-Employee, was calculated for both on and off-cluster firms in order to make a systematic comparison between on- and off-cluster firms. Then, we run a correlation analysis to understand the factors that influence the overall firm's profitability for both on- and off-cluster firms using SPSS.

Finally, we used Stata to build a fixed and random effect model using panel data analysis for both on- and off-cluster firms. Hausman test was used to choose between the fixed and random effect models (an approach similar to Al-kfairy et al., 2019b).

4. Results

After executing equation 1, we obtained the results in Table 1. Table 1 shows that the firms' total profit for on-cluster are much better than off-cluster at the aggregate level. This proves that, at the aggregate level, firms located on-cluster – financially - perform better than off-cluster firms.

Table 1: On- and Off-cluster Financial Data Summary (Salaries and Profit are measured as KSEK (thousands Swedish Krona)

Year	Number of Emps (Off-cluster)	Total Profit for all Firms (Off-cluster)	Number of Employees (On-Cluster)	Total Profit for all Firms (Off-cluster)
2008	466	91,775	1,203	781,009
2009	552	68,271	1,281	308,624
2010	607	-34,480	1,353	324,679
2011	696	64,703	1,340	207,752
2012	818	56,956	1,468	119,717
2013	863	87,420	1,610	273,235
2014	987	51,830	1,630	-80,207
2015	1,130	69,928	1,470	57,872
2016	1,145	71,075	1,463	-2,362

However, in order to get a better understanding of the obtained results, we calculate the average per-employee, which should give a better understanding of the firms' performance. Figure 1 shows that On-cluster outperforms off-cluster profit up to the year 2012, when the on-cluster profitability started to decline, and off-cluster firms become – on average – more profitable than on-cluster firms. Thus. We compared the growth in the number of employees to findout if the drop in the average profit is related to higher growth rate in the number of employees as shown in Figure 2.

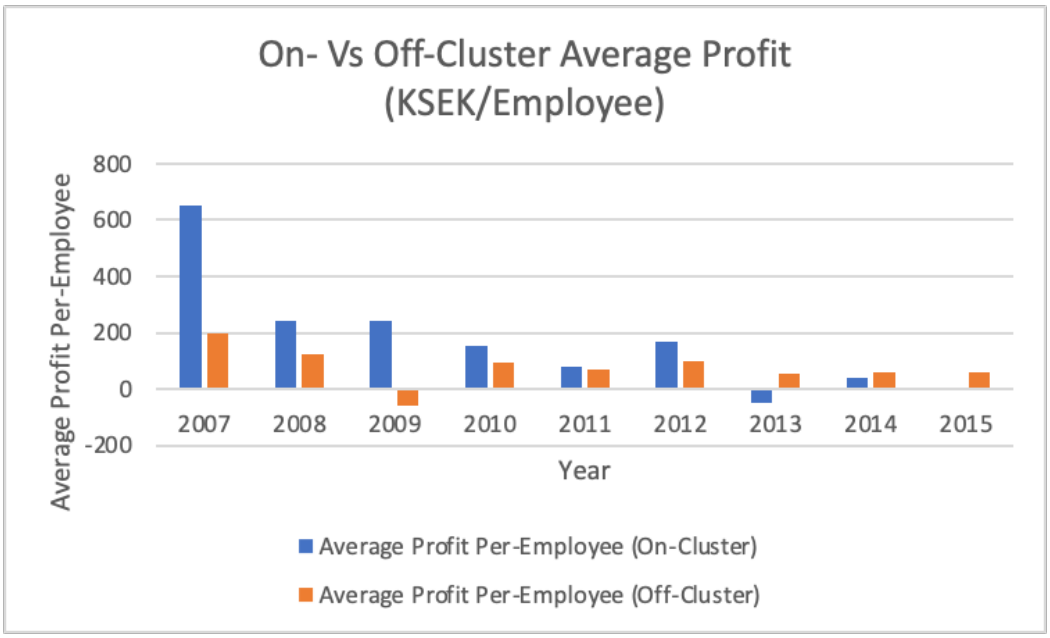


Figure 1: On-VS Off-Cluster Average Profit Per-Employee

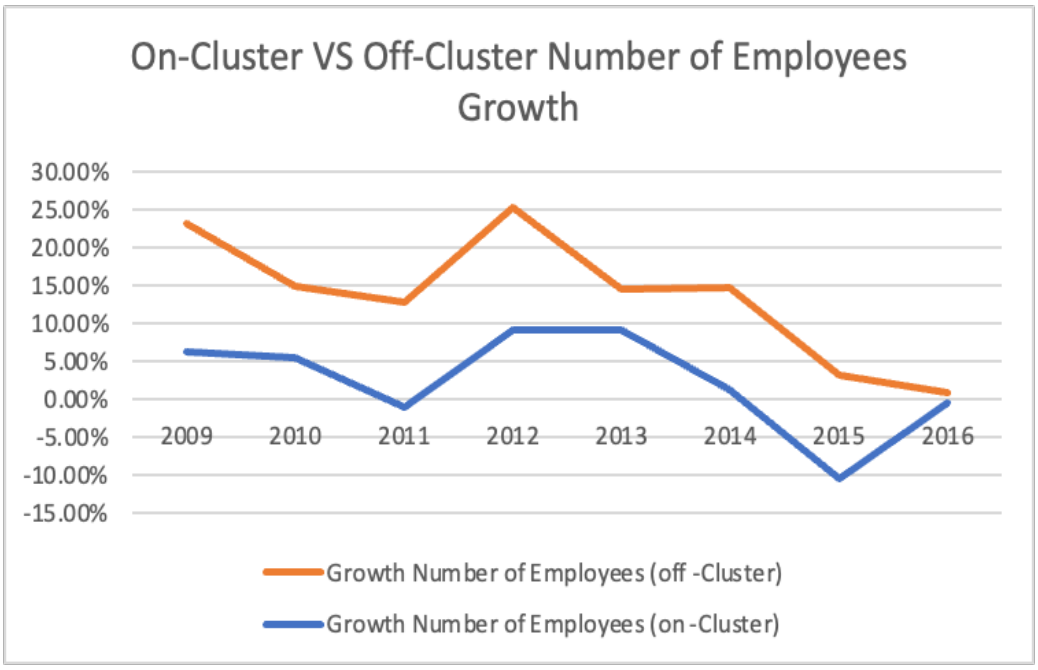


Figure 2: On-Cluster VS Off-Cluster Number of Employees Growth

Although the comparison shows that on-cluster firms – on average- are more profitable than off-cluster firms, the picture is still not clear, especially in understanding how time (age of the cluster) impacts the firms' profitability. Thus, SPSS was used to understand if there is a correlation between the growth in number of firms (size of the cluster) and firms profitability (in average). Figure 3 proves that there is an initial decline in the firms' average profitability as more firms are joining the cluster, which causes the average profit to decline, which is normally because firms take time to start generating profit. This can be explained by the lag between innovation generation and licensing innovation (Al-kfairy et al., 2019b).

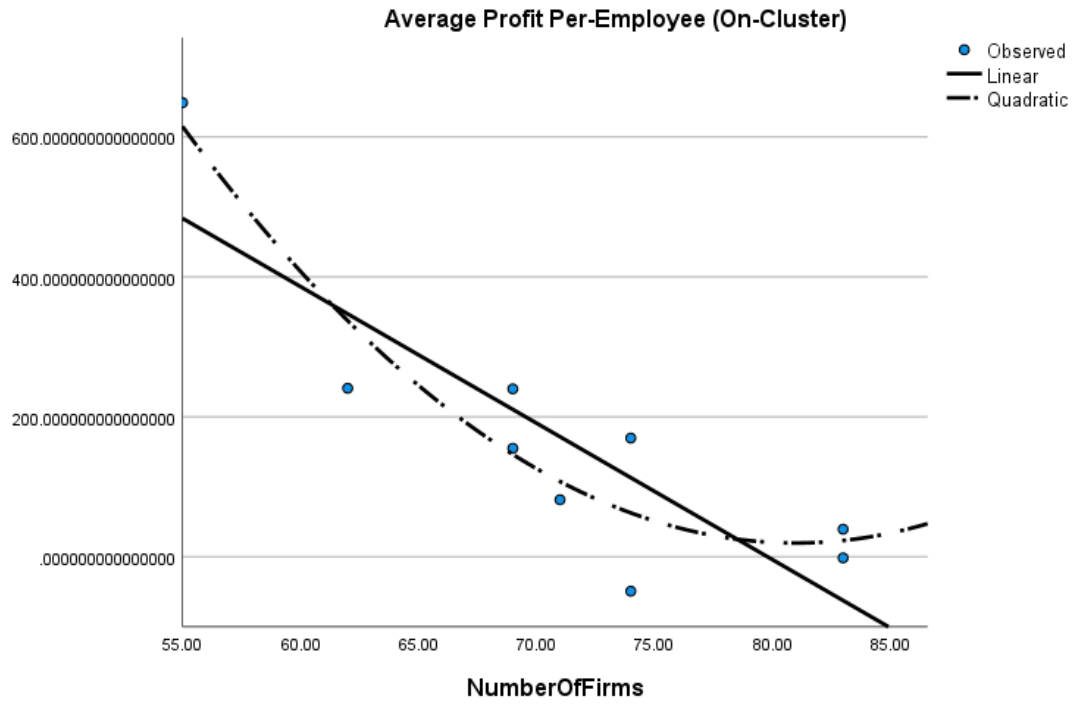


Figure 3: On-Cluster Number of Firms VS Average Profitability

Then, we analyzed the impact of the average innovation output on both on-cluster and off-cluster firms profitability, we run Spearman regression analysis between the average innovation output measured as patent and license income with firms profitability. Surprisingly, the results show a significant negative correlation between average patents and license income and firms' profitability for on-cluster firms (Rho = -0.783, p-value = 0.013). This indicates that the more innovation income the less profitable the company. However, as Al-kfairy et al., 2019b argued that there is a positive correlation between innovation output and Turnover, but a negative initial correlation, these results are compatible with their results, and the on-cluster firms will start benefiting from innovation output later in the cluster development. On the other hand, no significant correlation was identified between off-cluster firms' profitability and innovation output, which is again indicates that off-cluster firms financial return does not depend on how innovative is the firm, but on the nature of the firms' business which is most likely a consultation company.

Furthermore, we calculated the innovation capability per firm using the following equation:

$$Innov_{i,t} = \frac{P\&L_{i,t}}{Turnover_{i,t}}, i\ is\ the\ reporting\ firm, and\ t\ is\ the\ year\ (2007, 2008 \ldots 2015)$$

Equation 2

Then, we apply panel data analysis techniques with both fixed and random effect model to firms' profit data at both on-cluster and off-cluster firms. The final obtained regression model for on-cluster firms profit using fixed-effect model (Huasman test returned p-value of less than 0.001 and concludes that random effect model is not appropriate) is summarized in Equation 3:

$$Profit_{i,t} = C_1\ Innov_{i,t-1} + C_2 R\&D_{i,t-1} + C3GroupContribution_{i,t} + C4NumberofEmployees_{i,t} + Const$$

Equation 3: On-Cluster Firms Profit Regression Model

Table 2: Coefficient Values Obtained from the Regression Model (Equation 3)

	Coef	p-value
C_1	579.045	0.005
C_2	0.310	0.080

	Coef	p-value
C_3	0.520	0.001
C_4	-1139.154	0.000
const	21050.710	0.000

The model shows a positive lag effect of innovation parameters for Innov measured as patent and License outcome ratio to Turnover and the R&D investments. The model results support the results at the aggregate level, which shows no immediate effect of innovation output on the firms' profitability. Moreover, it shows a positive impact of firms' group contribution on firms' profitability, which further support the hypothesis that a firm is more likely to be profitable if it is part of a group. These results are in line with earlier results of Al-kfairy et al., 2019b, who shows a positive relationship between innovation and turnover for on-cluster firms.

In order to understand if there is a difference between the on- and off-cluster firms, we run the same model for off-cluster firms. The model shows a significant positive relationship between innovation (Patents and License Ratio to Turnover) as well as group contribution and firms' profitability, but no significant relationship between R&D investments and firm size (measured as a number of employees) and firms' profitability.

The previous results suggested that regardless of being on-cluster or off-cluster, innovation is always positively impacting the firms' profitability. However, one significant difference between being on-cluster and off-cluster is the R&D investment impact, which shows a positive effect in the case of being on-cluster. At the same time, no significant relationship was reported in case of being off-cluster. Thus, innovation is more influential in case of being on-cluster, which indicates that on-cluster firms are more innovation-driven than off-cluster firms.

Another significant difference is the size impact, which proves that on-cluster firms can be profitable but once it grows more, then it might need to move off-cluster to stay profitable as size does not have any significant impact on off-cluster firms.

5. Discussion

5.1 Theoretical Implications

This study enriches the theoretical landscape surrounding the Knowledge-Based View (KBV) of firms by elucidating the mechanisms through which knowledge management and innovation catalyze firm success within clusters. By highlighting the nuanced effects of on-cluster locations on innovation outputs and profitability, it offers empirical support for the KBV's assertion that proximity to similar and complementary businesses amplifies a firm's capacity to leverage external knowledge for competitive advantage. Additionally, the relationship between innovation outputs, such as patents, and firm profitability extends resource-based theories. This alignment underscores the necessity of not only possessing but also strategically deploying firm-specific capabilities and resources to achieve superior performance. The findings also contribute to cluster theory by illustrating how clustering benefits, like increased collaboration and access to specialized knowledge, impact firm profitability. This introduces a more balanced perspective on cluster dynamics, acknowledging potential drawbacks like resource saturation as clusters expand.

5.2 Practical Implications

From a practical standpoint, the insights from this study are invaluable for managers, policymakers, and entrepreneurs engaged with or considering involvement in Science and Technology Parks (STPs). Managers are advised to optimize their innovation strategies by aligning R&D investments with market demands and protecting intellectual property to fully capitalize on innovations. The study also informs location decisions, suggesting that firms evaluate the benefits and potential challenges of situating within an STP. While smaller firms and startups may find critical support in these environments, larger organizations might reconsider their placement as clusters become congested. For policymakers, these findings highlight the importance of designing and managing STPs to support sustainable firm growth and innovation, suggesting policies that adapt to the evolving needs of firms and the technological landscape. Furthermore, recognizing the diverse innovation profiles across different types of firms, both policies and management practices should be tailored to maximize the economic and competitive benefits of innovation activities within the cluster. These practical and theoretical insights collectively offer a robust framework for enhancing firm profitability through strategic innovation management and thoughtful engagement with STP ecosystems.

6. Conclusion and Future Work

STPs are considered as a regional tool for fostering regional development by stimulating regional employment and financial growth. During the last couple of decades, many regional authorities tried this tool. For example, IASP reported more than 350 members worldwide and more than 115,000 employees (IASP,2021). While the STPs organisation structure impact on firms' innovation has been well studied as in Al-kfairy et al., 2019a; Al-kfairy et al., 2020 and Al-kfairy and Mellor, 2020. However, the impact of STPs on financial growth is still debatable, especially if locating inside STPs will enhance the firms' probability to generate more profit. Thus, this study tried to uncover that by comparing on- and off-cluster firms' profitability.

The results indicate that locating on-cluster will increase the firms' profitability in general. However, as more firms join the STP over time, this will have a temporary impact on firms profitability which causes it to decline, then grow again. This conclusion which further support Al-kfairy et al., 2019b which indicated that STPs growth is not linear and moves between different stages. Furthermore, the results show that off-cluster firms provide better salaries on average to their employees than on-cluster, which can be explained by the fact that on-cluster firms spend more on innovation investment in the form of R&D than on employees salaries.

This study indicates that locating on-cluster will enhance the firms' profitability than selecting to locate off-cluster. However, the results show a positive impact of innovation for both on-cluster and off-cluster at the micro level, but this impact is partial on the off-cluster firms. Moreover, the firm size is negatively impacting firms' profitability in case of on-cluster firms, which means that cluster innovation impact on firms' profitability is temporary.

Although this study contributes to understanding how location can positively impact firms' profitability, it is crucial to understand firms' profitability for different industries as well as study business clusters at different development stages rather than a mature business cluster.

References

Al-Kfairy, M. and Mellor, R.B. (2020). The role of organisation structure in the success of start-up science and technology parks (STPs). Knowledge Management Research & Practice:1-9.

Al-Kfairy, M., Khaddaj, S. and Mellor, R. (2018, September) A longitudinal study of corporate benefits accrued by firms inhabiting a mature science park. In European Conference on Knowledge Management (pp. 43-XV). Academic Conferences International Limited.

Al-kfairy, M., Khaddaj, S. and Mellor, R.B. (2019a) Computer modelling reveals the optimal development for the organisational structure of business clusters. International Journal of Knowledge-Based Development 10(4): 249-275.

Al-Kfairy, M., Khaddaj, S. and Mellor, R.B. (2019b) Computer modelling and identification of factors important for the success of business clusters. International Journal of Knowledge-Based Development 10(4): 384-405.

Al-Kfairy, M., Khaddaj, S. and Mellor, R.B. (2020). Evaluating the effect of organisational architecture in developing science and technology parks under differing innovation environments. Simulation Modelling Practice and Theory 100: 102036.

Al-Kfairy, M., Khaddaj, S. and Mellor, R.B., 2017, December. Variables affecting high-tech cluster innovation: a statistical approach. In *7th International Conference on Law, Business, Marketing and Corporate Social Responsibilities.[online] London: HEAIG. Available at: http://heaig. org/images/proceedings_pdf H* (Vol. 12175121).

Aydemir, R., 2024. Examining the Cluster Life Cycle in the Process of Economic Development. *Journal of Policy Options*, *7*(1), pp.18-26.

Barkley, D.L. and Henry, M.S. (1997) Rural industrial development: to cluster or not to cluster?. Applied Economic Perspectives and Policy 19(2):308-325.

Breschi, S. and Malerba, F. (2001) The geography of innovation and economic clustering: some introductory notes. Industrial and corporate change 10(4): 817-833.

Cojocaru, A.M.R. and Ionescu, S. (2016) The advantages of business clusters. FAIMA Business & Management Journal 4(2):31.

Delgado, M., Porter, M.E. and Stern, S. (2010) Clusters and entrepreneurship. Journal of Economic Geography 10(4): 495-518.

Delgado, M., Porter, M.E. and Stern, S. (2014) Clusters, convergence, and economic performance. Research Policy 43(10):1785-1799.

Dettwiler, P., Lindelöf, P. and Löfsten, H. (2006) Utility of location: A comparative survey between small new technology-based firms located on and off Science Parks—Implications for facilities management. Technovation 26(4):506-517.

European commission (2018) Science Parks.Avialable at: http://s3platform.jrc.ec.europa.eu/science-parks. (Accessed March, 2019).

Folta, T.B., Cooper, A.C. and Baik, Y. (2006) Geographic cluster size and firm performance. Journal of Business Venturing 21(2): 217-242.

Gordon, I.R. and McCann, P. (2000)Industrial clusters: complexes, agglomeration and/or social networks?. Urban studies 37(3):513-532.
Grant, R.M. (2002) The knowledge-based view of the firm. The strategic management of intellectual capital and organisational knowledge 17(2):133-148.
Hobbs, K., Link, A. and Scott, J. (2017) Science and technology parks: an annotated and analytical literature review', The Journal of Technology Transfer 42(4): 957-976.
Kolehmainen, J. (2002) Territorial agglomeration as a local innovation environment the case of a digital media agglomeration in Tampere, Finland. Massachusetts Institute of Technology, Special working paper series on local innovation systems 25: 29.
Lecluyse, L., Knockaert, M. and Spithoven, A. (2019) The contribution of science parks: A literature review and future research agenda. The Journal of Technology Transfer 44(2): 559-595.
Martin, R. and Sunley, P. (2003) Deconstructing clusters: chaotic concept or policy panacea?. Journal of economic geography 3(1): 5-35.
Martin, R. and Sunley, P. (2011) Conceptualising cluster evolution: beyond the life cycle model?. Regional studies 45(10): 1299-1318.
Martin, R. and Sunley, P. (2011) The new economic geography and policy relevance. Journal of Economic Geography 11(2):357-369.
McCann, P., Arita, T. and Gordon, I.R. (2002) Industrial clusters, transactions costs and the institutional determinants of MNE location behaviour. International Business Review 11(6): 647-663.
Menzel, M.P. and Fornahl, D. (2009) Cluster life cycles—dimensions and rationales of cluster evolution. Industrial and corporate change 19(1):205-238.
Mondal, C., Al-Kfairy, M. and Mellor, R.B., 2023. Developing young science and technology parks: recent findings from industrial nations using the data-driven approach. Sustainability, 15(7), p.6226.
Mondal, C., Al-Kfairy, M. and Mellor, R.B., 2024. Entrepreneurial universities: Modelling the link between innovation producers and innovation users shows that team structures in the tech transfer function improves performance. Economic Analysis Letters, 3(2), pp.26-33.
ÖZKAN, N., 2022. R&D spending and financial performance: an investigation in an emerging market. Uluslararası Yönetim İktisat ve İşletme Dergisi, 18(1), pp.38-58.
Padmore, T. and Gibson, H. (1998) Modelling systems of innovation:: II. A framework for industrial cluster analysis in regions. Research policy 26(6): 625-641.
Porter, M. (2003) The economic performance of regions. Regional studies, 37(6-7): 549-578.
Porter, M.E. (2000) Location, competition, and economic development: Local clusters in a global economy. Economic development quarterly 14(1): 15-34.
Ramírez-Alesón, M. and Fernández-Olmos, M. (2018) Unravelling the effects of Science Parks on the innovation performance of NTBFs. The Journal of Technology Transfer 43(2): 482-505.
Ruiz, M.S., da Costa, P.R., Kniess, C.T. and Ribeiro, A.P.(2017) Proposal of a theoretical model for the implementation and scalability of science parks: a case study. RAI Revista de Administração e Inovação 14(1): 2-15.
Saxenian, A. (1996) Regional Advantage: Culture and Competition in Silicon Valley and Route 128, With a New Preface by the Author. Harvard University Press.
Schäper, T., Jung, C., Foege, J.N., Bogers, M.L., Fainshmidt, S. and Nüesch, S., 2023. The S-shaped relationship between open innovation and financial performance: A longitudinal perspective using a novel text-based measure. Research Policy, 52(6), p.104764.
Song, Y., Xiu, Y., Zhao, M., Tian, Y. and Wang, J., 2024. Intellectual property protection and enterprise innovation: Evidence from China. Finance Research Letters, 62, p.105253.
Tallman, S., Jenkins, M., Henry, N. and Pinch, S. (2004) Knowledge, clusters, and competitive advantage. Academy of management review 29(2):258-271.
Temouri, Y. (2012) The cluster scoreboard: measuring the performance of local business clusters in the knowledge economy.
Tung, L.T. and Hoang, L.N., 2024. Impact of R&D expenditure on economic growth: evidence from emerging economies. Journal of Science and Technology Policy Management, 15(3), pp.636-654.
Vásquez-Urriago, Á.R., Barge-Gil, A. and Rico, A.M. (2016) Which firms benefit more from being located in a Science and Technology Park? Empirical evidence for Spain. Research Evaluation 25(1): 107-117.
Wernerfelt, B. (1984) A resource-based view of the firm. Strategic management journal 5(2): 171-180.
Wonglimpiyarat, J. (2016) Exploring strategic venture capital financing with Silicon Valley style. Technological Forecasting and Social Change 102: 80-89.

The Factors That Affect the Knowledge-Sharing Behaviours of Female and Male Academics in Higher Education Institutions

Huda N. Almutairi, Paul Gooding and Adele Redhead
School of Humanities, University of Glasgow, Glasgow, UK

h.almutairi.1@research.gla.ac.uk

Abstract: For academics to be successful in a university career, it is generally acknowledged that relevant professional development is a necessity. Research by academics should be innovative and demonstrate an understanding of current issues and developments in their subject. Sharing such knowledge with others who are also endeavouring to learn, to understand or to keep abreast of current developments is as important. Knowledge management and knowledge-sharing in commercial settings, together with the elements that influence these practices, have been investigated by numerous researchers over a long period. However, there are few studies which have evaluated knowledge-sharing in an educational environment, and even fewer in relation to academics in Saudi Arabia. Saudi Arabia is, however, exceptional, in respect of knowledge management and sharing in the academic ecosystem, due to its atypical, prevailing socio-political environment and this may impact on the mechanisms and patterns of professional development amongst academics. Research in this social context, of behaviours well understood in conventional environments, is therefore merited in order to identify similarities and differences, filling an important literature gap and potentially contributing insights which may improve academic success in Saudi and stimulate new ways of thinking in other contexts. The aim of this paper is to determine the factors that affect knowledge-sharing behaviours amongst female and male academics in one of the higher education institutions in Saudi Arabia. A theoretical framework is proposed which is based on the Theory of Planned Behaviour (TPB; Ajzen, 1985). The factors which are commonly considered to be the most influential on both gender's knowledge-sharing behaviours will be analysed and discussed in this exceptional setting. A survey will be distributed amongst academics to gather information for this research. The findings of this study will contribute to the body of published knowledge relating to the practice of knowledge-sharing among academics through the differentiation and quantification of factors which affect it. This will offer academics the opportunity to enhance their understanding of this topic and subsequently, to optimise their part in knowledge exchange processes.

Keywords: Knowledge Sharing Behaviour,Higher Education,Knowledge Sharing Attitude, Academic Staff.

1. Introduction

Knowledge is an essential asset of institutions, and since economic dependence on knowledge is well established, it is also recognised as a precious and valuable resource (Fullwood et al., 2013; Amayah, 2013; Howell & Annansingh, 2013; Bello & Oyekunle, 2014). Commercial enterprises have long recognised that, from the perspective of gaining a competitive foothold, the possession and appropriate management of knowledge is extremely advantageous (Iqbal & Mahmood, 2012 ; Nielsen & Cappelen, 2014). The benefits are multiplied when knowledge-sharing (KS) is a routine practice (Nonaka & Takeuchi, 1995) and numerous initiatives pertaining to knowledge management (KM) have been based on facilitating and improving KS (Hislop, 2013). Educationally, KS can be broadly defined as a societal exchange which advocates optimal practice and sustainability, whilst disseminating both established and novel information. KS in an academic context ensures that up to date research and pedagogical practices, as well as many other proficiencies, are exchanged, in an attempt to guarantee their success in a competitive environment (Tan & Ramayah, 2014).

KS is a major contributor, which ensures a positive outcome from processes pertaining to KM and related agendas. There is a societal expectation that universities are knowledge-rich institutions, and so an absence or diminution of KS could be perceived as detrimental and as well as affecting both research performance and pedagogical commitments (Ali et al., 2014), could cause institutional reputational damage. Thus the practice of concealing or stockpiling knowledge, which is considered prevalent by some academics in a number of disciplines, causing either a direct or secondary effect on innovative skills (Bogilovic et al**.**, 2017; Malik et al., 2019) and professional abilities (Nguyen et al., 2022), is widely considered an institutional hindrance. Furthermore, such secrecy may harm social interactions and create a circular lack of trust which precipitates additional undesirable consequences (Cerne et al., 2014; Bogilovic et al., 2017). This practice of the accrual of unshared knowledge has, nevertheless, continued to plague and adversely affect academic establishments (Cheng et al., 2009; Fullwood et al., 2013; Carband and Jafari Navimipour, 2018; Fauzi et al., 2019).

A number of studies have suggested that there is little research relating to KS, compared to other aspects of KM (Jain et al., 2007; Amayah, 2013; Fullwood et al., 2013), a view substantiated by Ali et al. (2014) in their review. This is especially the case with respect to KS in universities and between academics (Al-Kurdi et al., 2020). The

lack of essential research into KS specifically is demonstrated by scarcity of studies which address educational KS and the relevant influential factors (Fullwood et al., 2013; Ali et al., 2014; Akosile & Olatokun, 2020).

The aim of this paper, therefore, is to determine, from the broad spectrum of factors established as important in other sectors and socio-political environments, those that most affect KS behaviours amongst female and male academics in one of the most important higher education institutions in Saudi Arabia.

In view of the lack of studies on this subject and, specifically, research relating to KS within educational establishments in Saudi Arabia, a major objective of this study is to recognise openings for further research. Analysis of the factors that affect KS processes would also be of value for the improvement of a positive university environment that advocates KS and optimises productivity. It will also enable the KS behaviours, positive and negative, of academics to be identified. These findings will contribute to the development of an educational ethos that supports the process of obtaining de novo knowledge, and the better sharing of such knowledge between academics.

2. Knowledge Sharing in Higher Educational Institutions

Although a number of endeavours have been made to offer descriptions of knowledge, KM and KS, controversy remains regarding agreed definitions, the latter varying according to the standpoint or setting to which they are applied (Iqbal & Mahmood, 2012; Ragab & Arisha, 2013; Ali et al., 2014). One academic-context definition of KS is that it comprises the basic method utilised by employees to participate in the effective implementation of knowledge and the development of creativity within the institution, to the latter's competitive benefit (Jackson et al., 2006). Accepting this definition means that KM and KS can be construed as being key elements for maximising competitivity (Al-Kurdi et al., 2018).

Typically knowledge-rich institutions, universities are major players in the discovery of knowledge via their research programmes, and in KS, through their published literature. Their engagement with commercial enterprises and other bodies facilitates both KS and development, as well as social and cultural profitability. University curricula also offer education and training courses for potential researchers. It could be anticipated that because of this reliance on KS, universities would take the initiative with respect to approaches to KM and that they would have an advanced and rich understanding of ways of dealing with and maximising their knowledge worth (Fullwood et al., 2013).

Academics are expected to be knowledge leaders, who should not demonstrate any reticence regarding KS, with the objectives of their university given primacy above their personal preferences (Al-Kurdi et al., 2018). The goals of higher education facilities include facilitating the development of de novo concepts through collaboration, encouraging KS and optimising learning proficiency through their academic staff, to benefit both the university and the academic staff themselves and to promote the institution's wider agenda (Tan & Ramayah, 2014; Dyer & Nobeoka, 2000).

3. Research Model and Hypothesis Development

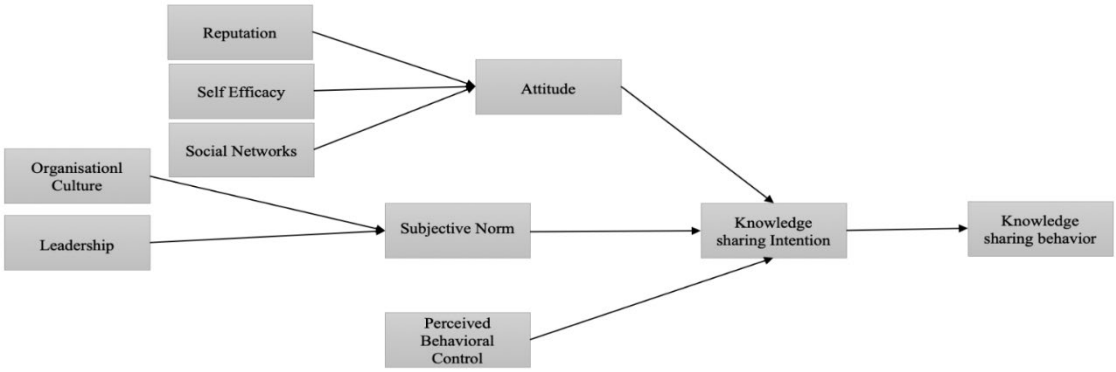


Figure 1: Research model

The TPB is the most commonly referenced explanation for why people act in certain ways (Sussman & Gifford, 2019) and postulates that behavioural intention can be used to predict, and is the best determinant of, certain actions. TPB has been frequently employed in relation to KM. According to the TPB (Figure 1), behavioural

intention is impacted by a triad of components: (i) attitude with respect to the behaviour; (ii) subjective norms relating to the behaviour; and (iii) perceived behavioural control affecting the behaviour (Sussman & Gifford, 2019). KS has been described in terms of the TBP by numerous researchers (Jolaee et al., 2014; Bock et al., 2005; So & Bolloju, 2005) and evidenced in a wide range of settings. In a similar manner, the TPB will be applied in the current study, which will investigate a number of pertinent covariates (elements or factors) identified in the literature as being influential on behavioural intentions. These elements, which were used to extend the research model, comprise reputation, social networks and self-efficacy, which are thought to influence an individual's attitude to KS, as well as the culture and leadership of an organisation thought to influence subjective norms towards KS intention. The aim was to identify those elements which had the greatest impact on KS behaviours practised by academics in higher educational establishments.

3.1 Intentions

within a KM domain, intention refers to a practitioner's enthusiasm and desire to share knowledge (Wu & Zhu, 2012). Many studies have evaluated this characteristic in academics with respect to KS, and determined that, overall, academics express positivity regarding their KS intentions. The first hypothesis arises from this.

H1. Intentions greatly influence knowledge sharing amongst academics.

3.2 Attitude

according to Kuo & Young (2008), attitude refers to the extent to which an individual makes a positive or negative assessment of a certain phenomenon. It has also been described as a psychological leaning with respect to any entity that is influential on intention (Hepler, 2015). A number of important studies have evaluated the association between attitude and KS practice (e.g. Fullwood et al., 2017; Jolaee et al., 2014). Their results demonstrate how people's attitudes about sharing knowledge reflect how ready they are to participate in the process. In particular, the more positivity a person demonstrates with respect to KS, the greater their intention (Afshar Jalili & Ghaleh, 2021; Stenius et al., 2015). Consequently, a second hypothesis is proposed.

H2. Attitude greatly influences the academic's intentions to share knowledge.

3.3 Subjective Norm

This term describes a person's subjective evaluation of how specific others anticipate that they should act, or how they should respond themselves in an equivalent context, i.e. a normative belief (Stenius et al., 2015). A number of studies have demonstrated that KS intentions are positively affected by subjective norms (e.g. Bock et al., 2005; Stenius et al., 2015; Igbinovia, 2018; Afshar Jalili & Ghaleh, 2021). These findings lead to the third hypothesis.

H3. Subjective Norm greatly influences academics' intentions to share knowledge.

3.4 Perceived Behavioural Control (PBC)

It is the degree to which an individual views their competence to engage in a specific behaviour (Ajzen, 1985). It has also been suggested that if individuals had enough control over their behaviour, they would be likely to follow through with their intentions when practical (Jolaee et al., 2014). Goh & Sandhu (2013) studied the effect of PBC on KS in a higher education establishment in Malaysia, and surmised that it was a powerful positive factor with respect to KS. A further hypothesis was therefore postulated.

H4. PBC greatly influences academic's intentions to share knowledge.

3.5 Reputation

Reputation has been shown to be linked with behaviours related to KS (e.g. Dezdar, 2017; Wasko & Faraj, 2005). Such studies have concluded that reputation is a powerful incentive to KS behaviour, findings substantiated by Tan & Ramayah (2014) who found that as an academic's reputation grew, she or he engaged in KS with peers more frequently. These results underpin the fifth hypothesis.

H5. Reputation greatly influences the attitudes of academics towards knowledge sharing.

3.6 Self-Efficacy

A definition of self-efficacy is an individual's confidence that they have the proficiencies required to be successful in a specific setting (Jolaee et al., 2014). This characteristic has also been demonstrated by several researchers to be an important influential factor on the attitude of university academics with respect to KS (e.g. Lin, 2007; Omojowolo, 2014; Dezdar, 2017). Akosile & Olatokun (2020) considered the relationships of self-efficacy and KS practice in the academic environment to merit additional study. A further hypothesis has therefore been proposed.

H6. The self-efficacy of academics greatly influences their attitudes towards knowledge sharing.

3.7 Social Networks

Fauzi et al. (2018) indicate that another factor that has a bearing on the academics' attitude towards KS is social networking. According to (Jolaee et al., 2014), social networks have a favourable and significant correlation with academics' attitudes on knowledge sharing, they stated that academic staff members may develop a propensity for good attitudes toward knowledge sharing if they expand their social networks. The following hypothesis was therefore constructed.

H7. Social networks greatly influence the attitudes of academics towards knowledge sharing.

3.8 Organisational Culture

Promoting an organisational culture that supports knowledge sharing (KS) is one of the main tasks of knowledge management (KM) (Angeloni & Grotto, 2009). According to several studies (e.g. Bousari & Hassanzadeh, 2012; Cheng et al., 2009; Noor et al., 2014), organisational culture is one of the key elements that greatly influences the success of knowledge sharing. A hypothesis was, therefore, postulated in relation to these findings.

H8. Organisational culture greatly influences the subjective norms of academics towards knowledge sharing.

3.9 Leadership

A substantial amount of literature in this field has emphasised the significance of leadership support and its favourable effects on desired knowledge-sharing behaviour inside an organisation (Muhammed & Zaim, 2020). Al-Kurdi et al.'s (2020) study amply demonstrated the beneficial impact of leadership on academic knowledge sharing. Thus, the following hypothesis.

H9. Leadership greatly influences academics' subjective norms towards knowledge sharing.

4. Methodology

A quantitative approach will be employed for this study. Data collection will be carried out using a questionnaire survey, using questions that were adapted from previously published studies to fit this research context. The proposed hypotheses will then be tested by analysing the resultant data using appropriate statistical tools to identify the factors that influence KS behaviour amongst Saudi academics and their relative strengths.

5. Expected Results and Benefits

The context of this research project is rare. It differs from previous studies on KS in that the aim is to determine the factors that have the greatest impact on KS behaviours of both female and male academics in a Saudi university that operates a gender segregation policy. Female academics work on a separate campus to their male counterparts. The results will be important because the importance of KS has been recognised in previous research and emphasised as vital to the success of KM in universities and to universities achieving their objectives. There is, consequently, a prerequisite for academic institutions to create tools that engender an academic atmosphere that promotes KS between academics.

The results of this research will, therefore, be of value to higher management in universities, as they will greatly assist them to identify the factors that have the greatest impact on the KS practices of Saudi academics. In addition to describing an institutional environment that encourages KS, this study will support the development of programmes and the use of incentives to improve knowledge behaviour amongst Saudi academics and their colleagues. The findings will provide administrators with a solid evidence base upon which to build their policies.

References

Afshar Jalili, Y. & Ghaleh, S. (2021). Knowledge sharing and the theory of planned behavior: a meta-analysis review. *VINE Journal of Information and Knowledge Management Systems*, Vol. 51 No. 2, pp. 236–258. https://doi.org/10.1108/VJIKMS-02-2019-0023.

Ajzen, I. (1985). From intentions to actions: a theory of planned behavior. In Kuhl, J. & Beckmann, J. (Eds), Action-Control: From Cognition to Behavior, Springer, Heidelberg, pp. 11–39. https://doi.org/10.1007/978-3-642-69746-3_2.

Akosile, A. & Olatokun, W. (2020). Factors influencing knowledge sharing among academics in Bowen university, Nigeria. *Journal of Librarianship and Information Science*, Vol. 52 No. 2, pp. 410–427. https://doi.org/10.1177/0961000618820926.

Ali, O.F., Gohneim, A. & Roubaie, A.A. (2014). Knowledge sharing culture in higher education institutions: Critical literature review. *European, Mediterranean and Middle Eastern Conference on Information Systems*, Vol. 2014, pp. 1-18.

Al-Kurdi, O., El-Haddadeh, R. & Eldabi, T. (2018). Knowledge sharing in higher education institutions: a systematic review. *Journal of Enterprise Information Management,* Vol. 31 No. 2, 226–246. https://doi.org/10.1108/JEIM-09-2017-0129.

Al-Kurdi, O.F., El-Haddadeh, R. & Eldabi, T. (2020). The role of organisational climate in managing knowledge sharing among academics in higher education. *International Journal of Information Management*, 50, pp.217-227. https://doi.org/10.1016/j.ijinfomgt.2019.05.018

Amayah, A.T. (2013). Determinants of knowledge sharing in a public sector organization. *Journal of Knowledge Management*, Vol. 17 No. 3, pp. 454-471. https://doi.org/10.1108/JKM-11-2012-0369.

Angeloni, M. & Grotto, D. (2009). A influencia na cultura organizacional no compartilhamento do conhecimento. Revista De Administração. *FACES Journal*, Vol. 8 No. 2, 76–93. https://www.redalyc.org/articulo.oa?id=194016886006.

Bello, O.W. & Oyekunle, R.A. (2014). Attitude, perceptions and motivation towards knowledge sharing: views from universities in Kwara State, Nigeria. *African Journal of Library, Archives & Information Science*, Vol. 24 No. 2, pp. 123–134.

Bock, G.W., Zmud, R.W., Kim, Y.L. & Jae, N. (2005). Behavioural intention formation in knowledge sharing, examining the roles of extrinsic motivators, social-psychological forces, and organizational climate. *MIS Quarterly*, Vol. 29 No. 1, pp. 87–111. https://doi.org/10.2307/25148669.

Bogilovic, S., Cerne, M. & Skerlavaj, M. (2017). Hiding behind a mask? Cultural intelligence, knowledge hiding, and individual and team creativity. *European Journal of Work and Organizational Psychology*, Vol. 26, 1–14. https://doi.org/10.1080/1359432X.2017.1337747.

Bousari R.G. & Hassanzadeh M. (2012). Factors that affect scientists' behaviour to share scientific knowledge. *Collnet Journal of Scientometrics and Information Management*, Vol. 6 No. 2, pp. 215–227. https://doi.org/10.1080/09737766.2012.10700935.

Cerne, M., Nerstad, C., Dysvik, A. & Skerlavaj, M. (2014). What goes around comes around: knowledge hiding, perceived motivational climate, and creativity. *The Academy of Management Journal*, Vol 57, pp. 172–192. doi:10.5465/amj.2012.0122.

Charband, Y. & Jafari Navimipour, N. (2018). Knowledge sharing mechanisms in the education: A systematic review of the state of the art literature and recommendations for future research. *Kybernetes*, Vol. 47 No. 7, pp. 1456–1490. https://doi.org/10.1080/09737766.2012.10700935.

Cheng, M.Y., Ho, J.S.Y. & Lau, P.M. (2009). Knowledge sharing in academic institutions: A study of Multimedia University Malaysia. *Electronic Journal of Knowledge Management,* Vol. 7 No. 3, pp. 313–324.

Dezdar, S. (2017). Promoting knowledge sharing in academic environments using non-monetary factors. *Library Review*, Vol. 66 No. 8/9, pp. 595–611. https://doi.org/10.1108/LR-11-2016-0092.

Dyer, J.H. & Nobeoka, K. (2000). Creating and managing a high performance knowledge-sharing network. *Strategic Management Journal*, Vol 21 No. 3, pp. 345–367. https://doi.org/10.1002/(SICI)1097-0266(200003)21:3<345::AID-SMJ96>3.0.CO;2-N.

Fauzi, M.A., Tan, C.N.L., Thurasamy, R. & Ojo, A.O. (2019). Evaluating academics' knowledge sharing intentions in Malaysian public universities. *Malaysian Journal of Library & Information Science*, Vol. 24 No. 1, pp. 123–143. https://doi.org/10.22452/mjlis.vol24no1.7.

Fauzi, M.A., Tan, C.N.L. & Ramayah, T., 2018. Knowledge Sharing Intention at Malaysian Higher Learning Institutions: The Academics' Viewpoint. *Knowledge Management & E-Learning*, Vol. 10 No. 2, pp.163–176. https://doi.org/10.34105/j.kmel.2018.10.011.

Fullwood, R. & Rowley, J. (2017). An investigation of factors affecting knowledge sharing amongst UK academics. J*ournal of Knowledge Management*, Vol. 21 No. 5, pp. 1254–1271. https://doi.org/ 10.1108/JKM-07-2016-0274.

Fullwood, R., Rowley, J. & Delbridge, R. (2013). Knowledge sharing amongst academics in UK universities. *Journal of Knowledge Management*, Vol. 17 No. 1, 123–136. https://doi.org/10.1108/13673271311300831.

Goh, S.K. & Sandhu, M.S., (2013). Knowledge sharing among Malaysian academics: Influence of affective commitment and trust. *Electronic Journal of Knowledge Management*, Vol. 11 No. 1, pp. 38–48.

Hepler, J. (2015). A good thing isn't always a good thing: dispositional attitudes predict non-normative judgments. *Personality and Individual Differences*, Vol. 75, pp. 59–63. https://doi.org/10.1016/j.paid.2014.11.016.

Hislop, D. (2013). *Knowledge management in organizations* (3rd ed.). Oxford, Oxford University Press.

Howell, K.E. & Annansingh, F. (2013). Knowledge generation and sharing in UK universities: A tale of two cultures? *International Journal of Information Management,* Vol. 33 No. 1, pp. 32–39. https://doi.org/10.1016/j.ijinfomgt.2012.05.003.

Igbinovia, M.O. (2018). Predictors of knowledge sharing behaviour on sustainable development goals among library personnel in Nigeria. *IFLA Journal*, Vol. 44 No. 2, pp. 119–131. https://doi.org/10.1177/034003521876344.

Iqbal, J. & Mahmood, Y. (2012). *Reviewing knowledge management literature. Interdisciplinary Journal of Contemporary Research in Business, 4(6), pp.1005-1026.*

Jackson, S.E., Chuang, C.H., Harden, E.E. & Jiang, Y.(2006).Toward developing human resource management systems for knowledge-intensive teamwork. *Research in personnel and human resources management*, Vol. 25, pp. 27–70. https://doi.org/10.1016/S0742-7301(06)25002-3.

Jain, K.K., Sandhu, M.M. & Sidhu, G. (2007). Knowledge sharing among academic staff: a case study among business schools in Klang Valley, Malaysia. *Journal for the Advancement of Arts and Science*, January, pp. 23–29.

Jolaee, A., Nor, K.M., Khani, N. & Yusoff, R.M. (2014). Factors affecting knowledge sharing intention among academic staff. *International Journal of Educational Management*, Vol. 28 No. 4, pp. 413– 431. https://doi.org/10.1108/IJEM-03-2013-0041.

Kuo, F. & Young, M. (2008). Predicting knowledge sharing practices through intention: a test of competing models. *Computers in Human Behavior*, Vol. 24 No. 6, pp. 2697–2722. .https://doi.org/10.1016/j.chb.2008.03.015

Lin H.F. (2007). Effects of extrinsic and intrinsic motivation on employee knowledge sharing intentions. *Journal of Information Science,* Vol. 33 No. 2, pp. 135–149. https://doi.org/10.1177/0165551506068174.

Malik, O., Shahzad, A., Raziq, M.M., Khan, M. & Yusaf, S. (2019). Perceptions of organizational politics, knowledge hiding, and employee creativity: The moderating role of professional commitment. *Personality and Individual Differences*. https://doi.org/10.1016/j.paid.2018.05.005.

Muhammed, S. & Zaim, H. (2020). Peer knowledge sharing and organizational performance: the role of leadership support and knowledge management success. *Journal of Knowledge Management*, Vol. 24 No. 10, pp. 2455–2489. https://doi.org/10.1108/JKM-03-2020-0227.

Nguyen, T.-M., Malik, A. & Budhwar, P. (2022). Knowledge hiding in organizational crisis: The moderating role of leadership. *Journal of Business Research*, Vol. 139, 161–172. https://doi.org/10.1016/j.jbusres.2021.09.026.

Nielsen, C. & Cappelen, K. (2014). Exploring the mechanisms of knowledge transfer in university- industry collaborations: a study of companies, students and researchers. *Higher Education Quarterly*, Vol. 68 No. 4, pp. 375-393. doi: 10.1111/hequ.12035.

Nonaka, I. & Takeuchi, H. (1995). *The knowledge creating company*. Oxford, Oxford University Press. https://doi.org/10.1093/oso/9780195092691.001.0001.

Noor A.D., Hashim H.S. & Ali N. (2014). Factors influencing knowledge sharing in organisations: A literature review. *International Journal of Science and Research* Vol. 3 No. 9, pp. 1314–1319.

Omojowolo O.O. (2014). Factors influencing knowledge sharing behaviour of University of Ibadan students. Unpublished Master's Project, University of Ibadan, Nigeria.

Ragab, M. a. F. & Arisha, A. (2013). Knowledge management and measurement: a critical review. *Journal of Knowledge Management*, Vol. 17 No. 6, pp. 873–901. https://doi.org/10.1108/JKM-12-2012-0381.

Ramayah, T., Yeap, J.A.L. & Ignatius, J. (2014). Assessing knowledge sharing among academics: a validation of the Knowledge Sharing Behavior Scale (KSBS). *Evaluation Review*, Vol. 38 No. 2, pp. 160–187, doi: 10.1177/0193841X14539685.

So, J.C. & Bolloju, N. (2005). Explaining the intentions to share and reuse knowledge in the content of IT service operations. *Journal of Knowledge Management Science*, Vol. 9 No. 6, pp. 30–41.

Stenius, M., Hankonen, N., Haukkala, A. & Ravaja, N. (2015). Understanding knowledge sharing in the work context by applying a belief elicitation study. *Journal of Knowledge Management*, Vol. 19 No. 3, pp. 497–513, https://doi.org/10.1108/JKM-12-2014-0523.

Sussman, R. & Gifford, R. (2019). Causality in the theory of planned behavior. *Personality and Social Psychology Bulletin*, Vol. 45 No. 6, pp. 920–933, doi: 10.1177/0146167218801363.

Tan, C.N.L. & Ramayah, T., (2014). The role of motivators in improving knowledge-sharing among academics. *Information Research: An International Electronic Journal*, Vol. 19 No. 1, p. 1. https://eric.ed.gov/?id=EJ1020843.

Wasko, M.M.L. & Faraj, S. (2005). Why should I share? Examining social capital and knowledge contribution in electronic networks of practice. *MIS Quarterly*, Vol. 29 No. 1, pp. 35–57. https://doi.org/10.2307/25148667.

Wu, Y. & Zhu, W. (2012). An integrated theoretical model for determinants of knowledge sharing behaviours. *Kybernetes*, Vol. 41 No. 10, pp. 1462–1482. https://doi.org/10.1108/03684921211276675.

Assessing the Moderating Role of Organizational Culture on the Effect of Knowledge Networks on Firm Innovation in Visegrad Countries: The Perspective of Knowledge Production Function

Emmanuel Ebo Arthur and Jan Stejskal
University of Pardubice, Pardubice, Czech Republic

emmanuel.arthur@upce.cz
jan.stejskal@upce.cz

Abstract: Among the elements of Knowledge Production Function (KPF), R&D remains one of the highly studied factors. In an era of interdependence and collaborations, no firm or enterprise can survive the prevailing highly competitive business environment by not networking with firms of similar interest, values, and goals. The unanswered question in prior literature on firm co-operation is what kind of firm co-operation best works? In finding an answer to fill this gap in literature, we examined the impact of R&D co-operation, innovation co-operation (excluding R&D) and co-operation based on other business activities on radical and incremental innovations. We further examined the moderating role of organizational culture on the effect of firm co-operation on innovation. Our study is based on open innovation theory and the KPF. Adopting the 2018 cross-sectional CIS data from the Eurostat database for the four Visegrad countries (Czech Republic, Poland, Hungary, and Slovakia), the OLS regression and Average Marginal Effects models were used for the analysis. We confirmed that when firms co-operate on R&D, there is a positive and significant effect on radical innovation but negative significant effect on incremental innovation. Firm co-operation on innovation activities excluding R&D has positive and significant effect on both radical and incremental innovations. Other business co-operations had positive and significant effect on incremental innovation but not on radical innovation. We further confirmed a positive significant moderating role on the effect of R&D co-operation on radical innovation. We proposed theoretical and practical implications of our study to firm managers, government, and policy formulators.

Keywords: R&D co-operation, Training and Development, Radical and Incremental Innovations, OLS, Visegrad

1. Introduction

Firms network or co-operate for varied reasons. Some include knowledge sharing, cost sharing and joint projects and other activities of mutual interest. Firm co-operation through strategic alliances spurs innovation and firm performance. Over the years, firms have co-operated in the areas of information technology and biotechnology (Boh, Huang & Wu, 2020). Effective firm co-operation has seen firms gained in the areas of creativity and innovation, market expansion and access, risk and cost sharing and enhanced competitiveness. (Boh, Huang & Wu, 2020; Shafi, 2021; Singh, 2022). One key area identified by extant literature for firm co-operation is on R&D and its impact on general innovation. Van Beers and Zand (2014) used the random-effects panel Tobit estimates, in Netherlands and found that, partner diversity in R&D had positive impact on radical and incremental innovations. But in Portugal, investments act as a constraint to SMEs collaboration in R&D towards product innovation (Paiva, Ribeiro & Coutinho, 2020). Despite the growing literature on R&D, Negassi (2004) argues that firm network and R&D co-operation remain limited. With the existence of few studies on R &D co-operation and innovation (Negassi, 2004; Pham et al., 2021; Bragoli, Cortelezzi, & Rigon, 2024; Peiró-Signes, Díez-Martínez & Segarra-Oña, 2024), the empirical relevance of the moderating role of organizational culture has rarely been considered. Not only that, but the diversity in R&D and non-R&D cooperation has also not been studied. The emphasis has been on firm heterogeneity in R&D co-operation. The neglect of examining the varied R&D and non-R&D firm co-operation is an issue because the other forms of firm network or co-operation also play a role in firm innovation performance.

The objective of this paper is to examine how networking or co-operation in the determinants of knowledge production function (R&D co-operation and non-R&D co-operation) impact on radical and incremental innovations in the Visegrad countries. We further aim to produce evidence on the moderating effect of organizational culture (expenditure on training and development) on the relationship between R&D co-operation and innovation. Our study contributes to the body of literature in three diverse ways. First, we prove that variations in firm co-operation (R&D and non-R&D) have heterogeneity effect on radical and incremental innovations. It is important to differentiate the impact of R&D co-operation on innovation and from that of non-R&D to give effective alternative to firm managers and stakeholders. It helps to inform and direct investment decisions on the kind of co-operation to engage. Second, we add to the understanding of existing literature on organizational culture by examining the extent to which it moderates the relationship between R&D cooperation and innovation in the Visegrad region. Thirdly, the study contribute enhances the KPF

concept, Resource Based View (RBV) and Collaborative Advantage Theory (CAT). We explained R&D as a knowledge-based determinant of KPF. Our study is based on RBV and CAT. RBV strides on the axiom, firm co-operate to leverage complimentary resources and capabilities they cannot realised internally. On the other hand, CAT posits that, firms that co-operate achieve optimal performance and competitive advantage. This study asserts that firms that network and co-operate improves their resources and capabilities, competitive advantage, and performance.

The rest of the study is framed as Section 2, literature, and framework of the study; Section 3, methodology, results and discussions in Section 4 and conclusion in Section 5.

2. Literature and Framework of the Study

2.1 Linking Firm Co-Operation, Organizational Culture, and Innovation.

There are several bases for firm co-operation either internally or internally. The mutual benefits associated with firm co-operation spur firms to make decisions to either co-operate or not. Firms that lack a resource, the capability to perform an activity or produce a product usually network or co-operate. The co-operation of firms is in various forms, but this study focuses on R&D co-operation, innovation co-operation (excluding R&R) and other business activities co-operation. R&D co-operation involves firms engage in strategic alliances for long term research projects with universities and other public research institutions. Park and Lee (2023) argue that firm horizontal R&D co-operation is effective when there is economic risk and lack of market knowledge regarding the introduction of a new product to the market. Several empirical studies show positive and insignificant impact of R&D co-operation on firm innovation (Žítek & Klímová, 2020; Choi & Choi, 2021). The effect of R&D co-operation on firm innovation has never been in dispute but, the direction and significance of the impact and the type of innovation have been in dispute owing to the discrepancies in the findings over the years. Innovation co-operation includes firms collaborating on innovation joint venture, feasibility of introducing new projects, acquiring patents and licenses and software introduction (Sohag, Chukavina & Samargandi, 2021). This excludes all research and development activities. Innovation activities improve product and process innovation (Madrid-Guijarro, Martin & García-Pérez-de-Lema, 2021) however, Rammer (2023) argues that there is no significant impact on process innovation output when firms co-operate on innovation activities. It suggests that, acquiring external knowledge is not certain for achieving process innovation. Firms also co-operate on other business activities. This form of co-operation is in the domain of sales and distribution, sustainable initiatives, manufacturing, marketing, and promotion. Firms that co-operate experience considerable innovation in marketing, sales, and distribution (Xian & Jiang, 2023). To sum the issues in existing literature, there are varied and inconclusive arguments on the impact of firm co-operation (R&D, innovation activities and other business activities) on innovation. We therefore hypothesized that:

H1a: Firm R&D co-operation improves radical and incremental innovation in the Visegrad region.

H1b: Firm co-operation on innovation activities excluding R&D enhances radical and incremental innovation in the Visegrad region.

H1c: The more firms co-operate on other business activities, the better it is for radical and incremental innovation in the Visegrad region.

Organizational culture defines the shared values, norms, beliefs, standards, leadership, teamwork, and artefacts that is associated with the organization (Srisathan et al., 2020). It influences how people talk, act, and behave in an organization. There is no significant relationship between organizational culture and open innovation performance (Alassaf et al., 2020). Organizational culture may be an improbable but a subtle obstacle to innovation. Some firms have the culture of spending on the training and development of their employees. The purpose is to enhance the skills and capabilities of the employee. While prior literature focuses on using organizational culture as explanatory variable, our study uses it as a moderator. We therefore suggest that:

H2: *Organizational culture positively moderates the relationship between R&D firm co-operation and innovation.*

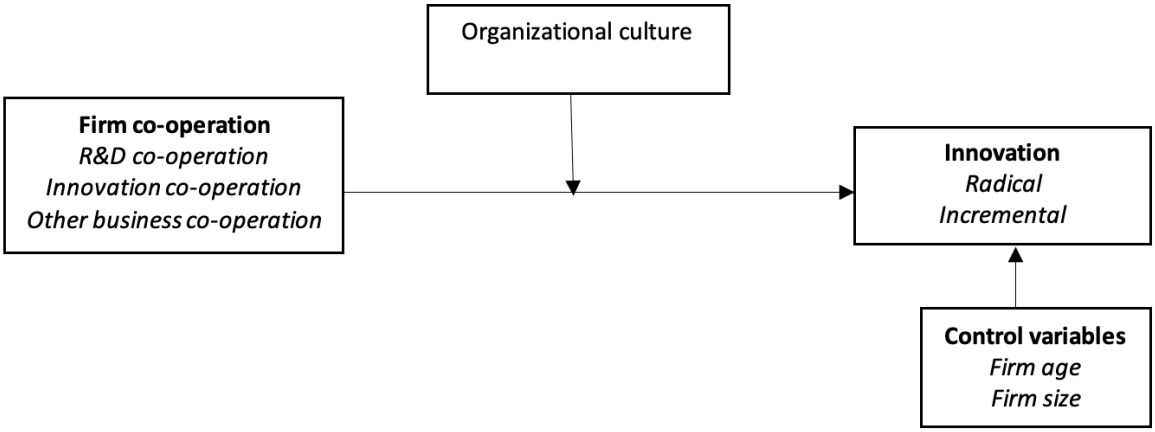


Figure 1: Conceptual framework

3. Methodology

3.1 Data Source and Variables Description

The study used 2018 Community Innovation Survey (CIS) cross-sectional data from the Eurostat database for the analysis. The Eurostat database is credible and reliable site and has been used by several empirical studies. The context of our study in the Visegrad region. It comprises four European countries namely, the Czech Republic, Poland, Hungary, and Slovakia. A total of 31859 firms from these countries participated in the study (Refer to Table 2 for details). According to the European innovation scoreboard 2023, the countries in the Visegrad region fall within emerging and moderate innovators. It is of immense interest to examine the influence of firm co-operation in R&D, innovation activities and other business activities on incremental and radical innovations in the region.

Our independent variable is innovation. Two indicators were used to measure innovation. One is products new to market and new to the firm is used to measure radical innovation while products new to firm only is used as proxy for incremental innovation. We used three indicators to measure firm co-operation. They are firm R&D co-operation, firm innovation co-operation excluding R&D and firm co-operation on other business activities. Expenditure on training and development is the proxy for organizational culture. We controlled for firm age, firm size, and country fixed effects. Firm size is classified into small firms (10-49 employees), medium firms (50-249 employees) and large firms (more than 250 employees). Firm age is coded as firms established in 2016 or later= 1, from 2010-2015 =2 and 2009 or before= 3. All other variables used are dummy in nature. It means they take the value 1 for "Yes" if the activity occurred and 0 for "No" if it did not occur. Refer to Table 1 for the details of variables used including literature sources.

3.2 Methods

We used the OLS regression to assess our hypothesis because it is a base line model for several empirical studies. The OLS model is presented as:

$$Inn\ (Z_1) = \beta_0 + \beta_1\ parameters + firm\ characteristics\lambda + \varepsilon_i \quad [1]$$

$InnZ_1$ represents "1" if the firm introduced a new product and "0" if it did not introduce a new product. β_0 is constant, β_1 parameters, firm characteristics λ is the vector and ε_i is the random error term.

We first assessed the issues of multicollinearity and heteroskedasticity which could be associated with our data and beset our findings. We used Variance Inflation Factor (VIF). The smaller the VIF values the better it is for the model. A VIF value above 10 indicates multicollinearity issues in the variables being studied. The VIF produced and average value of 1.16 indicating that multicollinearity is not an issue with our data. The Breusch-Pagan test for heteroskedasticity showed a P- value of 0.110 for incremental innovation and 0.240 for radical innovation. This insignificant p-values in the BP test implies the likelihood of less or not issues of heteroskedasticity. In the first stage of our analysis, we conducted an OLS regression analysis to examine the impact of firm co-operation (R&D, innovation activity and other business activities) on radical and incremental

innovations. Radical innovation is model 1 and incremental innovation is model 2. In the second stage of our analysis, we did a robustness test using the average marginal effect estimation to check the reliability and validity of the results in Table 5. We introduced expenditure on training and development as an interaction variable to the model in stage 3 of the analysis.

Table 1: Variable description

Variable	Indicators	Data source	Literature source
Dependent variable Innovation- Radical and incremental	Innovation product new to market Innovation product new to firm	CIS 2018	Van Beers & Zand at al., (2021)
Independent variable Firm co-operation	Co-operation on R&D Co-operation on innovation (excludes R&D) Co-operation on other business activities	CIS 2018	Paiva et al., (2020). Nagassi, (2004)
Control variables Firm age Firm size Country	Year of establishment Number of employees Visegrad countries	CIS 2018	Alassaf et al., (2020); Nagassi, (2004)
Moderating variable Organizational culture	Expenditure on staff training	CIS 2018	Alassaf et al., (2020); Srisathan et al., (2020).

Table 2: Firms per country

Country	Number	Percent	Cumulative percent
Poland	15495	48.64	48.64
Czech Republic	5749	18.05	66.68
Hungary	7377	23.16	89.84
Slovakia	3238	10.16	100.00
Total	31859	100.00	

Own calculations

Table 3 Multicollinearity diagnostic test

Variables	VIF	SQRT VIF
Co-operation on R&D	1.28	1.13
Co-operation on other innovation activities (excluding R&D)	1.39	1.18
Co-operation on other business activities	1.29	1.13
Firm expenditure on training and development	1.00	1.00
Firm age	1.04	1.02
Firm size	1.08	1.04
Country	1.09	1.04
Innovation product new to market	1.16	1.04
Innovation product new to firm	1.15	1.07
Mean	1.16	

Own calculation

4. Results and Discussion

Table 4 shows the descriptive statistics of the study. On the average, firms in Visegrad region reported 54.6% radical innovation and 81.5% incremental innovation. They also agree to have had 6.8% R&D co-operation,

7.6% co-operation on innovation (excluding R&D) and 9.8% co-operation on other business activities. Averagely, only 4% of the firms agree to have spent on the training and development of their employees. With a firm size mean of 1.394, it implies that majority the firms in the study were medium firms with 50-249 employees. Most firms involved in the study were established from 2010 to 2015.

The OLS regression analysis results in Table 5 help to evaluate hypothesis H1a, H1b and H1c. There is positive significant effect of R&D co-operation on radical innovation but negative significant effect on incremental innovation. It implies that, there is 10.2% improvement in radical innovation and surprisingly, 1.7% reduction in incremental innovation for every unit of R&D co-operation firms undertake. This partially supports hypothesis H1a. It also confirms the assertion of Choi and Choi (2021) that R&D co-operation has positive and significant impact on innovation although they did not classify the effect on radical and incremental innovations.

Table 4: Summary statistics

Variable	Obs.	Mean	Std. dev.	Min	Max
Co-operation on R&D	29138	0.068	0.251	0	1
Co-operation on other innovation activities (excluding R&D)	29138	0.076	0.265	0	1
Co-operation on other business activities	26110	0.098	0.297	0	1
Firm expenditure on staff training and development	26094	0.004	0.130	0.130	18.283
Firm age	31859	2.728	0.538	1	3
Firm size	31859	1.394	0.648	1	3
Country	31859	1.948	1.059	1	4
Innovation product new to market	31859	0.546	0.233	0	1
Innovation product new to firm	31859	0.815	0.181		01

Own calculations

Again, the results support the argument that R&D co-operation is effective when the economic risk of introducing the new product is high (Park & Lee, 2023). The economic risk associated with radical innovation is higher than incremental innovation. By implication, it is not surprising to find the impact of R&D co-operation on radical innovation stronger and positive in relation to incremental innovation. Firms' co-operations on innovation activities excluding R&D had positive and significant impact on both radical and incremental innovations. This fully supports hypothesis H1b. It confirms existing studies that co-operation on innovation activities enhances product and process innovations (Madrid-Guijarro, Martin & García-Pérez-de-Lema, 2021) even though our finding is on radical and incremental innovations. However, it is contrary to the findings of Rammer (2023) that there is no significant impact on process innovation by firms' co-operating in innovation activities excluding R&D. We partially confirm hypothesis H1c in Table 5 that, firms co-operating on other business activities positively and significantly impact incremental innovation but did not radical innovation. This partially confirms the argument by Xian and Jiang (2023) that firms that co-operate on non-R&D and non-innovative activities such as marketing, sales and distribution promote innovation. We found that this is true for incremental innovation but not radical innovation. To give unbiased results, we controlled for firm age, firm size, and country level effects in all our analyses.

Table 5: OLS regression analysis of the R&D and non- R&D co-operation and innovation

Variables	Model 1 Radical innovation	Model 2 Incremental innovation
Co-operation on R&D	0.102*** (0.006)	-0.017*** (0.005)
Co-operation on other innovation activities (excluding R&D)	0.043*** (0.005)	0.009* (0.004)
Co-operation on other business activities	0.001 (0.005)	0.025*** (0.004)
Firm age	0.003 (0.002)	- 0.001 (0.002)
Firm size	-0.010*** (0.001)	0.005** (0.002)
Country level fixed effect	Yes	Yes
_cons	0.538*** (0.007)	0.826*** (0.006)
R-sqr.	0 .017	0.0039
Adjusted R-sqr.	0.016	0.0037
Obs.	31859	31859

Note: Standard error in parenthesis * p< 0.1; ** p < 0.05; *** p < 0.01

Own calculations

In Table 6, we further conducted robustness test using the average marginal effect estimation to assess the reliability and validity of our results in Table 5. The results confirm that firm co-operation in R&D and innovation activities have significant and positive impact on innovation but insignificant impact on co-operation on other business activities. Thus, for a unit change in R&D co-operation, firms achieve 16.3% improvement in innovation and 8.3% for firm co-operation on innovation activities.

In testing hypothesis H2, we interacted expenditure on staff training and development and firm co-operation on R&D, we found that organizational culture positively and significantly moderates the relationship between R&D co-operation and radical innovation but not incremental innovation. This supports hypothesis H2 but disagrees with Alassaf et al., (2020) that there is no significant relationship between organizational culture and open innovation We reported only the positive results (Radical innovation) on the interaction effect.

Table 6: Robustness test results on the R&D and non- R&D co-operation and innovation using average marginal effect method.

Variables	Delta Method dy/dx
Co-operation on R&D	0.163*** (0.020)
Co-operation on other innovation activities (excluding R&D)	0.083*** (0.019)
Co-operation on other business activities	0.006 (0.019)
Firm age	0.020 (0.013)
Firm size	-0.027*** (0.010)
Country level fixed effect	Yes
Obs.	5038

Note: Standard error in parenthesis * p< 0.1; ** p < 0.05; *** p < 0.01

Own calculations

Table 7: Interaction effect of expenditure on staff training on the relationship between R&D co-operation and innovation

Variables	Model 1 Radical innovation
Co-operation on R&D	0.107*** (0.007)
Expenditure on staff training and development	0.004 (0.010)
Expenditure on staff training and development * Co-operation on R&D	0.335* (0.121)

Variables	**Model 1** Radical innovation
Co-operation on other innovation activities (excluding R&D)	0.049*** (0.007)
Co-operation on other business activities	-0.003 (0.005)
Firm age	0.003 (0.002)
Firm size	-0.010*** (0.002)
Country level fixed effect	Yes
_cons	0.540*** (0.007)
R-sqr. Adjusted R-sqr. Obs.	0.0174 0.0171 26094

Note: Standard error in parenthesis * p< 0.1; ** p < 0.05; *** p < 0.01

Own calculations

4.1 Discussion

Our first hypothesis H1a sought to examine how firm R&D co-operation improves radical and incremental innovation in the Visegrad region. We confirmed that R&D co-operation enhances radical innovation but surprisingly it retards incremental innovation. This provides an insight into the missing link existing in current literature (Žítek & Klímová, 2020; Choi & Choi, 2021) which mostly focus on R&D co-operation and its impact on general innovation. It is pertinent to state that, firm co-operation in R&D is effective in terms of Radical innovation but not incremental innovation. We also sought to find out the impact of non-R&D innovation on radical and incremental innovations in our hypothesis H1b. This was fully confirmed by our findings that when firms co-operate on innovation activities excluding R&D, is promotes both radical and incremental innovations. We refute Rammer's (2023) are argument that when firms co-operate on innovation activities, it does not necessarily lead to innovation. We extend the understanding in firm co-operation that, policy statements of firms that seek to achieve both radical and incremental innovation should give attention to co-operating on innovation activities excluding R&D with firms of mutual interest that have the resources and capabilities to carry out the co-operation agenda. Furthermore, we assert that, firm co-operation on other business activities excluding R&D and innovation promote only incremental innovation. Such co-operation does not impact on radical innovation. This was confirmed by hypothesis H1c that firm co-operation in other business activities did not have significant impact on radical innovation but was significant on incremental innovation. The essence of assessing the moderation role of organizational culture in the relationship between R&D co-operation was confirmed in hypothesis H2. We proved that, when firms focus on the culture of training and developing their employees and co-operate with other firm on R&D, they promote radical innovation. Firm co-operation is important and costly. It involves great investments. Hence, policy statements on firm co-operation should focus on the kind of co-operation to engage in, the kind of organizational culture to develop because they have a bearing on radical and incremental innovation.

5. Conclusion

The aim of our study is to examine firm co-operation in the determinants of knowledge production function and the impact on innovation. Also, we assessed the moderation role of organizational culture (expenditure on training and development) on the relationship between firm co-operation and innovation. The reason for the purpose of our study is due to the research gap in finding answers to specific firm co-operations and how they impact specific types of innovation. We partially confirmed our first hypothesis that firm R&D co-operation positively and significantly impact on radical innovation but negatively impact on incremental innovation. The second hypothesis was fully supported that firm co-operation on innovation activities excluding R&D positively and significantly impact on both radical and incremental innovations. The third hypothesis was partially confirmed that firm co-operation other business activities excluding R&D and innovation activities positively impact on only incremental innovation and not radical innovation. We confirmed our final hypothesis that an interaction between expenditure on training and development and firm co-operation on R&D positively and significantly impact on radical innovation. Practically, the implications of our findings suggest that firms that aim at achieving radical innovation succeed when they co-operate on R&D.

Because the economic risk in radical innovation requires committed investments policies on R&D and an effective triple helix system. Again, managers of firms that seek to achieve both radical and incremental innovations should have a policy direction towards co-operation on innovation activities. Besides, other business activities co-operation (excluding non-R&D and innovation activities) promotes incremental innovation. Finally, managers of firms that want to succeed with the introduction of a product new to both market and the firm should prioritize the culture of employee training and development as well as co-operating with other firms on R&D. Theoretically, these findings contribute to collaborative advantage theory (CAT), the knowledge production concept (KPF), and the Resource Based View Theory (RBV). From the point of CAT we confirm that when firms are open to co-operation, there is an inflow of new knowledge promotes innovation and the kind of co-operation firms undertake determine the kind of innovation the achieve. We further established that, value of organizational culture in interacting with the determinants of KPF to promote radical innovation in the Visegrad region. From the perspective of RBV, we affirm that new knowledge is a vital resource towards innovation and its acquisition is through various forms of co-operation. Firm co-operation must be done cautiously to achieve the optimal benefit. Regardless of the findings, our study is without limitations. The study focused on only four countries in the Visegard region. Therefore, generalising the findings should be done cautiously as it might not be a true reflection in the European region. Our data is also cross-sectional in nature sourced from the 2018 CIS. The results do not allow for longitudinal assessment over a period. The possibility of endogeneity and cross-sectional dependency issues cannot be ruled out in the data used. We suggest that future studies include all countries in Europe and use panel data for the analysis. We also suggest the that other determinants of KPF should be included in future studies to determine the consistencies and variations in the findings.

Acknowledgements

This work was supported by the Student Grant Competition of the University of Pardubice SGS_2024_013

References

Alassaf, D., Dabić, M., Shifrer, D., and Daim, T. (2020). The impact of open-border organization culture and employees' knowledge, attitudes, and rewards with regards to open innovation: an empirical study. *Journal of Knowledge Management*, Vol 24, No.9, pp 2273-2297.

Boh, W. F., Huang, C. J., and Wu, A. (2020). Investor experience and innovation performance: The mediating role of external cooperation. *Strategic Management Journal*, Vol 41, No1, pp 124-151.

Bragoli, D., Cortelezzi, F., and Rigon, M. (2024). Firms' innovation and university cooperation. New evidence from a survey of Italian firms. *Oxford Economic Papers*, Vol 76 No 1, pp 136-161.

Choi, J., and Choi, J. Y. (2021). The effects of R&D cooperation on innovation performance in the knowledge-intensive business services industry: focusing on the moderating effect of the R&D-dedicated labor ratio. *Technology Analysis & Strategic Management*, Vol *33 No.* 4, pp 396-413.

Madrid-Guijarro, A., Martin, D. P., and García-Pérez-de-Lema, D. (2021). Capacity of open innovation activities in fostering product and process innovation in manufacturing SMEs. *Review of Managerial Science*, Vol *15 No* 7, pp 2137-2164.

Negassi, S. (2004). R&D co-operation and innovation a microeconometric study on French firms. *Research policy*, Vol *33 No* 3, pp 365-384.

Paiva, T., Ribeiro, M., and Coutinho, P. (2020). R&D collaboration, competitiveness development, and open innovation in R&D. *Journal of Open Innovation: Technology, Market, and Complexity*, Vol 6 No 4, pp 116.

Pham, P. T., Popesko, B., Quddus, A., & Nguyen, N. T. K. (2021). Innovation and bank efficiency in Vietnam and Pakistan. *Scientific Papers of the University of Pardubice, Series D: Faculty of Economics and Administration*.

Park, B., and Lee, C. Y. (2023). Does R&D cooperation with competitors cause firms to invest in R&D more intensively? evidence from Korean manufacturing firms. *The Journal of Technology Transfer*, Vol 48 *No* 3, pp 1045-1076.

Peiró-Signes, Á., Díez-Martínez, I., and Segarra-Oña, M. (2024). The drivers of cooperation for innovation and the role of environmental orientation. *Corporate Social Responsibility and Environmental Management*.

Rammer, C. (2023). Measuring process innovation output in firms: Cost reduction versus quality improvement. *Technovation*, Vol *124*, 102753.

Shafi, M. (2021). Sustainable development of micro firms: examining the effects of cooperation on handicraft firm's performance through innovation capability. *International Journal of Emerging Markets*, Vol *16 No* 8, pp 1634-1653.

Singh, R., Chandrashekar, D., Hillemane, B. S. M., Sukumar, A., and Jafari-Sadeghi, V. (2022). Network cooperation and economic performance of SMEs: Direct and mediating impacts of innovation and internationalisation. *Journal of Business Research*, Vol 148, pp 116-130.

Sohag, K., Chukavina, K., and Samargandi, N. (2021). Renewable energy and total factor productivity in OECD member countries. *Journal of Cleaner Production*, Vol *296*, 126499.

Srisathan, W. A., Ketkaew, C., and Naruetharadhol, P. (2020). The intervention of organizational sustainability in the effect of organizational culture on open innovation performance: A case of thai and chinese SMEs. *Cogent business & management*, Vol *7* No 1, 1717408.

Van Beers, C., and Zand, F. (2014). R&D cooperation, partner diversity, and innovation performance: an empirical analysis. *Journal of Product Innovation Management*, Vol 31 N*o* 2, pp 292-312.

Xiang, Y., and Jiang, Y. (2023). Co-evolution of firm innovative capability and external network: entrepreneurial orientation as antecedent–a longitudinal case study of the CHINT group. *Asian Journal of Technology Innovation*, Vol *31 No* 2, pp 397-421.

Žítek, V., & Klímová, V. (2020). Regional resilience redefinition: Postpandemic challenge. *Scientific Papers of the University of Pardubice. Series D. Faculty of Economics and Administration*, *28*(4).

Informal Relationships, Digital Competences and Agility in Organizations

Paweł Bańkowski, Yuliia Boiko and Jacek Witkowski
Lublin University of Technology, Lublin, Poland

j.kubaj@pollub.pl
p.bankowski@pollub.pl
j.witkowski@pollub.pl

Abstract: Building interpersonal relationships in organizations plays a very important role and directly affects long-term cooperation with partners. Informal and partnership relations have a particular impact on the agility of the organization, i.e., the ability to immediately respond to changes occurring in the business environment. The aim of this article is to assess the impact of interpersonal relations on the organizational structure and the level of use of digital competencies. According to the literature on the subject, agility in the organization and digital competences contribute to the effective creation and transfer of knowledge. The benefits of implementing an agile structure in an organization also include better management of changing priorities, open cooperation and communication, and greater awareness of the current situation in the organization. The article uses the results of original initial research conducted as part of an inter-university research project entitled "Interorganizational Relations in the Socio-Economic Economy". The research covered relationships in the organization in five areas. The research among the students enrolled in the Master of Business Administration postgraduate program at the Lublin University of Technology was carried out using a quantitative method using a developed survey questionnaire. The analysis of the results confirmed the influence of partnership and informal relations on the agility of the organization and the high level of digital competences implemented. A flexible approach to building relationships enhances the creation of a networked organization. Informal relationships in the organization allow for the building of a team that is more resistant to crisis situations as well as changes in customer needs and sectoral turbulence of the economy. An important aspect of agility is also the high level of using digital competences, which influences the ability to create and transfer knowledge.

Keywords: Interpersonal Relations, Relationships, Agile Structure, Agile Organization, Digital Competences.

1. Introduction

Relationships within organizations serve as the cornerstone for efficient and effective functioning and development. These relationships, as noted by Klimas (2013), encompass both formal and informal aspects, including social and interpersonal connections. The significance of informal relationships is steadily increasing and directly correlates with the agility of an organization—its ability to promptly adapt to changes in the business landscape. Partnership and interaction emerge as pivotal components of cooperation, exerting a direct influence on the organizational structure.

In today's dynamic business landscape, the concept of agility has become paramount for modern organizations in response to the rapid emergence of uncontrollable changes, largely driven by global digitalization. This underscores the imperative of leveraging digital competencies to ensure the accuracy and comprehensiveness of data, as well as facilitate effective communication (Kocot & Kwasek, 2022).

The aim of the work is to examine whether there is a correlation between the type of interpersonal relationships in the organization and the level of use of digital competences of its members, as well as the agility of the organization itself. To achieve this goal, the results of a survey conducted among a group of middle-level managers participating in MBA postgraduate studies will be discussed.

2. Review of the Literature

The role of agility in organizational activities started to be discussed and documented in the 1980s and 1990s by such authors as H. Takeuchi, I. Nonaka, P. T. Kidd, S. L. Goldman, & R. N. Nagel, with increasing scholarly interest in the following decade. Joiner and Josephs (2007) not only focused on defining agile leadership but also mentioned an agile organization, describing it as capable of anticipating and responding to rapidly changing operational conditions. Rafi et al. (2022) and Atkinson et al. (2022) have underscored the significance of this capacity to respond to turbulent environments as the essence of agility. Additionally, these authors emphasize the multifaceted nature of agility, noting its various dimensions.

El Nsour (2021) draws attention to several dimensions of agility, including enterprise, employees, supply chain, customers, and services. Similarly, Silva and Oliveira (2023), in their work discussing research conducted in Brazil,

identify the dominant dimensions of agility in local companies representing Industry 4.0 as leadership, business, markets, strategy, and process.

Devie et al. (2023) contend that an agile organization will focus on its internal culture to support agility, as well as on customers and competitors. However, these authors also observe a research gap regarding the relationship between organizational effectiveness and internal and external changes occurring within the organization.

According to Bernstein (2007), capital is a distinct economic category denoting accumulated resources utilized for implementing and advancing business activities, characterized by the potential for value growth. Regardless of organizational specificity, the human factor holds a pivotal position in organizational structure. Honjo et al. (2022) highlight that enterprises grounded in human capital find it easier to access foreign funds due to being perceived as entities with enhanced creditworthiness. Hasan and Uddin (2022) argue that companies should prioritize retaining talented employees crucial to organizational operations by offering suitable motivational and financial incentives.

Employee relations, along with their interactions with external entities, are frequently viewed as organizational capital (Zhang et al., 2022; Drewniak et al., 2020). Sukarno et al. (2019) regard relational capital as a fundamental component of intellectual capital. Additionally, Ozgun et al. (2022) and Al-Omoush et al. (2020) highlight its favorable impact on organizational agility and enterprise performance.

Interorganizational relationships represent a vital activity for organizations, undertaken to streamline business operations and enhance their competitive positioning in the market (Bańkowski & Rzepka, 2024). The definition of relationships presented in this study was obtained through a literature review undertaken by the author. Another significant aspect concerning intra-organizational relationships is the collaboration between leaders and subordinates. Gren and Ralph (2022) and Reunamäki and Fey (2022) emphasize the necessity of fostering a willingness among individuals to share leadership responsibilities in order to cultivate agile leadership. They also acknowledge that traditional managerial approaches within team settings may impede the implementation of agility within organizations. Das et al. (2023) stress that leaders who prioritize reevaluation and problem examination enhance agility and foster a supportive work environment by demonstrating care for employees' needs and sentiments.

Tyagi et al. (2022) and Trzeciak & Banasik (2022) consider the organization responsible for implementing solutions that determine the effectiveness and commitment of members within agile project teams. A relatively new research avenue explores the impact of familial ties among employees on organizational functioning. Existing literature does not offer a definitive answer regarding how such relationships influence company operations. Ramirez-Solis et al. (2022) discovered, based on research conducted among a cohort of small and medium-sized enterprises in Mexico, that surveyed companies benefit from interactions between managers and the business environment, viewing them as sources of new products and services.

Probst, Raub, and Romhardt (2004) define knowledge as the accumulation of knowledge and skills utilized by individuals to resolve problems. However, while various analyses affirm the fundamental significance of relationships with stakeholders and the business environment for the processes of acquisition, learning, decision-making, and problem-solving in enterprises (AlQuershi et al., 2021; Dar, 2019), the influence of capital on knowledge sharing within these relationships remains a research gap in the literature (Aisyah et al., 2019). As highlighted by Rzepka and Sabat (2022), the efficacy of knowledge utilization is contingent upon employees' receptiveness to external contacts and willingness to embrace innovation.

The problem of the relationship between an organization's agility and its innovativeness is relatively well represented in the literature on the subject. Agility should be understood as the organization's ability to survive in a turbulent environment (Głowacz, 2022), while innovation is defined as the enterprise's ability to create and implement new solutions (Stefaniuk, 2019). Most researchers (e.g., Sjödin et al., 2020; Alamsjah, 2022) represent the view that the impact of agile behavior in organizations on their innovation is positive. However, there are items in the literature that contradict this theory. Annosi et al. (2021), based on research on changes implemented in a large telecommunications company, draw the unexpected conclusion that increasing agility has a negative impact on the ability of local employees to generate new solutions.

The agility of an organization is impacted by a multitude of elements, among which are database management and information technology proficiency (also known as digital competencies). As per the Ministry of Digitization of Poland's definition, digital competencies comprise an integrated amalgamation of knowledge, abilities, and attitudes that are indispensable for efficient operation in a society where digital technologies are integral to

living, learning, and working. Digital capabilities exert both direct and indirect influences on the development of business flexibility and agility, particularly in the context of interactions with external partners (Saputra et al., 2023; Gonçalves et al., 2022).

Wang et al. (2022) have even advocated for the adoption of more advanced technologies, such as artificial intelligence, highlighting their potential to enhance organizational innovation by fostering a greater sense of innovation among management staff. Conversely, Khalil et al. (2023) underscore the significance of large database analysis as a factor positively impacting organizational efficiency, marketing, and organizational innovations. Khalil and Winkler (2023) have proposed a model elucidating how rapid resource acquisition and deployment, experimentation with alternatives, and the emergence of self-organizing business teams contribute to agility.

These activities often intersect with cloud computing, which is viewed as a competitor to the traditional functioning of IT departments within organizations. Deng et al. argue that organizations achieve agility through outsourcing, with IT solutions playing a pivotal role (2021).

Based on the literature review conducted above, the authors of this work conclude that there is a research gap regarding the interdependence between the type of interpersonal relationship and the level of use of digital competences in an organization. The few works in which researchers refer, but not directly, to this issue include the study by Madhavaram et al. (2023), in which the subject of interest is, however, the broader understanding of intellectual capital and its impact on the use of employees' knowledge and abilities for digital development. The text published by Ritala et al. (2021) seems to be slightly more consistent with the topic proposed in this article discussing the beneficial impact of relational capital on the scale of the use of digital technologies. Similarly to the case of digital competences, there is a noticeable need to enrich research in the area of the impact of informal relationships in an organization on its agility.

3. Research Methodology

The authors conducted research as part of the project titled "Interorganizational Relationships in the Socio-Economic Economy," implemented in collaboration between the Lublin University of Technology and the University of Warsaw from October 1, 2023, to September 30, 2024. The research aimed to delve into the essence of interorganizational relationships across five key areas: defining relationships, factors driving and impeding relationships, control over relationships, the role of leadership in establishing relationships, and analyzing the structure and competencies of organizations.

The initial stage of the research project involved conducting pilot studies from December 2023 to January 2024. The primary objective was to gather insights into the functioning of interorganizational relationships within various facets of organizational activities. The research sample comprised middle-level managers who were students of postgraduate studies, specifically the Master of Business Administration program at the Lublin University of Technology.

The study utilized the Paper and Pencil Interview (PAPI) technique, with 47 respondents participating from both the public and private sectors of the economy. An original survey questionnaire, comprising 15 closed questions and information, served as the research tool. Respondents' answers were assessed using a combination of single- and multiple-choice questions, along with a five-point Likert scale for enhanced precision in measurement.

Table 1: Division of Respondents by sex, position held, and type and duration of organization's existence (% of Respondents)

Sex	
Female	38.3%
Male	61.7%
Managerial Position Held	
5 years or less	19.6%
6-10 years	17.4%
11-15 years	23.8%
16 years or more	11.0%
No	28.2%

Type of Organization	
Private	51.1%
Public	42.5%
Other	6.4%
Duration of company's existence	
0-1 year	0.0%
2-5 years	7.1%
6-10 years	7.1%
11 years or more	85.8%

Source: Own study based on research

The analysis of the respondents shows that the respondents were mainly men who had held a managerial position for an average of 11–15 years in an organization that had been operating for at least 11 years. It is worth noting that 51.1% of respondents are members of Generation Y (millennials), whose view is dominant in the presented results. For the purposes of this article, the authors formulated two research hypotheses. Their verification will help achieve the research goal, which is to determine the types of relationships that have a positive impact on the degree of use of digital competencies and agility in the organization.

H1: Informal relationships influence the degree of use of digital competences in the organization.

H2: An organization that is characterized by informal relationships is more likely to have an agile structure.

To verify the above hypotheses, the Mann-Whitney test was used, which allows to identify differences between two populations in the context of a specific variable. The hypothesis will be confirmed when the significance level does not exceed p-value of 5%. When interpreting the results regarding the agile structure, the "I don't know" answer option was treated as the respondent's feeling that the structure in his organization is not agile but cannot be called non-agile.

4. Results

The fragment of research presented below focused on the interaction between the form of relationships existing in the organization, the agility of its structure, and the degree of use of digital competencies. For the purposes of analysis, the forms of relationships were consolidated into two population groups. The authors examined respondents' answers to identify informal, partnership, formal, and bureaucratic business relations.

Table 2: The form of the relationship, the degree of use of digital competencies, and the agile structure in the surveyed organizations

	Informal relationships and partnerships	**Formal and bureaucratic relationships**
The Degree of use of Digital Competencies		
Very Tall	13.8%	5.6%
Tall	41.4%	27.8%
Mediocre	41.4%	55.6%
Short	3.4%	11.1%
Very Low	0.0%	0.0%
Agile Structure in the Organization		
No	13.8%	27.8%
I Don't Know	27.6%	55.6%
Yes	58.6%	16.7%
Form of Relationship		
Formal Relations	27.7%	
Informal Relationships	27.7%	
Partnerships	34.0%	
bureaucratic relationships	10.6%	

Source: Own study based on research

In organizations where the surveyed respondents are employed, all four forms of relationships are identified. Partnership relationships were identified by 34.0% of respondents, while both informal and formal relationships received the same percentage of responses - 27.7%. Bureaucratic relationships were identified by 10.6% of respondents.

Digital competencies have a positive impact on the knowledge creation process within the organization. Respondents from work environments characterized by informal and partnership relationships rated the use of digital competencies in their organization at a medium or high level (41.4% each). In contrast, among respondents working in formal and bureaucratic conditions, 55.6% assessed the level of digital competence utilization in their organization as average. A very high level of digital competence utilization was indicated by 13.8% of respondents from informal and partnership teams, while this figure was 5.6% for respondents in formal and bureaucratic relationships.

Regarding the existence of an agile structure in the organization, differences were identified in the occurrence of agility among enterprises employing the surveyed respondents. Respondents from organizations characterized by informal and partnership relationships most commonly described the structure of their organization as agile (58.6%). In contrast, only 16.7% of respondents from the group with formal and bureaucratic relationships identified an agile structure. Moreover, 55.6% of respondents from this group were unable to identify their organization's structure as agile.

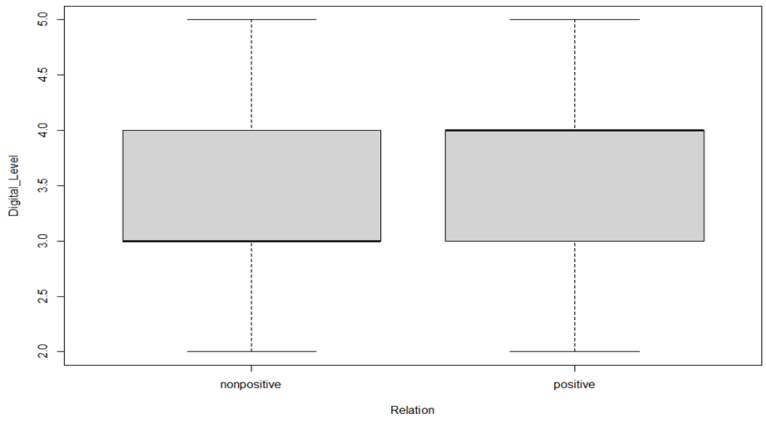


Figure 1:

Source: Own study based on research

The comparison of the degree of use of digital competencies in the studied populations using the Mann-Whitney test resulted in a p-value of 0.0545. This indicates that the level of digitization in both groups is statistically equivalent. Therefore, it suggests that informal relationships do not significantly increase the degree of use of digital competencies.

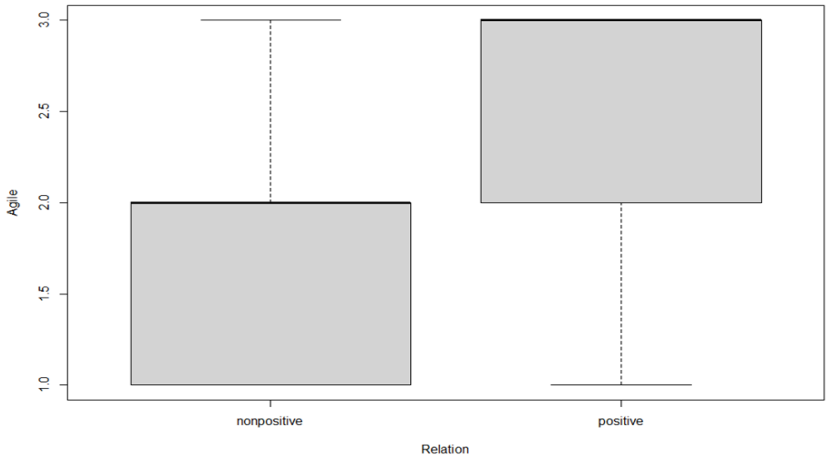


Figure 2:

Source: Own study based on research

The comparison of the presence of an agile structure in the organizations of the surveyed groups of respondents using the Mann-Whitney test yielded a p-value of 0.0051. This result confirms that informal relationships are associated with a more frequent occurrence of an agile structure within the organization.

5. Conclusions and Future Study

Based on the answers received from surveyed people managing various organizations, it was found that these entities usually use the digital competences of their employees to a large extent. At the same time, the statistical tool used in the study did not confirm that in organizations where informal interpersonal relationships dominate, this process is characterized by greater intensity, which means that the first hypothesis (H1) was not positively verified. The obtained results remain in some opposition to what can be read in the works of Madhavaram et al. (2023) and Ritala et al. (2021). In the first case it is concluded that elements of intellectual capital such as commitment, trust and intensity of relationships have a positive impact on software development and innovative capabilities in IT companies, and in the second one, the authors believe that they have at least partially confirmed the truth of the thesis that relational capital supports employees' achievement of goals related to the implementation of the organization's digital strategy.

The second hypothesis (H2), which linked the existence of informal relationships in the group of people employed in the organization with its agility, was confirmed. The conclusions drawn from the analysis remain largely consistent with what was obtained in this respect by other researchers whose publications were cited earlier. This applies in particular to works such as Sukarno et al. (2019), Ozgun et al. (2022) or Al-Omoush et al. (2020). Moreover, the results discussed above correspond to the conclusions of those authors who, focusing on the problem of leadership and its impact on organizational flexibility, quite strongly emphasize in this context the need for openness and departure from more traditional models (Rzepka & Sabat, 2022; Gren & Ralph, 2022; Reunamäki & Fey, 2022)

Analysis of the impact of relationships within the organization on various aspects of its functioning, including the growth and use of digital competences and agility, should be continued. However, examining personal relationships that constitute an intangible asset of every organization may pose some difficulties. In particular, it seems that there is a need to include in the arsenal of cognitive measures these tools that will enable more direct and reliable measurement. As Arszułowicz (2019) notes, this measurement may have a different nature and, therefore, could provide various information of a static or dynamic nature. Attempts are already being made to quantify what is difficult to measure in every organization, and the list of indicators that are potentially usable for the study relational capital is still growing (the set of selected ones is discussed, for example, by Vashishtha (2022)). The scope of knowledge about the possibilities of measuring digital competences is also expanding (e.g. Canina & Orero-Blat, 2021; Tomczyk, 2023) as well as agility (e.g. Yauch, 2011; Lacerda, 2020). This opens new perspectives for a better understanding of how human relationships and the capital based on them affect the knowledge sharing process, because, as Aisyah et al. (2019) writes, currently this phenomenon is still not fully recognized, and it is important both from the point of view of introducing and using digital technologies and organizational flexibility.

References

Aisyah, R.A., Sukoco, B.M. and Anshori, M. (2019) “The effect of relational capital on performance: knowledge sharing as mediation variables in supplier and buyer relation”, *International Journal of Logistics Systems and Management*, Vol. 34, No. 2, pp. 211-232. Doi: 10.1504/IJLSM.2019.102214.

Alamsjah, F. and Yunus, E.N. (2022) “Achieving Supply Chain 4.0 and the Importance of Agility, Ambidexterity, and Organizational Culture: A Case of Indonesia”, *Journal of Open Innovation: Technology, Market and Complexity*, Vol. 8, No. 83. Doi: 10.3390/joitmc8020083.

AlQuershi, N., Abas, Z.B. and Mokhtar, S.S.M. (2021) “The intervening effect of structural capital on the relationship between strategic innovation and manufacturing SMEs’ performance in Yemen*”, Management Science Letters*, No. 11, pp. 21–30. Doi: 10.5267/j.msl.2020.8.034.

Al-Omoush, K.S., Simón-Moya, V. and Sendra-Garcia, J. (2020) “The impact of social capital and collaborative knowledge creation on e-business proactiveness and organizational agility in responding to the COVID-19 crisis”, *Journal of Innovation & Knowledge*, Vol. 5, pp. 279-288. Doi: 10.1016/j.jik.2020.10.002.

Annosi, M.C., Mattarelli, E., Micelotta, E. and Martini, A. (2022) "Logics' shift and depletion of innovation: A multi-level study of agile use in a multinational telco company", *Information and Organization*, Vol. 32, 100421. Doi: 10.1016/j.infoandorg.2022.100421.

Arszułowicz, N. (2019). The Concept of Intellectual Capital and its Measurement Using the VAIC Method on the Example of PKN ORLEN. Optimum: Economic Studies, No. 4(98), 97-111. Doi: 10.15290/oes.2019.04.98.08.

Atkinson, P., Hizaji, M., Nazarian, A. and Abasi, A. (2022) "Attaining organisational agility through competitive intelligence: The roles of strategic flexibility and organisational innovation", *Total Quality Management and Business Excellence*, Vol. 33, No. 3–4, pp 297–317. Doi: 10.1080/14783363.2020.1842188.

Bańkowski, P. and Rzepka, A. (2024) *Relacje międzyorganizacyjne a innowacyjność oraz ich wpływ na przedsiębiorstwa*, Wydawnictwo Politechniki Lubelskiej, Lublin.

Bernstein, P.L. (2007), *Capital Ideas Evolving*, John Wiley&Sons, Inc., Hoboken, New Jersey.

Canina, L.; Orero-Blat, M. (2021). A practical tool to measure digital competences: Teamschamp. International Journal of Services Operations and Informatics 11(1), 1-12. Doi: 10.1504/IJSOI.2021.114107.

Dar, I.A. (2019) "Internationalisation of SMEs: how does global mindset and network relationships impact in India", *International Journal of Business and Globalization*, Vol. 23, No. 4, pp. 568-581. Doi: 10.1504/IJBG.2019.104835.

Das, K., Mukhopadhyay, S. and Suar, D. (2023) "Enablers of workforce agility, firm performance, and corporate reputation", *Asia Pacific Management Review*, Vol. 28, pp. 33-44. Doi: /10.1016/j.apmrv.2022.01.006.

Deloitte Poland (2023) "Report: Deloitte Agile Maturity Survey", [online], https://www2.deloitte.com/pl/pl.html.

Deng, C.P., Wang, T., Thompson, S.H.T. and Song, Q. (2021). "Organizational agility through outsourcing: Roles of IT alignment, cloud computing and knowledge transfer", *International Journal of Information Management*, Vol. 60, 102385. Doi: 10.1016/j.ijinfomgt.2021.102385.

Devie, Kwistianus, H., Wellyani, C.V.P. and Goenadi, G.N.R.O. (2023) „The Importance of Organizational Agility to Improve Performance: Evidence from the Hotel Industry in the Post-Covid-19 Era", *Binus Business Review*, Vol. 14, No. 3, pp. 271−284. Doi: 10.21512/bbr.v14i3.9363.

Drewniak, R., Słupska, U. and Posadzińska, I. (2020) „Leadership and Internal Relational Capital of Enterprises", *European Research Studies Journal*, Vol. 23, No. 1, pp. 373-388. Doi: 10.35808/ersj/1766.

El Nsour, J.A. (2021) "Investigating the impact of organizational agility on the competitive advantage", *Journal of Governance & Regulation*, Vol. 10, No. 1, pp. 153-157. Doi: 10.22495/jgrv10i1art14

Głowacz, A.D. (2022) „Zwinność organizacji jako źródło przewagi konkurencyjnej w Przemyśle 4.0", [in:] A. Górska, W. Górska, and R. Stachyra (eds.), *Zarządzanie i finanse – zagadnienia wybrane*, pp. 81–95.

Gonçalves, D., Bergquist, M., Alänge, S. and Bunk, R. (2022). "How Digital Tools Align with Organizational Agility and Strengthen Digital Innovation in Automotive Startups", *Procedia Computer Science*, Vol. 196, pp. 107–116. Doi: 10.1016/j.procs.2021.11.079.

Gren, L. and Ralph, P. (2022) "What Makes Effective Leadership in Agile Software Development Teams?" Paper read at 44th International Conference on Software Engineering (ICSE '22), Pittsburgh, PA, USA. ACM, New York, NY, USA. Doi: 10.1145/3510003.3510100.

Hasan, M.M. and Uddin, M.R. (2022) "Do intangibles matter for corporate policies? Evidence from organization capital and corporate payout choices", *Journal of Banking & Finance*, Vol. 135, 106395. Doi: 10.1016/j.jbankfin.2021.106395.

Honjo, Y., Kwak, Ch. and Uchida, H. (2022) "Initial funding and founders' human capital: An empirical analysis using multiple surveys for startup firms", *Japan & The World Economy*. Doi: 10.1016/j.japwor.2022.101145.

Joiner, B. and Josephs, S. (2007) *Leadership Agility. Five Levels of Mastery for Anticipating and Initiating Change*, San Francisco: John Wiley & Sons, Inc.

Khalil, M.L., Aziz, N.A., Long, F. and Zhang, H. (2023) "What factors affect firm performance in the hotel industry post-Covid-19 pandemic? Examining the impacts of big data analytics capability, organizational agility and innovation", *Journal of Open Innovation: Technology, Market, and Complexity*, Vol. 9, 100081. Doi: 10.1016/j.joitmc.2023.100081.

Khalil, S. and Winkler, T.J. (2023) "How software as a service simultaneously affords organizational agility and interia", *Journal of Strategic Information Systems*, Vol. 32, 101804. Doi: 10.1016/j.jsis.2023.101804.

Klimas, P. (2013) "Relacje interpersonalne kadry kierowniczej jako czynnik sprawności sieci", *Organizacja i Kierowanie*, No. 3(156), pp.149-160.

Kocot M. and Kwasek A. (2022) "Zwinność organizacyjna jako determinanta efektywnego wykorzystania ICT", *Zeszyty Naukowe Wyższej Szkoły Humanitas. Zarządzanie*, No. 4, pp. 91-105. DOI: 10.5604/01.3001.0016.2180.

Madhavaram, S., Appan, R., Manis, K.T. and Browne, G.J. (2023) "Building capabilities for software development firm competitiveness: The role of intellectual capital and intra-firm relational capital", *Information & Management*, Vol. 60, No. 2, 103744. Doi: 10.1016/j.im.2022.103744.

De Oliveira Lacerda, R.T, Calvetti, E.S., Bernardes, M.L., & Cargnin da Silveira, J.F. (2020) "Research opportunities about measuring agility in software development: a constructivist perspective", 11(2), pp. 37-63. Doi: 10.5585/gep.v11i2.17947

Ozgun, A.H., Tarim, M., Delen, D. and Zaim, S. (2022) "Social capital and organizational performance: The mediating role of innovation activities and intellectual capital", *Healthcare Analytics*, Vol. 2, 100046. Doi: 10.1016/j.health.2022.100046.

Probst G., Raub S. and Romhardt K. (2004*) Zarządzanie wiedzą w organizacji*, Oficyna Ekonomiczna, Kraków.

Rafi, N., Ahmed, A., Shafique, I. and Kalyar, M.N. (2022) "Knowledge management capabilities and organizational agility as liaisons of business performance", *South Asian Journal of Business Studies*, Vol. 11, No. 4, pp. 397–417. Doi: 10.1108/SAJBS-05-2020-0145.

Ramirez-Solis, E.R., Llonch-Andreu, J. and Malpica-Romero, A.D. (2022) "How beneficial are relational capital and technology orientation for innovation? Evidence from Mexican SMEs", *International Journal of Innovation Studies*, Vol. 6, pp. 1-10. Doi: 10.1016/j.ijis.2022.02.001.

Ritala, P., Baiyere, A., Hughes, M. and Kraus, S. (2021) "Digital strategy implementation: The role of individual entrepreneurial orientation and relational capital", *Technological Forecasting & Social Change*, Vol. 171, 120961. Doi: 10.1016/j.techfore.2021.120961.

Reunamäki, R. and Fey, C.F. (2022) "Remote agile: Problems, solutions, and pitfalls to avoid", *Business Horizons*. Doi: 10.1016/j.bushor.2022.10.003.

Rzepka, A. and Sabat, A. (2022) "Knowledge Creation in Teal Organizations", [in:] A. Rzepka, Z. Olesiński and E. Jędrych (eds.), *Self-Management, Entrepreneurial Culture, and Economy 4.0: A Contemporary Approach to Organizational Theory Development*, pp. 184-196, Routledge. Doi: 10.4324/9781003213048-15.

Saputra, N., Sasanti, N., Alamsjah, F. and Sadeli, F. (2022) "Strategic role of digital capability on business agility during COVID-19 era", *Procedia Computer Science*, Vol. 197, pp. 326–335. Doi: 10.1016/j.procs.2021.12.147.

Silva, B. and Oliveira, S. (2023) "Agility as a force to emerge from the darkness to better days", *Procedia Computer Science*, Vol. 217, pp. 1710–1718. Doi: 10.1016/j.procs.2022.12.371.

Sjödin, D., Parida, V., Kohtamäki, M. and Wincent, J. (2020) "An agile co-creation process for digital servitization: A micro-service innovation approach", *Journal of Business Research*, Vol. 112, pp. 478-491. Doi: 10.1016/j.jbusres.2020.01.009.

Stefaniuk, K. (2019) "Innowacyjność i jej znaczenie dla korporacji", *Zeszyty Naukowe Wyższej Szkoły Humanitas. Zarządzanie*, No. 1.

Sukarno, G., Wigati, W.R., Irbayuni, S. and Fitriyah, M.A.T. (2019) "Mapping in Intellectual Capital Measurement in Creative Industries in East Java", *International Journal of Financial Research*, Vol. 10, No. 5, Special Issue, pp. 145-152. Doi: 10.5430/ijfr.v10n5p145.

Tomczyk, Ł. (2023) "Measuring digital competences. Ten common methodological challenges", *Problemy Opiekuńczo-Wychowawcze*, 620(5), 49-58. Doi: 10.5604/01.3001.0053.6037.

Trzeciak, M. and Banasik, P. (2022) "Motivators Influencing the Efficiency and Commitment of Employees of Agile Teams", *Journal of Open Innovation: Technology, Market, and Complexity*, Vol. 8, 176. Doi: 10.3390/joitmc8040176.

Tyagi, S., Sibal, R. and Suri, B. (2022) "Empirically developed framework for building trust in distributed agile teams", *Information and Software Technology*, Vol. 145, 106828. Doi: 10.1016/j.infsof.2022.106828.

Vashishtha, S. (2022). Intellectual Capital: Concept, Constituents and Measurement. HSB 14th Annual National Conference on Business and Management. Guru Jambheshwar University of Science and Technology, Hisar(Haryana), 309-322.

Wang, X., Lin, X. and Shao, B. (2022) "How does artificial intelligence create business agility? Evidence from chatbots", *International Journal of Information Management*, Vol. 66, 102535. Doi: 10.1016/j.ijinfomgt.2022.102535.

Yauch, C.A. (2011) "Measuring Agility as a Performance Outcome", Journal of Manufacturing Technology Management, 22(3), pp. 184-204. Doi: 10.1108/17410381111112738.

Zhang, D., Wang, H. and Wang, W. (2022) "The Influence of Relational Capital on the Sustainability Risk: Findings from Chinese Non-State-Owned Manufacturing Enterprises", *Sustainability*, Vol. 14, 6904. Doi: 10.3390/su14116904.

An International Comparison of the Sustainability of Knowledge

Andrea Bencsik
Unicersity of Pannonia, Hungary

bencsik.andrea@gtk.uni-pannon.hu

Abstract: Sustainability and organisational knowledge have been of interest to academics for decades, but the long-term sustainability of knowledge within organisations is a less researched area. This study aims to fill gaps in the literature on knowledge sustainability through the views of knowledge management practitioners. It will also provide a generally useful definition of knowledge sustainability. The research was carried out using the Delphi method. A two-round questionnaire survey was carried out involving professionals from 7 continents. The expert groups surveyed were TM experts, Business experts, and Academic staff. In the first round of the survey, 106 respondents expressed their views and ideas on the sustainability of knowledge in a free-text format, which was evaluated using Atlas.ti. In the second round, the statements of the questionnaire, based on a content analysis of the first round of responses, were ranked by experts on a 6-point Likert scale. In this case, 126 responses were received. The ranked statements were evaluated using IBM SPSS 25 statistical program and the validity of our hypotheses was tested. The results confirmed that a trust-based organisational culture, based on the values of sustainability leadership, is a prerequisite for knowledge sustainability. Alignment of the elements of the knowledge management process with organisational objectives is essential for the long-term sustainability of knowledge and the IT tools of the organisation play a dominant role. The comparison of the 3 groups of experts isolated in the study and the opinions by continent did not show any significant differences. As a final summary of the results of the research, a definition of knowledge sustainability was formulated, which provides a new basis for further research into the theory and practice of building sustainable knowledge management systems.

Keywords: Knowledge Management, Sustainable Knowledge, Trust, International Research, Delphi Method

1. Introduction

The problem of knowledge loss has been around for centuries, even millennia, but research on its importance is not a preferred area of research (Massingham 2018; Levallet and Chan 2019). This gap is evident at both theoretical and practical levels. Research on the long-term preservation and sustainability of knowledge is therefore essential. This means that the integration of the knowledge management (TM) process into organisational operations is also a key to the future success of the organisation. A specific set of tools is needed to ensure synergy between organisational knowledge and long-term organisational performance. Sustainable organisational functioning has been a strategic priority for many years. It is a development process or organisational principle that meets the needs of the present without compromising the ability of future generations to meet their own needs (Our Common Future 1988). This definition opens the door to a sufficiently wide range of choices and actions. Thus, the different disciplines and organisational needs determine to a large extent the current actions behind the 'slogans'. The present research does not consider the application of traditional indicator systems but uses their values to develop an option focusing on the transferability and long-term preservation of knowledge.

The research questions were formulated as follows:

- What does the sustainability of knowledge mean for knowledge management experts and researchers?
- What conditions are needed for the long-term sustainability of knowledge?

The research aims to define the definition of knowledge sustainability and to define the organisational conditions for knowledge sustainability. To answer the research questions and to achieve the objective, a practical study was launched using the Delphi method after a literature review. These are presented in the following chapters. The significance of the study is that it (1) fills a gap in the definition of sustainable knowledge, (2) articulates the conditions for sustainable knowledge, (3) provides an international comparison between the views of KM experts, academic researchers and practitioners.

2. Literature Background

2.1 Sustainable Knowledge

According to the resource-based approach, knowledge is a unique internal resource (Freeman *et al.* 2021) that can only bring a competitive advantage if it is used wisely to develop the internal capabilities and competencies that best support the sustainable practices of the organisation. When the market is uneven, competition is at its

peak, profit is dominant, and the strategic position of organizations can be compromised (Gibson *et al.* 2021; Mishra 2019). In such a situation, traditional practices fail to deliver the expected results. Therefore, organizational knowledge becomes a potential resource that can make a pioneering contribution to building the strategic position of organizations (Torres *et al.* 2018). Lopez-Torres *et al.* (2019) in their research have shown how SMEs can adopt knowledge management as an effective strategy to make their operations sustainable. A knowledge culture thus developed is vital for organisations to operate effectively and sustainably (Shujahat *et al.* 2019; Caniglia *et al.* 2021; Glikson and Woolley 2020). Sustainable knowledge and knowledge management go beyond the typical expectations of sustainability in general (such as the preservation of the environment, the necessary use of renewable energy sources, etc.) and think on a scale that seeks not only to create the physical conditions and theoretical possibilities but also to imagine the conditions for an innovative future while achieving social well-being. As is well known, the most critical issue in the knowledge management process is how to solve the problem of sharing knowledge and thus preserving what has become common knowledge. In discussing the sustainability of knowledge, the research logic that characterises sustainability in general is reversed. It is not a question of how knowledge management helps an organisation to operate sustainably. The question is what organisational conditions and operations are needed to preserve and maintain common organisational knowledge in the long term. Phrased in this way, the role of trust in influencing knowledge sharing, capture, collaboration, culture building, etc. becomes clear. These factors call for a holistic approach and a complex way of thinking (Muhammad *et al.* 2020). In summary, to assess knowledge sustainability, it is necessary to go beyond the published knowledge to explore opinions that provide a legitimate basis for a more precise and broader definition and, at the same time, to explore the organisational conditions.

3. Research Methodology

The research represents a new approach and contribution to current knowledge in the field, both in theory and practice. We used both qualitative and quantitative methods, which were conducted using the Delphi method. We conducted a two-round questionnaire survey involving professionals from 7 continents. Respondents were classified into 3 groups: TM experts, business experts, and academic staff. In the first round of the survey, respondents expressed their views and ideas on the sustainability of knowledge in a free-form format. In the second round, the respondents were asked to rank the statements of the questionnaire, based on a content analysis of the first round of responses, on a 6-point Likert scale. The free-form responses of the first round were analysed using Atlas.ti. The statements ranked in the second round were evaluated using IBM SPSS 25 statistical software and then tested for the validity of our hypotheses.

3.1 Delphi Method

The Delphi method is a well-structured visioning method based on expert opinion, which gathers the opinions of experts on a given research problem in at least two rounds. It facilitates the acquisition of a variety of information that can help to provide a more comprehensive understanding of the research topic. Its anonymity and iterative nature ensure the expression of open ideas and opinions and allow for multiple returns to help further refine opinions.

The Delphi technique has four main features:

- anonymity between participants,
- iteration with controlled feedback from the group,
- statistical aggregation of the group's responses
- expert input.

Anonymity allows views to be expressed and changed in private, controlled feedback iteration ensures communication between participants and the sharing of perspectives, statistical aggregation of group responses allows data to be analysed and interpreted, and finally the concept of expert input suggests that all participants are knowledgeable in the area under study (Trevelyan and Robinson 2015).

A large body of research has marked the application of the method and it is often added to the palette of research methodologies in different disciplines (Hirschhorn, 2019). In recent years, it has been used successfully, mainly for research in education and health (de Villiers et al, 2005; Chitu & Pawlowski, 2004; Hsu & Sandford, 2019; Vogel et al, 2019; Chalmers et al, 2019; Varndell et al, 2021; Sablatzky, 2022).

A key part of the Delphi method is to select the right experts to ensure the quality of the results (Paré *et al.* 2013). The target group for our research is a group of experts with a high level of professional experience in the research topic.

The experts in this research are divided into seven panels and two-panel groups. The first-panel group is defined by the main source of opinion of the responding experts. The second group of panels is composed of four panels based on the continent from which the experts' views originate: Europe, America, Asia and the fourth panel is classified as Other. The panels allow the identification of cultural and contextual differences, which can contribute to the reliability and relevance of the research. Experts were selected using the multi-stage approach proposed by Okoli and Pawlowski (2004). A 'knowledge source identification worksheet' was developed to identify the relevant background and skills of the experts. The main selection criterion was the experts' years of experience in knowledge management and their work experience. The questionnaires were sent out online to experts from academic professional societies, websites, professional journals, conference participants, university websites, corporate websites, LinkedIn groups, etc. at the international level. Both rounds of the survey were conducted in approximately 3 months. In the first round, experts were asked to freely express their views on the topic of "**sustainable knowledge as the key to a successful, sustainable future**". The second questionnaire, based on the analytical results of the first round, asked respondents for their value judgements on the statements made, organised around four groups of questions. The second questionnaire followed the procedure of the "ranked" Delphi tests as defined by Schmidt (1997). The statements in the questionnaire were ranked individually and independently using a six-point Likert scale.

Question groups for Questionnaire 2:

- Knowledge sustainability goals and values
- Organisational culture, the role of leadership
- The link between knowledge management and knowledge sustainability
- The link between technological background and knowledge sustainability

3.2 The Sample

Delphi 1 - 1000/106 answers

Respondents:

- TM experts - 38,2%
- Business professional - 28,3%
- Academic sector - 33,5%

7 continents

- Europe - 44,8%
- Asia - 21,9%
- North America - 13.5%
- South America - 10.4%
- Africa - 5.2%
- Australia - 4.2%

Delphi 2 - 1000/126 answers

The characteristics of the first round of respondents are shown in Table 1.

Table 1: Characteristics of Delphi first-round respondents

Features	n	%
The main point of view/source of opinion comes from the following experience:		
• Knowledge management expert	48 persons	38 ,2%
• Individuals working in academia	42 persons	33,5 %
• Company specialist	36 persons	28,3%

Features	n	%
Professional experience in a field related to knowledge management:		
• Less than 5 years	9 persons	7,1 %
• Between 5 and 10 years	21 persons	16,7 %
• More than 10 years	96 persons	76,2 %
Field of qualification:		
• General Business Management / Economics	63 persons	54 %
• Human resource management	58 persons	46 %
Highest level of education:		
• Bachelor training	9 persons	7,2 %
• Master training	62 persons	49 %
• Doctoral studies (PhD.)	55 persons	43,8 %
The continent from which the main point of view/opinion originates:		
• Asia	28 persons	21,9 %
• Africa	7 persons	5,2 %
• North America	17 persons	13,5 %
• South America	13 persons	10,4 %
• Antarctica	0 persons	0 %
• Europe	56 persons	44,8 %
• Australia	5 persons	4,2 %

Source: own editing

Hypotheses

H1. There are significant differences in the way knowledge management experts, academics and business professionals define knowledge sustainability.

H2. There are significant differences between the opinions of experts from different continents.

4. Analysis

Atlas.ti software was used to evaluate the data. The software was used to perform a content analysis based on the first round of expert opinions. The content analysis process consisted of six steps.

- create a new project using the software (name, save location)
- importing replies received
- automatic encryption
- making memos
- list of most common words
- raw data processing

The most common terms are listed and also in the form of a word cloud.

Table 2 shows the most common terms.

Table 2: Delphi first round list of most common terms

Terms	Frequency of occurrence (n)	Frequency of occurrence (%)
Knowledge Management	126 pieces	100%
Organisational processes	112 units	89%
Organisational goals	109 pieces	87%
Corporate (business) strategy	106 units	84%

Terms	Frequency of occurrence (n)	Frequency of occurrence (%)
Competitive advantage (added value, organisational performance)	102 pieces	81%
Long-term thinking	99 pieces	79%
Cooperation (collaboration)	97 units	77%
Organisational culture	94 units	75%
Extremely important/essential/key	93 db	74%
People at the centre	90 pieces	71%
Strategic decisions/decision making	88 pieces	70%
IT solutions (IT, technology)	85 pieces	67%
Skills, competences	83 units	66%
Ethical issues	82 units	65%
A rapidly changing world	79 pieces	63%
Knowledge creation/creation	78 units	62%
Knowledge sharing	78 units	62%
Knowledge management system(s)	75 pieces	60%
Knowledge development/improvement	72 pieces	57%
Knowledge identification	72 pieces	57%
Ownership of knowledge	71 units	56%
Use of knowledge	71 units	56%
Tracking and tracing	67 units	53%
Dissemination	66 pieces	52%
Investment	64 pieces	51%
Communication	63 pieces	50%
Knowledge preservation	59 pieces	47%
Knowledge transfer (handover)	59 pieces	47%
Innovation	57 pieces	45%

Source: own editing

After identifying the most common terms and words, the second phase (questionnaire) was prepared. In this case, starting a new project with the software, the aim was to formulate the groups of questions and the questions to be asked to design the questionnaire, based on the most frequent expressions, words and phrases. The groups of questions and the questions assigned to them are shown in Table 3. After finalisation, the questionnaires were sent again online to the previous target group.

Table 3: Delphi Round 2 question sets and questions

Questions	Description of questions
Knowledge sustainability goals and values	• Organisational goal of knowledge sustainability • Knowledge sustainability as an organisational competitive advantage • Helping to achieve organisational goals • Integration into organisational activities • A vital factor for the 21st century • Making better decisions
The role of organisational culture	• An organisational culture based on trust • Cooperation and shared values between organisational members and management • Implementing the principles of sustainability management • Adequate and continuous training of employees • Ethical issues raised

Questions	Description of questions
The link between knowledge management and knowledge sustainability	• Incorporating elements of the knowledge management process • Continuous, unconditional knowledge sharing between organisational members • Knowledge development/learning renewal • The role of organisational memory • Aligning knowledge management with organisational goals
The link between technological background and knowledge sustainability	• The important role of IT background • Organisational members' trust in technology • Appropriate level of technological background • The role of artificial intelligence • IT solutions as a key role • IT knowledge and skills of organisational members

Source: own editing

The Delphi method and the SPSS program were used to test the hypotheses (to detect differences between expert and national panels).

The Delphi method allows a group of experts to measure consensus. For the second questionnaire, the mean and standard deviation of the responses were examined during the data analysis to understand the heterogeneity or homogeneity of the responses. Next, we focused on measuring the consensus by calculating the median and the interquartile range. In the case where the responses to a query are ordinal, the median can be defined as a measure of central tendency and the interquartile range (IQR) as a measure of dispersion (Hsu and Sandford 2007; Garson, 2014). The interquartile range is a statistical measure used to characterise the dispersion of data. IQR is the range between 25-75 percentile points above and below the median. So IQR represents the middle 50% of the distribution of the data. The interquartile range helps to measure consensus among respondents. In cases where the IQR is relatively small, we can speak of a higher consensus. Conversely, if the IQR is high, it means that opinions are spread over a wider range and there is no consensus. Outlier values are not included in the calculation of IQR and therefore do not bias the result. This allows for a clearer and more objective assessment of the degree of consensus. The use of IQR allows comparisons of consensus between different groups. Following Kittel-Limerick (2005), a value of 2.5 was set to determine consensus. SPSS software was used for this process, with a 5% significance level. The software summarised the results in a table, which allowed us to determine the degree of consensus for each panel group. Due to space limitations, we present as an example in Table 4 the results of the first (knowledge management expert, academic, corporate) and second (European, American, Asian, other continent) panel groups for the six statements related to the first group of questions (Knowledge Sustainability Goals and Values). Following a similar procedure (also analysing the other three groups of questions), we obtained the terms and vocabulary from the experts' opinions which, when summarised, define knowledge sustainability.

Table 4: Results of the first and second-panel groups' responses to the first set of questions.

Knowledge management expert			Individuals working in academia		Company specialist	
Claim	**Median**	**IQR**	**Median**	**IQR**	**Median**	**IQR**
1	5.00	1	4.00	1	5.00	2
2	5.00	1	5.00	2	4.00	1.5
3	5.00	1	4.00	2	4.00	2
4	5.00	1	4.00	2	5.00	1
5	5.00	1.5	6.00	1	6.00	1
6	6.00	1	5.00	1	6.00	2

Europe			America		Asia		Other	
Claim	**Median**	**IQR**	**Median**	**IQR**	**Median**	**IQR**	**Median**	**IQR**
1	5.00	1.5	6.00	2	5.00	2	5.00	1.5
2	5.00	2	5.00	2	5.00	2	5.00	2
3	6.00	2	6.00	2	6.00	1	5.00	2

Knowledge management expert			Individuals working in academia		Company specialist			
Claim	Median	IQR	Median	IQR	Median		IQR	
4	5.00	2	6.00	1	6.00	1	6.00	1
5	6.00	1	6.00	1	6.00	1	6.00	1
6	6.00	1	5.00	1.5	6.00	1	5.00	1.5

Source: own editing

In order to verify the validity of the definition, we focused on the questions in the four groups of questions that received the highest scores from the experts. These results are illustrated in Tables (5, 6, 7, 8) below.

Table 5: Knowledge sustainability goals and values

Claims	N	Average	Source
The organisational goal of knowledge sustainability is to increase the added value for stakeholders within the organisation.	126	4,71	1,24
Ensuring knowledge sustainability has become a key source of competitive advantage for organisations in a rapidly changing world.	126	**4,93**	1,01
Knowledge sustainability helps to achieve organisational goals.	126	4,68	1,24
Knowledge sustainability must be embedded in organisational activities.	126	4,92	1,10
In the 21st century, knowledge sustainability is a vital factor for organisations, regardless of the industry they operate in.	126	**5,22**	0,83
The value of knowledge sustainability is used to make better decisions.	126	**5,04**	1,00

Source: own editing

Table 6: Organisational culture and knowledge sustainability

Claims	N	Average	Source
A key to the sustainability of knowledge within an organisation is an organisational culture based on trust, where members of the organisation and its management work together.	126	4,79	1,17
Ensuring the knowledge sustainability cycle depends on the cooperation and shared values of the members of the organisation and its management.	126	**4,94**	1,01
To make knowledge sustainable in the long term, it is necessary to apply the principles of sustainable management.	126	**4,82**	1,09
Appropriate and continuous training of employees is a key element for successful knowledge sustainability.	126	4,66	1,29
Knowledge sustainability within the organisation raises ethical issues (e.g. inappropriate data management, etc.) that need to be addressed.	126	**5,00**	0,88

Source: own editing

Table 7: The link between knowledge management and knowledge sustainability

Claims	N	Average	Source
The integration of elements of the knowledge management process into organisational processes is a prerequisite for the long-term sustainability of knowledge within an organisation.	126	**5,06**	0,88
The continuous, unconditional sharing of knowledge between organisational members plays an important role in the cycle of knowledge sustainability.	126	**5,02**	1,05
Knowledge development/knowledge renewal is an important step in the organisational application of knowledge sustainability.	126	**4,91**	1,14
Organisational memory plays an important role in knowledge sustainability.	126	4,86	1,04

Knowledge sustainability requires the alignment of knowledge management objectives with organisational objectives.	126	4,89	1,07

Source: own editing

Table 8: Technological background and knowledge sustainability

Claims	N	Average	Source
The organisation's IT environment plays an important role in making knowledge sustainable within the organisation.	126	4,35	1,20
To ensure the long-term sustainability of knowledge within the organisation, organisational members must have IT knowledge and skills.	126	**4,75**	1,18
IT solutions are more important than other conditions.	126	2,85	1,58
Without artificial intelligence, the sustainability of knowledge cannot be ensured.	126	3,72	1,49
To make knowledge sustainable in the long term, it is necessary to have the right level of technological background.	126	**4,91**	1,14
A vital element of successful knowledge sustainability is the trust that organisational members have in technology.	126	**5,02**	1,05

Source: own editing

A definition of knowledge sustainability, summarised from the above peer review and opinions:

Knowledge sustainability is a vital organisational strategy to make better decisions for ethical and sustainable organisational operations by preserving the value and usefulness of knowledge (tacit and explicit) in the organisation over the long term. It contributes to gaining and maintaining a competitive advantage by continuously updating existing and new knowledge, embedded in organisational activities. At the heart of knowledge sustainability is human capital, the prerequisites for its provision within an organisation:

- An organisational culture based on trust (personal and impersonal), where members and management of the organisation work together in a spirit of sustainable leadership.
- Integrating the elements of the knowledge management process into organisational processes, ensuring a continuous, evolving, knowledge-sharing cycle of knowledge.
- Ensuring a high level of availability of the technological background supporting the knowledge management process, maintaining the stress-free operation of technology, ensuring digital and workplace well-being.

The definition also answers the research questions.

An ANOVA test was performed to test the validity of the two hypotheses. In order to explore the differences in mindset between each panel group, a Post-Hoc analysis was conducted. It allows us to make further detailed comparisons between groups or variables. Within the group of Post-Hoc analyses, we used Tukey's HSD (Honestly Significant Difference) test, which is mainly used to perform multiple comparisons in ANOVA analyses. The result was that there was no significant difference between the panels. Although there were statements with different perspectives in the two panel groups of experts interviewed, overall there were no significant differences.

5. Discussion and Conclusion

The definition of TM confirms that investment in intellectual capital is a key to competitiveness (Zsigmond and Mura 2023). The need to build knowledge management systems and to integrate them into organisational operations is a decades-old business model in Western societies, but a less preferred business model in less successful economies, such as in Central and Eastern Europe (Marquardt *et al.* 2023; Talmo and Bonanomi 2015). The need to build systems is often expressed at the level of management and strategy, but very few firms reach the level of operational implementation. *Organizational* competitiveness and success are inextricably linked to

learning and knowledge, which can be combined into ultimate performance at the organizational level through knowledge management processes (Ayatollahi and Zeraatkar 2019; Škudienė 2021; Abrams *et al.* 2003). In recent years, there has been a lot of research and publications discussing the results of this research on the relationship between knowledge sharing and trust (Darroch 2005; Sankowska 2013; Paliszkiewicz and Koohang 2013; Alsharo *et al.* 2017; Kipkosgei *et al.* 2020; Ayadi *et al*. 2020). Without exception, all confirm that trust influences the occurrence, quality and depth of knowledge sharing, and thus is closely related to the construction and functioning of organizational knowledge management systems. Competitiveness and economic success are interrelated in the so-called "knowledge management". "In this context, competitiveness and economic efficiency are interrelated with 'soft' factors, with a back-and-forth effect. These are long-term factors, focusing on short-term economic indicators can diminish their value, but ignoring them is an untapped opportunity. Knowledge management systems provide organisations with a framework for the long-term preservation of knowledge within a culture of trust (Miller 2019). However, research has not yet reached the point of defining the conditions and practices for the sustainability of necessary and up-to-date knowledge. To formulate an answer, we sought a basis - based on the wisdom of collective thinking - using the Delphi method. The results of a free-form consensus search based on the opinions of international expert groups and their analysis led to a definition of the long-term sustainability of knowledge and the organisational conditions for it. The definition was developed on the basis of expert ratings of the statements of the four groups of questions. The terms of the statements with the highest average score appear in the definition. The results of the consensus search show that the opinions of the expert groups and scientists from the continents on the sustainability of knowledge are converging.

5.1 Research Limitations and Further Possibilities

The limitations of the research are all factors that are specific to questionnaire surveys. First of all, the willingness to respond, which is a problem apparently all over the world. Although the Delphi method combines qualitative and quantitative approaches, at its core, the bias of expert respondents' informal expression of opinion must be taken into account. Professionalism, honesty, reservations about identifiability, possible misinterpretation of questions can be questioned. Despite our best efforts, these factors may affect the outcome. In the future, it would be useful to extend the studies by collecting additional samples. The results obtained, the definition could be further refined by increasing the sample size and/or ensuring representativeness. The inclusion of additional countries from different cultural backgrounds would allow for a more refined comparative analysis and provide an even deeper understanding of the knowledge sustainability practices of organisations and the possible cultural influences in their context.

References

Abrams, L.C., Cross, R., Lesser, E., and Levin, D.Z. (2003) 'Nurturing interpersonal trust in knowledge-sharing networks', *The Academy of Management Executive*, 17(4), pp. 64-77. https://doi.org/10.5465/AME.2003.11851845

Alsharo, M., Gregg, D. and Ramirez, R. (2017) 'Virtual team effectiveness: the role of knowledge sharing and trust', *Information & Management*, 54(4), pp. 479-490. https://doi.org/10.1016/j.im.2016.10.005

Ayadi, A. D., Zhang,Ch., Zouaoui, S.K. and Ohana, M. (2020) 'Interpersonal Justice and Innovative Behaviours: The Role of the Workgroup', *International Journal of Innovation Management,* 24(3), 2050073, https://doi.org/10.1142/S1363919620500735

Ayatollahi, H. and Zeraatkar, K. (2019) 'Factors influencing the success of knowledge management process in health care organizations: a literature review', *Health Information and Libraries Journal*, 37(2), pp. 98-117. https://doi.org/10.1111/hir.12285

Caniglia, G., Luederitz, C., von Wirth, T. et al. (2021) 'A pluralistic and integrated approach to action-oriented knowledge for sustainability', *Natural Sustainability,* 4, pp. 93–100 https://doi.org/10.1038/s41893-020-00616-z

Chalmers, J., Armour, M. (2019) The Delphi Technique. In: Liamputtong, P. (eds) *Handbook of Research Methods in Health*, Social Sciences, Springer, Singapore, pp. 715–735. https://doi.org/10.1007/978-981-10-5251-4_99

Chitu O. S. & Pawlowski, D. (2004) 'The Delphi method as a research tool: an example, design considerations and applications', *Information & Management*, 42(1), 15-29. https://doi.org/10.1016/j.im.2003.11.002

Darroch, J. (2005) 'Knowledge management, innovation and firm performance', *Journal of Knowledge Management,* 9(3), pp. 101-115.

de Villiers M.R., de Villiers P.J. & Kent A.P. (2005) 'The Delphi technique in health sciences education research', *Med Teach.* 27(7), 639-43. https://doi.org/10.1080/13611260500069947. PMID: 16332558

Freeman, R.E., Dmytriyev, S.D. and Phillips, R.A. (2021) 'Stakeholder Theory and the Resource-Based View of the Firm', *Journal of Management*, 47(7), pp. 1757-1770. https://doi.org/10.1177/0149206321993576

Garson, G. D. (2005) *The Delphi method in quantitative research*, Asheboro: Statistical Associates Publishers,

Gibson, C.B., Gibson, S.C. and Webster, Q. (2021) 'Expanding Our Resources: including community in the Resource-Based View of the Firm', *Journal of Management*, 47(7), pp. 1878-1898. https://doi.org/10.1177/0149206320987289

Glikson, E. and Woolley, A.W. (2020) 'Human Trust in Artificial Intelligence: Review of Empirical Research', *Academy of Management*, 14(2), https://doi.org/10.5465/annals.2018.0057

Hirschhorn, F. (2019) 'Reflections on the application of the Delphi method: lessons from a case in public transport research', *International Journal of Social Research Methodology*, 22(3), 309–322. https://doi.org/10.1080/13645579.2018.1543841

Hsu, C. C., and Sandford, A. B. (2007) 'The Delphi technique: making sense of consensus. Practical Assessment', *Research & Evaluation,* 12(10), pp. 1-8.

Hsu, Ch. & Sandford B.A. (2019) 'The Delphi Technique: Making Sense of Consensus', *Practical Assessment, Research, and Evaluation*: 12. Article 10. https://doi.org/10.7275/pdz9-th90

Kipkosgei, F., Kang, S.W., and Choi, S.B. (2020) 'A Team-Level Study of the Relationship between Knowledge Sharing and Trust in Kenya: Moderating Role of Collaborative Technology', *Sustainability* 12, 1615, https://doi.org/10.3390/su12041615

Kittel-Limerick, P. (2005) *Perceived Barriers to Completion of The Academy doctorate: A Delphi Study,* Texas: Texas A&M University

Our Common Future (1988) *The Brundtland Report*, Budapest.

Levallet, N. and Chan, Y.E. (2019) 'Organizational knowledge retention and knowledge loss', *Journal of Knowledge Management,* 23(1), pp.176-199. https://doi.org/10.1108/JKM-08-2017-0358

López-Torres, G.C., Garza-Reyes, J.A., Maldonado-Guzmán, G., Kumar, V., Rocha-Lona, L. and Cherrafi, A., (2019) 'Knowledge management for sustainability in operations', *Production Planning & Control*, 30(10-12), pp. 813-26.

Marquardt, C., Charles, A.P. and Scholz, S.G. (2023) 'An Approach for Sustainable Knowledge Management and Policy Upstreaming for Industry4.0 in Central Europe'. In Scholz, S.G., Howlett, R.J., Setchi, R. (eds) *Sustainable Design and Manufacturing. SDM 2022* Smart Innovation, Systems and Technologies, vol 338. Singapore: Springer https://doi.org/10.1007/978-981-19-9205-6_23

Massingham, P. (2018) 'Measuring the Impact of Knowledge Loss: More Than Ripples on a Pond?', *Management Learning,* 39(5), pp. 541–560. https://doi.org/10.1177/1350507608096040

Miller, D. (2019) 'The Resource-Based View of the Firmfree', *Business and Management*, https://doi.org/10.1093/acrefore/9780190224851.013.4 83

Mishra, N. (2019) 'Knowledge Management Practice for Effective Operations in SMEs', *Production Planning and Control*. 30(10-12), pp. 795-798. https://doi.org/10.1080/09537287.2019.1582108

Okoli, C. and Pawlowski, S.D. (2004) 'The Delphi method as a research tool: an example, design considerations and applications', *Information & Management*, 42(1), pp. 15-29, https://doi.org/10.1016/j.im.2003.11.002

Paliszkiewicz, J. and Koohang, A. (2013) 'Organizational trust as a foundation for knowledge sharing and its influence on organizational performance', *Online Journal of Applied Knowledge Management*, 1 (2), pp. 116-127.

Paré, G. Cameron, E-F. Poba-Nzaou, P. and Templier, M. (2013) 'A systematic assessment of rigor in information systems ranking-type Delphi studies', *Information & Management*, 50(5), pp. 207-217, https://doi.org/10.1016/j.im.2013.03.003

Sablatzky, T. (2022) 'The Delphi Method', *Hypothesis, Research Journal for Health Information Professionals*, 34(1), 1-6.. https://doi.org/10.18060/26224

Sankowska, A. (2013) 'Relationships Between Organizational Trust, Knowledge Transfer, Knowledge Creation and Firm's Innovativeness', *Learning Organization*, 20(1), pp. 85-100. https://doi.org/10.1108/09696471311288546

Schmidt C.R. (1997) 'Managing Delphi surveys using nonparametric statistical techniques', *Decision Sciences*, 28(3), pp. 763-774.

Shujahat,M., Sousa, M. J., Hussain, S., Nawaz, F., Wang, M. and Umer, M. (2019) 'Translating the impact of knowledge management processes into knowledge-based innovation: the neglected and mediating role of knowledge-worker productivity', *Journal of Business Research*, 94, pp. 442-450.

Škudienė, V., Augutytė-Kvedaravičienė, I. and Gabrielaityte, U. (2021) 'Knowledge Management and Perceived Organisational Innovativeness in Global Organisations', *Central European Business Review*, 10(3), pp. 51-65.

Talamo, C. and Bonanomi, M. (2015) *Knowledge Management and Information Tools for Building Maintenance and Facility Management*, Springer

Torres, A.I., Ferraz, S.S. and Santos-Rodrigues, H. (2018) 'The impact of knowledge management factors in organizational sustainable competitive advantage', *Journal of Intellectual Capital*, 19(2), pp. 453-472. https://doi.org/10.1108/JIC-12-2016-0143

Trevelyan, E.G. and Robinson, N. (2015) 'Delphi methodology in health research: how to do it?', *European Journal of Integrative Medicine*, 7(4), pp. 423-428, https://doi.org/10.1016/j.eujim.2015.07.002

Varndell, W., Fry, M. & Elliott, D. (2021) 'Applying real-time Delphi methods: development of a pain management survey in emergency nursing', *BMC Nurs* 20, 149. https://doi.org/10.1186/s12912-021-00661-9

Vogel, C., Zwolinsky, S., Griffiths, C. et al. (2019) 'A Delphi study to build consensus on the definition and use of big data in obesity research', *International Journal of Obesity*, 43, 2573–2586. https://doi.org/10.1038/s41366-018-0313-9

Zsigmond, T., and Mura, L. (2023) 'Emotional intelligence and knowledge sharing as key factors in business management - evidence from Slovak SMEs', *Economics and Sociology*, 16(2), pp. 248-264. https://doi.org/10.14254/2071-789X.2023/16-2/15

Knowledge and Creativity Management: Is it a Boost or a Limit for Healthcare in the Post-covid World ?

Marco Berardi, Andrea Ziruolo, Fabrizia Fontana and Simone Cifolelli
"G. d'Annunzio" University of Chieti-Pescara, Italy

https://orcid.org/0000-0002-0938-1714
https://orcid.org/0000-0002-8941-1839
https://orcid.org/0000-0003-0321-2474
https://orcid.org/0000-0001-6079-8948

Abstract: Knowledge Management (KM) and Creativity Management (CM) are increasingly linked to the analysis of healthcare management. The health management of the Covid 19 emergency has amply demonstrated how these two frameworks, which are widely debated in the literature, find practical operational feedback albeit with profound lights and shadows. This study aims to investigate the contributions and threats of KM and CM within the context of local healthcare in order to highlight, using a quantitative methodology, which variables impact healthcare management the most and which variables are negligible. The analysis conducted concerns a sample of 200 healthcare workers from one of the Italian regions that has been most affected by the pandemic and will show how quickly healthcare management has changed in terms of internal procedures and relationships with stakeholders, subverting the paradigm of "rational planning" connected to typical CM variables.

Keywords: Knowledge Management, Creativity, Healthcare Management

1. Introduction

In recent years, the healthcare system has been changed by notable pushes towards the introduction of managerial models (Berardi et. al, 2022; Cepiku et. al, 2021). If we considered the situation a few years after the change process, the result is a made up of positive and negative factors.

The positive factors undoubtedly consist in the fact that we hear more and more about management control, budgeting, reporting and so on, and that after so many words the first concrete applications of these tools are starting to appear. To these positive factors, however, we must add a substantial series of negative factors; we refer in particular to these facts:

- the new management along with its control tools have been interpreted mainly as a method to reduce and cut costs (Boyne, 2001);
- little attention has been paid by management models to the effectiveness and healthcare quality (Di Vincenzo et. al, 2022) ;
- as a consequence of this, the medical component, despite having to play a primary role in the application and use of these tools, has ended up being the great exclusion in many cases (Crosby et. al, 2017).

The limits just mentioned certainly constitute a valid stimulus to reflect and rethink healthcare management models and tools regarding most recent studies regarding creative management in the intelligent management of business processes (Kamara et al., 2002).

Part of the international literature highlights the need to combine traditional models of management and control of business processes with analyses focusing on the quality of the services offered considering the ability of healthcare workers to adapt to social and economic changes (Heeks, 2002 and 2003).

On this topic, the literature has highlighted how the COVID-19 pandemic represented the catalyzing event towards a process of profound rethinking in the management of public health.

While on the one hand the New Public Management has introduced the concept of rational planning (indicator) and achievable (target) objectives, the emergence of extraordinary and often unpredictable events have led the public-healthcare system to review the traditional programming levers by introducing new variables such as unconditional trust towards healthcare workers (trust) and the management of the unexpected on a par with so-called ordinary management (Sternberg et a., 1997).

In this scenario, the ability to adapt and creativity of healthcare workers represents the lever that allows critical issues to be overcome. Creativity and passion are of particular relevance to mission and vision statements. A

simple definition of creativity is the power or ability to invent. We sometimes think of creativity as being a purely artistic quality, but creativity in business is the essence of innovation and progress (Sargiacomo et al., 2021).

Defining passion we intend an intense feeling or conviction. Passion is also associated with intense emotions. This means that a point of view should reflect and communicate something that is relatively novel and unique, and such novelty and uniqueness are the products of creativity and passion (Robinson et. al, 2008).

On this topic, international literature has shown how the management of the COVID-19 health emergency was brilliantly overcome thanks to the creativity and passion of healthcare workers who, through the re-engineering of healthcare action plans (knowledge management in practice) led to the innovation of traditional managerial models.

On these premises, our paper will analyze the changed context of the management of health services through the field analysis of one of the Italian contexts hit by the COVID-19 pandemic event, namely the Abruzzo region. Our same reference context has in fact been the subject of numerous studies on the topic and even the international database "WHO Covid 19" has indexed numerous contributions on this topic. In this regard, as confirmed by the literature, although the Abruzzo population represents only 4% of the Italian population, the impact of the pandemic has literally exhausted the local healthcare system and only the profound dedication and creativity in managing the pandemic has allowed us to react very quickly to the health emergency (Papi et al., 2018).

By applying a quantitative methodology to the context of healthcare in Abruzzo, this work aims to answer the fundamental research question: what is the role of creativity management and knowledge management in the healthcare system?

To answer the research question, we structured the paper as follows: the literature review constitutes the link between Knowledge Management (KM) and Creativity Management (CM); the methodological section will describe the methods and times of the investigation we conducted in order to investigate the strengths and weaknesses of the reference frameworks. Finally, through the analysis of the results we will show the efforts made by the healthcare sector and how the new approach adopted has revolutionized the traditional management of public healthcare management. These conclusions will outline the limitations of our research, the weaknesses of the model adopted and provide ideas for further studies.

2. Literature Review

Creating value is the primary objective of a company and the managerial tools, behaviors and actions of each operator are inspired by this model. For healthcare companies, the value creation model can be valid as long as it is considers the peculiarities that characterize these companies. If creating healthcare value can become the strategic objective of a healthcare company, it is essential, at this point, to evaluate which are the key variables appear to be the paths for creating value.

The old management "tools" such as budgeting and reporting can be enriched from this perspective and constitute an excellent support for all operators, first and foremost for the medical profession, which for various reasons was in the past and still is today more reluctant and less involved in the use of these tools. The value creation model can become the underlying philosophy which inspires all healthcare management tools and can constitute the common language to facilitate meeting, dialogue and comparison of the different professionalities and cultures that coexist within healthcare companies.

In this regard, part of the traditional doctrine identifies the "Knowledge Management Cycle" as the ideal approach to creating healthcare value (figure 1). Knowledge management is commonly defined as the strategic and organized approach aimed at identifying, capturing, storing, organizing and distributing knowledge within an organization. The main objective of this approach is therefore to maximize the use of available intellectual resources, to improve operational efficiency and to promote innovation.

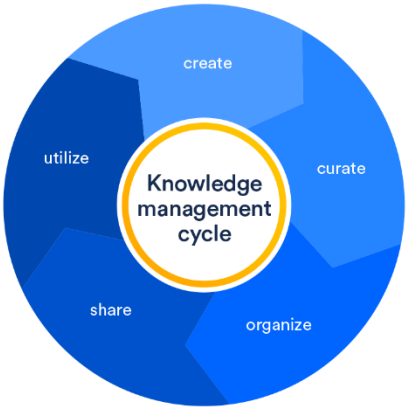


Figure 1: Knowledge Management Cycle (Machlup and Drucker,1978)

The knowledge management approach requires a series of activities to be put into practice: they range from the identification of knowledge to the evaluation and measurement of its effectiveness. Performing these activities perfectly, however, is not necessarily a guarantee of success: knowledge management is truly effective when it is supported by the creation of an organizational culture that promotes knowledge sharing, continuous learning and innovation.

It is therefore not enough to collect and share company knowledge, but it is necessary to convey the message at all levels that knowledge sharing is an essential part of the success of every company activity (Al Ahbabi, 2019; Capolupo et al., 2023). Thanks to knowledge management, the knowledge and skills attributable to this knowledge are not the exclusive relevance of a few, but become accessible to all. Having this fundamental advantage linked to knowledge management , it is also possible to identify other factors that are a direct consequence of:

- Improved productivity - as a strategic and structured approach, knowledge management allows for efficient management of information and, consequently, reduces the time needed to find answers or solve problems, thus supporting the organization's productivity.
- Risk reduction - the collection and sharing of knowledge can also support the identification and effective management of risks, as having access to accurate documentation of crucial information allows you to make informed decisions and potentially prevent, costly mistakes .
- Quality improvement - through the sharing of best practices it is in fact possible to facilitate the continuous improvement of operations and the general quality of its products and services.
- Skills development - the systematic sharing of company knowledge also allows for continuous training and the development of the skills of its collaborators, who can easily access training materials to improve their professional skills.
- Preservation of company know-how - thanks to knowledge management it is possible to share specific knowledge, possessed only by collaborators who carry out a particular activity and which would risk being lost with staff rotation.
- Support for Innovation - it may seem obvious, but it is of fundamental importance to share past experiences and solutions that can stimulate new ideas and innovative approaches.

Therefore, it is clear how knowledge management can significantly contribute to the success and growth of an organization by improving operational efficiency, stimulating innovation and allowing organizations to preserve and transmit the fundamental know-how to carry out their activities (Battiston et al., 2020; Capolupo et al., 2023).

At the same time, this approach is not particularly effective where extraordinary events, for example the COVID-19 pandemic, compromise the natural course of events by jamming the gear of the "Knowledge Management wheel". In these cases, the human capital of corporate organizations represents “The key that unlocks the chain”. As is known, the behaviors of people are characterized by numerous variables including: the predisposition to sacrifice, to teamwork, along with the previously gained experiences.

All things being equal, the literature highlights the creativity of individuals (creativity management theory) as the ability to overcome any corporate critical issues and guarantee the creation of corporate value.The health care

industry needs creativity and innovation to address challenges with quality, safety, cost, and access to care through the development and implementation of new or improved policies, processes, systems, products, technologies, diagnoses and treatments, services, and care delivery methods (Amabile, 1990). In this sense, creativity management is a system of principles, methods, techniques, practices, and instruments for managing employee creativity to get the maximum effect for the organization according to its goals, objectives, employee contingent, and available resources (Amabile; 1996; Ambabile et al., 2014; Al-Husseini, 2024).

Regarding creativity management literature (Patwary et al., 2024; Lubart, 2017) evidence on “the 7C’s the core” create a strong foundation to relate in a more mindful way. More specifically:

- Curiosity: we know that we don’t know everything and that we can’t know everything. When we reconnect with our curious side and practice being open to whatever we find.
- Cognition: By taking the time to explore our thoughts, we can also explore why we perceive, reason and understand in the way we do. As we learn to look at our thoughts, feelings and responses from a more objective point of view, we can begin to see things with greater clarity and understanding and how context can impact our words, actions and decisions;
- Compassion: when we’re compassionate, we decide to accept and engage with ourselves and others with kindness, without judgement, reaction or disengagement. Learning how to engage with ourselves and knowing which strategies we can use to take a gentler approach when times get tough is so important;
- Cultivation: We know learning a new skill or practice can be a messy one, with ups, downs, setbacks and breakthroughs; we get the most out of committing to something when we are able to do so in a consistent but flexible way. Creating meaningful changes can lead to genuinely profound shifts in perspective and behaviour and they take time, practice and patience;
- Celebration: a lot of the time we are so focused on the result, we overlook how far we have come. When we celebrate our achievements, we acknowledge and honour our effort, creating positive feedback loops that keep us motivated when times inevitably become difficult. Learning how to celebrate the journey allows us to experience more joy and gratitude;
- Community: the community is so important in our lives as in community, we find encouragement, accountability, and diversity. Having awareness of our strengths and knowing what we can offer others is so valuable. Being part of a community creates a more compassionate and curious culture where we can foster a sense of openness and kindness together, whilst reducing judgement and increasing tolerance;
- Connection: it’s how we build relationships, understanding and behavior. If we can connect to ourselves, others, and the world around us with understanding and compassion, we can fill the empty spaces in realtionships.

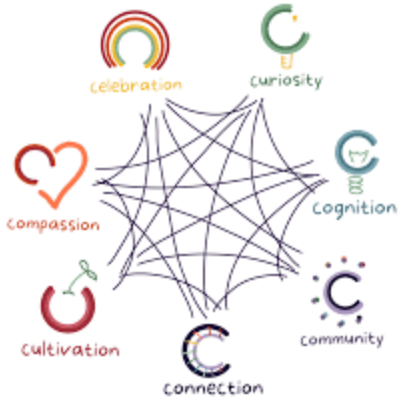


Figure 2: Creativity Management 7C’s (Lubart,2017)

The combination between a knowledge management (KM) and creativity management (CM) approach appears to have been the winning key for overcoming traditional approaches to healthcare management in the period preceding the pandemic emergency. The creation of healthcare value was in fact the final product of a "team game" involving a large series of variables, whose behavior was coordinated and balanced in a synergistic way. In particular, the variables of the model are divided among themselves according to a dual criterion:

- causal, whereby final health state objectives are identified (value for users), and intermediate (or instrumental) objectives aimed at achieving the former, and therefore logically connected to them by a cause/effect relationship that management it must necessarily presuppose.
- temporal, in the sense that the pursuit and realization of value creation requires a balance between actions whose effects will materialize in a short-term time frame, and medium-long term objectives aimed at preparing the conditions to guarantee in the long term the ability to create value. This category includes objectives linked to innovation and skills development projects, research, and the training of resources, the effects of which on the state of health of the population will not be seen immediately, but over a broader time lapse.

The value model thus articulated constitutes a conceptual structure that is no longer static and must not be translated through management support tools and mechanisms.

For this purpose, traditional programming and control "tools" can be profitably used, reviewed and re-calibrated with a view to creating value. This instrumentation has traditionally been based on a very simple logic: it is necessary to plan (first establish which results one intends to achieve) and control the management (then check whether the results being achieved are in line with the expected ones).

In particular, the theory of rational planning (Berardi et. al, 2021; Capolupo et. al, 2023) involves setting objectives and planning commitments and activities, to realize in advance, the possible problems that may be encountered and therefore study the countermeasures and solutions. Subsequently, while management, ascertain whether "things are going as expected", i.e. whether management is taking place in accordance with plans, to promptly realize the need to adopt appropriate corrective measures. Finally, verify in the final analysis whether the actual results corresponded to the planned ones, to "calibrate the aim better" in the development of subsequent programs.

The effort made by healthcare professionals (managers and employees) with respect to this general model we must adapt this formula to the logic of value, filling tools such as the definition of strategic objectives, the budget, reporting with specific contents.

Although COVID-19 has shocked the world and has hit most countries, businesses, and individuals unprepared, this sudden disruption has forced many of them to come up with innovative solutions and improvise, mainly to tackle the health emergency. While the health risks are currently the most frightening and upsetting, the social and economic crisis has vastly “resetted everything” (Berardi et. al, 2021).

3. Methodology

Considering previous literature, we focus our study on the same geographical area that has been investigated by other authors such as Battiston et al. (2021), Marziano et al. (2021) Berardi et al. (2021b, 2022) to provide more details that can contribute to a better understanding regarding how the public policy has affected local authorities. In the period between September 2023 and January 2024 we conducted 190 interviews with public employees from all the 4 main local healthcare districts (ASL), divided into the three macro categories: Deputy Employees (150 interviews), Managers (30), Senior Managers (10). Those four health hubs are the largest in terms of total customers of the Abruzzo Region (296.130 inhabitants in the four municipalities over 1.312 million of total inhabitants of the entire region) and have been largely investigated by Italian literature (Sebastiani et al., 2020; Berardi et al., 2021).

Table 1: Demographic characteristics of the respondents

Employee	**Deputy Employee (150)**		**Managers (30)**		**Senior Managers (10)**	
	Frequency	%	Frequency	%	Frequency	%
Age						
18-30						
31-44	10	6				
45-59	115	76	25	83	10	100
60 - 79	25	18	5	17		

Employee	**Deputy Employee (150)**		**Managers (30)**		**Senior Managers (10)**	
	Frequency	%	Frequency	%	Frequency	%
80+						
Gender						
M	90	60	25	83	8	80
F	60	40	5	17	2	20
Education						
No schooling completed						
Nursery school to 8 year grade						
High School	120	80				
Bachelor or master's Degree	30	20	30		8	80
Phd					2	20

In Table 1 we report the demographic profile of the respondent. Starting from this dataset we extract from interviews our dependent variable (Y) called "Knowledge and Creativity Contribution" computed as the use of new procedures inducted by national policies on digitalization of procedures to achieve smart governance (Vial, 2019). Such a variable was based on prior studies and used a validated single item measure (de Jong & den Hartog, 2010; Mascia &Cicchetti, 2011), by asking them: "how has your creativity influenced the response of your structure to the community needs in terms of healthcare?'.

This measure captured the effectively effort of creativity on KM procedures introduced in the local body with responses on a five-points scale, ranging from 1 (never) to 5 (very frequently). We chose this variable considering the impact that the central government acts (derived to the legislative decree 18/2020) had on the introduction of KM paradigms and logics in the healthcare sector. The dependent variables reconduct to Creativity variables as identified by international literature (Ramirez, 2020) and illustrated in table 2 in coherence with the process phase of the "knowledge management toolkit" (Robinson et al., 2010) measured with a Likert scale 0-5.

Table 2: Research items of the process phase of the C7's items

Process research Items	**Deputy employee**	**Managers**	**Senior Managers**
	Likert scale average	Likert scale average	Likert scale average
Curiosity and cognition	**2**	**4.66**	**4.66**
Community and Connection	**1**	**5**	**5**
Cultivation, Compassion and Celebration	**1**	**3**	**3**

Once the indicators were defined, the following regression model was applied (OLS) to consider all the variables included in the survey (Berardi et. al, 2021). In the equation below, Y represents the dependent variables, *α* represents the constant of the model, β represents the coefficient of the estimation of the variables (independent variables), logxni represents the logarithmic conversion of the variables measured with a Likert scale 0-5 (Table 2), while ε represents the standard error (Berardi et. al, 2022). The logarithmic conversion of some variables has been applied to reconduct the model to a Gaussian distribution. As a result, we build up three different regression models considering the three different clusters of interviews:

a) Deputy employee's C'7s model: YDE= a + βx1 + βlogx2 + βlogx3 + βx4 + βlogx5 + βlogx6 + εi;
b) Manager's C'7s model: YM= a + βx1 + βlogx2 + βlogx3 + βx4 + βlogx5 + βlogx6 + εi;
c) Senior Manager's C'7s model: YSM= a + βx1 + βlogx2 + βlogx3 + βx4 + βlogx5 + βlogx6 + εi;

The combination of the 6 variables which were considered showed no problems related to heteroskedasticity in all the three models (Breusch–Pagan tests results: $\chi 2 = 0.03$; Prob> $\chi 2 = 0.796$) and specificity (Ramsey test results: F (1.45) = 0.78; Prob> F = 0.337), as well as autocorrelation of some variables. Therefore, it was not necessary to proceed through stepwise regression (Shapiro–Wilk test results: pvalue= 0.698).

4. Results

What emerges from the analysis of the results, and answering to rq1, is a misalignment between employees and managers contribution on creativity and digitalization to the creation of public value. As shown in table 3 the YDE model is completely irrelevant for our analysis, as it has shown non-significant results while YM and YSM models reflect exactly the opposite situation.

Table 3: Results of the OLS regression, Source: Authors' own Table (2024)

Item	Regressor	YDE	YM	YSM
Curiosity and cognition	x1	-1,187 (0,245)	3.274 (1.988) *	3.172 (1.978) *
	logx2	0,137 (1,287)	6,846 (1,903) **	6,786 (1,897) **
	logx3	-1,481 (1,377)	8,133 (2,003) ***	7,983 (1,992) ***
Community and Connection	x4	-1,876 (0,345)	4,179 (2,078) *	3,879 (1,578) *
	logx5	-2,385 (2,273)	6,074 (1,738) *	5,874 (1,684) *
Cultivation, Compassion and Celebration	logx6	-3,175 (1.548)	2,507 (1,887) **	2,498 (1,787) **

To better understand the sense of this statical approach we report some extracts from the interviews conducted in the data set. In reference to the research item Community and Cognition, we asked them: "Are the measures adopted in line with the goal of achieve a digital environment?" while the managers just answered with no doubt that they are operating in the right direction, most of the employees specified that: "we are just doing what they asked us to do with absolutely no knowledge about what was going on. We are acting in the old way but with new sophisticated tools and instruments. Honestly, most of us are still having problems on procedures as they had a real lack back knowledge about Information Technologies. We have just received some basic commands and we move one step by step. This aspect had a terrible impact on our productivity because we must help those who are still having a problem after at least two years of the introduction of these new procedures. Moreover, many of us are afraid about the consequences of making an error so we spent a lot of time on re-check all the phases of the single processes. Only the sense of morality and the need to save lives helped us to move on to overcome all the issues".

Another relevant discordant point can be found in the measurement of the outcome or, in other terms, about the impact that the new procedures are having on the benefits for citizens and stakeholders (Bonner, 2023). What emerges from interview is that managers have a more long-range point of view about the outcome on communities:

For the first time in over 30 years of work experience, we have truly served our community. Every day, we found ourselves having to face completely different problems and situations and only our empathy and desire to help others in order to guarantee an efficient service to the community allowed us to overcome the traditional rigidities of the national healthcare system. At times, likely, we also broke some laws but faced with the need to save human lives, common sense prevailed over the rigidity of the procedures".

The extract of interviews, and the analysis we conducted, clearly show that while the managerial area of healthcare local bodies contributes to preserving the creative steam, the employees almost reject innovation, declining all the positive effects that it should have on their daily routine, thus confirming the second paradigm proposed by Rangarajan (2008). This creates a "no return way" in the process of creating public value in terms of user value, value to wide stakeholders or "value to wilder society" and basically let the achievement of public value as you are not in the condition of measure the real outcome on stakeholders, or at least to have no impact on them.

Innovation in the public health systems is taking several forms. For instance, video consultations and online consultations are now becoming regular practice for dealing with patients. This practice is rapidly taking hold in both acute and primary care, although it would have taken years to establish it in ordinary circumstances. Other examples are the test to diagnose breathlessness which has been introduced as soon as the emergency erupted or apps that trace the movement of infected patients and monitor their health condition. This fast transition brings certain risks such as data privacy risks or digital divide due to the limited access to health care of those parts of populations that lack digital connection. This aspect represents just some examples of the contribution of KM and CM that contribute to the rethinking of healthcare management that were emerges throughout the interviews conducted.

5. Conclusions

In this paper we highlighted a grey area still concerns the organizational design solutions related to creativity within the general context of generating new ideas. There is indeed a lack of literature in investigating the contribution of creativity and knowledge management. With this study we explored just one dimension of the policy making process that considers a knowledge management approach, also considering that the data set that we referred to only considers the public bodies organization of just one Italian Region that represent only the 5% of the Italian Population.

On the other hand, we give a first contribution on this topic showing that in a complex organization constituted by employees, managers, and senior managers, the process of creativity is completely different in the three different categories in order to contribute to international debate on KM and CM (Al-Husseini, 2023; Patwary et al., 2024) . The results of the OLS regression are emblematic and confirm that the process of creativity is strictly correlated on different levels and attitudes as supposed by several authors (Rangarajan, 2008; Boyne, 2001; Hood,1991; Amabile, 1996). Moreover, creativity positively affects the creation of value only when there is an alignment between the entire technostructure that gives the possibility to properly measure the impact of the adopted policies and measures.

In our opinion the key element of this study is that no matter where you live, or your income level, healthcare is ripe for change. According to international literature (Saulais et al., 2012), the state of health in the future will be radically better, but only if we create a favorable environment for implementing and adopting health innovations. Innovation within public and private healthcare entities is becoming both mandatory and vital and will be boosted by the creativity and knowledge of healthcare managers.

References

Al Ahbabi, S. A. (2019) 'Employee perception of impact of knowledge management processes on public sector performance', Journal of Knowledge Management, 23(2), pp. 351–373. doi: 10.1108/JKM-08-2017-0348.

Al-Husseini, S. (2023), "Examining the impact of top management support on employee creativity through the mediating role of knowledge management and absorptive capacity", International Journal of Innovation Science, https://doi.org/10.1108/IJIS-01-2023-0017

Amabile, T. (1996), "Assessing The Work Environment for Creativity", Academy of Management Journal. Vol. 39 No.5 pp 1154-1184.

Amabile, T. M., Goldfarb, P., & Brackfield, S. C. (1990), "Social influences on creativity: evaluation, coaction, and surveillance", Creativity Research Journal, Vol. 3, pp. 6–21.

Amabile, T. M. et al. (2014) 'Assessing the Work Environment for Creativity ASSESSING THE WORK ENVIRONMENT FOR CREATIVITY University of Michigan University of Southern California', 39(5), pp. 1154–1184.

Battiston, P., Kashyap, R. and Rotondi, V. (2020) 'Trust in science and experts during the COVID-19 outbreak in Italy'. doi: 10.31219/osf.io/twuhj.

Berardi M., Antonucci, G., Fontana, F., Ziruolo, A. (2022), "Rethinking classical knowledge management toolkits for the post covid public sector", Electronic Journal of Knowledge Management, Vol.20 n.3, ACPI, UK eISSN: 1479-4411;

Berardi, M. and Ziruolo, A. (2021) 'A Lack of Smart Governance in the Public Sector: The Italian Case Study', Lecture Notes in Information Systems and Organisation, 50 LNISO, pp. 219–232. doi: 10.1007/978-3-030-86858-1_13.

Bonner, A. (Ed.). (2023). COVID-19 and Social Determinants of Health: Wicked Issues and Relationalism (1st ed.). Bristol University Press. https://doi.org/10.2307/j.ctv36k5b4q.

Boyne, G. (2001) 'Planning, Performance And Public Services', Public Administration, 79(1), pp. 73–88. doi: 10.1111/1467-9299.00246.

Capolupo, N., Rosa, N., Adinolfi, P. (2023) The liaison between performance, strategic knowledge management, and lean six sigma. Insights from healthcare organizations. Knowledge Management Research & Practice 0:0, pages 1-13

Cepiku, D., Giordano, F., Bovaird, T., and Loeffler, E. (2021). New development: Managing the Covid-19 pandemic—from a hospital-centred model of care to a community co-production approach. Public Money and Management, 41(1), 77–80. https://doi.org/10.1080/09540962.2020.1821445.

Crosby,B., C., Hart, P., Torfing, J. (2017) "Public value creation through collaborative innovation", Public Management Review, Vol 19, issue 5, pp. 655-669, DOI: 10.1080/14719037.2016.1192165.

Di Vincenzo, F. and Iacopino, V. (2022) '"Catching the new": Exploring the impact of professional networks on innovative work behavior in healthcare', Creativity and Innovation Management, 31(1), pp. 141–151. doi: 10.1111/caim.12476.

Heeks, R. (2002) "Information systems and developing countries: failure, success, and local improvisations", The information society, Vol. 18, pp. 101-112.

Heeks, R. (2003) "Most e-government for development projects fail: how can risks be reduced?", iGovernment Working Paper Series, Paper no. 14.

Hood C. (1991), "A public administration for all seasons?", Public Administration Review, 69, Springer.

Jääskeläinen, A. (2009). Identifying a suitable approach for measuring and managing public service productivity. Electronic Journal of Knowledge Management, 7(4), 447-458. http://www.ejkm.com

Kamara,J.M., Anumba,J.C., Carrilo, A., (2002) "A CLEVER approach to selecting a knowledge management strategy", International Journal of Project Management, Vol 20, No. 3, pp 205-211.

Patwary, A.K., Alwi, M.K., Rehman, S.U., Rabiul, M.K., Babatunde, A.Y. and Alam, M.M.D. (2024), "Knowledge management practices on innovation performance in the hotel industry: mediated by organizational learning and organizational creativity", Global Knowledge, Memory and Communication, Vol. 73 No. 4/5, pp. 662-681.

Rangarajan, N. (2008) Evidence of Different Types of Creativity in Government: A Multimethod Assessment, Public Performance & Management Review. doi: 10.2753/pmr1530-9576320106.

Robinson, H., Carrillo, P., Anumba, C. J., and Patel, M. (2010), Governance and knowledge management for public-private partnerships. John Wiley & Sons, Chichester.

Saulais, P., Ermine, J.P., Creativity and Knowledge Management. Vine -London-, 2012, vol. 42 No. 3, pp.416-438.

Sargiacomo, M. and Walker, S.P. (2021), "Disaster governance and hybrid organizations: accounting, performance challenges and evacuee housing", Accounting, Auditing & Accountability Journal, Vol. 35 No. 3, pp. 887-916. https://doi.org/10.1108/AAAJ-12-2019-4323.

Sebastiani, G., Massa, M. and Riboli, E. (2020) 'Covid-19 epidemic in Italy: evolution, projections and impact of government measures', European Journal of Epidemiology, 35(4), pp. 341–345. doi: 10.1007/s10654-020-00631-6.

Sternberg, R. J., O'Hara, L. A., and Lubart, T. I. (1997), Creativity as Investment. California Management Review, 40(1), 8–21. https://doi.org/10.2307/41165919

Vial, G. (2019), "Understanding digital transformation: A review and a research agenda", Journal of Strategic Information System, 28(2), pp. 118-144.

Knowledge Creation on Costs in the Context of Economic Environment Changes: Perspective of SMEs

Renata Biadacz
Czestochowa University of Technology, Faculty of Management, Poland

renata.biadacz@pcz.pl

Abstract: The increasingly challenging geopolitical situation and the growing frequency of various unpredictable crisis threats make the future uncertain and unstable. On the one hand, the sharp rise in raw material prices and labor costs, supply chain issues, pressures to implement sustainable development principles and non-financial reporting, and the transition to a circular economy model is increasing cost awareness and, consequently, the demand for more detailed cost data. On the other hand, the rapid development of technology and digitization, along with the evolution of Industry 5.0, means that business managers increasingly recognize knowledge as an indispensable element of business management. Knowledge management is an excellent tool for streamlining processes, which each company constructs based on its goals, needs, and capabilities, essential for effective planning and proper organizational functioning. Therefore, enterprises are compelled to continuously self-improve and seek new management methods, including cost management. This article raises a research question concerning how cost knowledge is created in SMEs in the context of changes occurring in the economic environment. The article aims to analyze the use of cost knowledge in managerial decision-making in medium-sized enterprises operating in the Polish SME market. The research methods used to achieve this goal include participant observation, critical analysis, and synthesis. The empirical research was conducted in the form of surveys carried out using CATI/CAWI methods among 400 randomly selected medium-sized enterprises operating in Poland, along with personal interviews. The research results suggest managers should focus on acquiring broader knowledge about incurred costs. Many surveyed enterprises still use traditional cost accounting solutions, providing data necessary solely for reporting purposes. The potential and tools offered by cost accounting are used to a limited extent. This indicates a need to continue and expand the discussion on the usefulness of detailed knowledge about incurred and forecasted costs in decision-making processes. The research findings presented in the article are intended for both researchers and practitioners. The article concludes with practical recommendations for enterprises and future research tasks. It is a continuation of the author's research on the role of cost accounting in managing SMEs in Poland.

Keywords: Industry 5.0, CE, Cost Accounting, SME

1. Introduction

Running a business is associated with significant challenges nowadays. Businesses must adapt to increasingly rapid changes in technology, development, and climate. Just as companies got used to the concept of Industry 4.0 (for more, see Łada, Kozarkiewicz, 2021; Łada 2021; Remlein et al., 2022), there is already a growing vision of further changes dubbed Industry 5.0, which emphasizes harnessing human skills alongside the technological potential of robots and intelligent systems.

The numerous alarming and threatening crisis phenomena that have occurred in the past decade disrupt trade flows and destabilize oli markets and other commodities.

There is an increase in tensions in financial markets and a sharp rise in commodity prices. Growing economic uncertainty, slow economic growth, and rising inflation heighten the risk of business insolvency. This leads to increased uncertainty about the future and the effective operation of companies (Schaltegger, 2020; Becla and Czaja, 2022; Meadows et al., 2022).

In recent years, there has also been increasing pressure to conduct business in line with the concept of sustainable development (Eckert and Kovalevska, 2021; Weizsäcker and Wijkman, 2018). ESG reporting is one of the most frequently addressed issues in managing contemporary enterprises. The amount of scientific research conducted on the popularization of sustainable development, social responsibility, and ESG reporting is impressive and growing yearly (for example Robertson et al., 2023; Arena et al., 2023; Schaltegger et al., 2022; Schaltegger 2020; Tettamanzi et al., 2022; Elalfy et al., 2021; Songini et al., 2021; Kwakye et al., 2018). Additionally, relevant legal regulations are being implemented. European Union (EU) countries have committed to achieving climate neutrality by 2050, fulfilling their obligations arising under the Paris Agreement of 2015. As resources become increasingly depleted, a growing emphasis is on transforming businesses into a circular economy model.

The volatility of the business environment implies new knowledge about environmental instability and the necessity of implementing projects that adapt the company's business strategy to the challenges of the economic environment (Łęgowik-Świącik, 2021).

Knowledge is becoming the driving force behind business development and a key factor in creativity across all areas of life. An increasing number of companies are being forced to seek new management solutions to effectively meet contemporary challenges. Effective management in such an environment requires up-to-date and comprehensive information from various systems, including accounting. Detailed knowledge about incurred costs is becoming increasingly essential. This knowledge enables more effective and rational managerial decisions. Therefore, one of the key aspects of business management is tackling the challenges associated with acquiring and disseminating detailed cost knowledge, which allows for the implementation of necessary changes for efficient operation. This study aims to illustrate the extent to which cost knowledge is utilized in managerial decision-making by medium-sized enterprises in the SME sector operating in Poland.

2. Industry 5.0 - Opportunity or Threat for Businesses?

In 2021, the first comprehensive vision of the 5th Industrial Revolution was created as a report by the European Commission titled "Industry 5.0: Towards a Sustainable, Human-centric, and Resilient European Industry". This report attempts to comprehensively define the concept of Industry 5.0.

In the report, Industry 5.0 is portrayed as an evolutionary step in industry development, with a focus on social and environmental aspects, as well as the integration of advanced technologies with human needs (Di Nardo and Haoxuan, 2021; Longo et al., 2020; Elfar et al., 2021; Jamwal et al., 2021; Xu et al., 2021; Bai et al., 2020).

Industry 5.0 is envisioned as a response to the evolving reality and its challenges. A key element of this approach is the organization's ability to adapt and be flexible to changing conditions. Real-time data analysis allows production systems to adjust to shifting market conditions, eliminating overproduction and reducing costs. It paves the way for personalized production and on-demand manufacturing, contributing to increased competitiveness and sustainable development of enterprises (Yordanova, 2021; Zychowicz, 2023; Kwiek, 2022). Industry 5.0 is a construct that aligns well with the political agenda pursued by the European Union. It combines new technologies and digitization with an environmentally friendly approach, circular economy principles, and the creation of an "ecosystem" of companies and partners.

However, the implementation of Industry 5.0 brings many challenges. One of them is the proper preparation of workers to effectively collaborate with robots and use modern technologies. This requires flexibility from employees, as well as the ability to learn quickly and adapt to new situations. Therefore, investing in training is essential to enable employees to acquire the necessary competencies.

Another challenge is the integration of information and technological systems in manufacturing facilities. Industry 5.0 envisages sophisticated information systems, artificial intelligence, robotics, and the Internet of Things, which must be integrated and operate harmoniously. This requires the involvement of engineers, IT specialists, and automation experts (Saniuk, Grabowska, 2023). As Industry 5.0 involves collecting and processing vast amounts of information, ensuring data security and protection against cyber-attacks is essential. The development of Industry 5.0 also impacts changes in the accounting system. The level of organization of the accounting system in many Polish companies still reflects the limited organizational and financial potential presented at the beginning of their operations and does not evolve despite dynamic development. Therefore, it is necessary to adapt accounting systems to new requirements. Without this, companies will not be able to meet the challenges of the Industry 5.0 era.

3. The Circular Economy (CE)

The concept of the Circular Economy has garnered significant attention over the past few decades. Definitions of the Circular Economy presented in global literature reflect the evolution of its development and implementation (for more details, see Kulczycka and Pędziwiatr, 2019). The Circular Economy has also become one of the main strategic directions for thinking about the development of the European Union since the announcement of the action plan by the European Commission in 2015. Since then, the Commission has issued a series of directives concerning various aspects of the Circular Economy, and in 2020, it published a new, even more ambitious action plan for the Circular Economy. This is a part of the European Green Deal and efforts to achieve climate neutrality and resource efficiency by 2050. The Polish government adopted a Roadmap for the transition to a Circular Economy in 2019, aligning with these efforts.

In global literature and publications of many international organizations, there is also an indication of the role and connection of the Circular Economy with decoupling (separating economic growth from the use of limited

resources through breakthrough technologies). However, this may require radical structural modifications in existing business models and radical organizational changes (Baker et al., 2023; Cano-Rubio et al., 2021).

Nevertheless, there is still a research gap at the micro level regarding the impact of the Circular Economy on financial performance. More and more companies are incorporating circularity principles into their strategies due to regulations and increased societal interest. For companies to succeed in their transition from a linear economy and a take-make-dispose mindset toward a circular economy, it is essential to be able to measure and report progress. The diversity of definitions of the Circular Economy (over 200 definitions according to Kulczycka and Pędziwiatr, 2019) complicates efforts to develop standards and indicators. Due to the diverse definitions, the question of "what to measure?" remains unclear, increasing the risk of choosing different indicators and yielding inconsistent conclusions (Degerstedt and Schaumberger, 2022; Moraga et al., 2019).

Circular Economy models have the potential to create value, reduce costs, generate revenue, support the legitimacy of firms (Park et al., 2010; Tukker, 2015; Urbinati et al., 2017), and provide environmental benefits (Lieder and Rashid, 2016; Moraga et al., 2019; Murray et al., 2017; see also Aureli et al., 2023). However, according to Rodrigue and Picard (2022), managers perceive formal accounting procedures as limiting and seek alternative management accounting systems to meet the needs of a more inclusive and holistic system that can support social and environmental progress.

The transformation of a company's business model into a Circular Economy requires more detailed analytical knowledge regarding the incurred costs. Due to the fact that CE primarily aims to eliminate waste, it involves only two streams: raw materials (inputs) and main and by-product streams. Therefore, it is necessary to value the product streams. According to Uberman's opinion (2019), one of the most reliable methods is the benchmark method. However, the requirement of its reality must be remembered. The fundamental issue in the practical application of benchmarking methods in valuing revenues and production costs of combined products is that they are not aligned with methods used in financial accounting. For this reason, their implementation is only possible when a company has an independent unit responsible for managerial accounting (Uberman, 2019). When redesigning products to be more circular, it is essential to consider budgeting and costs associated with regeneration at the beginning stage of the production process. Cost accounting must include, in addition to direct and indirect costs, overhead costs, delivery and distribution costs, as well as new regeneration costs, to accurately apply cost control and cost determination methods.

It is also necessary to analyze the costs associated with greenhouse gas emissions within the framework of carbon accounting (Kazemian et al., 2022; Burritt et al., 2023; Higashida, 2020). Although it is widely acknowledged that carbon accounting practices are essential for improving corporate sustainability performance, there is little interest in disclosing information externally. Another important aspect emphasized in this regard is the expansion of information beyond the organization to include supply chains. Given that the sustainability of supply chains significantly impacts the sustainable development of products and overall operations, Material Flow Cost Accounting (Burritt and Schaltegger, 2014; Marco-Fondevila et al., 2020) is becoming increasingly important.

4. The Methodology

The primary objective of the research undertaken in this study is to analyze cost awareness and the extent of utilization of cost data in the decision-making process of enterprises in the context of changes occurring in the economic environment. The research focuses on enterprises in the SME sector, which constitutes about 99.8% of all businesses in Poland. Micro, small, and medium-sized enterprises drive the economy, accounting for 43.6% of the national GDP (Gruszkowski, 2023). They are thus a vital element and a key source of economic growth, dynamism, and flexibility. Their operation represents healthy competition and reflects the entrepreneurial spirit of society. Entrepreneurs in this sector typically concentrate on a relatively narrow area of activity, enabling them to contribute to the dynamic development of specific fields. They can develop solutions that large enterprises might overlook during mass production.

The vast majority of SMEs are micro and small enterprises, which face numerous threats and barriers often stemming from their structure and limitations. Most of these businesses use simplified record-keeping forms for tax purposes only, resulting in access to a significantly smaller pool of information to support decision-making processes and limited knowledge about incurred costs. Small enterprises that keep accounting books often limit themselves to recording costs for reporting purposes only. Consequently, the target research group selected for this study comprises medium-sized enterprises employing between 50-250 people. These enterprises typically

maintain accounting books and increasingly go beyond cost reporting to adopt solutions useful in cost management.

The empirical results presented in this study are part of ongoing research conducted by the author since 2018 on the use of pro-quality cost accounting by SMEs operating in Poland.

To achieve this goal, a triangulation of research methods was applied. The theoretical part was conducted based on a critical analysis of the literature. Critical literature analysis is a research method that presents existing theoretical and empirical approaches and demonstrates how to prepare research work aimed at expanding existing knowledge or developing a specific research area.

This allows for the presentation of a new approach to the research objective and indicates the validity and novelty of the adopted solutions. Critical literature analysis should, therefore, be regarded as a synthetic, objective, and reliable summary of a specific theoretical area. The descriptive analysis method was used to describe the research methodology adopted in the studies conducted in this study. The qualitative research method was employed to answer the research question, including a survey and unstructured interviews with practitioners. Conducting survey research is empirical as it enables the analysis and evaluation of the examined phenomena.

The research process involved conducting pilot studies to select the target group of enterprises, developing a survey questionnaire, and implementing the survey research. Following the pilot studies, the target group was identified as SMEs operating in Poland with 50 to 249 employees (medium-sized enterprises). Due to the scope of the survey research, the surveys were directed toward the managerial staff. The survey research was conducted in 2019 and is currently being repeated.

For some time now, unstructured interviews with practitioners have also been conducted regarding the solutions used in cost accounting and the level of interest in contemporary forms of cost accounting. Since last year, to supplement the knowledge about the level of interest of enterprises in the concept of sustainable development and the scope of actions taken in this regard, especially concerning reporting, the surveys and interviews have been expanded to include questions in this area. The interviews are conducted during meetings at scientific conferences, controllers' congresses and by seeking potential speakers at career fairs or on the LinkedIn platform.

5. Results of Empirical Research and Discussion

The survey was conducted on a representative group of 400 medium-sized companies from the manufacturing, services, and manufacturing services sectors. The study had a nationwide scope. An ordinal scale and a dichotomous scale were used in the survey. Therefore, the formula for the structure index was deemed appropriate for determining the minimum sample size. Assuming a 5% margin of error, the minimum sample size was determined to be 385. The obtained sample size of N=400 meets this requirement. The questions used in the questionnaire were verified for quality using Cronbach's alpha. The resulting value of $\alpha = 0.822$ for aggregated data and consistently exceeding 0.700 for individual items indicates that the scales and sequence of questions used are appropriate.

Given the scale used in the study, Wilcoxon signed-rank tests and Mann-Whitney U tests were employed to compare the assessments of individual objectives. The ϕ – Yule coefficient, based on the $\chi 2$ statistic, was used to examine correlations. For the tests applied in the study, a significance level of 0.05 was adopted (see Biadacz 2021, Biadacz 2024).

Due to the research objective pursued in this article, questions regarding the cost accounting solutions used by the examined SME entities and the statements obtained from unstructured interviews are analyzed. In the survey research, one part was dedicated to cost accounting. Three of the surveyed questions were concerned with the cost accounting method for operational activities. Among the 400 surveyed enterprises, 211 (52.75%) use simplified cost accounting, mostly in the form of cost types (chart of accounts 4) (188 respondents). These results are not surprising, as it is a normal trend that has been maintained for years.

Enterprises that indicated cost accounting in the form of cost types (a total of 377 enterprises) were asked to specify how it was expanded to adapt to the needs of the enterprise. The obtained results are summarized in Fig. 1.

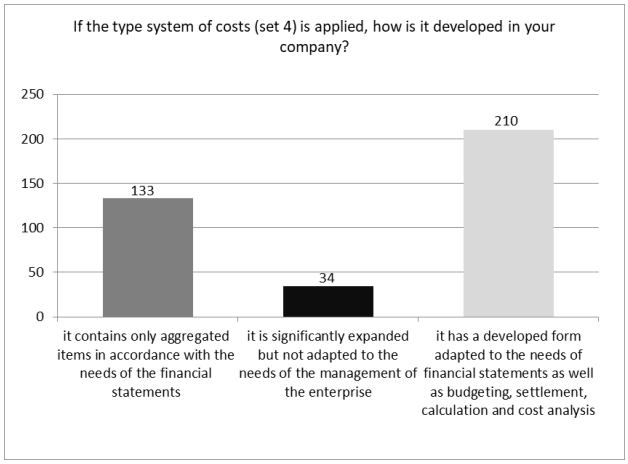


Figure 1: The degree of expansion of the type system of costs in the surveyed enterprise

Note(s): Twenty-three enterprises keep simplified cost accounting only in the costs by functions system (only chart of accounts 5).

Source: own study

Referring to this question, nearly 56% of the surveyed enterprises use an expanded cost type structure adapted for both reporting and managerial purposes, 9.02%, despite having an expanded structure of cost types, do not apply it for managing the enterprise, and 35.28% of the respondents use a cost type structure containing only aggregated items according to the needs of financial reporting. This means that enterprises moderately recognize the need to acquire broader knowledge regarding incurred costs.

The next question referred to the type of cost accounting used. Five of the most commonly applied cost accounting systems in business practice were listed. Respondents were allowed to select more than one solution. The responses are presented in Fig. 2.

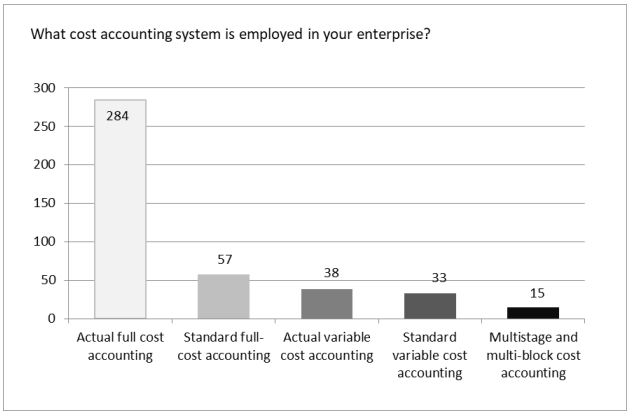


Figure 2: Cost Accounting Systems Used in the Enterprise (400 surveyed enterprises)

Note(s): Respondents could indicate more than one answer

Source: own study

After analyzing the responses to the above question, it is noteworthy that the majority of surveyed firms use the full actual cost accounting system (71%). Although much less commonly chosen, the second most preferred solution is the full standard cost accounting (14.25%). The use of actual variable cost accounting was indicated by 9.5% of respondents, while 8.25% indicated standard variable cost accounting. The multi-block cost accounting system is the least popular among respondents, with only 3.75% using it.

Regarding the method of allocating common costs used in the enterprise, 44% of respondents (176 out of 400 surveyed) indicated that they allocate common costs to departments. A similar number of companies allocates common costs to products/services (112 out of 400 respondents, 28%) as to tasks/projects (103 out of 400 respondents, 25.65%). The complete distribution of responses is presented in Fig. 3.

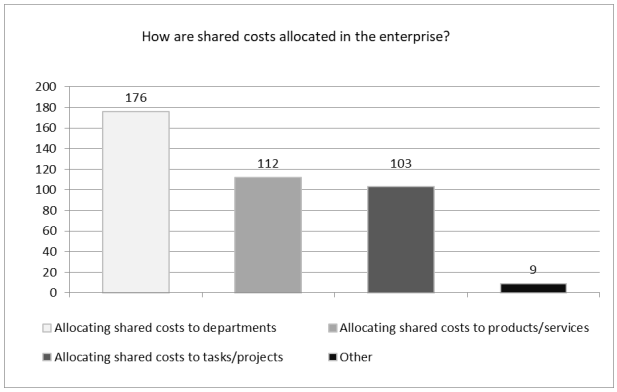


Figure 3: Allocation of shared costs in the enterprise.

Source: own study

One of the important issues for these studies relates to the systems used. In response to the question, "Do you have information systems that allow processing and storing a wide range of data?" as many as 349 respondents answered negatively. Considering the changes occurring in the environment and the perspective of transitioning to a circular economy and adapting enterprises to the Industry 5.0 concept, this cannot be considered a positive phenomenon.

The next question pertains to the calculation of the unit cost of the production of goods (provision of services). In this case, the results obtained are also unsatisfactory, as only 19.25% confirmed that they use cost accounting. A total of 323 respondents answered that they do not prepare calculations for the actual cost of producing products (provision of services). However, the cost of production of a product or provision of a service is an extremely important indicator for enterprises of this profile. It is used for various analyses both at the reporting and decision-making levels. It plays a crucial role in setting prices, managing resources, and business strategies in the enterprise. Knowing the unit cost of producing a product allows for setting competitive selling prices and identifying areas where costs can be reduced without compromising product quality. As a result, companies can improve their profit margins and increase competitiveness in the market. Efficient management of the cost of production of a product/service can positively impact the competitiveness of the company, its long-term stability, and its development. Therefore, different responses would be expected in the above area.

The responses to the question regarding the role of cost accounting in the enterprise can be moderately positive. The full distribution of responses regarding the role of cost accounting is presented in Fig. 4.

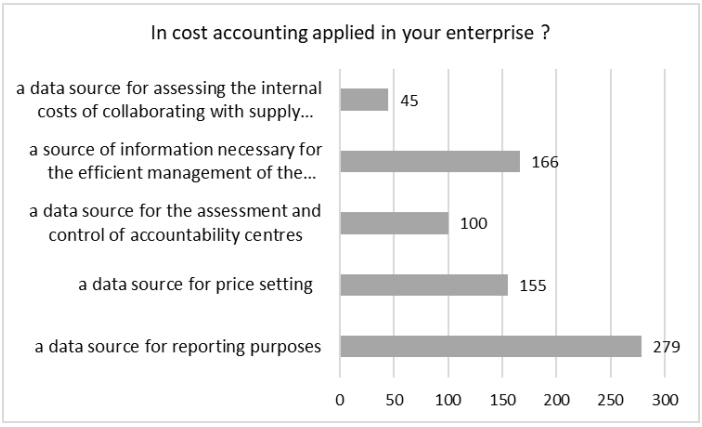


Figure 4: Role of cost accounting in enterprises

Note(s): Respondents could indicate more than one answer

Source: own study

After analyzing the respondents' answers, the following conclusions can be drawn: for 69.70% of respondents, cost accounting serves as a data source for reporting purposes; for 41.5%, it is a source of information necessary for effective enterprise management; for 38.75%, it is a source of data for pricing decisions. Cost accounting is

used by 25% of respondents for assessing and controlling responsibility centers, and by 11.25% for assessing internal costs of cooperation with partners in the supply chain.

These results are consistent with earlier research conducted in this area (Nesterak et al., 2017; Świderska, 2016). This is also confirmed by numerous case studies and publications referring to specific enterprises.

From the conducted research, it emerges that a small percentage of respondents indicate the use of the multi-block contribution margin cost accounting (28%). 72% do not use this solution. The full distribution of obtained responses is presented in Table 1.

Table 1: The use of multi-block cost coverage margin analysis in enterprises.

Is the multi-block cost coverage margin analysis used in the enterprise?	Total 400
A. Yes:	112
a) According to customer segments	24
b) According to product categories/goods/services	81
c) According to sales regions	7
B. No. It is not used	288

Source: own study

Supplementary to the research was a question concerning the application of selected elements of cost accounting. The results are presented in Fig.5. From the respondents' opinions, it appears that various solutions are being used. The majority, about 37.25% of surveyed enterprises, apply gross margin calculation, while 30.5% allocate indirect costs to cost centers. About 23% divide costs within cost centers into fixed and variable, and a similar percentage use planned costs for each center. Significantly fewer respondents identify and monitor the utilization level of production capacity (14.75%) or conduct variance analysis for all cost centers.

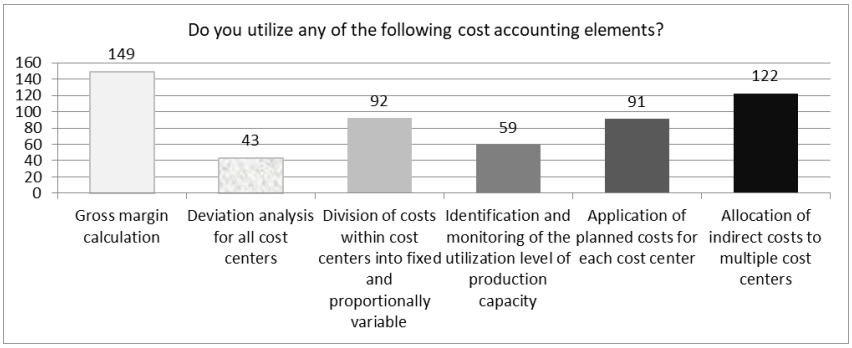


Figure 5: Utilization level of selected cost accounting elements.

Note(s): Respondents could indicate more than one answer

Source: own study

Surprisingly, 394 respondents answered affirmatively to the question of whether the information received from cost accounting is useful for managerial decision-making. This somewhat contradicts the earlier statement that cost accounting is primarily used for reporting purposes, and only 41.5% consider it a source of information necessary for the effective management of the enterprise. Respondents indicated that the data are useful for making both strategic (36%) and operational (47.25%) managerial decisions, as well as for efficient and detailed cost control and precise planning of future actions (both 48.75% of enterprises).

These results indicate that many medium-sized enterprises still use cost accounting only for reporting purposes. This is also confirmed by respondents' opinions from unstructured interviews.

The vast majority of respondents use cost accounting tools to a limited extent to support managerial decision-making. Contemporary variations of cost accounting arouse interest, although, in most cases, companies do not anticipate the possibility of implementing them in the near future. Regarding questions about sustainable development and reporting, only 4 surveyed companies indicated that they had taken action in this area.

6. Conclusion

As indicated by the above considerations, cost accounting should evolve, adapting to current economic, social, and environmental conditions. Unfortunately, this is not the case in a significant portion of the surveyed enterprises. The utilization of cost accounting is insufficient for making managerial decisions in today's volatile and unpredictable economic environment. Most surveyed enterprises rely solely on reporting cost accounting, which often fails to provide accurate information about the costs of resources, products, customers, or partners. Additionally, the calculation of product or service production costs and the utilization of production capacities are not conducted in many cases.

Relying on incomplete or inaccurate cost information results in making misguided decisions. Supporting the implementation of the intended strategy can be contemporary variations of cost accounting, serving as tools for strategic cost management and sustainable managerial accounting. While cost awareness has increased in recent years, interest in advanced cost accounting solutions and cost management is insufficient compared to the demands posed by the contemporary market and legislation. Therefore, it is crucial to raise awareness among the managerial staff of these enterprises about the necessity of implementing new tools adequate to current conditions.

The partial results presented above from the research indicate that selected cost accounting tools are not sufficiently utilized in the practices by medium-sized enterprises operating in Poland. It is therefore recommended that efforts be made to increase cost awareness among the management of these enterprises and convince them to implement new cost accounting solutions. These efforts will contribute to more effective enterprise management and operation in accordance with the principles of sustainable development.

This is essential because all enterprises, sooner or later, will need to adapt to new conditions and meet the challenges brought by the concept of Industry 5.0 and the increasingly emphasized necessity of transitioning to a circular economy model and reporting in this regard in order to survive in the market.

References

Arena, M., Azzone., Ratti, S., Urbano, V.M. and Vecchio, G. (2023), “Sustainable development goals and corporate reporting: An empirical investigation of the oil and gas industry”, Sustainable Development, Vol. 31, No. 1, pp. 12-25.

Aureli, S., Foschi, E. and Palett, A. (2023), “Management accounting for a circular economy: current limits and avenue for a dialogic approach”, Accounting, Auditing & Accountability Journal, Vol. ahead-of-print No. ahead-of-print.

Bai, C., Dallasega, P., Orzes, G., and Sarkis, J. (2020) “Industry 4.0 technologies assessment: A sustainability perspective”, International Journal of Production Economics, Vol 229, 107776.

Baker, M., Gray, R. and Schaltegger, S. (2023), “Debating accounting and sustainability: from incompatibility to rapprochement in the pursuit of corporate sustainability”, Accounting, Auditing and Accountability Journal, Vol. 36 No. 2, pp. 591-619.

Becla, A. and Czaja, S. (2022), “Paths of Implementation of Balanced and Sustainable Development in the Conditions of the Information Society, Knowledge-Based Economy and Economy Based on Wisdom”, Economics and Environment, Vol. 82, No. 3, pp. 38-49.

Biadacz, R. (2021), “Quality cost management in the SMEs of Poland”, The TQM Journal, Vol. 33, No. 7, pp.1-38

Biadacz, R. (2024), “Application of Kaizen and Kaizen Costing in SMEs”, Production Engineering Archives, Vol.30, No. 1, pp. 17-35.

Burritt, R.L., Schaltegger, S. and Christ, K.L. (2023), “Environmental Management Accounting – Developments Over the Last 20 years from a Framework Perspective”, Australian Accounting Review, Vol. 33, pp. 336-351.

Burritt, R. and Schaltegger, S. (2014), “Accounting Towards Sustainability in Production and Supply Chains”, The British Accounting Review, Vol. 46, No. 4, pp. 327-343.

Cano-Rubio, M., Maglio, R. and Núñez-Cacho Utrilla, P. (2021), “Factors influencing circular economy implementation in Smes business models: the case of Spain”, Piccola Impresa/Small Business. doi: 10.14596/pisb.2849

Degerstedt, G. and Schaumberger, S. (2022), The Effect of Circular Economy on Financial KPIs. A study on Swedish SMEs within the manufacturing industry, Department of Business Administration, Umeå School of Business, Economics and Statistics, Umeå.

Di Nardo, M. and Haoxuan, Y. (2021) “Special Issue Industry 5.0: The Prelude to the Sixth Industrial Revolution”, Applied System Innovation, Vol. 4, p. 45.

Eckert, E. and Kovalevska, O. (2021) “Sustainability in the European Union: analyzing the discourse of the European Green Deal”*, Journal of Risk and Financial Management*, Vol. 14 (2), p. 80.

Elafy, A., Weber, O., Geobey, S. (2021), “The sustainable development goals (SDGs): A rising tide lifts all boats? Global reporting implications in a post SDGs world”, Journal of Applied Accounting Research, Vol. 22, No. 3, pp. 557-575.

ElFar, O., Chang, C., Leong, H., Peter, A., Chew, K. and Show, P. (2021) "Prospects of Industry 5.0 in algae: Customisation of production and new advance technology for clean bioenergy generation", Energy Conversion and Management, X, Vol. 10, 100048.

Gruszkowski, P. (2023), PARP: 26. edycja „Raportu o stanie sektora małych i średnich przedsiębiorstw w Polsce", [Online], https://een.pomorskie.pl/parp-26-edycja-raportu-o-stanie-sektora-malych-i-srednich-przedsiebiorstw-w-polsce/ 11.05.2024

Higashida, A. (2020), "Supply Chain MFCA Implementation: Emphasizing Evidence on Coordination. Sustainability Accounting", Management and Policy Journal, Vol. 12, No. 4, pp. 695-718.

Jamwal, A., Agrawal, R., Sharma, M., and Giallanza, A. (2021) "Industry 4.0 technologies for manufacturing sustainability: A systematic review and future research directions", Applied Sciences, Vol. 11, No. 12, p. 5725.

Kazemian, S., Djajadikerta, H.G., Trireksani, T., Sohag, K., Sanusi, Z.M. and Said, J. (2022), "Carbon Management Accounting (CMA) Practices in Australia's High Carbon-Emission Industries", Sustainability Accounting, Management and Policy Journal, Vol.13 (5), pp. 1132-1168.

Kulczycka, J., Pędziwiatr, E. (2019), "Gospodarka o obiegu zamkniętym – definicje i ich interpretacje", [in:] Kulczycka, J. (ed.), "Gospodarka o obiegu zamkniętym w polityce i badaniach naukowych", Publishing Hause Polish Academy of Sciences, Krakow, pp.9-20.

Kwakye, T.O., Welbeck, E.E., Owusu, G.M.Y. and Anokye, F.K. (2018), "Determinants of intention to engage in Sustainability Accounting & Reporting (SAR): the perspective of professional accountants", International Journal of Corporate Social Responsibility, Vol. 3, No. 11.

Kwiek, D. (2022), Przemysł 5.0?, [Online], https://przemyslprzyszlosci.gov.pl/przemysl-5-0/ [14.03.2024]

Lieder, M. and Rashid, A. (2016), "Towards CE implementation: a comprehensive review in context of manufacturing industry", Journal of Cleaner Production, Vol. 115, pp. 36-51.

Longo, F., Padovano, A. and Umbrello, S. (2020) "Value-Oriented and Ethical Technology Engineering in Industry 5.0: A Human-Centric Perspective for the Design of the Factory of the Future", Applied Sciences-Basel, Vol. 10, No. 12, p. 4182.

Łęgowik-Świącik, S. (2021) "How Intellectual Capital Shapes the Business Model in Strategic Areas of Enterprise Management" [in:] Garcia-Perez, A. and Simkin, L. (ed.) Proceedings of the 22nd European Conference on Knowledge Management, pp. 492-500.

Marco-Fondevila, M., Moneva, J.M. and Llena-Macarulla, F. (2020), "Accounting for Carbon Footprint Flows in Wine Production Process. Case Study in Spanish winery", Applied Sciences, Vol.10, No. 23, p. 8381.

Meadows, M., Merendino, A., Dibb, S., Garcia-Perez, A., Hinton, M., Papagiannidis S., Pappas, I. and Wang, H. (2022), "Tension in the data environment: How organisations can meet the challenge", Technological Forecasting and Social Change, Vol. 175, 121315.

Moraga, G., Huysveld, S., Mathieux, F., Blengini, G.A., Alaerts, L., Van Acker, K., de Meester, S. and Dewulf, J. (2019), Circular economy indicators: What do they measure? Resources, conservation and recycling, Vol. 146, pp. 452-461.

Murray, A., Skene, K. and Haynes, K. (2017), "The circular economy: an interdisciplinary exploration of the concept and application in a global context", Journal of Business Ethics, Vol. 140 No. 3, pp. 369-380.

Nesterak, J., Kołodziej-Hajdo, M. and Kowalski, M.J. (2017), "Rachunek kosztów w praktyce przedsiębiorstw działających w Polsce", Krakow School of Controlling, Krakow.

Park, J., Sarkis, J. and Wu, Z. (2010), "Creating integrated business and environmental value within the context of China's CE and ecological modernization", Journal of Cleaner Production, Vol. 18, No. 15, pp. 1494-150.

Robertson F., Krasodomska J., Dyczkowska J. (2022), "Harmonising sustainability reporting in the face of stakeholders' awakening capitalism. The institutional background", Zeszyty Teoretyczne Rachunkowości (The Theoretical Journal of Accounting), Vol. 46, SKwP, Warsaw, pp. 129-160.

Rodrigue, M. and Picard, C.F. (2022), "Non-accountants and accounting: on the emancipatory mobilization of accounting by sustainability managers", European Accounting Review, Vol. 32, No. 5, pp. 1-29.

Saniuk, S., Grabowska, S. (2023), "Knowledge and Skills Development for Implementing the Industry 5.0 Concept", Proceedings of the 24th European Conference on Knowledge Management, ECKM 2023, pp. 1188-1195.

Schaltegger, S. (2020), "Unsustainability as a key source of epi- and pandemics: conclusions for sustainability and ecosystems accounting", Journal of Accounting & Organizational Change, Vol. 16, No. 4, pp 613-619.

Schaltegger, S., Christ, K.L., Wenzig, J. and Burritt, R.L. (2022), "Corporate sustainability management accounting and multi-level links for sustainability – a systematic review", International Journal of Management Reviews, Vol. 24, pp. 480–500.

Songini, L., Pistoni, A., Tettamanzi, P., Fratini, F. and Minutiello, V. (2021), "Integrated reporting quality and BoD characteristics: an empirical analysis", Journal of Management and Governance, Vol. 26, No. 1, pp. 579-620.

Świderska, G.K. (2016), "Ryzyko gospodarcze przy nieprawidłowej wycenie produktów", Scientific Journals of Częstochowa University of Technology, Management, Vol. 23, No. 2, pp. 60-68.

Tettamanzi, P., Venturini, G. and Murgolo, M. (2022), "Sustainability and Financial Accounting: a Critical Review on the ESG Dynamics", Environmental Science and Pollution Research, Vol. 29, pp. 16758–16761.

Tukker, A. (2015), "Product services for a resource-efficient and circular economy – a review", Journal of Cleaner Production, Vol. 97, pp. 76-91.

Uberman, R. (2019), "Instrumenty rachunkowości zarządczej mogące wpierać gospodarki o obiegu zamkniętym", [in:] Kulczycka J. (ed.), "Gospodarka o biegu zamkniętym w polityce i badaniach naukowych", Publishing Hause Polish Academy of Sciences, Krakow, pp. 129-140.

Urbinati, A., Chiaroni, D. and Chiesa, V. (2017), "Towards a new taxonomy of circular economy and business models", Journal of Cleaner Production, Vol. 168, pp. 487-498.

Weizsäcker, E.U. and Wijkman, A. (2018), "Ejże! Kapitalizm, krótkowzroczność, populacja i zniszczenie planety, Raport Klubu Rzymskiego", IBS, Warsaw University of Technology, Warsaw.

Xu, X., Lu, Y., Vogel-Heuser, B., and Wang, L. (2021) "Industry 4.0 and Industry 5.0-Inception, conception and perception", Journal of Manufacturing Systems, Vol. 61, pp. 530-535.

Yordanova, K. (2021) "The Curious Case of Industry 5.0", [Online], https://www.law.kuleuven.be/citip/blog/the-curious-case-of-industry-5-0/ [04.03.2024].

Zychowicz, P. (2023), Przemysł 5.0 czyli 5 rewolucja przemysłowa, [Online],https://www.menedzer-produkcji.pl/artykul/przemysl-5-0-czyli-piata-rewolucja-przemyslowa, 04.03.2024].

Knowledge Sharing and Protection Mechanisms in Hybrid and Remote Work Settings

Mario Bissani[1], Mírian Oliveira[1, 2], Tiago Gonçalves[2] and Carla Curado[2]
[1]Pontifícia Universidade Católica do Rio Grande do Sul, Escola de Negócios, Porto Alegre, Brazil
[2]Universidade de Lisboa - Advance/CSG, ISEG, Lisboa, Portugal

mario.bissani@edu.pucrs.br
miriano@pucrs.br
tgoncalves@iseg.ulisboa.pt
ccurado@iseg.ulisboa.pt

Abstract: Organizations can increase their competitive advantage by sharing knowledge. On the other hand, mechanisms are needed to protect this knowledge from leaking. Although there is a growing body research on hybrid and remote working, few studies have looked at the adoption of knowledge protection (KP) mechanisms in these work models. This study seeks to address this gap by analysing KP and knowledge sharing (KS) mechanisms in hybrid and remote work environments in information technology (IT) companies. The research method adopted was qualitative, exploratory, and cross-sectional, with data being collected through twenty semi-structured interviews conducted with professionals working in either hybrid or remote environments in IT companies. Regarding the interviewees' characteristics, the male-female ratio was 60% - 40%, with an average age of 36 years, average time in the same company of 4.5 years, and around 2.5 years in the same position. The content analysis technique was adopted in the data analysis. As there is no standardization of days and times in the hybrid system, KS is hampered by the lack of face-to-face interaction between employees. The KS mechanisms mentioned are training, formal meetings, mentoring, and content available on the organizational intranet or platforms, among others. Not all organizations see KP as being important, and some even allow employees to use their own equipment, which may be potentially damaging for the company. This article presents theoretical contributions, such as the identification of sharing and protection mechanisms used in the hybrid and remote environments, and practical contributions, such as a list of mechanisms that can be used by companies. This research also highlights opportunities for future research, such as the identification and analysis of mechanisms in other segments of the economy, as well as research on the role of organizational culture in protecting knowledge.

Keywords: Knowledge Protection; Knowledge Sharing; Mechanisms; Hybrid; Remote.

1. Introduction

Remote working is widely considered one of the most significant changes in recent times, both for workers and companies (Ganguly *et al*., 2022). It can be defined as a regime whereby employees work from their homes or other locations while connected to their workplace through information technology (IT) (Beno, 2022). Several terms are used in research as synonyms for remote work, including: hybrid work, flexible work, work from home, telecommuting and virtual work. Despite their often interchangeable usage, these terms encapsulate subtle distinctions. For example, hybrid work entails a division of working hours between on-site and remote settings, allowing employees to spend some time physically present in the workplace, with schedules either determined by the individual or the company. In contrast, remote work implies that employees operate entirely outside the confines of the traditional office environment (Beno, 2022). This study aims to explore both hybrid work and remote work in depth.

The rise in the adoption of hybrid or remote working has sparked a surge in research attention towards this subject. Recent studies (Beno, 2022; Yang *et al.,* 2022) have looked into the dynamics of hybrid and remote work, examining both their benefits and drawbacks. Notably, among the identified disadvantages is the challenge of maintaining effective communication among employees and a subsequent decline in knowledge sharing (KS) and innovation, primarily attributed to the prevalence of asynchronous communication methods (Yang *et al.,* 2022).

The growing number workers engaged in hybrid and remote work arrangements has underscored the importance of safeguarding knowledge within these settings (Abbas and Alghail, 2023). Understanding how knowledge protection (KP) mechanisms traditionally utilized in face-to-face work contexts can be adapted by companies to sustain this vital aspect within hybrid or remote work environments, while retaining the benefits of effective KS, and preventing the leakage of knowledge assets, has become a pressing concern for organizations (Beno, 2022).

Despite the growing body of research on remote and hybrid work, a notable gap persists concerning the integration of KP mechanisms within these work models, a topic of significance due to its intrinsic link with effective KS (Singh *et al*., 2021). KP plays a pivotal role in mitigating knowledge leakage, which occurs when a company's proprietary knowledge is inadvertently or deliberately acquired by external parties (Ahlfanger *et al*., 2022).

In light of the aforementioned factors, including the growing significance and prevalence of hybrid and remote work setups within IT companies in Brazil, coupled with the imperative for organizations to safeguard their knowledge assets, this study posits the following research question: **What KP and KS mechanisms are employed by IT companies in hybrid and remote work**?

This study aims to analyse the KP and KS mechanisms in hybrid and remote work environments in IT companies. In addition to this introduction, this article has the following sections: 2) literature review on KS and KP, considering remote and hybrid work arrangements; 3) research methods; 4) analysis and discussion of the results; and 5) conclusions, limitations, and suggestions for future research.

2. Literature Review

2.1 Knowledge Sharing

KS is a key process within Knowledge Management, being distinguished by its capacity to disseminate, transmit, or transfer knowledge among individuals and organizations (Le and Lei, 2018). Consequently, KS emerges as a significant source of competitive advantage for organizations (Chen *et al*., 2018), underlining its pivotal role in fostering innovation and growth. Moreover, the proactive engagement of employees in facilitating KS endeavours is crucial to the sustained development of the company (Fauzi *et al*., 2023).

The departure of specialized and experienced personnel from a company poses an elevated risk of knowledge loss or leakage, potentially compromising its competitive advantage (Joe *et al*., 2013). This risk is particularly pronounced within the realm of IT professionals, given the inherently knowledge-intensive nature of their work (Borges *et al*., 2018).

Yap and Lock (2017) outline various mechanisms aimed at facilitating KS, categorizing them as either technological or non-technological. Their research conducted in Malaysia identified face-to-face interaction, mentoring, and documentation as the preferred mechanisms for KS among professionals.

2.2 Knowledge Protection

KP encompasses "*the array of potential approaches, methods, or tools employed to safeguard not only the tangible results of knowledge exploration but also the knowledge itself*" (Bolisani *et al*., 2013, p. 194). Organizations have to weigh the risks and benefits when determining the nature and scope of their engagement in KS activities (Thalmann *et al.,* 2024). Effective KP mechanisms bolster a company's competitive capabilities within its product market domain, ultimately driving superior sales growth compared to rivals (Nguyen *et al*., 2023).

To safeguard their knowledge assets, organizations must deploy mechanisms capable of averting knowledge leakage and the subsequent erosion of competitive advantage (Guo *et al.,* 2020). Such KP mechanisms typically fall into two categories: formal and informal (Olander *et al*., 2014). Formal mechanisms hinge on legal measures, such as contractual agreements, and may necessitate external resources such as specialized software (Olander *et al*., 2014). Conversely, informal mechanisms rely predominantly on interpersonal relationships and trust, often being favoured by small and medium-sized enterprises with relatively limited resources (Gast *et al*., 2019). Knowledge-intensive enterprises typically adopt a blend of formal and informal mechanisms tailored to their specific needs and contexts (Thallmann *et al*., 2024).

Formal KP mechanisms commonly employed include contracts, non-disclosure agreements (NDAs), and intellectual property safeguards such as copyright, patent registration, and trademarks. However, informal KP mechanisms can be particularly valuable in situations where formal measures like intellectual property protection are not applicable (Olander *et al*., 2011). One prevalent informal method of KP is maintaining secrecy, which involves limiting the number of individuals privy to strategic projects as well as controlling access to specific company facilities or projects (Hurmelinna-Laukkanen and Puumalainen, 2007).

2.3 The Relationship Between KS and KP in Remote and Hybrid Work Settings

A few authors have examined the relationship between KS and KP (Foege *et al*., 2019). This relationship typically exhibits an antagonistic aspect: while companies benefit from KS through enhanced innovation, cost reduction, and increased value of products and services (Gast *et al*., 2019), they also have to ensure against undesirable outcomes such as knowledge leakage and unauthorized appropriation of intellectual property (Ritala *et al*., 2015). Thus, striking a balance between promoting effective communication and protecting valuable knowledge assets remains a critical challenge for organizations.

The sharing of specific knowledge pertaining to innovations, experiences, or confidential information tends to be more restricted and rigorously protected compared to that of more generalized knowledge concerning factories, sectors, or markets (Gast *et al*., 2019). This selective approach inhibits deeper collaboration between companies, as each entity tends to limit the sharing of information to what it deems non-essential.

Remote or hybrid work arrangements introduce novel scenarios wherein employees operate either entirely or on certain days from locations external to the company's physical office space. This necessitates adjustments in the interaction and communication patterns among colleagues and managers. Hybrid and remote work models pose fresh challenges and opportunities for coordinating effective KS within organizations (Kaiser *et al*., 2022).

3. Research Method

To achieve the research objective, a qualitative approach was adopted. The research is characterized as exploratory, being aimed at discovering more about the phenomenon under study to enhance the understanding of underlying issues (Saunders *et al*., 2009). Additionally, the research is classified as cross-sectional, since it focuses on the specific phenomenon at a particular point in time. It encompasses describing the incidence of the phenomenon while elucidating how various factors interrelate across different organizations (Saunders *et al*., 2009).

Data collection was conducted through semi-structured interviews, in accordance with the methodology outlined by Saunders *et al*. (2009). This approach involves utilizing a preliminary script while allowing for the inclusion of additional questions during the interview process, thus increasing the potential to uncover valuable insights pertinent to the research objective (Saunders *et al*., 2009).

The authors drew upon insights from prior studies (Abbas and Alghail, 2023; Beno, 2022; Ganguly *et al*., 2022) to inform the design of the interview questions and their arrangement. The semi-structured interview script was organized into four parts: 1) gathering sociodemographic information about the respondents; 2) exploring their experiences with hybrid and remote work settings; 3) probing into their perspectives KS in the context of those settings; and 4) examining their perceptions regarding KP in those same settings. Following this, the script underwent a rigorous review process, encompassing content validation by two subject matter experts and face validation by a professional possessing the profile of the interviewees. The suggested modifications were duly incorporated into the instrument prior to commencing data collection.

The unit of analysis for this study encompasses the KS and KP practices among employees within information technology companies situated in Brazil. These companies are known for their intensive use of knowledge (Jackowska and Lauring, 2021), with effective communication recognized as a crucial determinant of their success (Ginting, 2020). This specific profile was chosen based on the sector's significant contribution to the Brazilian economy and the identified research gap concerning KP in the context of hybrid and remote work arrangements within IT companies.

The selection of interview participants adhered to the following criteria: a) having engaged in hybrid or remote work for at least 6 months, and b) being IT professionals employed by companies operating in Brazil. Invitations were extended via WhatsApp and email, where the interviewer introduced themselves and outlined the research objective. Data collection occurred during individual interviews, facilitated by Microsoft Teams®. Participants were requested to authorize recording, and subsequently, the interviews were transcribed to streamline the data analysis process. Table 1 provides an overview of the interviewees' characteristics.

Table 1: Characteristics of the interviewees

Work Setting	Code	Position	Gender	Age	Time in the Company	Time in the Position
Remote	E1	Software Engineer	Male	39	17	3
	E6	Software Engineer	Male	28	3	2
	E7	Head of Development	Female	50	4	2
	E11	Developer	Male	28	6	0.5
	E12	Specialist	Male	26	1.5	1
	E14	Product Manager	Male	39	11	3
	E15	Project Manager	Female	45	6	3
	E17	Head of Security	Male	47	2	2
	E19	Project Manager	Female	45	1.5	1.5
	E20	Test Analyst	Female	28	0.1	0.1
Hybrid	E2	Partner	Male	59	13	13
	E3	Director	Male	53	4	1
	E4	Partner	Male	24	1	1
	E5	Partner	Male	34	9	9
	E8	Partner	Male	23	2	2
	E9	Scrum Master	Female	36	0.1	0.1
	E10	HR Manager	Female	33	5	1.5
	E13	HR Manager	Female	35	0.5	0.5
	E16	Support Manager	Male	36	4	4
	E18	Financial Manager	Male	20	1	0.4

The initial phase of data analysis involved the authors reading through the 90 pages of interview transcriptions, during which they identified and emphasized the main ideas extracted from the interviews (Creswell, 2017). Subsequently, MAXQDA® software , designed for qualitative data analysis in academic research, was employed to conduct open and axial coding, allowing for the organization and categorization of data according to emergent themes and patterns.

4. Results and Discussion

4.1 Hybrid and Remote Working

For the employees engaged in hybrid work arrangements, there is no set standard mandating specific days and times for on-site attendance, as expressed by E6: "*I don't have a fixed day, our employment contracts allow us to decide the days we'll be present, right? So it could be Monday and Friday, it could be Tuesday and Thursday, it could be Wednesday and Thursday.*"

None of the remote workers reported a requirement for physical attendance at the company, with some residing in different cities from their workplace. Additionally, certain companies, as mentioned by E13, do not maintain physical office spaces.

The interviewees identified several benefits associated with hybrid and remote work, primarily emphasizing gains in productivity and better time management. Another notable advantage highlighted by the participants is the enhanced security provided by having the online meetings recorded.

The insights from the interviews prompt several considerations: 1) The absence of standardized days and times in hybrid work setups poses challenges for effective KS due to limited face-to-face interactions among employees; 2) In companies where some employees work remotely while others adopt hybrid or on-site arrangements, the situation may be exacerbated. Discrepancies in attendance could result in uneven KS, potentially leaving some individuals poorly informed. Conversely, a unified presence, such as everyone attending the office on the same day, might facilitate smoother KS. When nobody is physically present in the office, KS can be compromised due to a lack of opportunities for interaction. Although physical co-location does not guarantee effective KS, it does foster informal interactions (Hu *et al*., 2023) and contributes to trust-building (Testoni *et al*., 2022), both of underpin effective communication (Ng, 2022).

4.2 Differences in KS Between Hybrid and Remote Working

It is evident that structured processes and incentives for KS, such as training and mentoring, are in place across companies of varying sizes. However, there remains scope for improvement, as expressed by E17: "*More explicit, more documented knowledge exists within the company, but it is still a little immature.*"

Regarding the existence of differences in KS between hybrid or remote environments, three types of responses emerged:

a. KS is better and more effective in a face-to-face environment - 12 interviewees (60%);
b. KS is better in a remote environment - 5 interviewees (25%);
c. There is no difference in KS - 3 interviewees (15%).

Table 2 presents the KS mechanisms cited by the interviewees.

Table 2: KS mechanisms used by the Organisations

Interviewees	Work Setting	KS Mechanisms													Total
		A	B	C	D	E	F	G	H	I	J	K	L	M	
E2	Hybrid	X			X						X	X			4
E3					X				X		X	X	X		5
E4		X							X	X	X	X		X	6
E5		X			X	X		X			X	X	X	X	**8**
E8		X								X	X	X	X		5
E9		X		X	X	X	X			X	X	X		X	**9**
E10		X	X	X	X	X		X	X	X	X	X		X	**11**
E13		X	X	X	X	X		X	X	X	X	X	X	X	**12**
E16						X			X		X	X	X		5
E18						X				X		X		X	4
Total		**7**	2	3	6	6	1	3	5	6	**9**	**10**	5	6	69
E1	Remote	X	X	X	X	X			X			X		X	**8**
E6		X	X	X	X	X			X	X		X		X	**9**
E7		X	X	X	X	X		X		X		X		X	**9**
E11		X			X	X			X	X		X		X	7
E12		X	X		X				X	X		X		X	7
E14		X	X	X	X	X	X		X	X		X		X	**10**
E15		X			X			X	X			X		X	6
E17		X		X	X	X			X	X		X		X	**8**
E19		X	X		X	X	X		X	X		X		X	**9**
E20		X				X				X		X		X	5
Total		**10**	6	5	**9**	**8**	2	2	**8**	**8**	0	**10**	0	**10**	78

Legend: A = Technical Presentations; B = HR Presentations; C = Communities of Practice; D = Project Management; E = Intranet; F = Job Rotation; G = Mentoring; H = Platform; I = Social Networks; J = Face-to-face Meetings; K = Online Meetings; L = Face-to-face Training; M = Online Training.

KS mechanisms were identified, with an observation: in hybrid work settings, face-to-face interactions are predominantly adopted for KS, whereas in remote work settings, a wider array of mechanisms is employed, all of which are non-face-to-face.

Analysis of the interviewee reports reveals the presence of structured processes and incentives for KS across most companies, aligning with findings by Henttonen *et al*. (2016). Commonly mentioned KS mechanisms include online meetings, social networks, platforms, and online training, consistent with observations made by Delfino and Van Der Kolk (2021). While communities of practice, mentoring, and job rotation are recognized as effective mechanisms applicable to both hybrid and remote work, they were less frequently mentioned by the interviewees, possibly due to the additional time required for their adoption.

The number of KS mechanisms reported by the interviewees indicates that the quantity of different mechanisms is nearly identical, irrespective of the work setting.

4.3 Differences in KP Between Hybrid and Remote Working

The interviewees highlighted a variety of KP mechanisms employed in companies, encompassing both formal and informal approaches, as outlined in Table 3. As can be seen, certain mechanisms, such as passwords, are universally present across all cases, and others, like contracts, are employed in almost all instances.

Table 3: KP mechanisms used by the organisations

Interviewees	Work Setting	Formal Mechanisms													Informal Mechanisms		
		A	B	C	D	E	F	G	H	I	J	K	L	Total	M	N	Total
E2	Hybrid				X	X		X		X	X	X		6	X		1
E3				X	X			X	X	X				5	X		1
E4					X			X		X				3	X		1
E5					X			X		X	X			4	X		1
E8					X			X		X	X			4	X		1
E9			X	X	X		X	X		X	X	X	X	9			0
E10		X	X	X	X		X	X		X	X	X		9		X	1
E13		X	X	X	X		X	X	X	X	X			9		X	1
E16		X	X	X	X			X	X	X	X	X	X	10		X	1
E18			X	X	X		X	X		X			X	7	X		1
Total		**3**	**5**	**6**	**10**	**1**	**4**	**10**	**3**	**10**	**7**	**4**	**3**	**66**	**6**	**3**	**9**
E1	Remote		X	X	X	X	X	X	X	X		X	X	10		X	1
E6			X	X	X	X	X	X	X	X		X	X	10		X	1
E7				X	X		X	X	X	X		X	X	8	X		1
E11			X	X	X	X	X	X	X	X		X	X	10		X	1
E12			X	X	X		X	X		X		X		7		X	1
E14			X	X	X	X	X	X	X	X		X	X	10		X	1
E15			X	X	X	X	X	X	X	X		X	X	10		X	1
E17				X	X		X	X		X			X	6	X	X	2
E19				X	X	X	X	X	X	X		X	X	9			0
E20			X	X			X	X		X				5			0
Total		**0**	**7**	**10**	**9**	**6**	**10**	**10**	**7**	**10**	**0**	**8**	**8**	**85**	**2**	**7**	**9**

Legend: A = Restricted Physical Access; B = Restricted Digital Access; C = Contracts; D = Company devices; E = NDA; F = Policies; G = Passwords; H = Monitoring Software; I = Communication Software; J = Face-to-face Training; K = Online Training; L = VPN; M = Trust; N = Selection Process.

Overall, there appears to be little variation in the types of formal and informal mechanisms employed across companies, although some exceptions exist, particularly regarding strategies implemented when there is a critical need to safeguard specific knowledge assets. For instance, as reported by E13, "*There is contractual clause whereby, depending on the individual's knowledge level, the company pays for them to be retained on the payroll for about 3 months, akin to a quarantine period, even if they are no longer actively engaged in the company's operations, after which they are released.*"

According to the interviewees, the organizations largely rely on formal mechanisms, particularly technical ones such as passwords, digital access restrictions, and monitoring software, to protect their knowledge assets. In terms of informal mechanisms, companies rely on trust in their employees' discretion regarding the non-disclosure of the company's strategic knowledge. Additionally, meticulous attention is given to the selection processes, ensuring that recruited individuals possess the integrity and reliability necessary to safeguard the organization's proprietary information.

The interviewees indicated that their companies have implemented KP initiatives. As expressed by E16: "*So there are a series of mechanisms and processes to ensure KP for different actors involved in the processes*." Moreover, the majority of interviewees noted that there is no distinction between the KP measures implemented for hybrid and remote work setups.

It is evident that not all companies attribute KP the same level of priority. Some organizations permit employees to utilize their personal devices for work purposes, a practice that can pose significant risks to the company and potentially facilitate knowledge leakage, as noted by Abbas and Alghail (2023). Additionally, certain organizations treat KP as a mere procedural formality, limited to the implementation of basic measures such as passwords and access restrictions to specific sections of their platforms. However, they do not prioritize investments in employee training and awareness-raising initiatives regarding the importance of KP.

Although the interviewees may not perceive a difference between hybrid and remote work in terms of KP, disparities in the mechanisms employed do exist. Specifically, the number of KP mechanisms mentioned is 28% greater for remote work environments compared to hybrid setups.

5. Conclusions, Limitations and Future Research

In answering the stated research question, this study provides insights into the mechanisms utilized for KP and KS in IT companies based in Brazil operating remote or hybrid work arrangements. Most of the interviewees claimed that KS mechanisms were part of their daily routine, with online meetings, training sessions, and technical presentations featuring prominently. While few differences in KS mechanisms were reported between hybrid and remote work, most of the interviewees suggested KS was more effective in a face-to-face setting, suggesting that hybrid work, with a planned balance of in-office and remote work, may offer advantages over remote work alone. In terms of KP, a greater emphasis was placed on formal mechanisms such as passwords and communication software. Informal mechanisms, however, were less frequently mentioned, with trust in employees and careful selection processes being the primary focuses for some interviewees.

This study contributes theoretically by identifying the mechanisms employed by companies, as reported by the interviewees, for both KS and KP. It sheds light on the distinctions between remote and hybrid work environments, particularly noting a greater diversity of KP mechanisms in remote work settings. Furthermore, this research provides practical contributions by furnishing a comprehensive list of both KS and KP mechanisms. The recognition by a majority of interviewees that KS is more effective in hybrid work implies that organizations embracing remote work models must proactively motivate employees to engage in effective KS practices.

Several limitations should be acknowledged in this study. Firstly, the surveyed companies are all within the IT sector, and therefore, to a greater or lesser extent, incorporate some type of KP. Additionally, the fact that many the interviewees were still adapting to hybrid or remote working arrangements may introduce variability in perceptions over time and influence their experiences with these work environments.

Indeed, this topic presents several avenues for future research. Firstly, expanding this study to encompass other sectors of the economy. The comparative analysis could shed light on sector-specific nuances in communication, collaboration, and KP practices. Furthermore, future research could focus on the development of a comprehensive framework that integrates KS and KP mechanisms within organizations adopting hybrid or remote work models.

Acknowledgement

The authors are grateful for the support provided by CNPq (Conselho Nacional de Desenvolvimento Científico e Tecnológico – Brazil) and FCT – Fundação para a Ciência e Tecnologia (Portugal), national funding through research grant UIDB/04521/2020.

References

Abbas, M. and Alghail, A. (2023) “The impact of mobile shadow IT usage on knowledge protection: an exploratory study”. *VINE Journal of Information and Knowledge Management Systems*, 53(4), 830-848.

Beno, M. (2022) “Differences between managing face-to-display workers and in-house workers (hybrid work model): A qualitative study from Austria”. *Academic Journal of Interdisciplinary Studies*, 11(2), 30-40.

Bolisani, E., Paiola, M. and Scarso, E. (2013) “Knowledge protection in knowledge-intensive business services”. *Journal of Intellectual Capital*, 14(2), 192 – 211.

Borges, R., Bernardi, M. and Petrin, R. (2018) "Cross-country findings on tacit knowledge sharing: evidence from the Brazilian and Indonesian IT workers". *Journal of Knowledge Management*, 23(4), 742-762.

Chen, H., Nunes, M. B., Ragsdell, G. and An, X. (2018) "Extrinsic and intrinsic motivation for experience grounded tacit knowledge sharing in Chinese software organizations". *Journal of Knowledge Management*, 22(2), 478-498.

Creswell, J. W. (2017) "*Research Design*: Qualitative, Quantitative, and Mixed Methods Approaches". SAGE Publications.

Delfino, G. F. and Van Der Kolk, B. (2021) "Remote working, management control changes and employee responses during the COVID-19 crisis". *Accounting, Auditing & Accountability Journal*, 34(6), 1376-1387.

Fauzi, M. A., Nguyen, M. and Malik, A. (2023) "Knowledge sharing and theory of planned behavior: a bibliometric analysis". *Journal of Knowledge Management*, ahead-of-print, n. ahead-of-print.

Foege, J. N., Lauritzen, G. D., Tietze, F. and Salge, T. O. (2019) "Reconceptualizing the paradox of openness: How solvers navigate sharing-protecting tensions in crowdsourcing". *Research Policy*, 48(6), 1323-1339.

Ganguly, A., Joseph, J. M., Dutta, S. and Dey, K. (2022) "Exploring the Employer–Employee Relationship: A Management Versus Employee Perspective of the Vicissitudes in the Virtual Workplace". *Global Business Review*, 0(0).

Gast, J., Gundolf, K., Harms, R. and Collado, E. M. (2019) "Knowledge management and coopetition: How do cooperating competitors balance the needs to share and protect their knowledge"? *Industrial Marketing Management*, 77, 65-74.

Ginting, Y. M. (2020) "Intellectual Capital Investigation in Achieving Sustainable Competitive Advantages in the Creative Industry: Does the Mediation of Knowledge Management System Affect"? *Journal of Management Information and Decision Sciences*, 23(2), 111-126.

Guo, W., Yang, J., LIband, D. and Lyu, C. (2020) "Knowledge sharing and knowledge protection in strategic alliances: the effects of trust and formal contracts". *Technology Analysis & Strategic Management*, 32(11), 1366-1378.

Henttonen, K., Hurmelinna-Laukkanen, P. and Ritala, P. (2016) "Managing the appropriability of R&D collaboration". *R&D Management*, 46(S1), 145-158.

Hu, J., Hu, D., Yang, X. and Chau, M. (2023) "The impacts of lockdown on open source software contributions during the COVID-19 pandemic". *Research Policy*, 52(10), 104885, 2023.

Hurmelinna-Laukkanen, P. and Puumalainen, K. (2007) "Nature and dynamics of appropriability: strategies for appropriating returns on innovation". *R&D Management*, 37(2), 95-112.

Jackowska, M. and Lauring, J. (2021) "What are the effects of working away from the workplace compared to using technology while being at the workplace? Assessing work context and personal context in a global virtual setting". *Journal of International Management*, 27(1), p. 100826.

Joe, C., Yoong, P. and Patel, K. (2013) "Knowledge loss when older experts leave knowledge-intensive organizations". *Journal of Knowledge Management*, 17(6), 913-927.

Kaiser, S., Suess, S., Cohen, R., Mikkelsen, E. N. and Pedersen, A. R. (2022) "Working from home: Findings and prospects for further research". *German Journal of Human Resource Management*, 36(3), 205-212, 2022.

Le, P. B. and Lei, H. (2018) "The mediating role of trust in stimulating the relationship between transformational leadership and knowledge sharing processes". *Journal of Knowledge Management*, 22(3), 521-537.

Ng, K. Y. N. (2022) "Effects of organizational culture, affective commitment and trust on knowledge-sharing tendency". *Journal of Knowledge Management*, 27(4), 1140-1164.

Nguyen, J. H., Pham, P. and Qiu, B. (2023) "Proprietary knowledge protection and product market performance". *Journal of Financial and Quantitative Analysis*, 58(8), 3521-3546.

Olander, H. (2011) "Formal and informal mechanisms for knowledge protection and sharing". *Acta Universitatis Lappeenrantaensis*, v. 52(2), 207–229.

Olander, H., Hurmelinna-Laukkanen, P. and Vanhala, M. (2014) "Mission: Possible but sensitive—Knowledge protection mechanisms serving different purposes". *International Journal of Innovation Management*, 18(6), 207-229.

Oorschot, K. E. V., Solli-Saether, H. and Karlsen, J. T. (2018) "The knowledge protection paradox: imitation and innovation through knowledge sharing". *International Journal of Technology Management*, 78(4), 310-342.

Ritala, P., Olander, H., Michailova, S. and Husted, K. (2015) "Knowledge sharing, knowledge leaking and relative innovation performance: An empirical study". *Technovation*, 35, 22-31.

Saunders, M., Lewis, P. and Thornhill, A. (2009) "*Research Methods for Business Students"*. 7th Edition, Pearson.

Singh, S. K., Gupta, S., Busso, D. and Kamboj, S. (2021) "Top management knowledge value, knowledge sharing practices, open innovation and organizational performance". *Journal of Business Research*, 128, 788-798.

Testoni, M., Sakakibara, M. and Chen, M. K. (2022) "Face-to-face interactions and the returns to acquisitions: Evidence from smartphone geolocational data". *Strategic Management Journal*, 43(13), 2669-2702.

Thalmann, S., Maier, R., Remus, U. and Manhart, M. (2024) "Connect with care: informal knowledge protection practices to enhance knowledge sharing in networks of organizations". *VINE Journal of Information and Knowledge Management Systems*, ahead-of-print.

Yang, L., Holtz, D., Jaffe, S., Suri, S., Sinha, S., Weston, J., Joyce, C., Shah, N., Sherman, K., Hecht, B. and Teevan, J. (2022) "The effects of remote work on collaboration among information workers". *Nature Human Behaviour*, 6(1), 43-54.

Yap, J. B. H. and Lock, A. (2017) "Analysing the benefits, techniques, tools and challenges of knowledge management practices in the Malaysian construction SMEs". *Journal of Engineering, Design and Technology*, 15(6), 803-825.

Evaluating Digital Intelligence on Growth Mindset Focus: Q-Methodology Study on Students' Openness

Eszter Bogdány, Krisztina Kiglics and Nóra Obermayer
University of Pannonia, Department of Management, Veszprém, Hungary

bogdany.eszter@gtk.uni-pannon.hu
kiglics.krisztina@uni-pannon.hu
obermayer.nora@gtk.uni-pannon.hu

Abstract: Global competitiveness emphasizes that nations with digitally literate and adaptable populations are likely to be more competitive in the global economy. In the contemporary global landscape, technology plays a pivotal role in economic growth, innovation, and competitiveness. Nations that prioritize the development of digital skills and foster a growth mindset among their populations are better positioned to thrive in the digital age. Moreover as technology continues to evolve, there is a need to understand how individuals integrate and adapt to new digital tools. Another significant aspect is that higher educational institutions can play a crucial role to ensure that graduates are well-prepared to meet the complex requirements of the new digital world. The aim of the research is to explore university students' digital intelligence (DQ) levels from the view of growth mindset. More specifically, understanding how the mindset of students contributes to their openness related to developing the different levels of DQ. The research applied Q-methodology, that allows to capture the diverse perspectives of students, providing a nuanced understanding of their openness to DQ maturity. Different individuals have distinct views on how it relates to a growth mindset, and the strategies they believe are effective for developing digital skills. Findings from this research offer implications for educational policies and curriculum development, ensuring that educational institutions are preparing students for the challenges and opportunities presented by the digital landscape. Moreover it allows educators to tailor teaching methods and curriculum design to enhance students' digital literacy and adaptability. It provides insights into the psychological and behavioral aspects of learning in a digital context. From a theoretical aspect the study contributes to understanding the cognitive processes involved in students' decision-making and attitudes towards different levels of DQ, considering the phenomenon of growth mindset.

Keywords: Digital Intelligence, Growth Mindset, Q-Methodology Study, Students' Openness

1. Introduction

Digital Intelligence (DQ) is crucial for global competitiveness, driving economic success in the digital age (Manasia, Pârvan & Ianos, 2018). Embracing a growth mindset is essential for individuals to adapt to the evolving digital landscape and continuously develop their DQ (Zhang, 2023). DQ encompasses a broad range of digital competencies rooted in universal moral values, empowering individuals to use, control, and innovate with technology (Park & Gentile, 2019). It is a lifelong journey of learning and adaptation, requiring a commitment to continuous improvement (Pornpongtechavanich & Wannapiroon, 2021; Zhang & Farooq, 2021). By investing in digital literacy and skills development, countries can drive sustainable growth, prosperity, and inclusive development (Sharma et al, 2016).

The rationale for exploring university students' DQ from a growth mindset perspective is multifaceted, aiming to enhance learning outcomes, address digital skills gaps, promote lifelong learning habits, prepare students for future success, and optimize educational interventions. Furthermore, the application of Q-methodology in this research could provide a valuable approach by capturing diverse perspectives, exploring subjectivity, identifying contrasting views, and thereby informing educational practice and policy to better support students in acquiring the digital skills needed to thrive in today's digital age.

Therefore, the aim of the research is to explore the diverse perspectives behind students' DQ levels in the context of growth mindset. More specifically, the aim is to investigate different perspective groups regarding how students perceive various elements of DQ in relation to their own developmental aspirations.

The following research question was formulated based on the aim:

RQ1. What are the different perspective groups among university students regarding their beliefs about the potential for growth and improvement in DQ?

This aim aligns well with the principles of growth mindset theory (Dweck, 1999), which emphasizes the importance of effort, perseverance, and a belief in the potential for growth and improvement. By exploring this, the research has the potential to provide a more nuanced understanding of the complex interplay between growth mindset and DQ levels.

This research not only contributes theoretically but also raises awareness among students about essential competencies for successful navigation in the digital realm. Participation offers students insights into areas for improvement, enhancing their understanding of strengths and weaknesses in terms of Digital Intelligence (DQ). It also highlights the significance of achieving higher DQ levels, guiding the design of educational programs tailored to students' developmental needs and expectations in the digital domain. This research covers the conceptualization of DQ and growth mindset, their relationship, and prior studies in higher education (Section 2), followed by methodology explanation (Section 3) and results analysis (Section 4). Finally, it discusses educational implications and future directions (Section 5).

2. Literature Review

2.1 Conceptualization of DQ and Growth Mindset

As the above mentioned definition explains, DQ encompasses a wide range of digital competencies grounded in fundamental moral values. It empowers individuals to effectively utilize, manage, and innovate with technology to drive human progress (Park & Gentile, 2019). The holistic conceptualization of DQ recognizes the importance of equipping individuals with the skills and mindset needed to thrive in an increasingly digital world. According to DQ Institute DQ is characterized as a holistic collection of technical, cognitive, meta-cognitive, and socio-emotional proficiencies deeply rooted in universal moral principles. These proficiencies empower individuals to confront the complexities and capitalize on the advantages presented by digital environments (Park, 2023). The formulation of the DQ framework (developed by DQ Institute) was guided by the transformative impact of technology on our social and professional interactions, prompting the incorporation of cognitive abilities alongside technical skills to effectively navigate interpersonal dynamics, conflicts, and negotiations (Park & Gentile, 2019). This DQ framework encompasses eight key domains, each comprising competencies delineated across three proficiency levels. By categorizing DQ into three maturity levels—digital citizenship, digital creativity, and digital competitiveness—a comprehensive understanding of digital capabilities is facilitated. Aligned with these DQ levels are the delineated eight areas, yielding a total of twenty-four competencies. These areas and competencies facilitate tailored learning experiences that address the immediate relevance of various aspects of individuals' lives (Park & Gentile, 2019). Moreover, the components of DQ according to the definition contain several factors. DQ encompasses various types of competences that individuals need to navigate effectively in a digital environment. This includes knowledge elements (e.g. digital literacy or knowledge about digital security (Dostal et al, 2017)), skills and abilities (e.g. operational, informational, strategic and digital fluency (Cismaru et al, 2018)) and values or attitude elements (e.g. a disposition, a mindset to act (Vuorikari, Kluzer & Punie, 2022)). Moreover, DQ is a complex phenomenon that is based on universal moral values such as honesty, integrity, respect, empathy, and responsibility, and these values serve as guiding principles for ethical behavior and decision-making in digital spaces (Park & Gentile, 2019). DQ equips individuals with the capabilities to address the diverse challenges they encounter in digital life such as cyberbullying, online privacy and security risks, misinformation, digital addiction, and digital divide, among others (Park, 2023). Beyond managing challenges, DQ enables individuals to leverage the myriad opportunities presented by digital technologies such as using digital tools for learning, communication, collaboration and so on (Avci & Adiguzel, 2020). Both DQ and the growth mindset advocate for a holistic approach to personal development, recognizing the interconnectedness of technical, cognitive, and socio-emotional competencies in navigating digital environments.

The concepts of fixed and growth mindset introduced by Dweck (2008) describe variations in individuals' beliefs regarding "the potential for change in fundamental personal attributes like intelligence or abilities, leading to distinct patterns of judgment and response across various tasks and contexts" (Solberg et al., 2020, p. 108). Believing in the potential for growth, adaptability, and the capacity to learn from experiences characterizes a growth mindset, while attributing personal traits to fixed qualities defines a fixed mindset (Dweck, 2008), and these outlooks significantly impact individuals' behaviors and ultimately influence their accomplishments. Masters (2014) demonstrated that a growth mindset correlates with positive learning behaviors among students, while Claro, Paunesku & Dweck (2016) enhances the impact on academic performance and fosters resilience in the face of academic setbacks (Dweck, 2000).

Summarizing the above mentioned concept, we conclude that the holistic conceptualization of DQ emphasizes a wide array of technical, cognitive, and socio-emotional competencies rooted in universal moral values, empowering individuals to navigate digital environments effectively, while the principles of a growth mindset,

which prioritize adaptability and learning from experiences, intersect with DQ, contributing to positive learning behaviors and academic performance among students.

2.2 The Link Between DQ and Growth Mindset, and Prior Researches in Higher Educational Settings

The intersection of DQ and growth mindset is evident in various aspects. Research by Dweck (2000) illustrates how individuals' mindsets, particularly in educational and professional settings, influence their adaptability and willingness to embrace change. The coexistence of physical and cyber space has given rise to a new mindset, particularly among younger generations immersed in digital technologies (Kineshanko & Jugdev, 2018) moreover the exploration of how digital learning contributes to the development of DQ. Santos et al (2017) emphasize the increasing importance of digital competencies in the context of the Fourth Industrial Revolution, highlighting the need for individuals to navigate the digital landscape effectively. Central to this discussion is the notion of being a changemaker in the digital environment, where organizational policies play a crucial role in delineating boundaries between personal, professional, and public communication (Banghart, Etter & Stohl, 2018). The growing demand for DQ, driven by economic imperatives and competitive pressures, underscores the significance of lifelong learning initiatives that address evolving market demands (Curran, Garrett & Puthiyamadam, 2017). However, criticisms have been levied against educational institutions for prioritizing market-driven skills development over holistic personal growth and community-building (Conley & Rauth, 2020; Barnett, 2007).

The research of Loble, Greenaune & Hayes (2017) underscores the importance of students' ability to perceive challenges and failures as opportunities for growth rather than obstacles. Embracing learning as a lifelong journey, with perseverance and a willingness to take intellectual risks, is crucial for success in the evolving digital world. A supportive ecosystem comprising physical and emotional well-being, access to technology, and a growth mindset is essential for effective technology utilization among students (Thomas et al., 2024). This highlights the significance of fostering not only technical skills but also a resilient and adaptable mindset to navigate the complexities of the digital age. Moreover, as advanced technologies reshape the landscape of the workplace, there is a growing demand for individuals, teams, and organizations to embrace adaptability and resilience (Trenerry et al., 2021). Programs and training aimed at cultivating workplace resilience and fostering a mindset shift towards adaptability are essential in the face of ongoing digital disruptions.

Lastly, individual attitudes and mindsets toward job roles and professional development play a crucial role in building resilience during challenging times (Cameron and Brownie, 2010).

This highlights the need for a balanced approach that not only equips individuals with technical skills but also fosters psychological development and creates supportive learning communities. In essence, the convergence of DQ and growth mindset underscores the importance of adaptable, resilient individuals who are capable of thriving in an ever-evolving digital landscape while also nurturing their personal and professional development.

3. Methodology

Q-methodology, renowned for its blend of quantitative and qualitative analyses, is a robust research approach used across various fields to explore competencies and attitudes (Watts & Stenner, 2012). By employing factor analysis, it unveils distinct viewpoints on a topic, as observed in studies spanning nurse education, critical thinking, teacher evaluation, and HRM competency rating (Hensel et al., 2022; Gyenes, 2021; Bogdány, Cserháti, Raffay-Danyi, 2023). While ensuring consistency across samples, its focus on qualitative evidence limits generalizability (Thomas & Baas, 1992). Despite its time-consuming nature, Q-methodology offers valuable insights and aids informed decision-making in higher education settings by aligning curricula with evolving labor market demands (Aldamen et al, 2021). Thus, it serves as a potent tool for identifying and prioritizing competencies crucial for navigating the digital world effectively (Morea, 2022).

The participant selection and recruitment procedures involved targeting higher educational students in their last semester of study. The choice of students in their final semester was deliberate, as this group is poised to transition from academia to the professional world, making their perspectives particularly relevant for understanding developmental aspirations. Participants were selected using purposive sampling, a common approach in Q-methodology (Atwal & Caldwell, 2005), which focuses on selecting individuals who can provide articulate viewpoints on the topic of interest. Specifically, students were chosen based on their ability to articulate their viewpoints on digital quotient (DQ) elements and their relevance to future career aspirations and educational goals. A total of 51 full-time students from the Faculty of Business and Economics were invited

to participate in the survey, of which 46 provided assessable responses (Table 1 present the main characteristics of the sample). This sample size aligns with typical Q-methodology studies, which generally include around 40-60 participants. The rationale for this range is rooted in the methodology's use of inverted factor analysis, which does not aim for generalization to a larger population but rather seeks to identify and analyze distinct viewpoints within a specific group.

Table 1: Sample characteristics

Gender			Age			Age when you started using an electronic device	
	N	Percent		N	Percent		
man	11	23,91%	18 - 20	4	8,70%	Mean	9,91
woman	35	76,09%	21 - 23	33	71,74%	St. Deviation	2,67
Total	46	100,00%	24 - 26	7	15,22%	Median	10
			27 -	2	4,35%		
			Total	46	100,00%		

The survey was administered during a scheduled lesson, facilitating convenient data collection. The survey included elements for ranking DQ elements in the light of developmental aspirations. By focusing on students nearing the completion of their academic programs, the study aimed to capture insights into how these individuals perceive DQ in relation to their future career aspirations and educational goals. By capturing their perspectives during this critical phase, the study provides valuable insights into how students nearing graduation view DQ elements, which can inform educational strategies and career readiness programs.

The following steps of Q-methodology were applied during the research (Table 2).

Table 2: Stages of applied Q-methodology

Stages	Description	Output
Development of concourse	Compilation of Q-sample: compilation of the statements of DQ elements' based on the integration of knowledge, skill, attitude and examples of DQ Institute's DQ Framework and DigComp 2.2 regarding to growth mindset	Q-set: 24 different statements in the light of growth mindset
Selection of P-Sample	Full-time higher educational students in their last semester of study were selected	P-Set: 51 students
The establishment of Q-sorts	Ranking procedure whereby students were asked to rank Q-set according to growth mindset	46 individual Q-sorts
The standard analytical process - Factor analysis	Using PQMethod software Centroid factor analysis, and Varimax Rotation: identifying distinct perspectives, exploring the underlying beliefs or attitudes within each perspective,	3 emergent factor
The interpretation of factors and results	Interpreting the factors, distinguished statements, and Z-score values to gain a deeper understanding of the different perspectives represented in the data. Discussing the implications of findings and how they contribute to the overall understanding of the research topic.	Research proposals, implications

The DQ ranking survey comprised a list of DQ elements derived from several sources. The DQ elements were developed based on established frameworks such as the DQ Institute and DigComp 2.2 (Digital Competence Framework). These frameworks provided comprehensive guidelines and standards for digital competence, encompassing a wide range of knowledge, skills, and attitudes. Each DQ element was accompanied by a coherent definition that clearly delineated its components. Definitions were structured to encompass knowledge, skills, and attitudes, ensuring a holistic understanding of each element. This approach allowed participants to evaluate DQ elements comprehensively and accurately. To provide context and clarity, examples were included for each DQ element. These examples illustrated how the knowledge, skills, and attitudes associated with each element might manifest in real-world scenarios. By incorporating examples, participants were better able to understand the practical implications of each DQ element and make informed judgments during the ranking process.

Participants were asked to rank DQ elements based on the prompt: "I'm willing to look to develop myself in the following areas by the right investment of time and energy...". Participants were instructed to rank the DQ

elements according to their perceived relevance, providing quantitative data on their preferences in DQ development.

Due to the extensive nature of the questionnaire, administered through the Q-methodology ranking method, and the intricate interconnections among DQ elements, completing the survey necessitated careful deliberation. Respondents followed predefined steps outlined by Watts and Strenner (2012), to complete the ranking process, resulting in individual Q-sorts reflecting participants' unique perspectives.

4. Results

After considering the different factor solutions, 3 factors emerged, whereby the average squared residual correlation was 0.036. Table 3 displays the different correlations between factor scores, the number of participants in each group and the reliability of the construct.

Table 3: Correlation between factor scores, the number of participants in each group and reliability

Factors	1	2	3
1	1.0000	0.0855	-0.1412
2	0.0855	1.0000	0.1983
3	-0.1412	0.1983	1.0000
No. of defining variables (participants in the group)	15	14	10
Composite reliability	0.984	0.982	0.976

Drawing from the provided approach, it was found that 7 students remained unclassified, while 39 participants were successfully categorized into distinct groups. The composite reliability of Q-sort items played a pivotal role in determining the reliability of factors. The study identified three discernible factors, each exhibiting composite reliability values ranging from 0.976 to 0.984, signifying a high level of consistency and reliability in the instrument employed, albeit with an emphasis on participants' subjectivity in Q-methodology. The interpretation of emergent factors was guided by the unique sets of perspectives associated with factor scores.

In the subsequent section, emergent factors were interpreted based on the distinctive perspectives of respondents regarding their growth mindset towards DQ elements (as presented in Table 4). Subsequently, significant distinguishing and consensus statements were elucidated.

Table 4: Factor scores with corresponding ranks and significantly distinguishing statements

	Factor 1		Factor 2		Factor 3	
	Z-SCR	Rank	Z-SCR	Rank	Z-SCR	Rank
Digital Citizen Identity	-0.04**	12	-0.82**	20	-1.60**	23
Balanced Use of Technology	1.44	2	0.38**	8	1.68	1
Behavioural Cyber-Risk Management	-1.09*	21	-0.41	18	-0.63	18
Personal Cyber Security Management	-1.11**	22	1.46	4	1.20	4
Digital Empathy	1.26**	5	0.57**	7	-1.33**	21
Digital Footprint Management	-0.77**	17	-1.24**	22	0.51**	9
Media and Information Literacy	1.57	1	-0.13**	11	1.27	3
Privacy Management	-0.10**	14	1.74**	1	0.76**	6
Digital Co-Creator Identity	0.11*	10	-0.36	17	-0.55	17
Healthy Use of Technology	1.41	3	1.72	2	0.39**	11
Content Cyber-Risk Management	-0.79*	18	-0.34*	16	0.25**	12
Network Security Management	-1.27**	23	1.55**	2	0.45**	10
Self-Awareness and Management	1.21**	6	-0.28*	15	-0.79*	19
Online Communication and Collaboration	0.84	7	0.71	6	0.17**	13
Content Creation and Computational Literacy	-0.60**	15	-1.92**	24	0.56**	7
Intellectual Property Rights Management	-1.03**	20	-0.20**	12	0.52**	8
Digital Changemaker Identity	0.22*	9	-0.20*	13	0.88**	5
Civic Use of Technology	0.01	11	-0.23	14	-1.92**	24
Commercial and Community Cyber-Risk Management	-0.84*	19	0.84**	5	-0.35*	16
Organisational Cyber Security Management	-1.61**	24	0.27	10	-0.10	15
Relationship Management	1.38**	4	0.29**	9	-1.53**	22
Public and Mass Communication	0.55**	8	-1.50*	23	-1.02*	20
Data and AI Literacy	-0.70	16	-0.73	19	1.27**	2
Participatory Rights Management	-0.05	13	-1.15**	21	-0.09	14

Label: (Z-SCR) Z Score Value, (*) P<0.0.5, (**) P<0.01)

Factor_1: This group of respondents emphasizes digital interactions, valuing not only technical proficiency but also social and ethical considerations. They prioritize elements such as Digital Empathy, Self-Awareness and Management, and Relationship Management, indicating a focus on social responsibility and effective communication. Distinguished statements highlight the importance of these elements in fulfilling the respondents' developmental aspirations. The distinguished statements, identified by their Z-score values, further elucidate the importance of certain DQ elements within factor_1. Notably, Digital Empathy, Self-Awareness and Management, Relationship Management, and Public and Mass Communication emerge as particularly salient DQ elements, indicating their alignment with the developmental aspirations of the respondents. Conversely, statements related to aspects such as Organizational Cyber Security Management and Network Security Management exhibit lower Z-score values, suggesting their relatively lower importance in fulfilling the respondents' developmental aspirations within the digital landscape.

Factor_2: Students in this factor prioritize security and responsible digital behavior, as evidenced by their emphasis on elements such as Privacy Management and Personal Cyber Security Management. They also value elements related to social intelligence, such as Digital Empathy and Relationship Management. The distinguished statements further underscore the significance of privacy and security in fulfilling students' developmental aspirations. The distinguished statements further elucidate the significance of certain DQ elements within the respondents' perceptions. Privacy Management, Network Security Management, and Public and Mass Communication emerge as particularly salient DQ elements, indicating their importance in fulfilling students' developmental aspirations. Conversely, elements such as Digital Footprint Management and Content Creation and Computational Literacy exhibit lower Z-score values, suggesting their relatively lower importance within the respondents' perceptions.

Factor_3: This group of students demonstrates a diverse range of competencies and skills related to digital literacy, security, creativity, and social impact. They prioritize elements such as Media and Information Literacy, Data and AI Literacy, and Digital Changemaker Identity, indicating a desire for proficiency in navigating digital content and making a positive impact in the digital realm. Distinguished statements highlight the importance of privacy, data literacy, and social impact in fulfilling students' developmental aspirations. The distinguished statements, identified by their Z-score values, further elucidate the significance of certain DQ elements within the respondents' perceptions. Notably, Privacy Management, Data and AI Literacy, and Digital Changemaker Identity emerge as particularly salient DQ elements, indicating their importance in fulfilling students' developmental aspirations. Conversely, statements related to aspects such as Civic Use of Technology and Relationship Management exhibit lower Z-score values, suggesting their relatively lower importance within the respondents' perceptions.

Answering to the RQ1. (What are the different perspective groups among university students regarding their beliefs about the potential for growth and improvement in DQ?), the findings suggest that students' perceptions of DQ vary based on their developmental aspirations, with some prioritizing social responsibility and effective communication, others focusing on security and responsible digital behavior, and still others valuing proficiency in digital literacy, creativity, and social impact.

5. Discussion

The literature underscores the significance of Digital Intelligence (DQ) in global competitiveness and individual development, with results revealing how individual mindset differences influence various DQ contexts (Manasia, Pârvan & Ianos, 2018; Sharma et al., 2016; Park & Gentile, 2019; Park, 2023). The three factors elucidate diverse perspectives on DQ, reflecting respondents' developmental aspirations ranging from social impact to security to creativity. Understanding these factors informs educational strategies catering to students' varying developmental priorities in the digital age (Park & Gentile, 2019; Park, 2023; Avci & Adiguzel, 2020). Factor 1 prioritizes a balanced approach, emphasizing digital co-creation and social impact, while Factor 2 focuses on security and responsible behavior. Factor 3 encompasses a multifaceted understanding, emphasizing critical thinking, creativity, and ethical considerations, highlighting the complex nature of DQ (Park & Gentile, 2019; Park, 2023). These insights underscore the importance of tailored educational interventions addressing diverse developmental aspirations and priorities in the digital landscape.

By tailoring programs to address specific areas highlighted by factors, such as social responsibility, cybersecurity, and creativity, universities can promote holistic DQ development (Dostal et al, 2017; Park & Gentile, 2019; Park, 2023). Initiatives should focus on enhancing skills in privacy management, content creation, and problem-solving to empower students in digital environments (Zhang, 2023). Practical implications suggest targeting

interventions based on identified proficiency gaps and fostering a culture of lifelong learning (factor_1, factor_2, factor_3). Theoretical contributions lie in integrating DQ with growth mindset, offering insights into how beliefs about growth influence digital skills development, and providing a foundation for further research (Zhang, 2023). This study highlights the importance of tailored educational interventions and the dynamic interplay between DQ and growth mindset, advancing theoretical discourse and informing future research directions.

6. Conclusion

In conclusion, our research findings shed light on the diverse perspectives among university students regarding their beliefs about the potential for growth and improvement in DQ. Factor_1 respondents prioritize digital interactions, emphasizing not only technical proficiency but also social and ethical considerations. Elements such as Digital Empathy, Self-Awareness and Management, and Relationship Management are deemed particularly salient, reflecting a focus on social responsibility and effective communication. Conversely, Factor_2 students prioritize security and responsible digital behavior, with Privacy Management and Personal Cyber Security Management taking precedence. Factor_3 students demonstrate a diverse range of competencies, prioritizing elements such as Media and Information Literacy and Data and AI Literacy, indicative of a desire for proficiency in navigating digital content and making a positive impact in the digital realm.

These findings underscore the importance of considering students' developmental aspirations in understanding their perceptions of DQ and growth mindset. By recognizing these diverse perspectives, educational interventions and policies can be tailored to better support students in acquiring the digital skills needed to thrive in today's digital age. Further research should explore the interplay between growth mindset and DQ to develop more targeted curriculum development strategies and educational interventions aimed at fostering a growth mindset and enhancing DQ maturity among students.

Acknowledgements

Prepared in the "National Laboratory for Social Innovation" project (RRF-2.3.1-21-2022-00013), within the framework of the Széchenyi Plan Plusz program, with the support of the Recovery and Resilience Instrument of the European Union.

References

Aldamen, H., Alkhateeb, H., Kercher, K., Duncan, K., and Hollindale, J. (2021) “Core competencies for the global workplace: A cross-cultural and skill-based simulation project in accounting.” *Accounting Education*, 30(4): pp 385–412. https://doi.org/10.1080/09639284.2021.1906719

Atwal, A., & Caldwell, K. (2005). Do all health and social care professionals interact equally: a study of interactions in multidisciplinary teams in the United Kingdom. Scandinavian journal of caring sciences, 19(3), 268-273. https://doi.org/10.1111/j.1471-6712.2005.00338.x

Avci, H., & Adiguzel, T. (2020) *Leveraging Digital Intelligence in Generation Alpha.* The Teacher of Generation Alpha, Wien.

Banghart, S., Etter, M., and Stohl, C. (2018) “Organizational boundary regulation through social media policies.” *Management Communication Quarterly*, 32(3), pp 337-373.

Barnett, R. (2007) *Will to Learn: Being a Student In an Age of Uncertainty.* McGraw Hill Education.

Bogdány, E., Cserháti, G., and Raffay -Danyi, Á. (2023) “A proposed methodology for mapping and ranking competencies that HRM graduates need.” *The International Journal of Management Education*, 21(2): 100789. https://doi.org/10.1016/j.ijme.2023.100789

Cameron, F., and Brownie, S. (2010) “Enhancing resilience in registered aged care nurses.” *Australas. J. Ageing* 29, pp 66–71. doi: 10.1111/j.1741-6612.2009.00416.x

Cismaru, D.-M., Gazzola, P., Ciochina, R. S., and Leovaridis, C. (2018) “The rise of digital intelligence: challenges for public relations education and practices.” *Kybernetes*, 47(10): pp 1924–1940. https://doi.org/ 10.1108/k-03-2018-0145.

Claro, S., Paunesku, D., & Dweck, C. S. (2016) “Growth mindset tempers the effects of poverty on academic achievement.” Proceedings of the National Academy of Sciences, 113(31), pp 8664–8668.

Conley, C. and Rauth, I. (2020). *The emergence of long life learning.* Modern Elder Academy White Paper.

Curran, C., Garrett, D., and Puthiyamadam, T. (2017) “A decade of digital. Keeping pace with transformation.” Global Digital IQ® Survey: 10th anniversary edition. PWC

Dostal, J., Wang, X., Steingartner, W., and Nuangchalerm, P. (2017) “Digital intelligence - new concept in context of future of school education.” In ICERI2017 Proceedings, 10th annual International Conference of Education, Research and Innovation, pages 3706–3712. IATED. https://doi.org/10.21125/iceri.2017.0997

Dweck, C. S. (1999) Self-theories: *Their role in motivation, personality, and development.* Philadelphia: Psychology Press.

Dweck, C. S. (2000). *Self-theories: Their role in motivation, personality and development.* Psychology Press, New York. https://doi.org/10.4324/9781315783048

Dweck, C. S. (2008) *Mindset: The new psychology of success*. Random House.
Gyenes, A. (2021) "Student perceptions of critical thinking in EMI programs at Japanese universities: A Q-methodology study." *Journal of English for Academic Purposes*, 54(February): 101053. https://doi.org/10.1016/j.jeap.2021.101053
Hensel, D., Toronto, C., Lawless, J., and Burgess, J. (2022) *A scoping review of Q methodology nursing education studies.* Nurse Education Today, 109: 105220. https://doi.org/10.1016/j.nedt.2021.105220
Kineshanko, M.K. and Jugdev, K. (2018) *Enhancing Digital Intelligence Through Communities of Learning*. In: Khare, A., Hurst, D. (eds) On the Line. Springer, Cham. https://doi.org/10.1007/978-3-319-62776-2_10
Loble, L., Greenaune, T., and Hayes, J. (2017) *Future Frontiers—Education for an AI World.* Melbourne, Victoria, Melbourne University Press in association with NSW Department of Education
Manasia, L., Pârvan, A., and Ianos, G. (2018) "Memories from the future. Is digital intelligence what matters in the forthcoming society?" In EDULEARN18 Proceedings, pp 7899-7906
Masters, G. N. (2014) "Towards a growth mindset in assessment." *Practically Primary*, 19(2), pp 4–7.
Morea, N. (2022) "Investigating change in subjectivity: The analysis of Q-sorts in longitudinal research"*Research Methods in Applied Linguistics*, 1 (3), 10.1016/j.rmal.2022.100025
Park, Y (2023) "DQ Global Standards Microcredentials (GSM): A Global Interoperable Codification of Digital Skills for AI and Sustainability." DQ Institute
Park, Y. and Gentile, D. (2019) "DQ global standards report 2019: Common framework for digital literacy, skills and readiness." DQ Institute.
Pornpongtechavanich, P., & Wannapiroon, P. (2021) "Intelligent interactive learning platform for seamless learning ecosystem to enhance digital citizenship's lifelong learning." *International Journal of Emerging Technologies in Learning (IJET)*, 16(14), pp 232-248.
Santos, C., Mehrsai, A., Barros, A. C., Araújo, M., and Ares, E. (2017) "Towards Industry 4.0: an overview of European strategic roadmaps." *Procedia manufacturing*, 13, pp 972-979.
Sharma, R., Fantin, A. R., Prabhu, N., Guan, C., and Dattakumar, A. (2016) "Digital literacy and knowledge societies: A grounded theory investigation of sustainable development." *Telecommunications Policy*, 40(7), pp 628-643.
Solberg, E., Traavik, L. E., and Wong, S. I. (2020) "Digital mindsets: Recognizing and leveraging individual beliefs for digital transformation." *California management review*, 62(4), pp 105-124.
Thomas, D. D., and Baas, L. R. (1992) "The issue of generalization in Q methodology: "Reliable Schematics" revisited." *Operant Subjectivity*, 16, 18–36. https://doi.org/10.15133/j.os.1992.014.
Thomas, D. R., Lin, J., Gatz, E., Gurung, A., Gupta, S., Norberg, K., Fancsali, S.E., Aleven, V., Branstetter, L., Brunskill, E. and Koedinger, K. R. (2024) "Improving Student Learning with Hybrid Human-AI Tutoring: A Three-Study Quasi-Experimental Investigation." In The 14th Learning Analytics and Knowledge Conference (LAK '24), March 18–22, 2024, Kyoto, Japan. ACM, New York, NY, USA, 17 pages. https://doi.org/10.1145/3636555.3636896
Trenerry, B., Chng, S., Wang, Y., Suhaila, Z. S., Lim, S. S., Lu, H. Y., and Oh, P. H. (2021) "Preparing workplaces for digital transformation: An integrative review and framework of multi-level factors." *Frontiers in psychology*, 12, 620766.
Vuorikari, R., Kluzer, S. and Punie, Y., (2022) DigComp 2.2: The Digital Competence Framework for Citizens, EUR 31006 EN, Publications Office of the European Union, Luxembourg, 2022, ISBN 978-92-76-48882-8, doi:10.2760/115376, JRC128415.
Watts, S., and Stenner, P. (2012) *Doing Q methodological research: Theory, method & interpretation.* Los Angeles, CA: Sage.
Zhang, M. (2023) "College Students' Social and Emotional Competence under the Background of Digital Intelligence: Deficiency Representation and Improvement Path." *Applied & Educational Psychology*, 4(9), pp 125-131.
Zhang, Y., and Farooq, Q. (2021) "Accounting reform of higher education: A social and managerial analysis in the era of digital intelligence." *Frontiers in Management and Business*, 2(1), pp 95-100.

Developing a Model of Knowledge Transactions: A Critical Review of Background Theories

Ettore Bolisani[1]; Tomas C. Kassaneh[1] and Anthony Wensley[2]
[1]Department of Management and Engineering, Università degli Studi di Padova, Stradella S. Nicola, Vicenza, Italy
[2]Department of Management, University of Toronto Mississauga, Mississauga, Ontario, Canada.

ettore.bolisani@unipd.it
tomascherkos.kassaneh@unipd.it
anthony.wensley@utoronto.ca

Abstract: Interactions between companies, crucial for economic success and knowledge advancement, involve significant exchanges of information and knowledge beyond mere economic transactions. Understanding how businesses can leverage these knowledge transactions (KTs) with trading partners is vital for both Knowledge Management (KM) research and practice. This entails identifying the knowledge essential for fruitful trading relationships, determining how to derive value from these exchanges, deciding what knowledge should be protected or shared, and developing value-adding strategies for knowledge exchange. To address these questions, this paper critically examines possible theoretical foundations for a KT model. It reviews nine notable KM models to assess the insights they provide (or do not provide) into knowledge exchange mechanisms both within organizations and between trading partners. These models provide some fundamental insights, but also have limitations, especially in addressing the "economic value" of knowledge exchanges. The study highlights the need for a comprehensive and effective KT model that positions knowledge exchanges in trading as a core, value-adding component of economic activities and business strategies. After this preliminary review of existing KM models, it suggests a new KT model, and indicates the need for further development towards a more encompassing approach.

Keywords: Knowledge Management, Knowledge Transaction, KM Models, Prerequisites, Literature Review

1. Introduction

When engaging in trading relationships, trading partners must exchange knowledge in order to augment the economic value of these relationships. This holds significance not only for each specific transaction but also under a broader perspective.

Trading interactions inherently involve substantial exchanges of information and knowledge. Understanding these mechanisms, referred to here as "knowledge transactions" (KT), is crucial (Bolisani, 2010). In this context, fundamental questions arise: What knowledge must companies exchange to establish fruitful trading relationships? How can their value be derived from the exchanged knowledge? By whom? What knowledge should be protected and what should be shared openly? What strategies can increase the value of trading?

Our analysis considers that, in an economic transaction, many KTs can occur, and they are fundamental for the effective conclusion of the economic transaction itself. Therefore, we advocate for a comprehensive and effective KT model that positions these KTs as a fundamental, value-adding components of economic activities. To develop this model, it is imperative to critically analyze the potential theoretical foundations that can be drawn from the KM literature. This critical analysis lays the groundwork for a more comprehensive model that captures the mechanism and economic value of KTs.

The paper proposes a preliminary review of some existing Knowledge Management (KM) models to glean insights and recommendations for the formulation of a new, more comprehensive model. Many useful models have been developed in the KM domain, each offering unique insights into the issue of how knowledge is created, shared, and used within and between organizations. In this study, nine prominent KM models have been selected and their strengths and limitations for modelling the dynamics of KTs in trading relationships have been analyzed. In the last sections, the foundations for an innovative model of KTs are then proposed and discussed.

2. Knowledge Transfer, Exchange, Sharing: Basic Definitions

It is firstly important to consider definitions and terms used in KM to refer to situations similar to the case analyzed here. Terms like knowledge transfer, knowledge exchange, and knowledge sharing generally refer to fundamental mechanisms through which knowledge passes between or across organizations or people. This section outlines their basic definitions and highlights differences and usefulness.

Knowledge Transfer, considering the many definitions proposed in the literature (e.g., Szulanski, 1996; Boyd et al. 2007; Avelino, 2023), can be described as ''the process through which a 'piece of knowledge' is passed from somebody who possesses it in some form to somebody else that is expected to use it in some way'' (Bolisani, 2008). This process depends on a transmission medium and occurs in a framework of rules and mechanisms that influence it. This definition stresses the main elements of this process: the transferred "knowledge item", the knowledge sources (users/receivers), and the channel or medium and enabling framework.

Knowledge exchange refers to the reciprocal transfer of knowledge between individuals, teams, or organizations, where both parties contribute and benefit from the exchange. It involves a complex "economy" of reciprocation and obligation (Konstantinou and Fincham, 2011). Davenport and Prusak (1998) emphasize social context and trust as crucial elements for the effective knowledge exchange, suggesting that knowledge flows best strong relational ties exist between the participants. Also, Wenger's (1998) works on communities of practice outline how social structures facilitate a deeper level of knowledge exchange through shared practices and learning.

Knowledge sharing is often seen as the act of openly distributing knowledge among members of an organization or community. Many authors (Brown and Duguid, 2000; Liu, 2008; Hargadon, 2002), argue that knowledge sharing is fundamentally a social activity, deeply embedded in the informal culture of an organization. Liu (2008, pp-3) defines knowledge sharing as "The process where individuals exchange their (tacit or explicit) knowledge and jointly created new knowledge in a knowing process under certain social contexts that are also constructed out of these activities." This conceptualization underscores the critical role of social interactions in fostering mutual understanding.

To sum up, while these three processes are closely interlinked and these terms have been used interchangeably, each carries its own unique focus and serves distinct purposes. Knowledge transfer is predominantly unidirectional and implies the efficient passage of knowledge from one entity to another, ensuring that the recipient acquires specific insights or skills from a source. Knowledge exchange is inherently bidirectional and reciprocal, crafted around the idea that the two participants both contribute to and benefit from the process. Knowledge sharing expands beyond a dyadic relationship and includes the idea of a more open distribution of knowledge across a network or community, often without any direct expectation of reciprocation.

3. Consideration of "Economic Value" in KM Models

The nine models that we analyze in this section refer, to some extent, to situations where the notions and definitions illustrated in the previous section are relevant. We now briefly examine their core principles, strengths, and limitations to derive suggestions for a new, comprehensive, and effective model that emphasizes the mechanisms and economic value of KTs.

3.1 SECI

Nonaka and Takeuchi's (1995) "Knowledge Spiral Model" is a foundational framework in KM. This model depicts knowledge creation as a dynamic, iterative process within organizations. It categorizes knowledge as being either tacit or explicit and delineates four modes through which knowledge is created and transferred: Socialization, Externalization, Combination, and Internalization (Nonaka and Takeuchi, 1995; Dalkir, 2011, Adesina and Ocholla, 2019).

The model quickly became one of the most popular in KM, and has been applied to diverse contexts (Dalkir, 2011). A key characteristic of the model is its simplicity, facilitating easy comprehension of its core principles and application where there is a need to understand the mechanisms involved in effective exchanges of knowledge between two parties. However, while it effectively delineates the transformations between tacit and explicit knowledge, it overlooks broader considerations such as the integration of these categories of knowledge into decision-making processes. Therefore, the economic value of KM dynamics and the reasons for engagement in knowledge transfer by trading parties are not clearly addressed. Also, some scholars have identified the challenges of applying the model in a variety of situations as well as the non-linear nature of the model(Adesina and Ocholla, 2019; Oztok, 2013; Chai et al., 2011). These critiques underscore the ongoing need for further refinement and adaptation of the SECI model to depict KM implications in interorganizational relationships. Some extended versions, such as Zhang and Huang's (2020), try to incorporate inter-organizational knowledge flows and open innovation principles to better depict the opportunities of knowledge exchanges within and across organizations.

In short, while SECI provides valuable insights into the specific knowledge conversion mechanisms, its applicability as a 'KT model,' as defined in the context of this study, is limited. The model primarily focuses on internal knowledge processes and does not explicitly address the dynamics, value, and motivations of knowledge exchange between two trading partners. In particular, it lacks emphasis on the economic value of these exchanges or their strategic nature and significance.

3.2 Sense-Making

Choo's (1998) Sense-Making Model provides an integrated framework for understanding the use of information within organizations by encapsulating sense-making, knowledge creation, and decision-making. This model presents a comprehensive perspective on how information is processed and transformed into actionable knowledge, factoring in the broader organizational context in which these transformations occur.

The model's strength is its incorporation of a holistic view of information handling, emphasizing the transformational journey from raw data to knowledge and subsequent actions (Choo, 1998; Neto, 2009; Dalkir, 2011; Cristea and Capatina, 2009). However, despite its broad applicability and the insights into organizational knowledge dynamics, its main limitation is the lack of analysis of economic aspects. Its extensive scope, while valuable for understanding internal processes, may also inadvertently gloss over the specific nuances and potential economic value generated through knowledge exchanges between trading entities. This suggests that while Choo's model is instrumental in conceptualizing knowledge processes within organizations, it may require adaptation or extension in order to fully address the complexities and economic implications of inter-organizational trading relationships. Also, this model is a modified and extended Information Science approach and therefore the link to transactions is limited.

3.3 Wiig

This model (Wiig 1993) focuses on the practical aspects of KM, emphasizing knowledge use, building, and maintenance within organizations. It defines a structured approach to KM, emphasizing the systematic management of knowledge assets to improve organizational effectiveness. One of its core strengths lies in its holistic view of KM, encompassing the identification, development, and application of knowledge to support organizational objectives by using a categorization of knowledge into four types—factual, conceptual, procedural, and methodological. Managing these knowledge types can effectively lead to improved organizational performance (Wiig, 1993; Dalkir, 2011; Evans et al., 2014; Cristea and Capatina, 2009). Considered to be a very pragmatic KM model, it seamlessly integrates various KM approaches surpassing the conventional tacit/explicit classification and providing a comprehensive framework adaptable to diverse contexts.

However, while it provides a comprehensive framework for internal KM, its application to the dynamics of relationships (and knowledge interactions) between trading partners is questionable. Firstly, the model primarily addresses KM within the confines of individual organizations and does not explicitly explore the inter-organizational dimensions. Second, the Wiig Model does not explicitly consider the economic aspects of KM. Although it acknowledges the importance of knowledge for competitive advantage, it lacks a detailed exploration of how knowledge exchange between trading partners can lead to the generation of economic value.

3.4 I-Space

The I-Space (Boisot, 1998) model offers a unique framework for understanding the dissemination and utilization of knowledge and basically conceptualizes information or knowledge flow along three dimensions: codification, abstraction, and diffusion. The model is a 3-dimensional framework, which helps in mapping the state and flow of knowledge. Codification refers to the process of converting knowledge into a format that can be easily disseminated. Abstraction involves the removal of contextual details to make knowledge more universally applicable. Finally, diffusion represents the spread of knowledge across a population. The strength of the Boisot model is that it incorporates a theoretical foundation based on social learning. The Social Learning Cycle (SLC) serves to link content, information, and KM in a very effective way - the codification dimension is linked to categorization and classification; the abstraction dimension is linked to knowledge creation, and the diffusion dimension is linked to information access and transfer (Dalkir, 2011; Spinuzzi, 2023; Canals et al, 2008).

Generally, this model sheds light on the complexities of KM particularly in terms of how knowledge is processed, stored, and shared. There is a strong potential of the I-Space model for mapping and managing an organization's knowledge assets and their importance for a learning cycle, which is not directly addressed by other KM models.

One set of limitations relate to the difficulty of applying the model to empirical cases (Spinuzzi, 2023) in real-life workplace situations. First, the underlying theory does not account well for how people use representations synchronically for their mutual learning. Second, it does not adequately bind an analysis case. Thus, it can be applied analogically but not directly for mapping representations in qualitative case studies. Furthermore, similar to the case of other KM models, this model primarily focuses on the properties and flow of knowledge without directly addressing aspects of economic value. Thus, the model, while useful for understanding knowledge dissemination, may not fully capture the strategic and value-related aspects of knowledge interactions in a trading context.

3.5 Von Krogh and Roos

This model (Von Krogh and Roos, 1995) emphasizes the epistemological perspectives and organizational contexts of knowledge creation and sharing. The model distinguishes between individual knowledge and social knowledge through the adoption of an epistemological viewpoint (Dalkir, 2011; Von Krogh and Roos, 1995; Cristea and Capatina, 2009). In the model, knowledge resides in both individuals and their relations, and the human and relational aspects of KM are stressed. By highlighting the importance of social dynamics, such as trust and mutual respect, Von Krogh and Roos offer an approach to understanding how knowledge is cultivated and disseminated within organizations. This perspective is crucial for fostering a collaborative environment.

While deep insights into the internal mechanisms of knowledge creation and sharing are provided, the application of this model to inter-organizational relationships is, again, difficult, especially in trade. In fact, the model does not explicitly address the complexities of KM across organizational boundaries, including issues related to intellectual property, competitive advantage, and the economic value of shared knowledge. It lacks a clear framework for assessing the economic impact of these knowledge transactions on organizational performance and market competitiveness. Again, there is also a lack of concern for linking knowledge to action which is critical both for the knowledge to be 'meaningful' to the organization and to be valuable.

3.6 Intelligent Complex Adaptive System (ICAS)

This model (Bennet and Bennet, 2004) views organizations as complex adaptive systems. Its foundation lies in a recognition of organizations as ecosystems where knowledge flows and evolves through complex interactions among members. It stresses the importance of adaptability, suggesting that the ability to respond to changes and challenges through effective KM is crucial for organizational success (Bennet and Bennet, 2004; Dalkir 2011; Cristea and Căpaţînă, 2009). ICAS systems are based on cybernetics principles, which use communications and control mechanisms as a basis for understanding, describing, and predicting what makes an organization viable. Adaptive systems are comprised of independent interacting agents whose behavior leads to complex adaptation patterns. There is no superior authority controlling agents, and complex system behavior arises because of all the interactions (Cristea and Căpaţînă, 2009, Dalkir, 2011).

The ICAS model provides valuable insights into internal organizational dynamics, but the manner in which it may be applied to inter-organizational relationships is unclear. The model focuses primarily on internal adaptability and learning, with less emphasis on how organizations can manage knowledge exchanges with external entities in order to create economic value and enhance viability. The extension of the principles of adaptability and complex interactions to external partnerships and collaborations, where different organizational cultures, goals, and KM practices should converge, is challenging.

3.7 EFQM Excellence

EFQM Excellence was developed by the European Foundation for Quality Management (EFQM), a not-for-profit membership foundation founded in 1988 in Brussels by fourteen leading European businesses to promote business excellence across the continent. Basically, the EFQM Model is part of a broader framework designed to help organizations improve their performance through a set of principles centered around excellence, including leadership, process, and customer results. It proposes a comprehensive approach to organizational quality, embedding KM in an overall organizational excellence (Bhatt, 2000; Dalkir, 2011; Criado-García, 2020). The EFQM model (Bhatt 2000) examines how KM contributes to achieving organizational objectives. Drawing from traditional models of quality and excellence, this framework establishes robust connections between KM processes and organizational performances, emphasizing the crucial role of knowledge in organizational success. Knowledge is seen as a key strategic resource and the integration of excellence and KM constitutes a dynamic capability for organizations based on continuous improvement, innovation, and learning (Criado-García, 2020).

Whilst the EFQM model provides a robust framework for integrating KM into organizational excellence, its focus on internal processes and outcomes may limit its applicability to the dynamics of knowledge exchange and collaboration among external entities, nor does it explicitly explore the economic value generated through such exchanges or their strategic dimension.

3.8 Inukshuk

The Inukshuk KM model (Girard, 2005) was developed primarily to help Canadian government departments better manage their knowledge. It utilizes the metaphor of Inuit stone landmarks (Inukshuks). Inukshuks serve several functions, including guiding travellers, warning of danger, assisting hunters and marking places of reverence. Inukshucks are used as a metaphior for guiding organizations in knowledge creation, sharing, and utilization in organizations. The model emphasizes the strategic placement of knowledge in an organization, advocating for knowledge to be as visible and usable as are Inukshuk in the Arctic, guiding individuals, and teams effectively towards decision-making and innovation (Dalkir, 2011; Sensuse, 2014). Its primary strength is the simplicity of its metaphor, underscoring the importance of making knowledge accessible and actionable. This approach aids in fostering an environment where knowledge is not just stored but is actively used, an idea also recalled by Davenport and Prusak (1998) who remind us of the necessity how organizations managing what they know.

Like most of the models reviewed, the Inukshuk KM Model offers valuable insights into knowledge accessibility and usability within organizations, but its application to inter-organizational and trading dynamics has limitations. In fact, the model primarily focuses on the internal organization with less emphasis on how knowledge is exchanged, co-created, or valued in inter-organizational contexts. Additionally, the economic value generated through external KT is not explicitly addressed, leaving a gap in understanding how knowledge sharing between partners can lead to mutual benefits and value creation.

3.9 KM Cycle (KMC) (Evans et al., 2014)

This comprehensive KM life-cycle model was developed by Evans, Dalkir, and Bidian (2014) by building on previous models and on Heisig's (2009) analysis of KM frameworks. It has seven non-sequential phases (i.e., identify, store, share, use, learn, improve, and create) and provides a structured approach to understanding the stages through which knowledge is identified, captured, processed, and utilized within organizations. This model emphasizes the iterative nature of KM, where knowledge is continuously developed and refined through cycles of learning and application. The focus on these different activities or processes is important because it helps understand how the cyclical iteration 'improves' the both individual and organizational knowledge. By outlining clear stages in the KM process, the model provides organizations with a roadmap for leveraging their knowledge assets to drive innovation and, potentially, competitive advantage.

Again, the KMC Model offers a robust framework for internal KM processes or cycles, but it primarily addresses KM within the confines of a single organization and does not explicitly explore the dynamics of sharing, co-creating, or monetizing knowledge in inter-organizational contexts. Furthermore, the economic value generated through knowledge exchange between business partners and its impact on market positioning and competitiveness is not directly addressed within the model's framework.

4. Analysis

Table 1 highlights the main pros and cons of the examined models as theoretical foundations for a comprehensive model of KTs. All these models provide important insights into the mechanisms related to the KM processes that involve transfer, exchange, and sharing of knowledge. However, they also have limitations.

On the one hand, they provide useful (and, sometimes, very detailed) insights into the mechanisms which involve knowledge exchanges. Some of them also emphasize the appropriate contexts that favor a fruitable interaction between parties.

On the other hand, they all have two main limitations. The first is they have insufficient applicability to inter-organizational contexts. The second is the general underestimation or complete lack of consideration of the economic value of interactions and exchanges of knowledge. Business organizations do not exchange knowledge just to exchange knowledge but to support economic value generation and, further enhance their strategic position with respect to their competition. Those few models that address this issue do not go beyond a general consideration of the point, providing no detailed analysis.

Based on this critical review and building upon these pros and cons, we argue that a new comprehensive KM is needed to explain how companies exchange knowledge in trading and how this contributes to economic value generation and enhance their strategic positioning, by means of the appropriation, absorption or development of knowledge.

This model should incorporate some key elements.

Inter-Organizational Focus: The new model should explicitly address the mechanisms of knowledge exchange between trading partners, considering the different types of knowledge that can be shared and the platforms or media through which this exchange can occur. Here, there is a need to investigate the nature of the transaction too.

Economic Value Generation: It is essential to integrate concepts from economic theory and value creation frameworks into the model. This integration would provide a foundation for understanding how knowledge exchange contributes to economic outcomes, such as innovation, competitive advantage, and and a variety of strategic objectives.

Table 1: Summary of the examined KM models

KM model	Pros	Cons
SECI	· Structured and foundational framework for understanding knowledge creation and conversion processes · Highlights the importance of tacit knowledge and social interaction · Provides simple and easily comprehensible model for practical applications	· Primarily focuses on internal knowledge processes and does not explicitly address the dynamics, value and motivations of knowledge exchange between trading partners · Lacks emphasis on the economic value of the knowledge exchange in the trading relationships and the implied strategic considerations
Sense-Making	· Offers a holistic perspective in knowledge transformation by considering collective sense-making within organizations · Ideal for Decision-Making Process · Highlights the role of information-seeking and sense-making in knowledge creation	· Lack of prescriptive guidance on how to effectively facilitate sense-making in an inter-organizational context · Limited discussion on the economic implications of the knowledge exchange in trading relationships
Wiig	· Offers a structured approach to managing knowledge assets · Designed Explicitly for Knowledge Building Scenario · Enduring relevance since its inception - remains relevant and widely used in KM practices	· Difficulty in application to dynamics of relationships between trading partners · Does not explicitly explore the economic value of knowledge exchange
I-Space	· Offers a conceptual framework for understanding the dynamics of knowledge as information flows · Emphasizes the role of codification and personalization in KM	· Limited application to inter-organizational relationships · Insufficient framework for economic evaluation of the value generated through knowledge exchange · Difficult empirical application
Von Krogh and Roos	· Emphasizes the importance of social interaction and communities of practice in KM · Emphasizes human and relational aspects of knowledge creation and sharing	· Difficult assessment of economic impact of KTs · Limited application to inter-organizational relationships
Intelligent complex adaptive system (ICAS)	· Relevant to recognize the complexity and dynamism of organizational knowledge based on advanced Intelligent Techniques · Emphasizes adaptability and learning through knowledge exchange	· Complexity in practical application within organizations · lack specificity in addressing knowledge exchange between trading partners. · Limited discussion on the economic value of knowledge exchange
EFQM Excellence	· Best for organizational excellence and performance measurement · Emphasizes the importance of leadership, strategy, and people in KM · Robust framework for integrating KM into organizational excellence	· Primarily focused on internal knowledge processes within organizations, limiting its applicability in a trading partnership · Not directly address the economic consideration of knowledge exchange between trading partners
Inukshuk	· Offers a visual representation of knowledge management processes. · Emphasizes the importance of communication and collaboration in knowledge exchange	· does not directly address the economic value generated through external knowledge transactions · Insufficient framework for economic evaluation
KM Cycle (KMC) *(Evans et al., 2014)*	· Best to demonstrate the holistic view of the knowledge life cycle · Emphasizes the iterative nature of knowledge management processes	· Primarily focused on internal knowledge processes within a single organization. · Lack of exploration of economic value generated by knowledge exchange

Knowledge Disclosure vs. Protection: The model should offer strategies for balancing the disclosure of knowledge with the need to protect proprietary information. This includes mechanisms for establishing trust, negotiating knowledge-sharing agreements, and utilizing intellectual property protections. Also, depending on the nature and characteristics of the knowledge being transferred there may be other requirements.

Adaptability and Contextual Relevance: Given the dynamic nature of trading relationships and market conditions, the model should be adaptable and consider the contextual factors that influence KT. This includes industry-specific challenges, regulatory environments, and cultural differences between trading partners.

Measurement and Evaluation: Finally, the new model should incorporate methods for measuring the impact of KT on economic value and organizational performance. This could include metrics for assessing the quality, relevance, and timeliness of exchanged knowledge, as well as its contribution to achieving strategic objectives.

5. A Model of Knowledge Transaction

This section presents an argument for viewing economic activities from a micro perspective, where a company or an economic player is seen as a system of stocks (wealth such as cash, machinery, real estate, accounts receivable) and flows (expenditures or receipts). Economic value creation is tied to operative activities over time and the accumulation of value in appropriate repositories. The model of knowledge transactions emphasizes the importance of interactions between economic players (e.g., trading) and how the value of assets is influenced through trading and by external conditions, such as market dynamics and trading rules. It introduces the notion that besides the physical exchange of goods/services and money, there is a crucial flow of communications between parties, involving the exchange of messages that allow for the definition of trading conditions and the execution of transfers. This exchange of messages, imbued with valuable knowledge, is essential for trading and underpins the proposed model of KT, highlighting the economic significance of knowledge exchange in the creation of economic value.

In other words, our analysis refers to KTs where knowledge is exchanged during an economic transaction, regardless that the sold goods are products or services. In other words, we have two levels of analysis. One is the classic “economic transaction” of goods, services (or even knowledge in the special case that it is the final product that is sold, for example for a consulting company). The other level is that of “KTs”, i.e. particular exchanges of knowledge that occur during an economic transaction and that have, however, value themselves. We can say that in an economic transaction there are many KTs that occur in parallel and are a value-adding components of economic transactions and, therefore, business strategies.

To sum up, KTs are defined as exchanges of valuable knowledge between traders, occurring multiple times during an economic transaction and being crucial for its execution, to complete economic transactions efficiently and effectively. KTs are differentiated from other communication models used in KM (see above) because they emphasize the economic value of the exchanged knowledge. This approach suggests that knowledge exchange, akin to barter systems, carries inherent economic value and should be analyzed beyond a view of mere data or information transfer ancillary to trade relationships. Knowledge has a role and, therefore, a value in action oriented decision-making. We argue that understanding KTs provides insight into the nature of economic transactions from a new perspective, emphasizing, among other things the cognitive underpinnings of economic activities.

A practical example can help to illustrate the concept of KT, using a simple transaction between a seller and a buyer of a consumer product (Bolisani, 2009), e.g. an item of clothing, a device, some food, or any similar item. Breaking down the interaction into a series of KTs - such as the exchange of information about the availability of that product, then the buyer's preferences, and next the negotiation of the price, etc. - we see that each step involves the exchange of knowledge that has its own economic value, because it influences the decisions and actions of both parties in any of the transaction steps. The example demonstrates that economic transactions are not merely about the physical exchange of goods and money but involve a complex series of KTs, where each piece of exchanged knowledge adds to the overall economic value of the transaction and, in addition, has its own value *per se*, even in the case of incomplete transactions. For example, even when the buyer decides, in the end, that the price of a product is too high in a shop and will not buy it, this is useful learning for the buyers future decisions about where to buy similar products in future. To the seller such knowledge allows the seller to investigate both the impact on price in the buyers purchase decision and other knowledge that may be indirectly conveyed to the buyer through the price signal (e.g. with respect to quality, the social status of the buyers, etc.).

6. Potential Application

A possible example is the analysis of business relationships between companies, specifically within a network of client-supplier relationships. In industries where OEM companies assemble the final products (eg.: automotive, electronics, household appliances, etc.), or in cases where the product is co-designed in the interaction between a client and a supplier, the KT model can be applied to understand the intricate web of knowledge exchanges among firms, including the leading company, local dealers, and final clients, during the development of the new product, its manufacture, and sale (Bolisani, 2010).

The case study presented by Bolisani (2010) highlights the value of KTs in learning from business relationships, capitalizing on exchanged knowledge, and understanding the mechanisms of knowledge exchange during different steps of business relationships and economic transactions. It also points out the challenges that companies must face due to the need for knowledge disclosure on the one hand, as is unavoidable when a component must be co-designed in collaboration between suppliers and customers, and the need for knowledge protection, to avoid leakages and misuse by competitors. The traditional focus on financial transactions is, on the one hand, not sufficient to highlight these implications, while the typical KM models of knowledge exchange, on the other hand, do not stress the value of any element of knowledge that the parties exchange.

7. Conclusion

In synthesizing the strengths and limitations of the KM models discussed in this study, it becomes evident that while each contributes valuable insights into the transformation of knowledge within organizations by means of interactions, exchanges, and sharing, there is a discernible gap in their direct applicability to the economic and strategic aspects of KMs in trading relationships. This gap highlights the need for a model that more directly ties KM practices to economic outcomes in the context of inter-organizational relationships. A new model aimed at addressing these gaps must incorporate a balanced approach to knowledge sharing and protection, facilitate inter-organizational collaboration, and emphasize the measurement and monitoring of KT outcomes to enhance economic activities and business strategies. Such a model would not only advance the theoretical foundations of KM but also offer practical guidelines for leveraging knowledge as a core value-adding component in trading relationships.

In the paper, it is suggested that KTs can play a foundational role in the creation of economic value within the knowledge economy. By focusing on the exchange of knowledge between parties, we also propose a shift in how economic activities are viewed and analyzed, emphasizing the cognitive aspects of trading and the inherent value of knowledge exchange. This perspective opens new avenues for research and analysis in economic and accounting studies, underlining the importance of KTs in understanding the dynamics of the modern economy.

The paper has some limitations. First, it includes a selection of the many models that have been developed in the KM field. Although these models have currency and relevant to the task at hand, our selection is intrinsically subjective. Second, the paper is a preliminary proposal of a new model that still requires refinement and, especially, more robust empirical validation. This can be part of a future research agenda.

References

Adesina, A.O. and Ocholla, D.N. (2019) ''The SECI Model in Knowledge Management Practices: Past, Present and Future'', *Mousaion*, Vol 37, No. 3.

Avelino, J. (2023) ''Knowledge Transfer: What is it and how does it work?'', [online], https://www.edapp.com/blog/knowledge-transfer/.

Bennet, A. and Bennet, D. (2004) *Organizational survival in the new world: The intelligent complex adaptive system. A new theory of the firm,* Routledge, Burlington.

Bhatt, D. (2000) *EFQM excellence model and knowledge management implications*, Published by EFQM Organization, 8.

Boisot, M. H. (1998) *Knowledge assets: Securing competitive advantage in the information economy*, Oxford University Press, New York.

Bolisani, E. (2008) *Understanding knowledge transfer on the Net: Useful lessons from the knowledge economy, In E. Bolisani (Ed.), Building the knowledge society on the Internet: Sharing and exchanging knowledge in networked environments (pp. 110-128)*, Information Science Reference (an imprint of IGI Global), Harshey, New York.

Bolisani, E. (2009, October). Modelling cognitive transactions for economic and accounting analysis. In *International Conference on Knowledge Management and Information Sharing* (Vol. 2, pp. 242-247). Madeira.

Bolisani, E. (2010) ''Capitalising knowledge exchanges: an interpretative model'', *In Proceedings of the 11th European Conference on Knowledge Management,* pp 137-145.

Boyd, J., Ragsdell, G., Oppenheim, C. and Martins, B.(2007)'' Knowledge transfer mechanisms: a case study from manufacturing'', *In Proceedings of the 8th European Conference on Knowledge Management*, Vol. 1, pp 139-146.

Brown, J.S., and Duguid, P. (2000) *The Social Life of Information*, Harvard Business School Press.

Canals, A., Boisot, M., and MacMillan, I. (2008) ''The spatial dimension of knowledge flows: a simulation approach'', *Cambridge Journal of Regions, Economy and Society*, Vol. 1, No. 2, pp 175-204.

Chai, H., Liu, L., and Luo, S. (2011) ''Knowledge transferring in virtual organization. In 2011 2nd International Conference on Artificial Intelligence'', *Management Science and Electronic Commerce (AIMSEC),* pp 3089-3092.

Choo, C. (1998) *The knowing organization*, Oxford University Press, New York.

Criado-García, F., Calvo-Mora, A., and Martelo-Landroguez, S. (2020) ''Knowledge management issues in the EFQM excellence model framework'', *International Journal of Quality and Reliability Management*, Vol. 37, No. 5, pp 781-800.

Cristea, D. S., and CĂPAŢÎNĂ, A. (2009) ''Perspectives on knowledge management models. The Annals of "Dunarea de Jos" University of Galati Fascicle I – 2009'', *Economics and Applied Informatics*, Years XV – no 2 - ISSN 1584-0409.

Dalkir, K. (2011) *Knowledge management in theory and practice (2nd ed.)*, Mass. MIT Press, Cambridge.

Davenport, T.H. and Prusak, L. (1998) *Working knowledge: How organizations manage what they know*, Harvard Business Press.

Evans, M., Dalkir, K. and Bidian, C. (2014) ''A holistic view of the knowledge life cycle: the knowledge management cycle (KMC) model'', *Electronic Journal of Knowledge Management*, Vol. 12, No. 2, pp 85-97.

Girard, J. (2005) ''The inukshuk: A Canadian knowledge management model'', *KMPRO Journal, Vol.* 2, No. 1, pp 9 – 26.

Hargadon, A. (2002) *How Breakthroughs Happen: The Surprising Truth About How Companies Innovate*, Harvard Business School Press.

Heisig, P. (2009) ''Harmonisation of knowledge management: Comparing 160 KM frameworks around the globe'', *Journal of Knowledge Management*, vol. 13, no. 4, pp 4-31.

Konstantinou, E. and Fincham, R. (2011) ''Not sharing but trading: Applying a Maussian exchange framework to knowledge management'', *Human Relations*, Vol. 64, No. 6, pp 823-842.

Liu, S. (2008) *Knowledge sharing: Interactive processes between organizational knowledge-sharing initiative and individuals' sharing practice, In E. Bolisani (Ed.), Building the knowledge society on the Internet: Sharing and exchanging knowledge in networked environments (pp. 1-23)*, Information Science Reference (an imprint of IGI Global), Harshey, New York.

Neto, R, C, D, A, Souza, R. R., Queiroz, J. G., and Chipp, H. (2009) ''Knowledge Management Implementation: a Process Design Proposition at Brazil's ONS (National Operator of the Interconnected Power System)'', *Electronic Journal of Knowledge Management*, Vol. 7, No. 5, pp 593-604.

Nonaka, I., and Takeuchi. H. (1995) *The knowledge-creating company: How Japanese companies create the dynamics of innovation*, Oxford University Press, New York.

Nonaka, I., Toyama, R., and Konno, N. (2000) ''SECI, Ba and leadership: a unified model of dynamic knowledge creation'', *Long range planning*, Vol. 33, No. 1, pp 5-34.

Oztok, M. (2013) ''Tacit knowledge in online learning: Community, identity, and social capital'', T*echnology, Pedagogy and Education*, Vol. 22, No. 1, pp 21-36.

Sensuse, D. I., Sucahyo, Y. G., Rohajawati, S., and Anggia, P. (2014) ''Models and frameworks of knowledge management: A literature review. In 2014 International Conference on Information Science'', *Electronics and Electrical Engineering,* Vol. 2, pp 1166-1170.

Spinuzzi, C. (2023) ''Mapping representations in qualitative case studies: can we adapt Boisot's I-Space model?'', *Journal of Workplace Learning*, Vol. 35, No. 6, pp 562-583.

Szulanski, G. (1996) ''Exploring internal stickiness: Impediments to the transfer of best practice within the firm'', *Strategic Management Journal*, Vol. 17(S2), pp.27-43.

Von Krogh, G., Roos, J., and Kleine D.(1998) *Knowing in firms: Understanding, managing and measuring knowledge*, Sage Publications, London.

Wenger, E. (1999) *Communities of practice: Learning, meaning, and identity*, Cambridge University Press

Wiig, K. (1993) *Knowledge management foundations: Thinking about thinking. How people and organizations create, represent and use knowledge,* Schema Press, Arlington.

Zhang, Z., and Huang, F. (2020) ''An extended SECI model to incorporate inter-organisational knowledge flows and open innovation'', *International Journal of Knowledge Management Studies (IJKMS)*, Vol. 11, No. 4. https://doi.org/10.1504/ijkms.2020.10031579.

The Impact of Knowledge Dynamics on Multicultural Leadership and the Mediating Role of Cultural Intelligence

Constantin Bratianu[1,2], Dan Paiuc[3] and Ruxandra Bejinaru[4]
[1]Academy of Romanian Scientists, Bucharest, Romania
[2]Bucharest University of Economic Studies, Bucharest, Romania
[3]National University of Political Studies and Public Administration, Bucharest, Romania
[4]University "Stefan cel Mare" of Suceava, Suceava, Romania

constantin.bratianu@gmail.com
dan.paiuc@facultateademanagement.ro
ruxandrabejinaru@yahoo.com

Abstract: Business internationalization and globalization naturally led to the need to manage across cultures and develop new competencies for leaders. One of these competencies is cultural intelligence (CQ) that is actually a meta-competence because it incorporates rational, emotional, spiritual, and social intelligence. *Cultural intelligence* expresses the capacity of a leader to understand different cultures and the behavioral types generated by them, and to make decisions able to satisfy multicultural requirements, avoiding intercultural conflicts due especially to different cultural and religious values and principles. Different cultures are characterized by different knowledge dynamics which influence the process of decision making and multicultural leadership. The purpose of this paper is to explore the impact of knowledge dynamics on multicultural leadership, in multicultural business environments, and what is the role of cultural intelligence in this process. Based on the critical literature review we identified the main constructs and connections we have to explore through an investigation based on questionnaires and a statistical analysis using PLS-SEM method. The findings confirmed our initial hypotheses.

Keywords: Knowledge Dynamics, Cultural Intelligence, Social Intelligence, Leadership, Multicultural Leadership

1. Introduction

The increasing dynamics of business internationalization and globalization (Vatamanescu & Mitan, 2024) challenge the leadership competencies within the multicultural environment (Lewis, 2018). Leading across cultures requires a deep understanding of the different value sets of people coming from different cultures to work together in the same company, and making managerial decisions in social contexts with a high potential of conflicts. The new competence required is *cultural intelligence* (CQ), and it can be defined as a capacity to understand different cultures and create a convergence of business interests within a company (Bratianu & Paiuc, 2023; Meyer, 2014). Cultural intelligence is a meta or higher-order intelligence because it is composed of rational, emotional, spiritual, and social intelligence.

Cultural intelligence is impacted by *knowledge dynamics* (KD) understood as a transformation of one form of knowledge (i.e., rational, emotional, spiritual) into another form of knowledge. That relationship is mediated by the decision making that is performed within a multicultural environment (Bratianu et al., 2020; Kahneman, 2011). However, a critical literature review reveals a knowledge gap concerning the influence of knowledge dynamics on multicultural leadership and what are the main constructs involved in this complex process. The purpose of this paper is to explore the connections between knowledge dynamics and multicultural leadership in multicultural business environments and what other variables should be considered in such an analysis. The originality of the present research comes from addressing that knowledge gap and helping managers and leaders working in multicultural business environments to understand the new challenges of the decision making processes.

2. Literature Review

A critical literature review concerning multicultural leadership and the new challenges it faces by comparison with classical management that operates within a monocultural environment reveals the importance of the following constructs: knowledge dynamics, cultural intelligence, and multicultural leadership. The following presentation will focus on the main characteristics of these constructs and on the possible connections between them.

Knowledge dynamics (KD) is a multidimensional concept encompassing variations of knowledge in time and space. Knowledge variation in time is a direct result of learning or unlearning processes at the individual level

(Bereiter, 2002; Cegarra-Navarro & Wensley, 2019; Kolb, 2015; Nonaka & Takeuchi, 1995) or at the organizational levels (Argote, 2013; Cegarra-Navarro, Elridge & Martinez-Martinez, 2010; Nonaka & Takeuchi, 1995, 2019). By extension from knowledge to intangibles, some authors considered the dynamics of intellectual capital (Kianto, 2007; Kianto et al., 2017). In this situation, the dynamics reflect the increase or decrease of the knowledge level from a quantitative point of view. Although there is no measuring system for the quantity of knowledge yet, we can compare the two different states of knowledge before and after a learning or unlearning process, and say which of them is higher. Therefore, it is possible to evaluate a relative variation of the knowledge level instead of an absolute one. At the organizational level, three main processes contribute to the balance of knowledge (Bratianu, 2007; DeLong, 2004): knowledge creation, knowledge acquisition, and knowledge loss. Knowledge dynamics based on the variation of knowledge in space is known metaphorically as *knowledge flow* (Bolisani & Oltramari, 2012; Nissen, 2006; Nonaka, Toyama & Hirotaka, 2008).

From the theory of knowledge fields, knowledge dynamics means *a transformation* of one form of knowledge into another one (Bratianu & Bejinaru, 2020). This transformation process is done continuously within our brain with the final result of making decisions. The classical theory of decision making is based exclusively on rational knowledge and rational intelligence. However, cognitive sciences revealed through many experiments and psychological analyses demonstrated that emotional knowledge and emotional intelligence are very important in decision making (Damasio, 2012; Gladwell, 2005; Goleman, 1995; Hill, 2008). Wise leaders go beyond economic values and consider an enlarged spectrum of values and principles for their thinking and decision making (Kaiser & Martinez, 2023; Nonaka & Takeuchi, 2019; Rocha & Pinheiro, 2021; Zohar & Marshall, 2004). They perform what Aristotle called *phronesis*, or practical wisdom (Aristotle, 1999; Rocha et al., 2021; Shotter & Tsoukas, 2014). Aristotle asserts that *phronesis* is "a state of grasping the truth, involving reason, concerned with action about things that are good or bad for human beings" (Aristotle, 1999, p. 89). In any organization, there is a shared set of values that establishes a certain organizational behavior. That is described in the company's code of ethics. For example, Samsung's ethical code is structured as a "Trinity of Values", that contains the company's management philosophy, core values, and business principles (Song & Lee, 2014, p. 111). "Samsung has set forth core items that were to be followed by all employees as its management principles. The company has 5 overarching principles, 15 detailed principles, and 42 conduct rules that its employees are expected to follow" (Song & Lee, 2014, p. 111). If economic decisions are based mostly on rationality, employees' motivation is based dominantly on emotionality, and their behavior is based on the dynamics between rationality, emotionality, and spirituality. Therefore, their organizational behavior is influenced by knowledge dynamics. It is an independent variable that will be considered in the present research model.

Cultural intelligence (CQ) is a higher-order intelligence because it integrates rational, emotional, spiritual, and social intelligence and becomes significant for people working in multicultural environments, like multicultural companies with employees from different countries (Ang & Van Dyne, 2015; Lewis, 2018; Paiuc, 2021). Understanding the way people from other countries think and behave is essential in creating a supportive working atmosphere in teams and multinational organizations, as well as in competing with products and services on international markets. Rational intelligence (IQ) is the capacity to process efficiently rational knowledge and make the best decisions for a given situation or context (Hawkins & Blakeslee, 2004; Pinker, 2021). As Simon remarks, "intelligence is the work of symbolic systems" (Simon, 1996, p. 23). It is the generic intelligence measured traditionally using IQ tests based on items coming mainly from positive sciences. It is the intelligence developed through formal education in schools and universities and used as a predictor for a successful career. Managers use rational intelligence in making decisions based on economic factors because economic science is based on rational principles like mathematics and physics.

Gardner (1983) introduced the new paradigm of multiple intelligences and opened the way for emotional intelligence and spiritual intelligence. *Emotional intelligence* (EQ) represents the capacity to understand personal emotions and how to work with them. More rigorously, emotional intelligence is defined as: "The capacity to reason about emotions, and of emotions to enhance thinking. It includes the abilities to accurately perceive emotions, to access and generate emotions, so as to assist thought, to understand emotions and emotional knowledge, and to reflectively regulate emotions so as to promote emotional and intellectual growth" (Mayer, Salovey and Caruso, 2004, p. 197). They process emotional knowledge (Goleman, 1995; Mayer, Salovey & Caruso, 2004; Salovey & Mayer, 1990). Emotional intelligence shapes people's motivation and their behavior. It is nonlinear and it manifests faster than rational intelligence in making decisions (Gladwell, 2005; Hill, 2008; Kahneman, 2011). Due to its powerful impact on motivation and behavior, emotional intelligence can be a better predictor for personal success in life and leadership than rational intelligence. *Spiritual intelligence* (SQ) represents the capacity to understand the meaning of life and work, and making decisions in accordance with a

set of well-defined values and principles (Aristotle, 1999; Zohar & Marshal, 2004). As Zohar and Marshall remark, "We know today that human beings are by definition primarily creatures of meaning and value (that is, of 'self-actualization'). We need a sense of meaning and driving purpose in our lives. Without it we become ill or we die" (Zohar & Marshall, 2004, p. 17). Spiritual intelligence is the main ingredient of *phronesis* (Rocha & Pinheiro, 2021; Rocha et al., 2021; Shotter & Tsoukas, 2014). Rational, emotional, and spiritual intelligence are defined at the individual level. When several people work together, the relationships between them become important and that leads to social intelligence (Goleman, 2007). Each of these intelligences may have different levels when people within a team or organization come from different cultures. Therefore, understanding them and leading them toward convergent objectives requires a high level of cultural intelligence.

Multicultural leadership is a complex construct used for leaders of multicultural teams and organizations. The main features of those social contexts are the diversity of education, culture, and thinking models. Leading across cultures requires a high level of cultural intelligence and a balance of knowledge dynamics (Batsa, Abadir & Neubert, 2020; Iskhakova & Ott, 2020; Stahl & Maznevski, 2021). The risk of leading across cultures is the potential conflict between people. The main challenge is to create a set of shared values and a convergent organizational behavior toward achieving the designed objectives.

3. Methodology

The literature review shows a knowledge gap concerning the connections between three main constructs that are characteristic for cross-cultural management: knowledge dynamics, cultural intelligence, and multicultural leadership. Trying to get insight into this complex cross-cultural nexus, we formulate the following research questions (RQ):

RQ: What is the role of knowledge dynamics and cultural intelligence in developing multicultural leadership?

To answer this question we designed a research model containing all three constructs: knowledge dynamics (KD) as an independent variable, cultural intelligence (CQ) as a mediating variable, and multicultural leadership (ML) as a dependent variable. Figure 1 illustrates this research model. The model represents a linear simplification of the nonlinear reality, but it is in accordance with the logic used in designing the quantitative approach based on a questionnaire and statistical analysis using the method of Structural Equations Modeling (SEM). The research model suggests the following hypotheses:

H1: Knowledge dynamics (KD) influences positively multicultural leadership (ML).

H2: Knowledge dynamics (KD) influences positively cultural intelligence (CQ).

H3: Cultural intelligence (CQ) influences positively multicultural leadership (ML).

The construct of KD is measured with three indicators: KD1 – Rational knowledge; KD2 – Emotional knowledge; KD3 – Spiritual knowledge. The mediating construct of CQ is measured with four indicators: CQ1 – Metacognitive cultural intelligence; CQ2 – Cognitive cultural intelligence; CQ3 – Motivational cultural intelligence; CQ4 – Behavioral cultural intelligence. Multicultural leadership is measured using four indicators: ML1 – Administrative skills; ML2 – Interpersonal skills; ML3 – Conceptual skills; ML4 – Multicultural skills. These variables and indicators were defined based on our literature review.

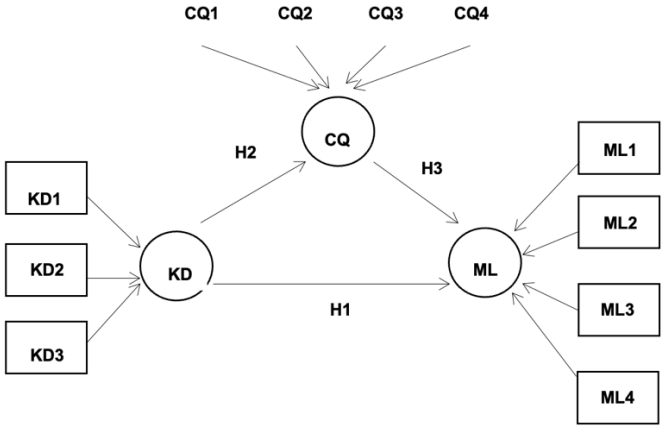


Figure 1: The research model

We designed a questionnaire based on the research model presented in Figure 1 and distributed it online to 396 managers working in multinational companies worldwide. We received 439 answers, out of which we could use 396 valid questionnaires. To establish the sample size we used the standard procedure and data obtained from adequate databases like ILO (2021), STATISTA (2021), and ZIPPIA (2022). The questionnaire has an introductory part where we explain the purpose of the project and guarantee the data confidentiality. Our study reached out to potential participants for the questionnaire through targeted online social media and personal connections such as LinkedIn, Facebook, and email. We used our personal networks of managers working in multinational companies worldwide. Also, we used SurveyMonkey, a worldwide recognized platform for professional online surveys. The valid response recovery rate was 89.14% (396 valid and recorded answers from 439). The demographic statistics show that the respondents can be grouped into three categories: a) males (n=200, 50.5%); b) females (n=188, 47.5%); c) non-binary group (n=8, 2.0%). The educational groups were formed of university graduates (n=164, 41.4%), master graduates (n=157, 39.6%), Ph.D. graduates (n=48, 12.1%), and high school only (n=27, 6.8%). The geographic distribution shows that a number of 47 (11.9%) participants were from Africa, 70 (19.9%) were from Asia, 130 (32.8%) were from Australia, 73 (18.4%) were from Europe, 73 (18.4%) were from North America, and 29 (7.3%) were from South America.

4. Results and Discussions

In the first stage of our analysis, we used IBM SPSS Statistics version 22 software to check the validity of variables, and Cronbach's Alpha's values, for reliability. In the second stage, we used the Partial Least Squares Structural Equation Modeling (PLS-SEM) to test our hypotheses (Hair et al., 2017; Hair et al., 2019). For reliability, we analyzed the factor loading for each item and found that their values were higher than 0.70 (Hair et al., 2019). Therefore, we retain all items for further analysis. All constructs and sub-constructs of the research model met the significant construct reliability threshold of $\alpha > 0.80$.

Our analysis proved that knowledge dynamics has a positive influence on multicultural leadership. Therefore, the hypothesis H1 is validated. Also, knowledge dynamics has a positive influence on cultural intelligence. Therefore, the hypothesis H2 is validated. Furthermore, cultural intelligence has a positive influence on multicultural leadership. Therefore, the hypothesis H3 is validated. In conclusion, all three hypotheses we considered in the present research model are valid, which demonstrates its logical consistency.

The validation of this research model shows that it can be used for further investigations considering more variables and the roles of mediation and moderation. Also, the present research has practical implications for managers and leaders working in multicultural business environments making them aware of the cognitive connections between knowledge dynamics, cultural intelligence, and multicultural leadership. Knowledge dynamics is at the heart of any decision making and thus it is critical for multicultural leadership. The balance between rational, emotional, and spiritual knowledge entering the dynamics varies from one culture to another and therefore leaders should be aware of knowledge dynamics (Bratianu et al., 2020; Bratianu, 2023; Kahneman, 2011). The capacity to understand the potential barriers of cultural diversity and overcome them can be improved through the mediating role of cultural intelligence and the new achievements of neuroscientists (Ang & Van Dyne, 2015; Davidovich & Brunton, 2023; Meyer, 2014). From this perspective, the present research has a

5. Conclusions and Limitations

The present research starts from the new leadership context created by the internalization and globalization of the business processes. Leading teams composed of people coming from different cultures requires a new understanding of how people react to designing and implementing business projects. That difficulty is generated by the different balances between rational, emotional, and spiritual knowledge and intelligence which are specific for different cultures. Knowledge dynamics is the core mechanism in any managerial decision making process and therefore it has a significant influence on multicultural leadership. Also, knowledge dynamics impacts on cultural intelligence, a meta-intelligence that is specific for people living and working in multicultural social contexts. Multicultural intelligence represents the capacity to understand how people from different cultures think and behave. Having different value sets they have different attitudes and behaviors in organizational environments. Multicultural leaders should be capable of anticipating possible working conflicts and finding solutions for mitigation when they appear.

The present research aims at analyzing the influence of knowledge dynamics on multicultural leadership directly and indirectly through the mediation of cultural intelligence. Therefore, we designed a research model

composed of these three main constructs (i.e. knowledge dynamics, cultural intelligence and multicultural leadership) and their relationships. We performed a critical literature review of the literature to extract some ideas from previous similar research and to use them. However, we found that the construct of knowledge dynamics from the thermodynamics perspective was not incorporated in previous studies. Identifying this knowledge gap we designed a questionnaire and a worldwide investigation among the managers working in multicultural business contexts. We collected data from 439 respondents and validated 396 answers. In the first stage of statistical analysis we used IBM SPSS software, and in the second stage we used PLS-SEM software. Findings show that our hypotheses are valid, and therefore we can state that knowledge dynamics influences positively multicultural leadership through the mediating role of cultural intelligence.

The main limitation of the present research comes from the fact that the decision making process of leaders in multicultural companies is a nonlinear process, and we had to consider a simplified linearized model for the purpose of evaluating the interactions between the three constructs (i.e. knowledge dynamics, cultural intelligence, and multicultural leadership). That is in accordance with the logic inherent in the statistical analysis with IBM SPSS and PLS-SEM.

References

Ang, S., & Van Dyne, L. (2015). Handbook of cultural intelligence: Theory, measurement and applications. 2nd Edition. Routledge, London.

Argote, L. (2013). Organizational learning: Creating, retaining and transferring knowledge. Second Edition. Springer, New York.

Aristotle (1999). Nicomachean ethics. Second Edition. Hackett Publishing Company, Indianapolis.

Batsa, E.T., Abadir, S., & Neubert, M. (2020). Bicultural managers leading multicultural teams: A conceptual case study. International Journal of Teaching Case Studies, 11(1), 71-93.

Bereiter, C. (2002). Education and mind in the knowledge edge. Routledge, New York.

Bolisani, E. and Oltramari, A. (2012). Knowledge as a measurable object in a business context: A stock-and-flow approach. Knowledge Management Research & Practice, 10(3), 275-286.

Bratianu, C. (2007). An integrated perspective on the organizational intellectual capital. Review of Management and Economical Engineering, 6(5), 107-112.

Bratianu, C. (2022). Knowledge Strategies. Cambridge University Press, Cambridge.

Bratianu, C. (2023). Knowledge dynamics: Exploring its meanings and interpretations. Management Dynamics in the Knowledge Economy, 11(2), 100-111. https://doi.org/10.2478/mdke-2023-0007.

Bratianu, C., & Bejinaru, R. (2020). Knowledge dynamics: A thermodynamics approach. Kybernetes, 49(1), 6-21.

Bratianu, C., & Paiuc, D. (2023). Diversity and inclusion within multicultural leadership in the COVID years: A bibliometric study 2019-2022. Oradea Journal of Business and Economics, 8(1), 40-51.

Bratianu, C., Vatamanescu, E.M., Anagnoste, S., & Dominici, G. (2020). Untangling knowledge fields and knowledge dynamics within the decision making process. Management Decision, 59(2), 306-323.

Cegarra-Navarro, J.G., & Wensley, A. (2019). Promoting intentional unlearning through an unlearning cycle. Journal of Organizational Change Management, 32(1), 67-79.

Cegarra-Navarro, J.G., Elridge, S., & Martinez-Martinez, A. (2010). Managing environmental knowledge through unlearning in Spanish hospitality companies. Journal of Environmental Psychology, 30(2), 249-257.

Damasio, A. (2012). Self comes to mind: Constructing the conscious brain. Vintage Books, New York.

Davidovich, C., & Brunton, J.E. (2023). Five brain leadership: How neuroscience can help you master your instincts and build better teams. Page Two.

DeLong, D.W. (2004). Lost knowledge: Confronting the threat of an aging workforce. Oxford University Press, Oxford.

Gardner, H. (1983). Frames of the mind: The theory of multiple intelligences. Basic Books, New York.

Gladwell, M. (2005). Blink: The power of thinking without thinking. Back Bay Books, New York.

Goleman, D. (1995). Emotional intelligence. Bantam, New York.

Goleman, D. (2007). Social intelligence: The new science of human relationships. Bantam, New York.

Hair, J.F., Hult, J.T.M., Ringle, C.M., & Sarstedt, M. (2017). A primer on Partial Least Squares Structural Equations Modeling (PLS-SEM). 2nd Edition. Sage Publications, San Francisco.

Hair, J.F., Risher, J.J., Sarstedt, M., & Ringle, C.M. (2019). When to use and how to report the results of PLS-SEM. European Business Review, 31(1), 2-24.

Hawkins, J., & Blakeslee, S. (2004). On intelligence. Times Books, New York.

Hill, D. (2008). Emotionomics: Leveraging emotions for business success. Revised Edition, Kogan Page, London.

ILO. (2021). World employment and social outlook: Trends 2021. In: International Labour Organization.

Iskhakova, M., & Ott, D.L. (2020). Working in culturally diverse teams. Journal of International Education and Business, 13(1), 37-54.

Kahneman, D. (2011). Thinking, fast and slow. Strauss, Giroux and Farrar, New York.

Kaiser, A., & Martinez, H.A. (2023). Future paths of knowledge management: How do spirituality, calling, and knowledge management fit together? In: Bratianu, C., Handzic, M., & Bolisani, E. (2023). The future of knowledge management:

Reflections from the 10th anniversary of the International Association of Knowledge Management (IAKM). Springer, Cham.

Kianto, A. (2007). What do we really mean by the dynamic dimension of intellectual capital? International
Journal of Learning and Intellectual Capital, 4(4), 342-356.

Kianto, A., Inkinen, H., Ritala, P., & Vanhala, M. (2017). A temporal perspective to the intellectual capital in Finnish firms from 2013 to 2017. In: Tsui, E. & Cheung, B. (Eds.). Proceedings of the 14th ICIKM, 7-8 December 2017, The Hong Kong Polytechnic University, pp. 134-138. Academic Conferences and Publishing International, Reading.

Kolb, D.A. (2015). Experiential learning: Experience as the source of learning and developing. Second Edition. Pearson Education, Upper Saddle River.

Lewis, R.D. (2018). When cultures collide: Leading across cultures. 4th Edition. Nicholas Brealey Publishing, London.

Mayer, J.D., Salovey, P. & Caruso, D.R. (2004). Emotional intelligence: Theory, findings and implications. Psychology Inquiry, 15(3), 197-215.

Meyer, E. (2014). The culture map: Decoding how people think, lead, and get things done across cultures. Public Affairs, New York.

Nissen, M.E. (2006). Harnessing knowledge dynamics: Principled organizational knowing & learning. IRM Press, Hershey.

Nonaka, I., & Takeuchi, H. (1995). The knowledge-creating company: How Japanese companies create the dynamics of innovation. Oxford University Press, Oxford.

Nonaka, I., & Takeuchi, H. (2019). The wise company: How companies create continuous innovation. Oxford University Press, Oxford.

Nonaka, I., Toyama, R. and Hirotaka, T. (2008). Managing flow: A process theory of the knowledge-based firm. Palgrave Macmillan, New York.

Paiuc, D. (2021). The impact of cultural intelligence on multinational leadership: A semantic review. Management Dynamics in the Knowledge Economy, 9(1), 81-93.

Pinker, S. (2021). Rationality: What it is, why it seems scarce, why it matters. Viking, New York.

Rocha, R., & Pinheiro, P. (2021). Can organizational spirituality contribute to knowledge management? Management Dynamics in the Knowledge Economy, 9(1), 107-121.

Rocha, R., Pinheiro, P., d'Angeles, M., & Kragulj, F. (2021). Organizational phronesis scale development. In: Garcia-Perez, A., & Simkin, L. (Eds.). Proceedings of the 22nd European Conference on Knowledge Management (pp. 631-638), Coventry University, UK, 2-3 September 2021.

Shotter, J., & Tsoukas, H. (2014). Performing phronesis: On the way to engaged judgment. Management Learning, 45(4), 377-396.

Salovey, P. & Mayer, J. (1990). Emotional intelligence. Imagination, Cognition and Personality, 9(3), 185-211.

Simon, H. (1996). The science of artificial. 3rd Edition. The MIT Press, Cambridge.

Song, J., & Lee, K. (2014). The Samsung way: Transformational management strategies from the world leader in innovation and design. McGraw-Hill.

Stahl, G.K., & Maznevski, M.L. (2021). Unraveling the effects of cultural diversity in teams: A retrospective of research on multicultural work groups and an agenda for future research. Journal of International Business Studies, 52(1), 4-22.

STATISTA. (2021). Number of employees worldwide from 1991 to 2022 (in billions). https://www.statista.com/statistics/1258612/global-employment-figures/

Vatamanescu, E.M., & Mitan, A. (2024). Managerial relationships and SMEs internationalization: Unweaving the fabric of business performance. Routledge, New York.

ZIPPIA. (2022). Manager demographics and statistics (2021): Number of managers in the US. https://www.zippia.com/manager-jobs/demographics.

Zohar, D., & Marshall, I. (2004). Spiritual capital: Wealth we can live by. Berrett-Koehler Publishers, San Francisco.

Knowledge Management Practices in Hospital Management: An Integrative Review

Jakeline Becker Carbonera, Cristiano José Castro de Almeida Cunha, and Solange Maria da Silva
Florianópolis, Santa Catarina, Brazil

jakeline.carbonera@ufsc.br
01cunha@gmail.com
solange.silva@ufsc.br

Abstract: This research seeks to identify the state of the art regarding knowledge management practices that have been applied in hospitals with a specific focus on how these practices improve organizational effectiveness, innovation, and performance. Using an integrative review methodology that includes problem identification, strategic literature search, rigorous data evaluation, thematic analysis, and synthetic presentation of results, the research encompassed 19 relevant studies extracted from the Scopus, EBSCOhost, and Scielo platforms. The results demonstrate a predominant use of information technologies, reinforcement of organizational culture, and strengthening of trust and organizational learning. Remarkably, leadership emerged as a critical factor, not only for facilitating the implementation of knowledge management practices but also for actively involving employees in achieving organizational goals. There is also clear demand for substantial increases in investments in training and collaboration technologies to maximize the potential for knowledge creation, retention, and sharing in hospitals.

Keywords: Knowledge Management, Organizational Practices in Hospitals, Organizational Culture and Leadership, Organizational Learning, Health Information Technologies.

1. Introduction

Managing an organization is challenging, especially when it comes to hospitals. Promoting the commitment of a team to the management of human, financial, social, and asset resources with quality, economy, sustainability, and effectiveness requires a differentiated approach to management (Cançado et al., 2020).

Hospitals, regardless of their public or private nature, constitute a business and need to adopt efficient management methods to ensure their permanence (Vilaça & Oliveira, 2008). This need has been partially met by Knowledge Management (KM), whose dissemination of knowledge is crucial in organizational strategy (Colauto & Beuren, 2003). Siddique et al. (2021, p. 04) understand that " knowledge management in a hospital requires well reputable and contributive mechanism, which enriches the main objective of serving humanity and saving a life."

Knowledge Management is considered by Barroso and Gomes (1999) as the ability to identify and map intellectual assets; generate new knowledge to offer market competitive advantages and promote accessibility of large amounts of information by sharing best practices and technology (Barroso & Gomes, 1999). It " improves the competitive advantage and enhances the performance of an organization, its role in the process of innovation and sustainable development cannot be disputed" (Popa et al., 2018, p.555).

Nonaka and Takeuchi (1997, p.01) understand "organizational knowledge creation as the ability of a company to create new knowledge, disseminate it throughout the organization, and incorporate it into products, services, and systems." Knowledge sharing improves services in organizations, elevating them to the status of learning organizations where lessons learned are made available for continuous learning by others (Alajmi et al., 2015; Shateri & Hayat, 2020).

Managers and leaders have already realized that promoting the increase and development of intellectual capital through knowledge management practices is an important action to elevate the company to the knowledge society (Popa et al., 2018).

Knowledge management practices are "the various activities, procedures, techniques and systems which are explicitly intended or utilized for creating and processing knowledge" (Casco, 2000, p. 634). They can provide support to companies in building practical measures to improve their responsiveness, breaking with innovation constraints arising from organizational culture or history (Casco, 2000).

In the health sector, KM has been considered a means to address current challenges such as the introduction of new technologies, the need to provide services to an aging population with chronic diseases, budget cuts, and

the need to redesign the system after the COVID-19 pandemic (Dal Mas et al., 2020). In this sense, the adoption of KM practices can provide health organizations with improved quality of care (Colauto & Beuren, 2003; Shateri & Hayat, 2020). Therefore, hospitals in developing countries are encouraged to develop knowledge management tools to improve hospital performance and practice in the healthcare sector (Shateri & Hayat, 2020), emphasizing KM in patient care rather than information (Tang, 2017a).

However, the application of Knowledge Management practices in hospitals has been very problematic (Alajmi et al., 2015), and the operationalization of knowledge management in different healthcare organizations is not similar, resulting in problems in adapting practices and strategies in healthcare (Siddique et al., 2021).

Considering the specificities and difficulties of applying KM practices in hospitals, this research aims to identify the state of the art regarding knowledge management practices that have been applied in hospitals with a specific focus on how these practices improve organizational effectiveness, innovation, and performance.

2. Method

This research adopts the integrative review method proposed by Whittemore and Knafl (2005), consisting of 5 phases: problem identification, literature search, data evaluation, data analysis, and presentation of results.

2.1 Problem Identification

Considering the importance of KM today and the difficulties in its development in healthcare management, the research question of this review was to investigate how knowledge management practices have been applied in hospital management.

2.2 Literature Search

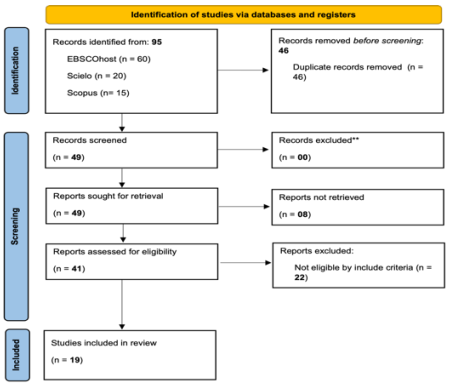
The data search was conducted in the databases of the Scopus, EBSCOhost, and Scielo platforms, using the search string: Hospital AND Knowledge Management Practice. Ninety-five articles were found, and after applying inclusion criteria and removing duplicates, 41 documents remained for analysis. After analyzing the 41 studies through full-text reading, under the lens of the guiding question of this research and the inclusion and exclusion criteria (Table 01), 19 articles remained for thematic analysis of the data. The process of capturing studies is presented in the flow diagram for integrative reviews, which included searches of databases and registers only, presented in Figure 01.

Table 1: Criteria for inclusion and exclusion of articles.

Inclusion Criteria	Exclusion Criteria
Articles referring to hospital management	Articles not related to the research question
Peer-reviewed articles	Articles published before 2017
Articles published after 2017	

Source: Developed by the authors (2024).

Figure 1: Flow diagram for integrative reviews which included searches of databases and registers only



Source: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. Doi: 10.1136/bmj.n71. For more information, visit: http://www.prisma-statement.org/

2.3 Data Evaluation

The articles included in this review were analyzed to identify emerging themes and subthemes. Table 02 presents the list of articles and some of their characteristics.

Table 2: List of articles selected for analysis

Authors	Method	Themes Identified	Conclusions
Ayanbode & Nwagwu , 2021	Quantitative	Technology	The use of collaborative technologies has a direct effect on KM processes and impacts the creation, sharing, transfer and retention of knowledge.
Zhou et al., 2021	Quantitative	Technology Organizational Learning	Improving and promoting the development of intellectual capital through KM practices, associated with technological tools, is an important action to elevate the company in the knowledge society.
Siddique et al., 2021	Quantitative	Technology Organizational culture	KM practices increase efficiency and reduce risks by optimizing resources and providing the development of organizational performance.
Rosário et al., 2021	Qualitative and quantitative	Technology	It is concluded that knowledge management (KM) has become an institution in the health sector.
Ekionea & Fillion , 2021	Qualitative	Organizational Trust	Organizational maturity is achieved when KM processes are effectively managed and applied.
Dal Mas et al., 2020	Qualitative case study	Technology	Institutions must guarantee knowledge translation mechanisms so that it is possible to alleviate differences and provide for the creation and sharing of knowledge.
Shateri et al., 2020	Quantitative	Organizational trust	The results revealed a significant and positive association between perception of organizational support, organizational trust, and knowledge sharing.
Karamitri , et al., 2020	Quantitative	Organizational culture	Leaders must encourage and form a corporate culture beneficial to knowledge sharing and must work on a KM system to enable this sharing in the medical industry.
Gao & Sun, 2020	Evolutionary game theory	Organizational trust	It is necessary to equalize the level of knowledge of groups, increase the degree of trust, reduce the cost of sharing, and increase incentives. Differences in the formation of knowledge between decision makers affect the quality of the process.
Ayatollahi & Zeraatkar , 2020	Qualitative	Technology Organizational culture	Therapy team members should focus on using technology to continually create and share knowledge.
Ouédraogo & Rinfret , 2019	Quantitative	Technology Organizational culture Organizational learning	The organizational determinants for sharing and promoting knowledge management among managers are organizational structure, leadership, organizational culture, organizational climate, technology, training, and performance guidance.
Liu & Li, 2019.	Quantitative survey	Technology Organizational culture Organizational learning	The proposed information system helps to optimize hospital organization, improve knowledge, and increase the quality and efficiency of medical services through learning and knowledge management.
Popa, et al. 2018	Quantitative survey	Technology Organizational culture	Improving and promoting increased development of intellectual capital with KM practices, associated with technological tools, is a relevant action to elevate the company in the knowledge society.

Authors	Method	Themes Identified	Conclusions
Tian et al., 2018	Quantitative and survey	Technology Organizational learning Organizational culture Organizational trust	Companies must implement actions based on promoting participatory leadership, promoting managerial knowledge, sharing, a culture of collaboration and trust, decentralized decision-making, communication, continuing education, and appropriate technologies.
Karamitri et al., 2017	Qualitative	Technology Organizational Learning	Healthcare managers must cultivate a knowledge environment, function as role models, provide the tools for KM, and reward people who act as knowledge brokers.
Bahar , et al., 2017	Qualitative	Organizational culture	The studies analyzed reinforce the relevance of the scientific search to support KM practices in health, as well as using and transforming information into practices that can be socialized to health professionals.
Tang, 2017a	Quantitative	Technology Organizational culture	Technological resources can improve efficiency and performance but may not directly improve finances. IT management capacity and knowledge plays a significant role in improving clinical performance.
Tang, 2017b	Quantitative	Organizational learning	The results of this study indicated a significantly positive correlation between KM, culture, performance, and organizational effectiveness
Alolayyan et al., 2020	Quantitative	Organizational culture of sharing	The better the KM, the greater the organizational effectiveness and organizational culture, as it influences organizational culture and improves the organization's effectiveness.

Source: Prepared by the authors (2024)

2.4 Data Analysis

The analysis of the articles eligible for this review was conducted based on thematic analysis by Braun and Clark (2012). Through thematic analysis of the selected studies, themes and subthemes related to the use of KM practices in hospitals and healthcare organizations were identified. The themes and subthemes are presented in Table 03 along with the authors who addressed them.

Table 3: Analysis Themes

Themes	Subthemes	Authors
Information Technology - IT	Improvement of clinical, organizational performance and decision making; *Strengthening knowledge management*	Ayanbode & Nwagwu , 2021; Zhou et al., 2021; Siddique et al., 2021; Rosário et al., 2021; Dal Mas et al., 2020; Ayatollahi & Zeraatkar , 2020; Ouédraogo & Rinfret , 2019; Kartawiguna et al., 2019; Liu & Li, 2019; Popa et al., 2018; Tian et al., 2018; Tang, 2017a.
Culture Organizational	Organizational performance and effectiveness Innovation	Siddique et al., 2021; Karamitri , et al., 2020; Ouédraogo & Rinfret , 2019; Liu & Li, 2019; Popa, et al. 2018; Tian et al., 2018; Bahar , et al., 2017; Tang, 2017a; Alolayyan et al., 2020.
Organizational Trust	Productivity, achieving objectives and sharing knowledge	Ekionea ; Fillion , 2021; Shateri et al., 2020; Gao & Sun, 2020; Tian et al., 2018.
Organizational Learning	Continuously improving sharing, effectiveness, and performance	Zhou et al., 2021; Ouédraogo & Rinfret , 2019; Tian et al., 2018; Karamitri et al., 2017; Tang, 2017b; Liu; & Li, 2019.

Source: Prepared by the authors (2021).

2.5 Presentation of Results

The themes and subthemes displayed in Table 03 are presented and discussed in Section 4.

3. Presentation and Discussion of Results

Based on the analysis of the selected articles, it was identified that the most applied KM practices in hospitals are technology, organizational culture, trust, and organizational learning. Such practices and the impacts of their application are further explained in the following sections.

3.1 Information Technology - IT

In the analyzed articles, it was found that technology is imperative in the development of KM in hospital institutions (Siddique et al., 2021). Its results lead to better clinical and organizational performance, driving the processes of knowledge creation, sharing, and retention, supporting decision-making processes, increasing efficiency, reducing risks, optimizing resources, and leveraging the KM process (Ayatollahi & Zeraatkar, 2020; Siddique et al., 2021; Zhou et al., 2021; Alolayyan et al., 2020; Tang, 2017; Rosário et al., 2021; Dal Mas et al., 2020; Ouédraogo & Rinfret, 2019; Liu & Li, 2019; Popa et al., 2018; Tian et al., 2018). Its impacts are discussed below.

3.1.1 Improvement of Clinical, Organizational Performance, and Decision Making

The use of collaborative technologies has a direct impact on KM processes and indirectly on the creation, sharing, transfer, and retention of knowledge (Ayatollahi & Zeraatkar, 2020). Clinical team members should focus on using technologies that effectively support the process of externalization, combination, and internalization of knowledge, improving the clinical performance of the team and the hospital (Ayatollahi & Zeraatkar, 2020).

A study conducted at the University Hospital in Pakistan pointed out that the intensive use of technological tools in the workplace increases efficiency, reduces risks, optimizes financial resources and revenues, improves organizational performance, and decision-making (Siddique et al., 2021).

The adoption of innovative technologies leads to increased intellectual capital and improvement in organizational performance, promoting market development, better brand reputation, increased organizational value, intellectual capital, and consequently, profits (Zhou et al., 2021).

3.1.2 Strengthening Knowledge Management

Information and communication technologies, when combined, facilitate cross-fertilization of ideas, intuition, skills, and experience for effective personal and collective management, professional development, and efficiency (Ayatollahi & Zeraatkar, 2020).

The study by Alolayyan et al. (2020) in Indonesian hospitals concluded that only organizations that have a constant routine of creating and disseminating new knowledge and technologies, especially in the field of medicine, will succeed.

Governments should focus on improving investments in technology, offering incentives to hospitals or healthcare organizations that have programs to improve their technological capacity, and directing their focus on the competitive advantages provided by KM (Alolayyan et al., 2020; Tang, 2017a).

3.2 Organizational Culture

Different studies have shown that the establishment of an organizational culture of knowledge sharing leads to improved organizational performance and effectiveness, as well as fostering innovation (Tang, 2017b; Alolayyan et al., 2020; Sussan, 2012; Karamitri et al., 2020; Siddique et al., 2021; Ouédraogo & Rinfret, 2019; Liu & Li, 2019; Popa et al., 2018; Tian et al., 2018; Bahar et al., 2017; Tang, 2017a).

3.2.1 Organizational Performance and Effectiveness

The purpose of Knowledge Management is the creation, accumulation, and use of knowledge. For this reason, a good capacity for knowledge creation can contribute to the increase in organizational effectiveness in the health industry (Tang, 2017b, p.1842).

In Abu Dhabi, research identified that KM influences organizational culture and improves organizational effectiveness (Alolayyan et al., 2020). It is necessary, therefore, to strengthen education and integrate channels among employees so that professionals can acquire new knowledge and exchange their skills in a timely manner (Alolayyan et al., 2020).

3.2.2 Innovation

Organizational culture is linked to the development of KM. According to Sussan (2012), the primary condition for a company to create high-quality organizational innovation is to establish a culture and corporate environment of knowledge sharing.

Considering that without innovation organizations do not survive in the market, one of the goals of KM is to contribute to organizations improving their capacities to recognize, manage, and produce successful innovations (Karamitri et al., 2020). To innovate, it is important to establish a culture of knowledge sharing because "people are willing to share information with others as long as they are motivated" (Karamitri et al., 2020; p.09).

The results found in this theme show the importance of organizational culture for Knowledge Management. Organizational culture is a set of norms and values that influence the behavior of members of an organization (Sussan, 2012) and, therefore, affects the sharing behavior of knowledge and information among its members (Allameh et al., 2012). Therefore, KM thrives more strongly in organizations where there is a culture of knowledge sharing (Allameh et al., 2012).

3.3 Organizational Trust

Among the KM practices used in healthcare management, organizational trust was identified as an effective strategy for: 1) achieving a good level of productivity; 2) effectiveness in task development and achievement of organizational objectives; and 3) leveraging knowledge sharing. Additionally, organizational trust is closely related to organizational culture and learning (Ekionea & Fillion, 2021; Shateri et al., 2020; Gao & Sun, 2020; Tian et al., 2018). Its impacts are described below.

3.3.1 Productivity and Task Effectiveness

Trust between leaders and employees is essential for organizational effectiveness (Gao & Sun, 2020). Trust is the result of repeated interactions, where individuals can predict each other's behavior with some certainty, reducing uncertainty in human relationships (Fillion, 2021).

The effectiveness of tasks depends largely on trust between organizational members (Shateri et al., 2020). Trust in colleagues and managers, when high, creates a favorable environment for knowledge sharing, which in turn improves organizational productivity (Gao & Sun, 2020).

3.3.2 Knowledge Sharing

Trust facilitates knowledge sharing between colleagues and supervisors (Ekionea & Fillion, 2021; Shateri et al., 2020; Gao & Sun, 2020). This sharing is essential for improving task performance and achieving organizational goals (Ekionea & Fillion, 2021). Trust increases employees' willingness to share their knowledge, leading to better decision making, increased innovation, and better organizational performance (Gao & Sun, 2020; Shateri et al., 2020).

3.4 Organizational Learning

From the perspective of organizational learning, KM contributes to defining the quality of knowledge and the effectiveness of an organization (Lemay et al., 2012; Pérez López et al., 2004). In general, "organizational learning is the way companies enrich and organize knowledge and the tasks around the activities and the culture and develop effectiveness for improving the competencies of their workforce" (Ekionea & Fillion, 2021, p. 398).

According to the articles in this review, organizational learning relates to culture and the KM process. It encourages knowledge sharing, enhances organizational performance and "intelligence," and increases the effectiveness of the organization and its employees (Zhou et al., 2021; Ouédraogo & Rinfret, 2019; Liu & Li, 2019; Tian et al., 2018; Karamitri et al., 2017; Tang, 2017b). The detailed impact of this KM practice is presented below.

Tian et al. (2018, p.1980) believe that "the creation of a learning climate could reinforce the intention to execute knowledge management and knowledge sharing in an organization and further enhance the continuous progress of the organization."

In the same vein, Liu and Li (2019, p.474) consider that "in an era when intangible assets have become the source of wealth and progress, knowledge management and learning organization may be the missing factors " to improve organizational performance.

Strategically, KM encourages the organization to become "intelligent" and challenges its ways of doing and thinking about things and reinventing itself, thanks to its continuous processes of human and technological learning (Ouédraogo & Rinfret, 2019) provided by knowledge sharing practices.

Furthermore, organizational learning has a significant influence on organizational culture, which is crucial for shaping the sharing culture (Tang, 2017b). For this reason, leaders should encourage a problem-solving culture in the organization based on a willingness for lifelong learning (Chang et al., 2009; Karamitri et al., 2017).

4. Final Considerations

This study investigated the application of knowledge management (KM) practices in hospital administration and healthcare organizations, revealing that technology, organizational culture, trust, and organizational learning are the most prevalent practices. These practices have shown significant improvement in clinical and organizational performance, supporting effective decision-making, increasing efficiency, fostering innovation, and achieving strategic goals. Additionally, there has been continuous improvement in knowledge sharing among healthcare professionals.

The investment in training and learning programs that foster the creation, retention, and sharing of knowledge and the adoption of advanced KM technologies has been identified as a good strategy for hospitals to overcome organizational barriers and promote a culture of continuous learning and innovation.

Furthermore, it has been found that the development of knowledge management in hospitals improves organizational performance and the quality of services provided. The more KM is embedded in the organizational culture, the better the organizational climate, the capacity for innovation, the strategic development of learning, employee satisfaction, organizational learning, and patient care.

Therefore, considering the emerging technological revolution and the continuous need for organizational improvement in the healthcare sector, knowledge management consolidates itself as one of the main pillars for the sustainability of hospitals today and in the future.

5. Future Studies

From the analyzed research, it was possible to identify some practices used and their effects on healthcare organizations, and their limited use in the healthcare industry in general was noticeable. Future research is needed on the development of tools related to the generation, retention, and sharing of knowledge to improve innovation, performance, and patient care.

Studies are also important on each aspect addressed in the data analysis of this review related to organizational sustainability in healthcare and its adaptation in post-Covid-19 hospital routines, a fundamental milestone in health management in current society. Finally, we suggest research on the role and impacts of leadership in the implementation of KM in healthcare organizations.

Acknowledgment to Funding Agency

This work was carried out with the support of the Coordination for the Improvement of Higher Education Personnel (CAPES) – Funding Code 001.

References

Alajmi, B., Marouf, L., & Chaudhry, A. (2015). Knowledge Management Practices - A Study of Knowledge Management Adoption Among Physicians in Kuwait. World Academy of Science, Engineering and Technology, International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering, 9(1), 128-134.

Allameh, S. M., Abedini, A., Piscina, J. K., & Kazemi, A. (2012). An analysis of factors affecting team knowledge sharing in the central library of Isfahan University using the extension of Rational Action Theory. International Journal of Human Resource Studies, 2(1), 158.

Alolayyan, M. N., Alalawin, A. H., Alyahya, M. S., & Qamar, A. (2020). The impact of knowledge management practice on hospital performance in Abu Dhabi. In Cogent Business and Management (Vol. 7, Issue 1). https://doi.org/10.1080/23311975.2020.1827812.

Ayanbode, O. F., & Nwagwu, W. E. (2021). Collaborative technologies and knowledge management in psychiatric hospitals in Southwest Nigeria. Information Development, 37(1), 136–157. https://doi.org/10.1177/0266666919895563.

Ayatollahi, H., & Zeraatkar, K. (2020). Factors influencing the success of knowledge management process in health care organizations: a literature review. Health Information and Libraries Journal, 37(2), 98–117. https://doi.org/10.1111/hir.12285.

Bahar, N., & Bahri, S. (2017). Knowledge management process-oriented strategy for healthcare organizations. International Journal of Knowledge Management, 13(4), 73–89. https://doi.org/10.4018/IJKM.2017100104.

Barroso, A. C. de O. e Gomes, E. B. P. (1999). Trying to understand knowledge management. Revista de Administração Pública, 33(2), 147-170. Available at: https://periodicos.fgv.br/rap/article/view/7656 (Accessed: 25 April 2024).

Braun, V., & Clarke, V. (2012). Thematic analysis. APA handbook of research methods in psychology, Vol 2: Research designs: Quantitative, qualitative, neuropsychological, and biological., 2, 57–71. https://doi.org/10.1037/13620-004.

Cançado, V. L., Moraes, L. F. R. de, & Silva, E. M. da. (2020). Organizational commitment and human resource management practices: the case of company XSA. RAM. Mackenzie Management Review, 7, 11-37.

Casco, R., Combs, R., & Peltu, M. (2000). Knowledge management practices for innovation: an auditing tool for improvement. International Journal of Technology Management, 5-8, 633-656.

Colauto, R. D., & Beuren, I. M. (2003). Proposal for knowledge management evaluation in philanthropic entity: the case of a hospital organization. Contemporary Administration Review, 7, 163-185.

Dal Mas, F., Biancuzzi, H., Massaro, M., Barcellini, A., Cobianchi, L., & Miceli, L. (2020). Knowledge translation in oncology: a case study. Electronic Journal of Knowledge Management, 18(3), 212–223. https://doi.org/10.34190/EJKM.18.03.002.

Ekionea, J. P. B., & Fillion, G. (2021). Assessing KM capabilities in two African healthcare organizations: Case study. Electronic Journal of Knowledge Management, 18(3), 392–406. https://doi.org/10.34190/EJKM.18.3.2135.

Gao, Y., & Sun, B. (2020). The Large-Small Group-Based Evolutionary Game on Knowledge Sharing in Uncertain Environment under the Background of Telemedicine Service. Complexity, 2020. https://doi.org/10.1155/2020/9818417.

Karamitri, I., Kitsios, F., & Talias, M. (2020). Developement and validation of a knowledge management questionaire for Hospitals and other healthcare organizations. Sustainability, 12(2730), 1–15.

Kartawiguna, D., Prabowo, H., & Jap, T. (2019). The role of information technology in mediating the effect of medical resources on hospital clinical performance. International Journal of Advanced Trends in Computer Science and Engineering, 8(6), 2887–2892. https://doi.org/10.30534/ijatcse/2019/33862019.

Lemay, L., Bernier, L., Rinfret, N., & Houlfort, N. (2012). Organizational maturity of public organizations and knowledge management. Canadian Public Administration, 55(2), 291–314. https://doi.org/10.1111/j.1754-7121.2012.00223.x.

Liu, J., & Li, K. (2019). An information system of clinical pathway management based on the integration between knowledge management and learning organization. Engineering of Information Systems, 24(5), 473–480. https://doi.org/10.18280/isi.240503.

Nonaka, I., Byosiere, P., Borucki, C. C., & Konno, N. (1994). Organizational knowledge creation theory: A first comprehensive test. International Business Review, 3(4), 337–351. https://doi.org/10.1016/0969-5931(94)90027-2.

Nonaka, I., & Takeuchi, H. (1997). Knowledge Creation in Organizations - How Japanese Companies Generate the Dynamics of Innovation. Rio de Janeiro: Campus Publisher.

Popa, I., Ştefan, S. C., Morărescu, C., & Cicea, C. (2018). Research regarding the influence of knowledge management practices on employee satisfaction in the Romanian Healthcare System. Amfiteatru Economic, 20(49), 567–582. https://doi.org/10.24818/EA/2018/49/553.

Pérez López, S., Manuel Montes Peón, J., & José Vázquez Ordás, C. (2004). Knowledge management: The link between culture and organizational learning. Knowledge Management Review, 8(6), 93–104. https://doi.org/10.1108/13673270410567657.

Rosário, A. M. F. T., et al. (2021). Literature review on Knowledge Management in Health in the last 10 years (2009-2019). Electronic Journal of Knowledge Management, 18(3), pp. 338-355. Retrieved from www.ejkm.com

Shateri, K., & Hayat, A. A. (2020). Investigating the mediating role of organizational trust in the relationship between perceived organizational support and Knowledge sharing. Knowledge Management and E-Learning, 12(3), 298–314. https://doi.org/10.34105/j.kmel.2020.12.016.

Siddique, R., Shahzad, K., Siddique, I., & Hashmi, M. A. (2021). Exploring the Practices for Knowledge Management by Doctors of Services Hospital Lahore. Library Philosophy and Practice, 2021.

Sussan, F. (2012). Interaction with the consumer as intellectual capital. Journal of Intellectual Capital, 13(1), 81-105.

Tang, H. (2017a). A study of the effect of knowledge management on organizational culture and organizational effectiveness in medicine and health sciences. Eurasia Journal of Mathematics, Science and Technology Education, 13(6), 1831–1845. https://doi.org/10.12973/eurasia.2017.00700a.

Tang, H. (2017b). Effects of leadership behavior on knowledge management and organization innovation in Medicine and Health Sciences. Eurasia Journal of Mathematics, Science and Technology Education, 13(8), 5425–5433. https://doi.org/10.12973/eurasia.2017.00840a.

Tian, G., Cai, H., & Jiang, Y. (2018). A study of the effects of organizational support on organizational learning based on knowledge management. Eurasia Journal of Mathematics, Science and Technology Education, 14(5), 1979-1986.

Van Beveren, J. (2003). Does health care manage knowledge? Knowledge Management Review, 7(1), 90-95.

Vilaça, W. P. T., & Oliveira, M. de M. (2008). Sustainability and Communication in the hospital context: raising awareness. Journal of the Atomic Energy Society of Japan, 49(3), 209–210. https://doi.org/10.3327/jaesj.49.209.

Whittemore, R., & Knafl, K. (2005). The integrative review: Updated methodology. Journal of Advanced Nursing, 52(5), 546–553. https://doi.org/10.1111/j.1365-2648.2005.03621.x

Zhou, F., et al. (2021). Knowledge management practice of medical cloud logistics sector: semantic discovery of transport resources based on ontology modeling. Journal of Intellectual Capital, 22(2), 360-383.

Determinants and Strategies of Knowledge Transfer in Teaching Hospitals

Jolanta Chluska
Częstochowa University of Technology, Częstochowa, Poland

jolanta.chluska@pcz.pl

Abstract: Teaching hospitals are healthcare entities rendering healthcare services to patients. Specialized medical staff not only provide medical services, but also educate future medical staff, conduct clinical research and support the development of medical technologies. The majority of these staff are also research and teaching staff at medical universities. The aim of this article is to identify the determinants of knowledge transfer and the intellectual potential of employees in the relationship between teaching hospitals and medical universities. The inference was made on the basis of the available development strategies of medical universities, including reference to the intellectual potential of employees and the mission of teaching hospitals published on their websites. The following research questions were posed: Is the mission of medical universities consistent with the mission of teaching hospitals? Does the transfer of knowledge and skills of medical staff between a medical university and its teaching hospital contribute to the mission of teaching hospitals? The preliminary findings indicate that the intellectual capital of the scientific-medical staff is of vital importance in the mission of teaching hospitals, which is on a par with the development of the facilities. The analyses were of an expert nature, from the perspective of a statutory auditor and a long-standing researcher of the problems of the functioning of medical entities, namely hospitals. The considerations undertaken in the article are an important voice in the recognition of the determinants for the development of teaching hospitals as entities with intellectual capital useful in solving international health problems. The article is a continuation of the author's research on the development of intellectual capital of employees of teaching hospitals in Poland. The relationship between the findings of the development strategies of medical universities (the founding bodies) and the mission statements of their teaching hospitals confirm their coherence and complementarity.

Keywords: Knowledge Transfer, Intellectual Potential of Hospital Employees, Hospital Management, Knowledge Workers in Hospitals.

1. Introduction

In the era of the knowledge economy, knowledge is the most important asset of an organization. The theoretical and application value of the knowledge of employees is a crucial factor in the development of an economic entity. Learning processes accompany the decision-making and management of the entity, as well as having an impact on the environment. Teaching hospitals are specific economic entities in which human resources, the knowledge and skills of employees, constitute a key asset.

For most teaching hospitals, medical universities are the founding bodies. Medical universities educate future employees, namely, doctors and other medical staff. The place of their education and practical training is the teaching hospitals. The high-level skills of the medical staff are thus shaped by both academic education and practical classes. These relationships indicate the bidirectional nature of knowledge and skills transfer in the relationship between the two entities. When considering a knowledge transfer system, the close relationship between medical universities and teaching hospitals in the area of intellectual capital and human resources, their connections, and interactions must be taken into account. In order to educate future medical staff, their practical experience in patient treatment processes is essential. The reverse relationship can also be considered: the intellectual potential of medical staff is built to a large extent in the educational process. Educational processes accompany medical staff throughout their training and professional work. Lifelong education is embedded in the specifics of the profession and guaranteed by law (Law of 5 December 1996, Article 18).

Knowledge resources, from the point of view of their origins, can be divided into knowledge related to experience (skills), conceptual knowledge (concepts, projects), routine knowledge resources (organizational culture), or systemic knowledge resources (databases, patents, licenses) (Little, Ray, 2005, p.25). There are four basic phases in the knowledge life cycle, such as creation, mobilization, diffusion, and commoditization (Birkinshaw, Sheehan 2002, p.75). For the knowledge transfer process to be effective, all four phases are necessary and, in addition, the process should be continuous and strategic.

2. Essence and Principles of Knowledge Transfer: Literature Review

In an era of rapid technological progress and globalization, knowledge resources, which are a source of competitive advantage, are crucial for the development of a company. For the success of a business entity, knowledge sharing among employees is essential at all levels of collaboration and decision-making..

The concept of knowledge can be discussed based on different approaches and categories. It can be considered as tacit knowledge and explicit knowledge. Tacit knowledge is individual, specific and difficult to formalize. It includes skills, qualifications, and other individual characteristics of its holder. Explicit (accessible) knowledge is formalized by nature and can therefore be transferred between actors using specific tools and forms (Nonaka, Takeuchi 2000, p. 82). Other interesting characterizations of the essence and types of knowledge emphasize its features such as its universal and theoretical nature (episteme), practical and instrumental dimension (techne), "practical wisdom" (phronesis), its non-transferability (sticky knowledge) and the transferability of knowledge between entities, both within and outside the organization (leaky knowledge) (Szyjewski 2003, p.17; Kłusek-Wojciszke, B., Łosiewicz, 2009, p. 140). From the point of view of considerations on knowledge transfer in the health sector, I consider it important to divide knowledge into four categories as follows: know what (facts), know why (principles), know how (skills), know who (context) (Knowledge Management..., 2000, p. 21)."Know what" refers to the knowledge of "facts", "know why" is the knowledge that explains reality, "know how" refers to people's skills, public access to it is limited, "know who" - identifies knowledge holders and describes the extent of knowledge they have (Kłusek-Wojciszke, B., Łosiewicz, 2009, p. 139).

The foundation for the development of an economic entity and the achievement of a competitive advantage is not only the possession of the knowledge, but above all its transfer. Knowledge sharing takes place within the economic entity, but the directions of knowledge transfer may include inter-organizational relations. Proper communication at the entity level is determined by factors such as organizational structure, interpersonal (personnel) relations and organizational culture. These factors can determine both the successes and barriers to knowledge transfer. Among the factors constituting barriers and difficulties in knowledge transfer processes, the following are most often mentioned: the lack of mutual trust, limited perception of knowledge acquisition, the belief that knowledge is assigned to specific groups or positions, different needs and priorities among communication participants, attitudes of uncertainty towards researchers or the value of research, the lack of incentives to participate in communication, excess of various responsibilities, passive forms of knowledge exchange, top-down forms of this exchange, the lack of belief in the capacity and applicability of research knowledge and vice versa (Davenport, Prusak 1998 [after:] Klak M. 2010, p. 82 , Molleman, Fransen2012, p. 160, Gagliardi A. R. et al., 2016, p. 9).

In order to prevent and resolve barriers and difficulties in knowledge sharing, the management of teaching hospitals should establish strategies to deal with them and implement them consistently. Such solutions include the following: creating interpersonal relationships based on trust and cooperation, favouring teamwork among specialists from different disciplines, creating an effective and employee-accepted system of incentives and rewards, and promoting ethical and pro-social attitudes. Selected suggestions for strategies to improve knowledge transfer are presented in Table 1.

Table 1: Suggestions for strategies to improve knowledge transfer in selected publications

Author	Factors for improving knowledge transfer
Eljiz K. et al., 2020	The authors suggest the nine communication methods through which knowledge can be translated: research reports, posters, healthcare industry and academic presentations, peer-reviewed articles, presentations, podcasts, webinars, and infographics.
Wensing M., Grol R., 2019	1. *Researchers and advisors from different disciplines work together in multidisciplinary teams,* 2. *Better recognition of published work,* 3. *Validation of structured approaches,* 4. *Critical evaluation of the effects of implementation programmes,* 5. *Measurement of the results of improvement, transfer, and implementation according to a new generation of measures.*
Gagliardi A. R. et al., 2016	1. Numerous and varied opportunities for interaction, 2. Strong leadership commitment, skills, and experience, 3. Phased approach to developing a common language, achieving success, 4. Support from experts, champions, innovators, 5. Clear and agreed objectives, roles and expectations, 6. Cooperation between researchers and decision-makers, 7. Formalized creation of the brand, structure, and processes.
Wang W., Hou Y., 2015	8. Knowledge sharing is significantly influenced by rewards (hard and soft) and altruism for organizational benefit.
Van Acker F. et al., 2014	1. Trust increases the likelihood of disclosure of accurate information (based on benevolence and competences), 2. Actual knowledge sharing is more frequent in an interpersonal environment than online,

Author	Factors for improving knowledge transfer
	3. Trust in knowledge sharing is higher in an interpersonal environment than in an online environment.

Source: self-compilation based on literature.

In subject-related literature, the boundary between concepts such as data (facts, figures), information (processed data), knowledge (information and people), and wisdom (knowledge, intuition, experience) is sometimes blurred. However, their essence is indicated by attributes, defining their specificity and distinctiveness (complexity, users). (Włodarkiewicz-Klimek, 2016, p. 196)

The term 'knowledge transfer' can therefore be understood and considered at different levels of complexity, from data to information, reaching the goal of wisdom.

Knowledge transfer in the relationship between medical universities and teaching hospitals should be supplemented by additional directions of such transfer: within each entity, from entity to environment, and from environment to entity. Significant enrichment of the knowledge of medical (scientific and medical) staff takes place through their cooperation with the national and international environment. The experience of recent years with the COVID-19 pandemic, its control and prevention, has shown how valuable these relationships are.

3. The Teaching Hospital as a Knowledge Transfer Entity: Methodology of the Research.

The aim of this article is to identify the determinants of knowledge transfer and the intellectual potential of employees in the relationship between teaching hospitals and medical universities. The inference was made based on the available development strategies of medical universities, including reference to the intellectual potential of employees and the mission of teaching hospitals published on their websites.

1. In the research process, the following research questions were posed:
2. Is the mission of medical universities consistent with that of teaching hospitals?
3. Does the transfer of knowledge and skills of medical staff between the medical university and its teaching hospital contribute to the mission of teaching hospitals?

The research process consisted of the following stages:

1. Analysis of legislation on the rules governing teaching hospitals,
2. Recognition of the role of human resources and their intellectual capital in medical universities and teaching hospitals, knowledge building and transfer in these entities (literature review, review of the websites of teaching hospitals and medical universities, synthesis),
3. Compilation and classification of selected data characterizing human resources and the management of these resources, the missions and strategies of medical universities and teaching hospitals,
4. Expert analysis of the relationship of information from sources such as the development strategy of medical universities and teaching hospitals, as well as mission and strategy information materials (websites),
5. Analysis of the conclusions from selected areas of research conducted by the author in previous years on the intellectual capital of hospital employees,
6. Conclusions from the conducted research.

Out of 33 teaching and university hospitals, five teaching hospitals and their founding bodies - medical universities - were selected for analysis. Websites and documents published on them, including mission statements and development strategies were analysed.

The entities for the study were selected while taking into account the possibility of obtaining complete data on documents with a defined mission and strategy of the teaching hospital and its founding body, namely the medical university. In many cases, the development strategy of the medical university was available for analysis, but the teaching hospital established by it did not publish a development strategy, or a formulated mission. The websites of teaching hospitals in the vast majority of cases do not publish activity strategies. Development strategies of teaching hospitals are developed, but they are considered to be classified documents.

Among teaching and university hospitals, 24 of them are on the list of hospitals accredited for the quality of medical services. The list of 187 accredited hospitals is published by the CMJOZ (Centre for Monitoring Quality in Health Care) (List of accredited hospitals, 2024). One of the prerequisites for a hospital to be accredited is to have a strategic plan, while taking into account the fact that the results of the health needs analysis, while also

the need to act on the requirements and financial feasibility of the plan. The strategic plan should include a description of the policy for improving the quality of services provided and this plan should be updated periodically. It is also an important requirement to have a staffing plan and human resource management to carry out tasks such as the following:

1. Implementation of a policy of continuous improvement of staff qualifications,
2. Identification of the educational needs of specific professional groups,
3. Establishment of a training plan for employees, including, among others, quality management,
4. Provision of financial resources for training,
5. Assessment of staff qualifications and professional activity,
6. Employee evaluation,
7. Actions taken on the basis of the conclusions of the staff evaluation (Standards, p. 122).

The CMJOZ periodically assesses the level of implementation of the applicable standards. As the results of the analyses, which are included in the document 'Level of fulfilment of accreditation standards in hospitals in 2022', show, the highest score achieved by a hospital is 96% and the lowest is 42% in terms of the fulfilment of the requirements of accreditation standards. In terms of human resource management, almost 40% of the surveyed accredited hospitals achieved a score of above 90% with regard to meeting the accreditation requirements. The high level of fulfilment of the standards means that the tasks of effective human capital management and human resources are important management areas for these entities. The published results are in the form of a median and are not attributed to specific hospitals. (Levels of fulfilment of standards, pp. 2, 15)

4. Knowledge as a Resource in the Development of the Hospital - Research Findings

Teaching hospitals are distinguished among medical entities not only by the type of specialized health services as an object of activity, but also by their important tasks in the training of medical staff, the performance of teaching, research, consultation, opinion-forming functions, and other tasks assigned by scientific institutions, local government units, or central authorities. Hospitals may carry out economic activities if they do not impede the basic tasks for which they have been established. Such a wide range of activities, educational, research, and scientific tasks is conditioned by a very high level of knowledge and skills of medical staff. Therefore, this group of healthcare entities was chosen as research subjects. Teaching hospitals constitute a knowledge management environment for the intellectual capital (Bose, 2003). Medical universities are also such an environment. Employees of teaching hospitals continuously develop their intellectual potential, which is a long-term activity of strategic importance. The place for the education and continuous training of medical staff is primarily the medical universities. Medical employees are at the same time academics, hence the knowledge they possess is not only developed, but also transferred between different entities.

These strong personal ties justify the link between the missions and strategies of teaching hospitals and their founding bodies, namely, medical universities. The mission of a teaching hospital and its founding medical university was examined, using selected examples. The results of the analyses are presented in Table 2.

Table 2: Teaching hospitals and medical university - missions and strategies

Pos.	Mission of the teaching hospital	Mission of the medical university (the founding body)
		Medical university development strategy
1.	The highest level of treatment, education, research - the constant pursuit of excellence in the field of healthcare	We provide high quality education and research in medical and health sciences. We make a significant contribution to the development of the healthcare system. We are an efficiently managed university whose foundation is people - talented students, excellent teachers, passionate scientists, and professional managers.
Strategic objective 2: Promotion of employee performance and engagement		
Operational objective 1: Development of internal and external recruitment		
Operational objective 2: Promotion of the culture of continuous improvement		
Operational objective 3: Improvement of management competences, leadership, and ability to develop innovative attitudes among employees		
Operational objective 4: Improvement of the teaching staff competences		

Pos.	Mission of the teaching hospital	Mission of the medical university (the founding body)
2.	Our vocation is to treat, educate and conduct research	Creating and strengthening the intellectual capital of the country and the region based on highly qualified medical staff, modern teaching facilities and high-quality educational methods. State-of-the-art pre-graduate and post-graduate medical staff training, combined with the recruitment of new and upskilling of existing academic staff. Raising - nationally and regionally - the level of knowledge, skills, and competences in the field of health sciences.
Strategic objectives 1. Provision of modern and effective education for students in the first and subsequent 6-year teaching cycles 2. Continuous improvement of the quality of education in terms of acquiring the latest medical knowledge, practical professional skills, but also shaping and creating the highest, appropriate ethical and social attitudes 3. Acquisition of new medical staff 4. Upgrade of the skills of existing medical staff 5. Initiating postgraduate training and education 6. Liaising with the medical community and local government in the region		
3.	The highest ethical imperative for us is the welfare of the patient	The mission is to carry out teaching, research, staff development, and health care activities of the highest standards
Strategic objective: Achieving and maintaining a high scientific position in Poland and worldwide Operational objectives: 1. High scientific potential. 2. Systematizing and expanding activities related to the commercialization of knowledge. 3. Development of activities aimed at implementing innovative research projects and conducting commercial scientific research. 4. Development of activities aimed at implementing innovative basic research. 5. Scientific development of staff. 6 Effective management of scientific activities.		
4.	Over 100 years of tradition and modernity in providing the highest quality health services in the care of women, newborns and children.	Our mission is to provide the best education based on innovative medicine and top-level research.
Strategic objectives: Support and development of innovative research and achievement of research university status 2. Strong academic treatment base to ensure effective collaboration in teaching and learning. 3. Modern human capital management - development of staff qualifications and work organization culture		
5.	The mission of the hospital is to provide health services at the highest level and to promote health in conjunction with teaching and scientific research tasks.	Creating a welcoming environment for the academic community, within which high quality modern educational, scientific, and commercial offerings are created
Strategic and operational objectives –Teaching hospital capacity: 1. Using the knowledge and experience of teaching hospital experts in the teaching process a. Maintenance of existing staff resources in teaching units b. Creation of an incentive mechanism to encourage teaching activities among the teaching hospital staff c. Standardization of employment contracts in teaching units by taking clinical and teaching tasks into account d. Supporting the development of the teaching competences of the teaching hospital staff		

Source: Self-study.

The missions of teaching hospitals are dominated by objectives such as:

1. Achieving the highest quality of medical services,
2. Comprehensive implementation of treatment, teaching and development tasks,

3. Comprehensive patient care,
4. Health promotion.

These tasks cannot be fulfilled if there is no medical staff with the right competencies and skills.

Medical universities see the following as their mission:

1. Ensuring that staff are trained to the highest possible standard,
2. Research and development,
3. Building and developing intellectual capital,
4. National and international knowledge development and transfer,
5. Commercialization of educational offerings.

The missions of the teaching hospitals are reflected in the development strategies of the universities. In the refinement of the strategic goals, great emphasis is placed on the education and development of the staff and the development of research. This means that the transfer of knowledge and skills of medical staff between the medical university and the teaching hospital contributes to the mission of teaching hospitals.

The analysis of the missions and strategies of teaching hospitals and their founding bodies - medical universities - indicates a close link and coherence in terms of intellectual capacity development and knowledge transfer. This creates a comprehensive dimension of the knowledge transfer strategy.

5. Discussion on Results and Implications for Practice: Directions of Change for Knowledge Transfer in Teaching Hospitals

The alignment between the strategic goals and missions of teaching hospitals and medical universities identified in the research is a very positive phenomenon. The great importance of this coherence was particularly confirmed in an emergency situation, namely, the COVID-19 pandemic. Medical and scientific staff focused their efforts on containing the pandemic, identifying its causes, combating the effects, while also preventing its spread.

Although millions of patients died during the pandemic, there would certainly have been more victims had it not been for the scientific and research achievements of doctors and scientists. In these difficult, complex and unpredictable times, there will be more crises. The development of knowledge resources and new treatment techniques should be a necessary strategic objective. The existing legal and information environment of teaching hospitals in Poland provides a basis for stating the existence of the intellectual potential of employees and the management of the intellectual capital (Chluska, 2021).

In order to achieve the ambitious strategic goals of teaching hospitals and medical universities, the support and cooperation of the socio-economic environment are needed and these activities should be systemic. An increase in salaries (labour costs) as a motivating factor for improving efficiency and developing goodwill, primarily personal goodwill, results in new opportunities for health services and higher operating revenues. Attention to maintaining and developing the intellectual potential of employees results in an increase in the economic potential of teaching hospitals in the form of increasingly larger contracts for the provision of health services (Chluska 2023).

In order for knowledge resources to develop and for their multi-directional transfer to take place properly, material and financial resources are required. This is confirmed by one of the SWOT analyses of the teaching hospital. The weaknesses included the following: "*the inability to make full use of flexible forms of employment, the lack of a fully integrated IT system, the difficult situation on the labour market - especially the shortage of doctors, which limits the possibility of negotiating rates, the lack of full predictability of the functioning of the new model of health care financing, the increasing costs associated with running the core business, while also the need to invest in modern medical equipment, infrastructure*...".

6. Conclusions and Future Directions

An analysis of the relationship between the two organizationally and scientifically related knowledge entities, namely teaching hospitals and their founding medical universities, showed a consistency in the mission and strategic goals of both entities. Teaching hospitals possess and develop the intellectual capital of their employees, which is confirmed by reliable publicly available data of a financial nature (Chluska 2021, 2022, 2023). In addition to the data indicating the development of knowledge resources in teaching hospitals, the high potential for the development of the intellectual capital is confirmed by the missions and development strategies

of teaching hospitals and their founding bodies, namely, medical universities. Thus, it can be concluded that it was possible to outline the determinants of knowledge transfer and intellectual potential of employees of both entities. The coherence and mutual complementarity of the missions and strategic objectives have, in effect, one main goal –'patient welfare'. The conclusions of the analyses demonstrate that the aim of the article has been achieved and that the research questions posed have been answered.

It remains to be further researched and analysed what the role of health sector legislators should be in terms of stimulating and facilitating the development of the intellectual capacity of teaching hospitals and medical universities as the foundation for healthcare transformation and development strategies, in the face of the challenges of the 21st century. The decision-making processes of both specific teaching hospitals, medical universities and the policies of the health sector as a whole may also provide answers to a number of questions in this regard.

References

Accreditation standards, https://www.cmj.org.pl/akredytacja/?typ=szpital (accessed 15.02.2024).

Act of 5 December 1996 on the Professions of Doctors and Dentists, Journal of Laws 2023, item 1516 as amended.

Birkinshaw J., Sheehan T. (2002) 'Managing the knowledge life cycle', *Sloan Management Review* 44/1, pp 75-83.

Bose, R. (2003) 'Knowledge management-enabled health care management systems: capabilities, infrastructure, and decision-support', *Expert Systems with Applications* 24 (2003), pp 59-70.

Chluska, J. (2021) *'The Intellectual Potential of Employees in Hospital Management', Proceedings of the 22nd European Conference on Knowledge Management GARCIA-PEREZ A., SIMKIN L. (ed.), Academic Conferences and Publishing International Limited, p.159, DOI: 10.34190/EKM.21.104*

Chluska, J. (2022) 'The Intellectual Potential of Employees in Hospital Crisis Management During a Pandemic', Vol. 23 No. 1 (2022): Proceedings of the 23rd European Conference on Knowledge Management, p 180, DOI: 10.34190/eckm.23.1.584.

Chluska, J. (2023) 'The Role of the Intellectual Potential of Employees in Creating the Goodwill of a Teaching Hospital', Proceedings of the 24th European Conference on Knowledge Management. Vol. 24 No. 1 (eds.) MATOS Florinda, ROSA Alvaro.

Davenport, T. H., Prusak, L. (1998) *Working Knowledge - How Organisations Manage What They Know,* Harvard Business School Press, Boston, [after:] Kłak M. (2010) Zarządzanie wiedzą we współczesnym przedsiębiorstwie. (Knowledge Management in a Contemporary Enterprise), Publishing House of the University of Economics and Law in Kielce, Kielce.

Eljiz, K., Greenfield, D., Hogden, A., Taylor, R., Siddiqui, N., Agaliotis, M., Milosavljevic, M. (2020) 'Improving knowledge translation for increased engagement and impact on healthcare', *BMJ Open Qual* Vol. 9(3), DOI: 10.1136/bmjoq-2020-000983.

Gagliardi, A. R., Berta, W., Kothari, A., Boyko, J., Urquhart R. (2016) 'Integrated knowledge translation (IKT) in health care: a scoping review', *Implem Sci.* 11/38. DOI: 10.1186/s13012-016-0399-1.

Kłak, M., (2010) *Zarządzanie wiedzą we współczesnym przedsiębiorstwie [Knowledge management in a modern enterprise]*, Publishing House of the University of Economics and Law in Kielce, Kielce.

Kłusek-Wojciszke, B., Łosiewicz, M. (2009) *Wiedza jako specyficzny zasób przedsiębiorstwa [Knowledge as a specific asset of an enterprise]*, [in:] Fryca J., Jaworski J. (ed.), Współczesne przedsiębiorstwo: zasobowe czynniki sukcesu w konkurencyjnym otoczeniu [Modern enterprise: resource factors of success in a competitive environment], WSB (Wyższa Szkoła Bankowa) University in Gdańsk, CeDeWu, Gdańsk, Warsaw, pp 133-147.

List of accredited hospitals, https://www.cmj.org.pl/akredytacja/certyfikaty.php (accessed 15.02.2024)

Little, S., Ray T. (2005) *Managing knowledge: An essential reader, 2nd ed.,* Sage, London.

Molleman, G., Fransen, G. (2012) 'Academic collaborative centres for health promotion in the Netherlands: building bridges between research, policy and practice', *Family Practice*, Vol. 29/1, pp. 157-162, https://doi.org/10.1093/fampra/cmr073.

Nonaka, I., Takeuchi, H. (2000) *Kreowanie wiedzy w organizacji [Knowledge creation in organisations]*, Poltext, Warsaw.

Poziomy spełniania standardów akredytacyjnych w 2022 roku. Szpitale [Levels of compliance with accreditation standards in 2022. Hospitals], https://www.cmj.org.pl/akredytacja/ranking.php?typ=szpital (accessed 15.02.2024).

Szyjewski, Z. (2003) *Zarządzanie wiedzą korporacyjną [Corporate knowledge management]*, [in:] Zarządzanie wiedzą we współczesnych organizacjach [Knowledge management in modern organizations], Kisielnicki J. (ed.), R. Łazarski Higher School of Commerce and Law in Warsaw, Warsaw.

Van Acker, F., Vermeulen, M., Kreijns, K., Lutgerink, J., van Buuren, H. (2014) 'The role of knowledge sharing self-efficacy in sharing Open Educational Resources', *Computers in Human Behavior,* Vol. 39, pp 136-144.

Wang, W., Hou, Y. (2015) 'Motivations of employees' knowledge sharing behaviours: A self-determination perspective', *Information and Organization*, Vol. 25/1, pp 1-26.

Wensing, M., Grol, R.(2019) 'Knowledge translation in health: how implementation science could contribute more', *BMC Med. 2019*; Vol. 17, p. 88, DOI: 10.1186/s12916-019-1322-9

Włodarkiewicz-Klimek, H. (2016) '*Wiedza jako kluczowa wartość organizacji'* [*Knowledge as a key value of the organisation]* [in:] Zarządzanie współczesnym przedsiębiorstwem [Managing a modern enterprise], Publishing House "Dom Organizatora", pp 195 - 206.

Zarządzanie wiedzą w społeczeństwie uczącym się (2000) [*Knowledge Management in a Learning Society* (2000)], OECD, Polish edition: Ministry of Economy - Department of Economic Strategy, pp 13-14.

The Utilization of Blockchain Technology in Healthcare Management

Andrzej Chluski
Czestochowa University of Technology, Poland

andrzej.chluski@pcz.pl

Abstract: This paper explores the potential of blockchain technology in healthcare management. It discusses the key features and characteristics of blockchain technology that can enhance management in the healthcare sector, particularly in knowledge management and improving information processing. The paper underlines the potential of blockchain technology to revolutionise healthcare service delivery, presenting new forms of healthcare delivery that are only possible with the cost-effective and efficient use of blockchain technology. The research methods used in the paper include an analysis of selected theoretical studies on blockchain technology and the fundamentals of providing healthcare services, along with the presentation of several case studies. The paper also highlights the practical use of blockchain technology in both large organisations and small niche players serving the global market. The benefits and risks of using blockchain technology in healthcare are also identified.

Keywords: Healthcare Management, Blockchain Technology, Information Processes And Knowledge Management In Healthcare.

1. Introduction

The business activities in the medical sector are based on providing interrelated services to meet human health needs. Medical services include all necessary activities related to prevention, diagnosis of health status, and treatment of specific diseases (Medical service, 2011).

Every human activity requires access to a certain amount of data and its appropriate use. The sources of these data, the methods of processing and using them, and the information processes form what is known as an information system. The information system in the medical industry is very diverse. It is created and used by various stakeholders to meet the needs of a wide range of clients, such as patients (consumers of services), intermediaries in the provision of medical services, and providers of these services, i.e. doctors and other individuals from medical staff working in the respective centres, while also those who finance the provision of medical services (Rainer, Prince, 2021). Patients' needs include a wide range of information, such as information about specific health conditions, methods of diagnosis, treatment, places of services, and opinions about doctors and medical facilities. This information is partly in the form of other patients' views. Healthcare providers need information about different providers and competitors, as well as information about industry trends, the development of medical science, opportunities for further staff training, and planning while also developing the entity (Winter et al., 2023). Blockchain technology is an essential part of modern information technologies. It enables the distributed storage of data and its direct transfer between users, resulting in increased transparency and more secure transactions. Blockchain technologies, when applied to social media to verify the authenticity of patients' opinions and experiences, can significantly aid in their decision-making process related to choosing the right doctor and medical facility. Implementing Blockchain in healthcare can lead to tangible improvements in the management of diagnostic and treatment processes and the financing and administration of medical entities (Upadhyay et al., 2021). Blockchain technology, including the medical industry, can play a significant role in the economy and contribute to its development (Zhang, 2018).

The article aims to explore how blockchain technology can improve healthcare management by enhancing knowledge management and information processing. It examines theoretical and practical case studies highlighting Blockchain's benefits, risks, and practical applications in healthcare services.

The article presents three practical examples of blockchain use in healthcare to supplement the theoretical considerations. Use cases were selected considering the utility of applying Blockchain technology in healthcare for various stakeholders, including patients, medical staff, and service providers, as well as other stakeholders such as insurance companies, public funding bodies, governments, policymakers, and the public. The author intended to present the broadest possible benefits and risks of using Blockchain in healthcare.

Similar studies were conducted by Kurtz et al. (2018), focusing on business models in healthcare utilizing Blockchain technology. Mikula & Jacobsen (2018) analyzed the use of Blockchain technology in managing access to patient medical data. Reda et al. (2020) examined the impact of Blockchain on health supply chain

management. The system of patient appointment booking in healthcare services using Blockchain technology was described by Sumati et al. (2023). A systematic review of the use of Blockchain in healthcare was also conducted by Zang et al. (2018).

2. Blockchain: Distributed Ledger Technology

A blockchain is a chain of blocks (Crosby et al., 2016). Technically, it is a database that functions as a distributed ledger and is accessible to all authorised network users (Chien et al., 2020).

Blockchain technology is a chain of data blocks that store and transmit information about transactions in a network arranged in consecutive data blocks. Each transaction is recorded in this list as a block containing data on its value and time of conclusion. It is an open distributed database with relatively high security ensured using appropriate encryption techniques. Blockchain technology automatically stores data in many different locations. Only a person with private cryptographic keys has the right to edit such records. The keyholder is considered to be the data owner in a blockchain (Odeh et al., 2022).

Blockchain technology is usually associated with virtual currencies, such as Bitcoin. One of the main advantages of these currencies is their independence from state institutions, central banks, etc. The software of the nodes of this network is open and available to any participant. Bitcoin is based on the transfer between accounts using asymmetric cryptography, while all transactions are public and stored in a distributed database. Each transaction in the Bitcoin network is distributed to other nodes and requires confirmation within a time-stamped list of all known transactions, i.e., blockchains. This confirmation is based on mathematical evidence and specific computer operations, otherwise known as *proof of work*.

Another important element of blockchain technology is smart contracts. These are computer programs integrated into network blocks that automatically execute a contract when the specific conditions placed in that contract are met (Crosby et al., 2016). Executing smart contracts using a decentralised cryptographic system enables untrusted parties to conduct transactions securely without using a trusted third party. Smart contracts are most commonly implemented on the Ethereum network. The public Ethereum blockchain was created in 2014 as an open-source project and an alternative to the Bitcoin network. With the introduction of smart contract functionality, applications built on Ethereum can automate selected business transactions without the need for human intervention (from a legal standpoint). The structure of the database, linking all previous to newly added blocks using unique identifiers (hash), makes it impossible to make modifications that are unnoticeable to other users. The result is a database that is considered secure, attack-resilient, and trustworthy.

The most important features of blockchain technology relevant to data management are as follows (Rot, Zygala, 2018):

- security: Blockchain uses cryptography to store data and transactions securely. Each block is protected by mathematical hash functions, making data manipulation and falsification extremely difficult.
- decentralisation: Unlike conventional systems, Blockchain spreads data across multiple nodes, making it more difficult for hackers to attack and alter data.
- transparency: All transactions and operations are visible to network participants, which increases trust in the system and allows processes to be monitored and audited.
- irreversibility: Once the data have been validated and stored on the Blockchain, they cannot be changed or deleted. This guarantees the permanence and immutability of data, which is particularly important for financial transactions and legal documents.
- automation: Smart contracts can automate processes that must be controlled manually. This facilitates management by reducing costs and eliminating intermediaries.

With these features, Blockchain can speed up processes, increase efficiency, reduce costs, and increase trust between business entities.

In the future, more and more blockchain applications can be expected in various sectors of the economy and society, thus allowing further development and innovation in information and communication technology. Gartner (2017) predicts that by 2030, more than 30 per cent of businesses will be using Blockchain as an essential technology for business activity (Antonopoulos, 2017, p. 110).

3. Potential Areas of Application for Blockchain Technology in the Healthcare Sector

Every medical activity requires using well-chosen modern information and communication technologies (ICT). This applies to both patients and healthcare providers. Patients can use the technology to optimise their choice of doctor and place of service, while providers use ICT to develop and better promote their services in the medical market. As an essential element of ICT, blockchain technology can be used in several areas of medical activity, as outlined below.

Improving medical research and knowledge acquisition: Blockchain technology is increasingly used in biomedical research, knowledge acquisition, and medical education, helping protect privacy and maintaining data integrity while sharing and storing data. It is significant for clinical trials mainly because of its unique properties that ensure the safety and invariability of records. Data stored in the Blockchain are protected from unauthorised access, and cryptographic mechanisms guarantee their integrity. As indicated by Nagasubramanian (2018) and Nugent et al. (2016), this significantly increases data reliability obtained during clinical trials. These authors emphasised that smart contracts used in Blockchain can effectively prevent data falsification and the underestimation of undesirable research results, which is critical to maintaining ethical scientific standards.

Blockchain enables data to be securely transferred and shared between various entities without the risk of modification or corruption (Mytis-Gkometh et al., 2017). This is particularly important in large research projects, where collaboration requires a reliable information exchange mechanism. With data transparency and immutability, Blockchain increases confidence in clinical trials. Participants, sponsors, and regulators can verify all the information collected without worrying about its authenticity. With proper implementation and regulation, Blockchain has the potential to revolutionise the medical research sector, leading to significant advances in diagnostics, therapeutics and overall medical knowledge management.

Using blockchain technology helps improve the quality of *monitoring of treatment progress and the overall health status of patients* in the hospital environment. These systems enable secure and uninterrupted real-time tracking of medical data (Griggs et al., 2018). An integral part of such solutions is sensors for health parameters that can be controlled remotely, which aligns with the idea of the Internet of Things (IoT). Processes such as reading, transferring, processing and securing access to sensor data are carried out using blockchain technology (Meisami e. al., 2021). Similarly, results obtained from diagnostic devices used in the hospital can be securely processed and transmitted, for example, to the Electronic Patient Record by using cryptographic methods provided by the Blockchain (Chelladurai, Pandian, 2022).

Identity and privacy: Blockchain technology can be used in applications to help establish the identity of patients. The correct verification of a patient's identity, with the patient's informed consent, enables immediate and secure access by authorised persons to all their medical data at the place of service (Mikula, Jacobsen, 2018). It is a similar case in terms of *the verification of the identity of a doctor* as an employee authorised to access a patient's distributed medical data (within a blockchain database). The benefit of this solution is that an authorised employee of the medical entity (doctor, physiotherapist, radiologist) has immediate access to all the necessary patient's medical data stored in a distributed blockchain database.

Inventory management of medicines and medical supplies: Inventory management in the medical sector is critical due to its large share in the cost of such services. Blockchain technology can improve inventory management and reduce costs by decentralising and reducing the role of intermediaries. Controlling the quality and originality of medicines and other medical supplies is crucial. Medicines, medical supplies, and technical diagnostic equipment must meet stringent requirements for the quality, type, and origin of drugs, diagnostic materials and other auxiliaries. Depending on the procurement procedures and how these funds are distributed, different types of fraud are possible in this area of medical activity. This primarily concerns the purchase of counterfeit medicines and other medical supplies (Reda et al., 2020).

Registration and booking of healthcare services: Blockchain-based solutions can improve the booking and scheduling of services. Medical services, in the vast majority of countries, are provided within a regulated market. The restriction of the free market forces the time rationing of some medical services. This leads to queues of patients being formed while waiting for services. Such queues should be subject to control processes and some optimisation. This relates to the appropriate allocation of patients to the relevant medical entities while considering the option of patient transport. It is also essential, for example, to properly manage cases where a patient opts out of service and does not inform the healthcare provider while remaining on the waiting list. A centralised waiting list based on blockchain technology can reduce this problem (Sumathi et al., 2023).

Medical transport: Blockchain enables efficient real-time processing of medical transport data. Current weaknesses of transport data systems include the need for more connectivity between many medical transport providers and other barriers to transport. This is particularly true of emergency medical transport (Wu, Ho, 2023). Emergency transport resources should be deployed as efficiently as possible (Odeh et al., 2022). Optimisation should not only concern geographical data (the transport to the patient and the destination hospital) but also access to sensitive patient health data. Blockchain allows data collection at all stages of medical transport services. The benefit for the patient is the faster intervention of a doctor with immediate access to all necessary medical data.

Payments: Payments for medical services are made at multiple stages of treatment. The patient's resources finance some medical services. Still, more often than not, a significant part of these services is financed by funds of a public nature (from the state budget or various medical insurance companies). One of the areas for improvement of modern computerised payment systems is multiple data exchanges between different entities and numerous verification steps, which limit the possibility of creating one simple global system. As a decentralised database, blockchain technology can minimise inconveniences by streamlining payment processes while reducing potential errors and fraud.

Opinion-forming social media: Blockchain technology can simplify the creation and use of opinion-forming social media. With blockchain technology, it is possible to create universal online platforms to collect real-time feedback on doctors and medical entities. The opinions can be signed with private cryptographic keys, thus making it much more difficult to falsify views posted on social media.

4. Selected Examples of Practical use of Blockchain Technology in the Management of Medical Activities

4.1 Supporting the Maintenance of the Electronic Patient Record

Any patient-related data entered and processed in the IT system is critical to the patient and the provider. Patient medical data are collected from various healthcare providers. These include the patient's health status, as well as the results of diagnostic tests, methods and course of treatment, outcomes of treatment, etc. They must be accessible and processed independently of their technical implementation and the location where they are created. They should be collected through public resources, such as the Internet, with limited security and access to authorised persons. Essential information about the patient's health and treatment history should be collected to improve the quality and effectiveness of treatment and support lifestyle changes. The most commonly used name is the Electronic Patient Record (EHR).

The International Organisation for Standardisation (ISO) defines an EHR as an electronic repository of patient health data stored and shared securely and made accessible to multiple users with appropriate authorisation levels. It contains historical, current, and predictive information, at least to some extent. The main objective of creating and using EHRs is to improve the quality and efficiency of healthcare delivery by all healthcare providers (ISO/DTR 20514, 2004).

There are several reference models of EHR available in subject-related literature. EHR reference models should be developed so that they ensure the following:

- sharing patient medical data between professionals from different fields of medicine,
- interoperability between healthcare provider organisations, regional and national health system institutions, and, in the future, between supranational organisations,
- interoperability between software developed by different suppliers.

The need to meet the conditions listed above, standardisation, and the object-oriented paradigm approach to programming and data modelling are causing EHR reference models to become increasingly abstract, 'decoupled' from hardware and communication infrastructure, and, therefore, more generic, universal, and flexible. These can be called virtual electronic patient records.

Blockchain technology can significantly facilitate and simplify the practical implementation of EHRs operating according to the proposed reference models.

Computerised systems supporting EHRs have long been developed and implemented in many entities. They use conventional centralised databases maintained in specific computer centres. Administrators also centralise and control access to these data. Blockchain technologies can simplify and automate the allocation of access rights

to these data for medical staff from multiple healthcare providers. The optimal solution would be a distributed blockchain database maintained on a private or public blockchain network (Shahnaz, 2019).

Specialised software companies can provide technological support for the operation of EHRs in medical entities using blockchain technology. Due to the nature of blockchain technology and global access to the Internet, these can be small multi-branch companies. An example of such an entity is Guardtime (Guardtime, 2024).

Guardtime is one of the leaders in implementing blockchain technology in various sectors, including the healthcare sector and healthcare systems. The enterprise uses its proprietary KSI blockchain technology to increase security, transparency, and operational efficiency across multiple applications. Guardtime has been actively researching and developing blockchain protocols and applications for over ten years (Guardtime, 2024) and employs over 120 people (Crunchbase-guardtime, 2024). Outlier Ventures (Outlierventures, 2024) and SCIPA (2024) are the leading investors· Guardtime is working with the Estonian government using blockchain technology to process data in Estonian e-health systems. Their technology allows for the secure management of health records and citizen services that are available online, supporting more than 1,000 different public services (Guardtime-Estonia, 2024).

Furthermore, Guardtime has entered into a contract with a private healthcare provider in the United Arab Emirates. Implementing blockchain technology aims to improve data privacy and security. This project aims to develop a transparent and secure data management system that could serve as a model for other regional medical institutions. Guardtime develops innovative medical data management methods that meet high-security standards and are efficient and compliant with local healthcare data protection regulations.

4.2 Automation of Payment Services and Insurance Claims

Health insurance claims are a broad category of problems and challenges that health systems face worldwide. Most problems concern designing organisational structures and procedures to handle health insurance reasonably and efficiently.

Health insurance is often complex and challenging for the average user to understand. The procedures for making a claim, the documentation required by insurers, and the deadlines for dealing with claims are complex. One of the biggest problems is the high rejection rate of claims. The reasons for rejection vary, including errors in the completion of documents, insufficient evidence of the need for a particular medical service, and the pace of the policy being too low. Delays in the processing and payment claims are another critical problem that can significantly affect their patients' lives and health.

The rising cost of health insurance is a global issue, affecting policies' availability and effectiveness. High premiums can exclude people with lower incomes, increasing inequalities in access to healthcare.

Fraud by healthcare providers and patients is another serious problem for health systems. False claims or prescribing unnecessary medical procedures to obtain insurance money entails significant losses. The incompatibility and complexity of health insurance regulations in different countries can also hinder the effective management and enforcement of claims. Differences in legislation make global insurance operations difficult and require detailed knowledge of local conditions by insurers. Differences in standards of medical care between countries can lead to problems with the recognition of claims, particularly for people receiving healthcare abroad. Furthermore, this can complicate the procedures for verifying and assessing medical needs.

All the problems require nationally and internationally coordinated action to make health insurance systems more user-friendly and cost-effective.

Founded in 2018, MediConCen operates in the insurance technology sector. It has quickly gained local and international recognition for its innovative solutions. This company has used blockchain technology and the latest technological advances to automate insurance claims processes, thus revolutionising the handling of these claims. Through its activities, MediConCen streamlines and significantly changes how claims are managed in the insurance sector (Mediconcen, 2024).

MediConCen has developed an advanced computer system based on Hyperledger Fabric technology (Hyperledger, 2024) (Cachin, 2016), automating medical insurance claims and eliminating the need for paper documentation. This is an excellent example of an application that illustrates how blockchain technology can increase the operational efficiency of insurance companies and healthcare providers while eliminating the need for data reconciliation between the parties.

MediConCen has over 600,000 users in 14 insurance companies and over 900 doctors. In 2021, the company was also recognised in the prestigious Forbes Asia 100 to Watch list (Forbes, 2021), which promotes the most promising startups in the Asia-Pacific region.

Implementing digital signatures via QR codes makes the platform scalable. It enables the integration of insurers and healthcare providers globally without compromising data integrity on providers and claims. This innovation significantly reduces the burden on all involved parties, especially the medical staff, who can focus on more urgent tasks.

MediConCen uses blockchain smart contracts that are triggered automatically when certain conditions contained in the policy are met. This process limits human intervention, allowing a neutral and impartial technology to fulfil the contract's provisions once specific criteria have been met. Furthermore, using the company's proprietary API eliminates the need to submit data in paper form, which is a time-consuming conventional process and is often subject to the risk of forgery.

4.3 Optimising Pharmaceutical Supply Chain Management

The Drug Supply Chain Security Act (DSCSA) (FDA, 2024) was passed by the US Congress in 2013 as part of a larger legislation framework known as the Drug Quality and Security Act (DQSA). The main objective of DSCSA is to increase security in the pharmaceutical supply chain by introducing stricter rules for identifying and tracking pharmaceutical formulations.

The DSCSA requires operators in the medicines supply chain (such as manufacturers, distributors, and pharmacies) to use systems to accurately track medicines' movement at various distribution stages. This system is designed to protect against counterfeiting, theft, and other forms of fraud. Each pharmaceutical product must be equipped with a unique identifier, which allows it to be identified and authenticated at each stage of the supply chain.

Founded in 2016, LedgerDomain specialises in developing blockchain platforms that enable IT systems to operate efficiently in real time. The company is a member of Hyperledger, the Linux Foundation, and the Clinical Supply Blockchain Working Group. In 2019, LedgerDomain and UCLA Health were selected to participate in the DSCSA Pilot Programme to explore and evaluate methods to improve safety and security in the drug supply chain.

As part of this program, UCLA and its solution partner, LedgerDomain, focused on developing a complete system based on the BRUINchain blockchain that would meet all the key objectives of the DSCSA Act for a distributor operating solely based on commercial technology (Chien et al., 2020).

The system developers claim that automated queries to drug manufacturer relational databases implemented using their proprietary BRUINchain technology will reduce the cost of DSCSA compliance to 17 cents per individual drug package. The authors believe that manufacturers adopting an efficient, fully automated computer system based on distributed ledger technology (DLT) can further reduce these costs (Chien et al., 2020).

The interoperability of such a system enables real-time verification without human intervention, which is a critical factor in reducing compliance costs. With 4.2 billion prescriptions dispensed annually in the USA, blockchain technology would reduce the projected cost per unit to 13 cents per unit (saving $183 million per year in labour costs). Still, it would also make incorrect or fraudulent transactions much more difficult. At the same time, it also reduces the need for safety stock and improves the detection and elimination of potentially dangerous drugs from the drug supply chain (Chien et al., 2020).

By working with LedgerDomain, UCLA Health has positively changed its supply chain management for medicines. The appropriate use of blockchain technology can help improve logistics operations in the health sector, which is a significant step forward in combating problems such as drug counterfeiting and other supply issues.

5. Conclusion

Blockchain technology is an innovative tool for improving efficiency and reducing costs. It is a revolutionary concept that offers new possibilities for delivering previously unknown or unfeasible services and creating new innovative business models. New approaches to old problems provide excellent application potential, while the technology's flexibility allows it to be freely adapted to different tasks.

Blockchain technology benefits the healthcare sector by improving data and process management. Some main advantages include the following (Shae et al., 2019) (Reda et al., 2020).:

- Data security: Blockchain technology provides exceptional protection for medical information by cryptographically protecting blocks of data, which is crucial for sensitive patient data.
- Transparency and immutability: Blockchain registers are durable and transparent, thus enabling accurate tracking of medical history and preventing data manipulation.
- Operational efficiency: Blockchain automation of administrative and financial processes can significantly reduce costs and management time while improving the efficiency of health services.
- Information sharing: Blockchain technology facilitates the secure and transparent sharing of data between different medical entities, which supports better diagnosis and treatment planning while also improving the accumulation of medical knowledge and its transfer, i.e. the education of medical staff and patients.
- Reducing fraud: The technology can help reduce fraud and abuse in healthcare by accurately tracking medical products and drugs and automating processing insurance policies and other payments.
- Inventory management: Blockchain technology helps manage inventory efficiently to reduce waste and optimise resources.
- Patient rights: Patients can better control access to their health data, strengthening their privacy and security.

These advantages show how blockchain technology can transform healthcare, making it more secure, efficient, and friendly for providers and patients. Blockchain in healthcare is not just the future; it is a technology already transforming healthcare while benefiting all participants in the healthcare system.

Using blockchain technology in healthcare also involves risks (Kuo, Kim, 2019) (Tsung-Ting 2017). These particular concerns are as follows :

- complex implementation that requires integration with existing systems and the need for collaboration between different actors.
- the lack of uniform regulations in different countries, especially about personal data protection and regulations for medical services in other countries, including various ways of financing healthcare.
- cyber-security risks may relate to the theft, leakage, or manipulation of data stored on the blockchain network (particularly applicable in private blockchain networks controlled by individual organisations that are not adequately distributed).
- performance limitations of public blockchains, which are essential in the medical sector and are characterised by the transfer of large amounts of data and the need to perform most data processing quickly.
- the expected broader automation of processes may affect employment in the medical sector, especially in support and administrative staff. This may require appropriate adaptation measures.

Large companies most often implement innovative blockchain technologies. However, the technology's specifics allow relatively small niche enterprises to participate in the global medical market, for example, in areas where services can be provided partly remotely (Kurtz, 2019).

Data transparency, traceability, immutability, flexible access, trust, privacy, and security are the major problems faced by modern healthcare data management systems. Blockchain is a revolutionary and decentralised modern technology that has the potential to significantly change the way data is processed in the healthcare sector and provide a solution to most of these problems (Odeh et al., 2022).

Future research may concern the application of AI and Blockchain in healthcare. Distributed ledger technologies are databases containing static records of specific data. Smart contracts securely execute certain simple algorithms related to this data. The operation of smart contracts is formalised and precisely defined using relatively simple programming languages. The conditions for "triggering" a smart contract are also strictly specified. The general goal of using smart contracts is the automation of selected processes. In this context, an attractive solution might be using artificial intelligence to expand the scope of this automation (Rai et al., 2023). Utilising AI in mathematically formalised and algorithmic areas is relatively safe, as the outcomes of AI algorithm learning must be mathematically proven.

The article's limitations are as follows. This paper is theoretical rather than experimental, focusing on analysing potential applications of blockchain technology in healthcare management. The research sample consists of

deliberately and subjectively chosen examples by the author to illustrate the discussed concepts. Future research should use quantitative methodologies (e.g., Structural Equation Modeling methods). For this purpose, experiences related to the studies regarding information technology adoption models can be utilised (Zolait, 2012).

Blockchain technology can significantly enhance healthcare management by providing a secure and immutable record of patient data, ensuring data integrity and privacy. Additionally, it can streamline administrative processes, reduce fraud, and improve the efficiency of healthcare supply chains through transparent and traceable transactions. Utilising Blockchain in healthcare management can benefit patients, medical staff, administrators of healthcare facilities, and other stakeholders.

References

Antonopoulos, A., (2017). *Mastering Bitcoin: Unlocking Digital Cryptocurrencies*, 2nd. Ed., New York, O'Reilly.

Cachin, C. (2016). „Architecture of the Hyperledger Blockchain Fabric". *Workshop on Distributed Cryptocurrencies and Consensus Ledgers*, Vol. 310, 4.

Chelladurai, U., Pandian, S., (2022). „A novel blockchain-based electronic health record automation system for healthcare", *J. Ambient Intell. Human. Comput.* Vol. 13 (1). pp. 693–703.

Chien, W., de Jesus, J., Taylor, B., Dods, V., Alekseyev, L., Shoda, D., & Shieh, P. B. (2020). „The Last Mile: DSCSA Solution Through Blockchain Technology". *Blockchain in Healthcare Today*.

Crosby, M. Nachiappan, P., Verma, S., Kalyanaraman, V., (2016). *„*Blockchain technology: Beyond Bitcoin*", Applied Innovation Review*, Vol. 1(2), pp 6–10.

Crunchbase-guardtime, (2024). [online], crunchbase.com/organization/guardtime.

FDA, (2024). fda.gov/drugs/drug-supply-chain-integrity/drug-supply-chain-security-act-dscsa.

Forbes, (2024). [online], forbes.com/sites/forbesasiateam/2021/08/09/forbes-asia-100-to-watch

Gartner, T. Networks. *Blockchain - Leading the Digital Transformation* (2017), [online], gartner.com/ imagesrv/media-products/pdf/Talari-Networks.

Griggs, K.N., Ossipova O., Kohlios, C.P., Baccarini, A.N., Howson, E.A., Hayajneh, T., (2018). „Healthcare blockchain system using smart contracts for secure automated remote patient monitoring", *J. Med. Syst.*, Vol. 42 (7).

Guardtime, 2024, [online], guardtime.com.

Guardtime-Estonia, 2024, [online], guardtime.com/blog/estonian-ehealth.

Hyperlegder, 2024, [online], hyperledger.org

ISO/DTR 20514, Health Informatics – Electronic Health Record – Definition, Scope, and Context, 2004.

Kuo, T., Kim, H. E. (2019). A survey of blockchain security issues and challenges. International Journal of Engineering and Information Systems (IJEAIS), 3, 115-123.

Kurtz, P., Dietzel, C., & Hann, I. (2018). The impact of blockchain technology on business models in healthcare. Springer Online Journal, 1, 157-166.

Medical service. (n.d.) *Segen's Medical Dictionary*. (2011). [online] https://medical-dictionary.thefreedictionary .com/medical+service

MediConCen, 2024, [online], mediconcen.com.hk/about-us/.

Meisami, S., Beheshti-Atashgah, M., Aref, M. R. (2021). „Using blockchain to achieve decentralised privacy in IoT healthcare", *arXiv preprint arXiv:2109.14812*.

Mikula, T., Jacobsen, R.H., (2018). *Identity and access management with Blockchain in electronic healthcare records,* 21st Euromicro Conference on Digital System Design (DSD), 29-31 Aug.

Mytis-Gkometh, P., Drosatos, G., Efraimidis, P.S., Kaldoudi, E. (2017). *Notarisation of Knowledge Retrieval from Biomedical Repositories Using Blockchain Technology*. ICBHI 2017, IFMBE Proceedings, vol 66. Springer, Singapore.

Nagasubramanian, G., Sakthivel, R.K., Patan, R., Gandomi, A.H., Sankayya, M., Balusamy, B., (2018). Securing e-health records using keyless signature infrastructure blockchain technology in the cloud. *Neural Comput Appl*. Vol. 32(3), pp 639–647.

Nugent T, Upton D, Cimpoesu M. (2016). „Improving data transparency in clinical trials using blockchain smart contracts" *F1000Res. Vol 5* p. 2541.

Outlierventures, 2024, outlierventures.io.

Odeh A, Keshta I, Al-Haija QA, (2022). „Analysis of Blockchain in the Healthcare Sector: Application and Issues", *Symmetry,* Vol. 14(9), p. 1760.

Rai, B.K., Kumar, G., Balyan, V., (2023). *AI and Blockchain in Healthcare,* Singapore*,* Springer Nature

Rainer R.K. Prince B. (2021). *Introduction to information systems*, 9th. Ed New Jersey, John Wiley & Sons.

Reda M., Dominique Kanga D.B., Fatima T., Azouazi M., (2020). „Blockchain in health supply chain management: State of the art challenges and opportunities", *Procedia Computer Science*, Vol. 175, pp 706–709,

Rot A., Zygała R. (2018) „Technologia blockchain jako rewolucja w transakcjach cyfrowych", *Informatyka Ekonomiczna, UE Wrocław*, Vol. 4.

SCIPA, 2024, scipa.com

Shahnaz, A., U. Qamar, A. Khalid, (2019). „Using blockchain for electronic health records", *IEEE Access*, Vol. 7, pp. 147782–147795.

Shae Z., Kuo A. M. H., Lee, H. Y. (2019). Challenges, solutions, and future directions in accessing health care: A blockchain-driven solution. Journal of Medical Systems, 43, 328.

Sumathi, M., Dhiraj, I., Mahita, D. S., & Raja, S. P. (2023). „Appointment Booking and Drug Inventory System in Healthcare Services Using Blockchain Technology", *Advances in Distributed Computing and Artificial Intelligence Journal*, Vol. *12*(1), e31607.

Tsung-Ting Kuo, Hyeon-Eui Kim, Lucila Ohno-Machado (2017). Blockchain distributed ledger technologies for biomedical and health care applications, J AM MED INFORM ASSN, Vol. 24, Iss. 6, pp1211–1220

Upadhyay, A., Mukhuty, S., Kumar, V. Kazancoglu, Y., (2021). „Blockchain technology and the circular economy: Implications for sustainability and social responsibility", *Journal of Cleaner Production*, Vol. 293, 126130.

Winter A., Ammenwerth E., Haux R., Marschollek M., (2023) *Health Information Systems: Technological and Management Perspectives*, 3rd ed. Cham, Springer.

Wu T-C, Ho C-TB. (2023). „Blockchain Revolutionizing in Emergency Medicine: A Scoping Review of Patient Journey through the ED". *Healthcare*, Vol. 11(18) p. 2497.

Zdrowie w normie, [online], uhc.com.pl/index.php.

Zhang, P., White, J., Jha, S., Zhao, J., & Benitez, J. (2018). Blockchain technology in healthcare: A systematic review. Healthcare, 6(2), 1–30.

Zolait, A. H. S. (2012*). Knowledge and Technology Adoption, Diffusion, and Transfer: International Perspectives*. IGI Global.

Knowledge Management in Virtual Teams: From the Perspective of Pluralistic Ignorance

Hao-Fan (Joshua) Chumg, Pei-Rong Lu and Min-Jing Li
National Chin-Yi University of Technology, Taichung City, Taiwan

h.chumg@ncut.edu.tw
3B131061@gm.student.ncut.edu.tw
3b131076@gm.student.ncut.edu.tw

Abstract: With the ever-accelerating development of the Taiwanese economy and Information and Communication Technologies (ICTs), the formation and cooperation of virtual teams consisting of inter-departments or inter-organisations is even more critical for Taiwanese enterprises. Notwithstanding, knowledge-sharing behaviours among virtual teams' members seem more to be difficult because of the social influence factors of their short-term cooperation and coordination within such dynamic teams. In light of the above-mentioned crucial facts, this study draws on social influence relevant theories but also adds pluralistic ignorance (which stems from social cognitive bias resulting from behaviour that generally adheres to social norms) as a critical inhibitor or motivator to explore factors affecting knowledge-sharing behaviour through knowledge management systems (KMSs) within virtual teams of the Taiwanese society. Consequently, our predicted findings show that knowledge-sharing behaviour results from a complex interplay of individual psychological motivations, social influences, and the Chinese culture rooted within such virtual teams. The study provides significant insight into the theoretical, practical and cultural implications of KMSs strategies and offers valuable advice for knowledge managers or scholars in Taiwanese society.

Keywords: Virtual Teams, Pluralistic Ignorance, Knowledge Management Systems (Kmss), Social Influence

1. Introduction

With the advent of the knowledge-based economy and the ever-accelerating development of information and communication technologies (ICTs), an increasing number of Taiwanese enterprises are adopting the concept of virtual teams to cope with rapid innovation and shorter product cycles. Notwithstanding, how individuals have the willingness to cooperate, coordinate and even share knowledge with colleagues still lacks enough research studies, especially within virtual teams (Chumg et al., 2022). Pluralistic ignorance, which is one of sociological theories, is a widespread misconception involving two kinds of social cognitive errors. The first is the social comparison error, which is the mistaken belief that other people's behaviours and attitudes are different from our own or that there are deviations from social norms (Prentice & Miller, 1993). The second is accuracy error, which is the false belief that an individual can accurately evaluate the opinions of others (Prentice & Miller, 1993). Halbesleben et al. (2007) pointed out that minority groups may influence pluralistic ignorance or agree with a particular point of view in public to maintain social identity but may hold different opinions in private. Past research shows that pluralistic ignorance can lead to employees' cognition of differences among others in the organisation, suppression of genuine emotions, and change of norms. This, in turn, weakens organisational culture, increases voluntary turnover, or leads to poor group decision-making. Bjerring et al. (2014) pointed out that the critical factors in the formation of multiple ignorances are that the group has an independent view of a specific situation, believes that other group members hold different views, individual behaviour is contrary to personal belief but in line with the view of others, and believes that the behaviour of group members represents personal belief. However, Prentice and Miller (1993) proposed strategies for pluralistic ignorance: agents can adjust private beliefs to approach those supported by group behaviour, promote group beliefs to approach their private beliefs or choose to reject or alienate social groups. In the setting of virtual teams, members composed of different departments or organisations may be unfamiliar with each other, so teams' cooperation and knowledge-sharing behaviours seem more difficult. Finally, this research proposes an integrative model through social influence theory, which combines social norms and critical mass with pluralistic ignorance. We posit that pluralistic ignorance causes changes in social norms and critical mass, affecting the user's knowledge-sharing behaviour within virtual teams in the context of Taiwanese society. This is mainly because, from a socio-cultural perspective, Taiwan is more collectivist than other countries (Sarkar & Huang, 2012). This research aims to improve virtual team members' willingness to share their knowledge within virtual teams in the Taiwanese societal context.

2. Literature Review

2.1 Pluralistic Ignorance

Pluralistic ignorance is a widespread social phenomenon in which a large majority of people in a group privately hold a belief or opinion but mistakenly believe that most others hold the opposite view (Halbesleben & Buckley, 2004). This, in turn, supports ideas or norms that most people may dislike or deny. Research has shown that pluralistic ignorance occurs in a variety of contexts, such as views on race relations (most white Americans support integration, but believe most others support segregation (O'Gorman & Garry, 1976)), drinking norms (college students privately believe that excessive drinking is unwise, but believe that most others support such norms (Prentice & Miller, 1993)) and in the classroom environment (most students are confused about what is being taught, but think that most other students understand it (Miller & McFarland, 1991)). Geiger and Swim (2016) explored the impact of individuals' views on climate change on their willingness to participate in discussions, and the study showed that individuals tend to be hesitant to express their ideas or opinions when they believe that their views or beliefs are in the minority. The phenomenon of pluralistic ignorance can be a barrier to knowledge sharing because people are less willing to share their knowledge or engage in discussions on specific topics if they perceive themselves as in the minority (Prentice & Miller, 1996). Halbesleben et al. (2007) pointed out that multiple ignorances hurt knowledge-sharing behaviour. In an organisational setting, when pluralistic ignorance leads to consistent behaviour among employees or group members, it leads to a decline in the quality of group decision-making. Because employees do not share their genuine opinions in a group decision-making environment, they are more likely to adopt solutions that do not have the support of employees from various groups. For example, Westphal and Bednar (2005) found in their research survey on corporate boards that external board members underestimated other members' concerns about the company's low performance, showing pluralistic ignorance. Specifically, they found that board members tended not to express concerns about the company's poor performance. As a result, minority views supporting the currently ineffective strategy are expressed and treated as majority views. In essence, the minority's views mislead other board members into believing there is more support for the current strategy than there actually is, leading to pluralistic ignorance and ultimately missing opportunities to initiate strategic changes or adjustments. Because Taiwan belongs to a very collective culture (Hofstede, 1997), such behaviour in terms of pluralistic ignorance may play a more critical role in employees' maintaining harmony at work.

2.2 Social Influence

Social norms are norms established by collective action, and individuals often feel uncomfortable when they realise that their attitudes differ from the norms of the social group around them. To address this difference, they tend to adjust their attitudes to conform to social norms (Prentice & Miller, 1993). Social norms are divided into descriptive norms and injunctive norms. Descriptive norms are those that describe typical or normal situations, that is, what most people do, by providing evidence to prove effective actions. Prohibitive (prescriptive) norms are those that specify what constitutes morally approved and disapproved behavior, rules, or beliefs (Cialdini et al., 1990). Thompson et al. (1991) argued that social norms are similar to subjective norms in the Theory of Reasoned Action (TRA). Previous studies on the social psychological aspects of "social norms" include gender norms (Van Grootel et al., 2018), healthy and sustainable eating norms (Moojen et al., 2022), and racial norms (O'Gorman, 1975). Li et al. (2016) investigated the resistance of employees to KMSs in a large petrochemical enterprise in China from the perspective of status quo bias. They found that social norms, loss aversion and transformation cost had a positive impact on KMS resistance willingness. In addition, the relationship between loss aversion, transition cost, social norms and KMS resistance intention is positively moderated by inertia. Companies need to consider these factors when promoting new technologies or systems.

3. Propositions and Research Model

3.1 Social Influences and Knowledge-Sharing Behaviours

Social norms stem from the theory of reasoned action and the theory of planned behaviour, and state that “the attitude of the person who is important to him will affect whether the individual makes the decision” (Ajzen & Fishbein, 1975). Individuals may behave certain behaviours or actions if someone they feel is important to them wants them to do so, even if they do not necessarily agree with those behaviours (Venkatesh & Davis, 2000). Some research studies have validated that social norms positively relate to knowledge-sharing behaviour (Wu et al., 2023; Bock et al., 2005). Hence, this leads us to establish the following proposition.

Proposition 1. Social norms positively relate to their knowledge-sharing behaviour within the virtual teams.

Critical mass can be regarded as a basic factor that triggers group behaviour (Oliver et al., 1985). Initial adopters can create enough motivation in specific interactive media systems to publish valuable information that promotes potential adopters' adoption (Oliver et al., 1985). Critical mass theory has been utilised in the social sciences to offer sophisticated theoretical models for generating collective action. Moreover, critical mass theory is used to analyse the collective behaviour of knowledge sharing in online encyclopedia communities (Zhao et al., 2013). Innovation can only diffuse when it receives support from the critical mass (Rogers, 1983). Therefore, this research considers that when adopters use the KMSs to have more friends (social relations), they perceive that it is more practical and, thus, motivated to contribute their knowledge within virtual teams. Consequently, this leads us to establish the following proposition.

Proposition 2. Critical mass positively relates to their knowledge-sharing behaviour within the virtual teams.

3.2 Social Influence and Pluralistic Ignorance

On the other hand, pluralistic ignorance can arise when social norms are influential but misunderstood. In the context of social norms, people may confuse their views with beliefs they believe others hold, leading to misunderstandings about valid social norms (Perkins et al., 2005; Lewis & Neighbors, 2006). In the field of college students' health behaviours, especially regarding issues such as alcoholism, college students generally mistakenly believe that alcoholism is widely accepted by society, even though it is not (Baugh et al., 2022). Social norms can influence people's cognition of a certain behaviour. At the same time, multiple ignorances may lead people to misunderstand this norm and think that others support a certain behaviour, thus affecting their own behaviour choices.

Proposition 3. The degree to which individuals increase pluralistic ignorance positively relates to their social norms.

Pluralistic ignorance is mainly studied in homogeneous groups in a given environment, e.g., students (Miller & McFarland, 1987; Prentice & Miller, 1993; Baugh et al., 2022), community residents (Moojen et al., 2022), colleagues (Halbesleben et al., 2007), etc., due to the wrong ideas of others, even if most people disagree with this social norm, still in the cycle of misunderstanding and conformity (Berkowitz, 2004). Since Taiwan belongs to a very collective culture (Hofstede, 1997), this pluralistic ignorant behaviour may play a more critical role in employees maintaining work harmony.

Proposition 4. The degree to which individuals increase pluralistic ignorance positively relates to critical mass.

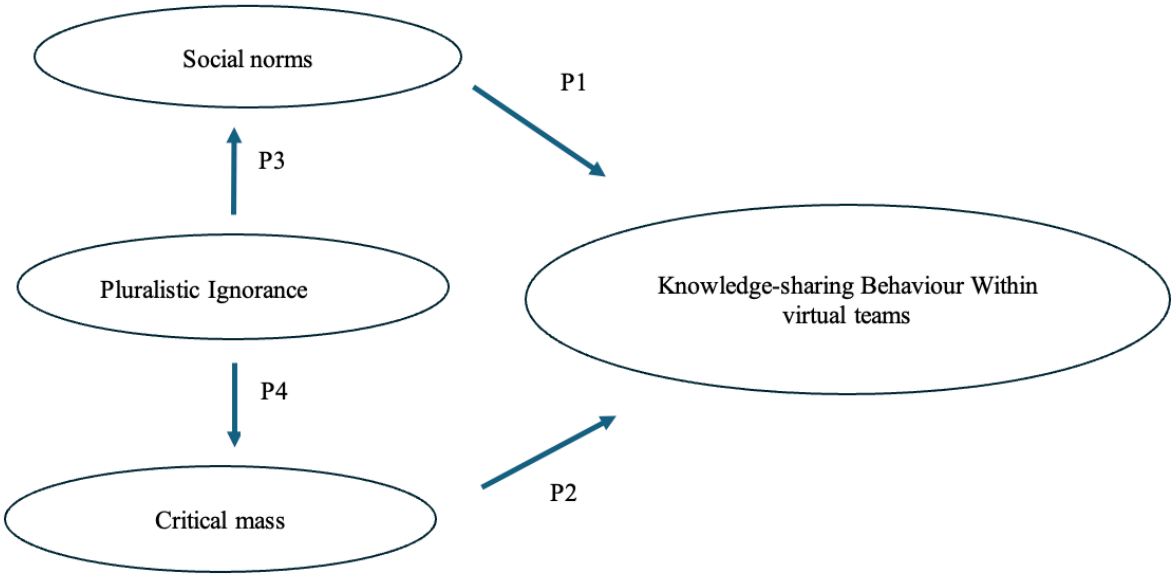


Figure 1: Theoretical model

4. Methodology

In our theoretical model, we have chosen to focus on the behaviour construct rather than intention. While intention is a central component in theories such as the Theory of Reasoned Action (TRA), our decision to emphasise behaviour directly aligns with the specific objectives and context of our study on virtual teams in Taiwanese companies. By focusing on behaviour, we aim to capture observable actions and outcomes within virtual team dynamics, which are particularly relevant for understanding performance, collaboration, and effectiveness in this context. Furthermore, behaviour provides a more concrete and measurable construct, allowing for clearer operationalisation and analysis within our research framework. While the intention may still play a role in shaping behaviour, our model prioritises the direct examination of behaviours exhibited by virtual team members in response to various factors and stimuli. Through this approach, we seek to offer actionable insights applicable to the challenges and opportunities Taiwanese organisations face in managing virtual teams effectively. Having considered the complex and multiple social influences, individual psychology and the context of virtual teams rooted in Taiwanese society may be insufficient to permit a comprehensive understanding of all the complex and abstruse factors affecting knowledge-sharing behaviour within Taiwanese virtual teams; this research will then utilise quantitative equally to analyse the data. Based on the above research model, this study uses a survey method to analyse the behavioural patterns related to knowledge-sharing behaviour within virtual teams of the context of the Taiwanese society. The relevant constructs and items are adapted from prior research, initially developed in English and then translated into Chinese. The translation was validated through a reverse translation process (Brislin, 1980). The questionnaire items were adjusted according to validated scales used in prior literature, with some wording changes. Questions about pluralistic ignorance are sourced from Chumg et al. (2020). Questions about critical mass are drawn from Shen et al. (2013). The social norm is referenced from Shen et al. (2013). Items related to knowledge-sharing behaviour are based on the works of Chumg et al. (2016).

5. Conclusion

These three types of social influences are important antecedents of knowledge-sharing behavior within virtual teams in the context of the Taiwanese society. In this regard, virtual teams' members who in order to maintain the harmony of the team and strengthen the recognition of other members are more likely to develop "common identity" for sharing knowledge within virtual teams. As mentioned above, our predicted results show that critical mass, social norms and pluralistic ignorance affects members' behaviour in terms of knowledge sharing. In this sense, our findings provide additional empirical support for the impact of pluralistic ignorance on knowledge-sharing behaviour particularly within the context of virtual teams in Taiwanese society. This article also explores the potential cultural aspect within the theoretical model, particularly in the context of Taiwanese society. Referencing Hofstede's six dimensions of culture or other relevant cultural frameworks can provide a theoretical basis for understanding cultural influences on virtual team dynamics (Hofstede, 1997). We will also discuss how cultural factors, such as power distance, individualism vs. collectivism, or uncertainty avoidance, may manifest in the behaviour and interactions of virtual team members in Taiwan and highlight any specific Taiwanese cultural aspects that are particularly salient or influential within the context of virtual teams.

Reference

Ajzen, I., & Fishbein, M. (1975). A Bayesian analysis of attribution processes. Psychological bulletin, 82(2), 261.

Baugh, C. M., Foster, C. A., Johnson, B. R., & D'Lauro, C. (2022). Pluralistic ignorance as a contributing factor to concussion underreporting. *Health Education & Behavior*, 49(2), 340-346.

Berkowitz, A. D. (2004). *The social norms approach: Theory, research, and annotated bibliography*.

Bjerring, J. C., Hansen, J. U., & Pedersen, N. J. L. L. (2014). On the rationality of pluralistic ignorance. *Synthese*, 191, 2445-2470.

Bock, G. W., Zmud, R. W., Kim, Y. G., & Lee, J. N. (2005). Behavioural intention formation in knowledge sharing: Examining the roles of extrinsic motivators, social-psychological forces, and organizational climate. *MIS Quarterly*, 87-111.

Brislin, R.W. (1980) Translation and content analysis of oral and written material. In: Triandis, H.C. and Berry, J. W., Eds., Handbook of cross-cultural psychology: Methodology, Allyn and Bacon, Boston, 389-444.

Chumg, H.F., Shi, J.W., Chiang, H.Y., & Ho, M.T. (2022). What drives working habits for sharing knowledge in virtual teams? An organisational embeddedness perspective. *Sage Open*, 12(1), 1-16.

Chumg, H.F., Shi, J.W., & Sun K.J (2020). Why employees contribute to pro-environmental behaviour: The role of pluralistic ignorance in Chinese society. *Sustainability*, 12(1), 239.

Chumg, H.F., Seaton, J., Cooke, L., & Ding, W.Y. (2016). Factors affecting employees' knowledge-sharing behaviour in the virtual organisation from the perspectives of well-being and organisational behaviour. *Computers in Human Behavior*, 64, 432-448.

Cialdini, R. B., Reno, R. R., & Kallgren, C. A. (1990). A focus theory of normative conduct: Recycling the concept of norms to reduce littering in public places. *Journal of personality and social psychology*, 58(6), 1015.

Geiger, N., & Swim, J. K. (2016). Climate of silence: Pluralistic ignorance as a barrier to climate change discussion. *Journal of Environmental Psychology*, 47, 79-90.

Halbesleben, J. R., & Buckley, M. R. (2004). Pluralistic ignorance: historical development and organizational applications. *Management Decision*, 42(1), 126-138.

Halbesleben, J. R., Wheeler, A. R., & Buckley, M. R. (2007). Understanding pluralistic ignorance in organizations: Application and theory. *Journal of Managerial Psychology*, 22(1), 65-83.

Lewis, M. A., & Neighbors, C. (2006). Social norms approaches using descriptive drinking norms education: A review of the research on personalized normative feedback. *Journal of American college health*, 54(4), 213-218.

Li, J., Liu, M., & Liu, X. (2016). Why do employees resist knowledge management systems? An empirical study from the status quo bias and inertia perspectives. *Computers in Human Behavior*, 65, 189-200.

Miller, D. T., & McFarland, C. (1987). Pluralistic ignorance: When similarity is interpreted as dissimilarity. *Journal of Personality and social Psychology*, 53(2), 298.

Miller, D. T., & McFarland, C. (1991). When social comparison goes awry: The case of pluralistic ignorance. In *Social comparison* (pp. 287-313). Routledge.

Hofstede, G. (1997). Cultures and organizations: Software of the mind. New York: McGraw-Hill.

Moojen, R., Gillebaart, M., & de Ridder, D. (2022). Misperceived eating norms: Assessing pluralistic ignorance in the food environment. *Appetite*, 179, 106284.

O'Gorman, H. J. (1975). Pluralistic ignorance and white estimates of white support for racial segregation. *Public Opinion Quarterly*, 39(3), 313-330.

O'Gorman, H. J., & Garry, S. L. (1976). Pluralistic ignorance—A replication and extension. *Public Opinion Quarterly*, 40(4), 449-458.

Perkins, H. W., Haines, M. P., & Rice, R. (2005). Misperceiving the college drinking norm and related problems: a nationwide study of exposure to prevention information, perceived norms and student alcohol misuse. *Journal of Studies on Alcohol*, 66(4), 470-478.

Prentice, D. A., & Miller, D. T. (1993). Pluralistic ignorance and alcohol use on campus: some consequences of misperceiving the social norm. *Journal of personality and social psychology*, 64(2), 243.

Prentice, D. A., & Miller, D. T. (1996). Pluralistic ignorance and the perpetuation of social norms by unwitting actors. In *Advances in experimental social psychology* (Vol. 28, pp. 161-209). Academic Press.

Sarkar, S., & Huang, K. L. (2012). Do cultural groups differ in their attitudes towards unions? Evidence from Indian and Taiwanese samples. *Asian Business & Management*, 11, 395-423.

Shen, X. L., Cheung, C. M., & Lee, M. K. (2013). Perceived critical mass and collective intention in social media-supported small group communication. *International Journal of Information Management*, 33(5), 707-715.

Thompson, R. L., Higgins, C. A., & Howell, J. M. (1991). Personal computing: Toward a conceptual model of utilization. *MIS Quarterly*, 125-143.

Van Grootel, S., Van Laar, C., Meeussen, L., Schmader, T., & Sczesny, S. (2018). Uncovering pluralistic ignorance to change men's communal self-descriptions, attitudes, and behavioral intentions. *Frontiers in psychology*, 9, 390492.

Wang, J., Yang, J., Chen, Q., & Tsai, S. B. (2016). Creating the sustainable conditions for knowledge information sharing in virtual community. *Springer Plus*, 5, 1-9.

Westphal, J. D., & Bednar, M. K. (2005). Pluralistic ignorance in corporate boards and firms' strategic persistence in response to low firm performance. *Administrative Science Quarterly*, 50(2), 262-298.

Wu, Y., Hu, X., Wei, J., & Marinova, D. (2023). The effects of attitudes toward knowledge sharing, perceived social norms and job autonomy on employees' knowledge-sharing intentions. *Journal of Knowledge Management*, 27(7), 1889-1903.

Zhao, S. J., Zhang, K. Z., Wagner, C., & Chen, H. (2013). Investigating the determinants of contribution value in Wikipedia. *International Journal of Information Management*, 33(1), 83-92.

Research on Patent Knowledge Management Mechanism and Innovation Performance of Research Universities in Taiwan

Hao-Fan (Joshua) Chumg, Min-Jing Li and Pei-Rong Lu
National Chin-Yi University of Technology, Taichung City, Taiwan

h.chumg@ncut.edu.tw
3b131076@gm.student.ncut.edu.tw
3B131061@gm.student.ncut.edu.tw

Abstract: The main objective of this study was to identify and interpret the role of the patent team members' intellectual property claims on knowledge acquisition and innovation performance in the context of today's knowledge-based economy and dramatic ongoing changes (technological and otherwise) in Taiwan, and to survey the Research and Development departments of various universities in Taiwan. To effectively understand and establish a model of patent team knowledge management (KM) and innovation. This study will adopt the qualitative research multiple case study method, with patent team members of universities and colleges in Taiwan as subjects. This study further divides the composition of patent teams into four categories, including national universities, national universities of science and technology, private universities and private universities of science and technology. Using a concurrent combination of quantitative and qualitative approaches, a pragmatist research philosophy was chosen for this research to obtain in-depth analysis and provide comprehensive new insights into the key incentives promoting innovative knowledge-sharing behaviour among university academic staff in Taiwan. The predictive results of this study will provide important theoretical and practical insights into the patent knowledge management strategy and innovation performance of Taiwan universities and colleges, as well as valuable suggestions for patent knowledge managers in the context of Taiwan society.

Keywords: Knowledge Ownership, Knowledge Management, Innovative Performance, Pragmatist Research Philosophy

1. Introduction

The academic community's attention to knowledge sharing stems from the expansion of knowledge management research in the late 20th century when the characteristics of the knowledge economy were obvious. Karahanna (2013) detailed the design scheme of the organisational system suitable for knowledge sharing. Since then, more and more scholars have studied knowledge sharing from different perspectives, and the research field has been expanding from enterprises to social organizations such as government and education. The research on knowledge sharing has gradually become the focus of knowledge management. As for the concept of knowledge sharing is generally regarded as a process of knowledge transfer, interaction and communication, but different researchers have different understanding emphases, and some emphasize the sharing of knowledge between knowledge holders and demanders (Xie et al., 2016). Some emphasize the knowledge exchange and learning process among members of an organization (Senge, 1997), and some emphasize the process of one-party transferring knowledge to the other. The subject scope of knowledge sharing can be both internal and cross-organizational (Lee et al., 2016). Regarding the process of knowledge sharing, Nonaka et al. (2000) put forward the SECI model based on the four parts of knowledge socialisation, externalisation, combination and internalisation based on summarizing knowledge management, knowledge sharing and innovation. Szulanski (2000) proposed a five-stage model from the knowledge transfer perspective, including acquisition, communication, application, reception and assimilation. As for the factors that influence knowledge sharing, many scholars at home and abroad have studied them from different perspectives. Simmoni (1999), Coleman and Casselman (2016) argue that knowledge ambiguity affects knowledge sharing due to the reticence, complexity and specificity of knowledge. Regarding organisational characteristics, the salary system, incentive system, organisational atmosphere and organisational culture impact knowledge sharing (Serenko & Bontis, 2016). Individual characteristics, individual personality, self-realisation, sense of self-worth embodiment, attitude, organisational identity, and status competition motivation impact knowledge sharing (Kim, et al., 2019).

The scope of research in knowledge management at home and abroad is getting broader and wider, and remarkable achievements have been made. Various discussions and empirical studies have different concerns and perspectives, as well as different theoretical frameworks and research questions. However, judging from the current research perspective and scope, the current research on patent knowledge ownership still has considerable room for expansion. The comprehensive interdisciplinary perspective of knowledge sharing has yet to be expanded, and the comprehensive influencing factors of patent knowledge ownership have yet to be analysed. More comprehensive and specific. Research on universities as knowledge-intensive organisations

needs to be strengthened from the perspective of knowledge ownership of patents. In particular, most domestic research on the knowledge management of university teachers or scholars mainly conducts theoretical discussions, and research on the knowledge ownership mechanism of university teachers' patents is insufficient, especially since there is a lack of research on issues related to patent ownership among cross-regional university teachers, which points out the space and direction for this research.

2. Literature Review

2.1 Research on Knowledge Sharing Among University Academics

Learning and practising through teaching, practice and research, and enhancing innovation through collaboration with businesses and institutions, universities are generally viewed as knowledge-intensive and knowledge-creative entities that play a vital role in the dissemination and sharing of knowledge (Patel & Ragsdell, 2011; Fullwood et al., 2013; Ramayah et al., 2014). Therefore, the research on knowledge sharing of university teachers is an important part of knowledge sharing research. Regarding the importance of knowledge sharing among university teachers, scholars communicate with each other and share knowledge, and effective knowledge management is considered to be a key factor in the success of higher education (Fullwood et al., 2013; Fullwood & Rowley, 2017), this factor is particularly significant in research universities (Goddard, 1998). Tan (2015) believes that knowledge sharing and research collaboration among scholars are fertile soil for knowledge innovation and foster new knowledge for the academic community. Therefore, encouraging important behaviours, such as frequent knowledge sharing, cannot be ignored in academia. For example, in the relevant programs of government departments (such as the special research plan of the Ministry of Science and Technology, the teaching practice plan of the Ministry of Education, etc.), most teachers in research universities choose to cooperate with others to provide each other with the research knowledge and work experience accumulated over the years, so as to complete academic work jointly. Therefore, academic personnel working in universities, especially research universities, through the sharing of knowledge among each other, carry out collaborative research, thereby creating new theories and ideas and establishing new research principles. Unfortunately, many institutions, including research universities, do not seem to realize the importance of knowledge management, and the implementation of knowledge management programs within institutions is still hampered by a lack of enthusiasm and initiative (Tan, 2015). Therefore, universities should focus on increasing the importance of knowledge management to understand the preparation of universities to maintain a knowledge-based society, including the sharing of quality resources, expertise, research work and collaboration, so as to achieve good development (Jandaghi et al., 2014). In the past, influential factors and ways of promoting knowledge sharing among university teachers have attracted much attention, such as the willingness to share knowledge. Osterloh and Frey (2000) pointed out that knowledge-sharing behaviour among scholars is closely related to the motivation behind it. Donate and Canales (2012) believe that the market mechanism will not improve the enthusiasm of university scholars for knowledge sharing. On the contrary, these scholars will be encouraged to retain and hide their own knowledge or research results. Therefore, intrinsic motivation is the key factor affecting the transfer and sharing of implicit knowledge by university scholars, while external motivation has no expected impact on knowledge-sharing behaviours of organizational members (Fullwood et al., 2013; Fullwood & Rowley, 2017). Many researchers have also paid special attention to social network factors. Relevant studies believe that teachers' knowledge-sharing behaviour is affected by job titles, scientific research collaboration networks, friendship relationship networks, team affiliations, etc.

2.2 Research on Patent Knowledge Management and Knowledge Ownership of Organisational Members

According to the World Intellectual Property Organization (WIPO), intellectual property can be primarily divided into the following types: patents, trademarks, trade secrets, geographical indications, and industrial designs (WIPO, 2021). Concerning the importance of intellectual property knowledge management, for scholars, how to effectively manage and share knowledge, practice, and protect intellectual property is a topic worth attention. However, constrained by various factors such as school encouragement, awareness of intellectual property knowledge, innovation and novelty of research and development outcomes, the presence of technology transfer centers, university attributes, etc., many institutions, including research universities, do not seem to realize the importance of intellectual property knowledge management, leading to limitations in the implementation of intellectual property knowledge management programs (AR et al., 2021). Effective patent knowledge management is even more crucial for scholars in research universities within intellectual property. Research

universities need to enhance scholars' emphasis on patent knowledge management. Besides understanding the academic contributions of scholars in science and technology to the socio-economic aspects, sharing high-quality resources, expertise, research outcomes, and industrial collaboration can further disseminate laboratory research results through incubation centres and research institutions. In the realm of patent knowledge management, many scholars analyse from a technical perspective, such as countries, inventors, applicants, citations, etc., to gauge the extent of knowledge diffusion (Kayal & Waters, 1999; Sun et al., 2008; Hall & Helmers, 2013; Song et al., 2018). Some scholars also use social network analysis as a substitute for patent citation analysis to understand the diffusion of knowledge across different institutions and countries (Hsieh & Wang, 2009) and utilize multidimensional network analysis of patents to evaluate the impact of network structure and government funding on knowledge diffusion networks (Jiang et al., 2013). In studies on organizational and individual patent ownership, scholars have examined factors at the organizational, individual, and patent levels and their respective relationships with academic patents, indicating that for academic inventions, the value of the patent itself appears unrelated to choices in patent ownership (e.g., whether a university owns it) (van Burg et al., 2021). Furthermore, there is a positive correlation between the proactiveness of intellectual property ownership and the success of university-industry cooperation (UIC) projects when companies implement robust shared governance (Gretsch et al., 2020). In research on patent knowledge ownership, scholars suggest that companies can strategically disclose their inventions based on internal knowledge, demonstrating their ownership of knowledge (Dornelles, 2020).

3. The Overall Framework and Contextual Development of This Research

This research will utilise a concurrent combination of quantitative and qualitative approaches to obtain an in-depth analysis and provide comprehensive new insights into the key incentives promoting innovative knowledge-sharing behaviour among university academic staff in Taiwan. The predictive results of this study will provide important theoretical and practical insights into the patent knowledge management strategy and innovation performance of Taiwan universities and colleges, as well as valuable suggestions for patent knowledge managers in the context of Taiwan society.

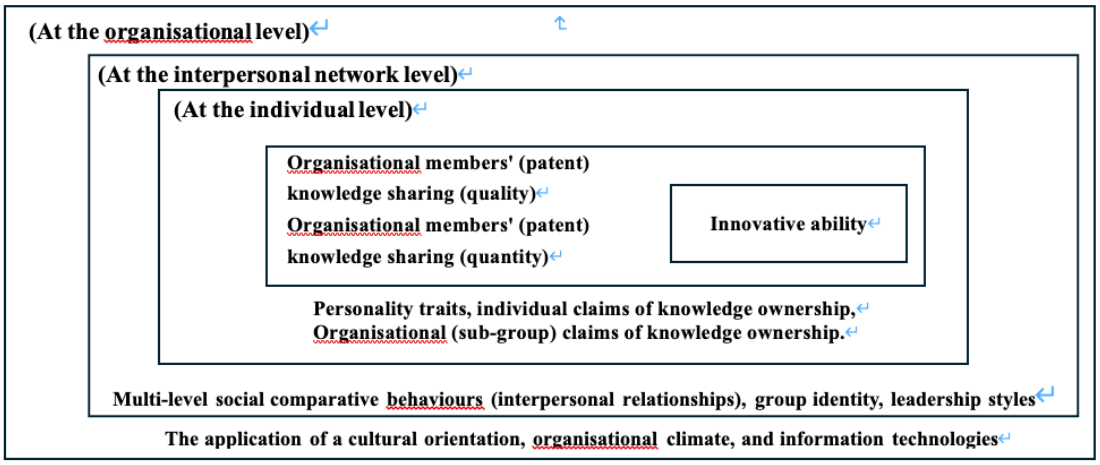


Figure 1: The application of the concept of organisational behavior (based on different historical backgrounds and social contexts) in this study.

This research aims to reveal the "black box" of the relationship between academic staff's traditional cultural orientation and their knowledge-sharing behaviour at the individual level. Research key points include: ① Introducing knowledge ownership to deduce the general mechanism of employee innovative behaviour; ② Analysing the potential "interaction" relationship between different traditional cultures and social network variables and different innovation motivations; ③ Using the "values → motivation → behavioural tendency model "(VMB) examines the mediating effect of different innovation motivations between different traditional cultural variables and employee innovative behaviour; ④ based on the first three points, construct a path model of the individual-level employee traditional cultural orientation on employee innovative behaviour, and Empirically test whether the impact of cultural orientation on innovative behaviour is mediated by different innovation motivations to produce a "masking effect".

Building upon the analysis results of the previous research content, this study delves deeper into the complex causal relationships among knowledge-sharing behaviour, interpersonal (relationship) networks, organizational culture, and organizational innovation capability of academic staff in Taiwan. This project is grounded in organizational behaviour research, integrating psychology (micro-level knowledge-sharing behaviour through ICTs), social psychology (mid-level), organizational systems, and anthropology (macro-level) to explore. Combining research breadth and depth, it explores a cross-layer collaborative mechanism model.

This research aims to explore whether the impact direction and magnitude of the innovative knowledge-sharing behaviour of academic staff at Taiwanese universities will be subject to the interference (moderation) of social comparison situational variables. Key research points include: ① Determining the heterogeneous effects of individual knowledge-sharing behaviours due to multi-level social comparison behaviours; ② Determining the heterogeneous effects of cultural social contexts in Taiwan's different regions (academic universities, industry-oriented universities) on knowledge-sharing behaviours in contrasting scenarios (high innovation demand atmosphere vs. low innovation demand atmosphere, cooperative atmosphere vs. autonomous atmosphere); ③ Determining the heterogeneous effects of culture on knowledge-sharing behaviours in contrasting scenarios (high-performance pressure vs. low-performance pressure).

4. Ongoing Research

This research aims to complete the transformation from theoretical research to practical application. Based on the previous theoretical research, this research will ultimately be based on Taiwan's unique cultural values and ideologies, focusing on the dual cultural subject of "individuals - other team members" and focusing on multiple groups of comparative innovation scenarios from the perspective of personal intrinsic motivation, Organisational workplace networks, organisational culture, organisational structure and other areas propose governance strategies that are suitable for promoting innovatively knowledge-sharing behaviour among university academic staffs in Taiwan. At the same time, this research will also provide theoretical references and a basis for decision-making for creating a cultural system and environment conducive to the national innovation-driven development strategy at the macro level. Finally, the full article containing the entire work is expected to be finished by August 2024.

Reference

Alshahrani, H. & Pennington, D.R. Why not use it more? Sources of self-efficacy in researchers' use of social media for knowledge sharing. *Journal of Documentation*, 74(6), 1274-1292, (2018).

AR, I. M., Temel, S., Dabic, M., Howells, J., Mert, A., & Yesilay, B.R. (2021). The role of supporting factors on patenting activities in emerging entrepreneurial universities. *IEEE Transactions on Engineering Management*, 1-12.

Dornelles, J.P. (2020). Why are they hiding? *Patent secrecy and patenting strategies, Innovation*, 22(3), 316-333.

Fullwood, R. & Rowley, J. An investigation of factors affecting knowledge sharing amongst UK academics. *Journal of Knowledge Management*, 21(5),1254-1271, (2017).

Gretsch, O., Tietze, F., & Kock, A. (2020). Firms' intellectual property ownership aggressiveness in university–industry collaboration projects: Choosing the right governance mode. *Creativity and Innovation Management*, 29(2), 359-370.

Guan, X., Frenkel, S.J. Explaining supervisor-subordinate Guanxi and subordinate performance through a conservation of resources lens. *Human Relation*, 72, 1752-1775, (2019).

Hall, B.H. & Helmers, C. (2013). Innovation and diffusion of clean/green technology: can patent commons help? *Journal of Environmental Economics and Management*, 66 (1), 33-51.

Hsueh, C. & Wang C. (2009). *The use of social network analysis in knowledge diffusion research from patent data*. International Conference on Advances in Social Network Analysis and Mining, 393-398.

Kayal, A.A. & Waters, R.C. (1999). An empirical evaluation of the technology cycle time indicator as a measure of the pace of technological progress in superconductor technology. *IEEE Transactions on Engineering Management*, 46(2), 127-131.

Jiang, S., Gao, Q., Chen, H., & Roco, M. C. (2015). The roles of sharing, transfer, and public funding in nanotechnology knowledge-diffusion networks. *Journal of the Association for Information Science and Technology*, 66(5), 1017-1029.

Kim, H., Lee, J., & Oh, S.E. Individual characteristics influencing the sharing of knowledge on social networking services: online identity, self-efficacy, and knowledge sharing intentions. *Behaviour & Information Technology*, 1-12, (2019).

Ou, C.X.J, Davison, R.M. & Wong, L.H.M. Using interactive systems for knowledge sharing: the impact of individual contextual preferences in China. *Information and Management*. 53(2), 145-156.

Tan, C.N.L. (2015). Enhancing knowledge sharing and research collaboration among academics: the role of knowledge management. *Higher Education*, 71(4), 525-556, (2016).

van Burg, E.; Du, J. & Kers, J. G. (2021), When do academics patent outside their university? An in-depth case study. *Technovation*, 107, 102287.

Song, K., Kim, K. & Lee, S. (2018). Identifying promising technologies using patents: a retrospective feature analysis and a prospective needs analysis on outlier patents. *Technological Forecasting and Social Change*, 128, 118-132.

Sun, Y., Lu, Y., Wang, T., Ma, H. & He, G. (2008). Pattern of patent-based environmental technology innovation in China. *Technological Forecasting and Social Change*, 75(7), 1032-1042.

The Role of the Communication Department in Knowledge Sharing in Higher Education Institutions

Daniela Firmino Cidade[1] and Mírian Oliveira[1, 2]
[1]Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre, Brazil
[2]Universidade de Lisboa - Advance/CSG, ISEG, Lisbon, Portugal

dfcidade@gmail.com
miriano@pucrs.br

Abstract: Organizations, particularly those that are knowledge-intensive, such as educational institutions, increasingly recognize the importance of managing knowledge sharing (KS). Consequently, KS in universities is an emerging research area as the transfer of knowledge from universities to the socio-economic environment is growing in importance. This study investigates the relationship between the communication departments and KS in two Brazilian universities. To this end, fifteen interviews were conducted with institution managers, communicators, researchers, and stakeholders involved in KS projects. The interviews were transcribed and subjected to content analysis. The key findings suggest that while communication departments play a vital role in transferring knowledge to various stakeholders, they could be further leveraged. Challenges identified include the complexity of university ecosystems, academic language barriers, and the reluctance of researchers to provide access to the knowledge they generate. Students are identified as the primary recipients of university knowledge, followed by public/political bodies and companies. However, society at large is perceived as the most distant stakeholder. According to the interviewees, the involvement of communication departments in knowledge transfer hinges on the visibility of the projects they undertake. Limitations in this process include restricted access to researchers, limited understanding of the strategic role of the communication department and resource constraints. The research paves the way for more in-depth investigations into the integration of communication departments in the university environment, as well as the construction of more assertive guidelines for the work of communication departments, to enable all the stakeholders, including society in general to make the most of the knowledge generated by the HEIs.

Keywords: Knowledge Transfer; Knowledge Sharing; Corporate Communication; Stakeholders

1. Introduction

Higher education institutions (HEIs) face increasing demands to foster knowledge sharing (KS) with society (Benneworth, Pinheiro, & Barrioluengo, 2016). Nevertheless, elucidating how KS can be optimized remains a challenge, especially in the context of contemporary trends such as globalization, digitalization, and mediatization (Seiffert-Brockmann *et al*., 2021). Moreover, the complex nature of HEIs poses obstacles to effectively engaging diverse audiences and broader society (Benneworth, Pinheiro, & Barrioluengo, 2016).

Managing KS in HEIs has emerged as a research agenda yet to be fully explored (Al-Kurdi *et al*., 2018). HEIs are expected to lead in knowledge generation and application, so that their wealth of knowledge can be shared within the regions around them (Dal Buono & Fortezza, 2017). Despite possessing the expertise, communication departments in HEIs have thus far underutilized their potential contribution to the KS process (Cidade & Oliveira, 2023). In light of this, the study aims to address the following research questions:

Q1. In HEIs, what are the biggest challenges to KS with their different stakeholders?

Q2. Regarding KS, which are the closest and most distant stakeholders to the HEIs?

Q3. What is the biggest difficulty facing HEI communication departments in this scenario?

Based on these inquiries, this research endeavours to enrich the understanding of the role of Organizational Communication (OC) in facilitating dialogue between HEIs and their stakeholders. Additionally, the study seeks to provide a scholarly contribution by pinpointing gaps in KS within HEIs and the challenges OC encounters in this context. Moreover, it proposes to formulate recommendations for future research with the aim of enhancing the role of the communication departments of HEIs in the realm of knowledge sharing.

Following this introduction, the article is organized as follows: Section 2 introduces the key concepts underpinning the discussion. Section 3 outlines the adopted methodological procedures. Section 4 presents the analysis and discussion of the results. Finally, Section 5 encompasses the conclusion, limitations, and suggestions for future research.

2. Literature Review

2.1 Knowledge Sharing: HEIs and Their Stakeholders

Efficient knowledge management within organizations necessitates prioritizing KS (Wang *et al*., 2014). Recognizing that the mere creation and acquisition of knowledge are often insufficient, it is imperative for organizations to ensure the dissemination of that knowledge among individuals to maximize its benefit. Knowledge can be either tacit, residing within individuals' minds and thus relatively challenging to convey, or explicit, being documented in materials such as manuals, rules, and procedures (Nonaka, 1994). The benefits of KS are seen in various forms, including innovation and the development of novel products, processes, and departments (Tseng, 2010), along with enhanced operational efficiency (Ahmad & Karim, 2019).

Numerous studies have emphasized the need for organizations to disseminate the knowledge they generate to address contemporary challenges and benefit their ecosystems (Al-Kurdi, El-Haddadeh, & Eldabi, 2018; Benneworth, Pinheiro, & Barrioluengo, 2016; Dal Buono & Fortezza, 2017; Wereda & Wozniak, 2018). A recent literature review by Leonitou *et al.* (2020) underscores academia's central role as a stakeholder in studies focusing on enhancing innovation management and fostering entrepreneurship. This prominence is attributed to the fact HEIs are acknowledged as key hubs for knowledge sharing and dissemination (Al-Kurdi, El-Haddadeh, & Eldabi, 2020), thereby constituting a shared heritage within their communities (Dal Buono & Fortezza, 2017).

Beyond educational settings, knowledge and its dissemination among stakeholders have garnered attention from organizations. For instance, Wereda and Wozniak (2018) examined a cohort of Polish companies experiencing a decline in market value, concluding that insufficient KS with stakeholders, due to ineffective communication, was a determinant factor in their situation. Additionally, Leonidou *et al*. (2020) synthesized a framework, drawing from an extensive literature review, that delineates various stakeholders influencing organizational innovation and entrepreneurship. Furthermore, another study found effective stakeholder management entails processes such as identifying and understanding needs, managing expectations, monitoring activities, and the continual review of these processes (Bourne, 2009).

2.2 Organizational Communication

Since the 1990s, communication departments have progressively gained visibility and significance within organizational frameworks (Riel, 1995). In recent years, these departments have evolved to encompass more strategic functions (Koehler & Zerfass, 2019), overseeing processes that ultimately address stakeholder relationships, including image crisis management, internal communication, employee engagement, Corporate Social Responsibility (CSR) reporting, and various digital channels (Brockhaus & Zerfass, 2022).

According to Barker (2013), communication is characterized as a strategic process involving the exchange of messages via information knowledge management, fostering mutual understanding and beneficial relationships between an organization and its stakeholders. Within the scope of this article, organizational communication also encompasses specialized areas within organizations responsible for managing communication processes, staffed by professionals with distinct expertise and practices. Wereda and Wozniak (2018) assert that efficient communication is indispensable for generating new and valuable knowledge and collaborating effectively with other partners.

Recent research highlighting the gap in communication functions hindering knowledge dissemination from HEIs to society is scarce. Miklosik, Evans, and Hlavaty (2023) examined online channels available to HEI audiences, discovering that knowledge communicated through these channels correlates with factors such as institutional longevity and type (public or private), among others. They note that while universities are expected to disseminate knowledge, the manner in which knowledge is communicated beyond HEIs remains largely unexplored in academic studies. Torres, Ziviani, and Silva (2012) proposed a competency mapping initiative at the Federal University of Minas Gerais to establish a catalogue of experts or dissemination guide, aiming to enhance the KS in the University.

This study acknowledges the significant role of communication departments in knowledge management, recognizing that knowledge must be effectively transferred to be fully explored, a process achievable only through communication (Grigorsescu, Lupu, & Zink, 2014).

3. Research Method

3.1 Classification

This study adopts a positivist philosophy, aiming to understand reality independently, objectively, and ontologically (Saunders, Lewis, & Thornhill, 2019, p. 130). Data collection involved semi-structured interviews with managers and researchers holding management positions at two HEIs in southern Brazil. An inductive approach was employed, beginning with specific questions and expanding to more general inquiries, providing clearer insights into the research topic (Saunders, Lewis, & Thornhill, 2019), potentially yielding novel information (Hair *et al*., 2005). Prior to the interview stage, the semi-structured script was reviewed by two scholars and was pilot-tested with a professional from an HEI.

3.2 Data Collection

Data were collected during individual exploratory interviews held between October 2023 and February 2024. The semi-structured interview script consists of three parts: 1) challenges encountered in KS between HEIs and their stakeholders; 2) regarding KS, identification of stakeholders more closely and distantly associated with the HEIs; and 3) assessment of the significance and potential constraints faced by communication departments in facilitating KS.

The interviews involved eight university researcher-managers, along with seven managers, four of whom were affiliated with the communication departments and three from various sectors of the university, namely planning, governance, and a technology park. Each interview lasted an average of 29 minutes, and all sessions were transcribed and subjected to content analysis.

Interviewees were initially contacted via email, and the interviews were conducted via videoconference. Saturation, as recommended by Saunders *et al*. (2019), was employed to determine the appropriate number of interviews. According to Guest *et al*. (2006), in homogeneous groups, saturation is typically achieved with around 12 interviews. In this study, saturation was reached after the eleventh interview, as no new ideas emerged in the subsequent four interviews.

3.3 Data Analysis

The data were meticulously analysed following each interview, facilitating the identification of saturation, while the content analysis was applied as proposed by Bardin (2009). This method encompasses systematic procedures for content description, employing both qualitative and quantitative indicators, as advocated by Bardin (2009) and Krippendorff (1980). Initial open coding involved the dissection of data based on its contextual interpretation, succeeded by axial coding, wherein these open codes were grouped into coherent categories, enabling cross-interview comparisons. These codes were derived directly from the speeches provided by the interviewees. One researcher conducted the interviews, while two researchers concurrently scrutinized the acquired data. Any variances detected in their respective analyses were thoroughly discussed until a consensus was reached, thus affirming the reliability of the findings, in alignment with the criteria outlined by Krippendorff (1980).

The data were analysed both collectively, as a single group, and with a distinction made between researcher-managers (8) and other managers (7). This approach was done to discern potential differences in the understanding of knowledge transfer among those who not only hold leadership positions but also actively manage their own research.

4. Analysis and Discussion of the Results

4.1 Challenges to be Overcome

The analysis revealed several significant challenges that HEIs must address to enhance the efficiency of KS with their diverse stakeholders. Among these challenges, two aspects emerged with great frequency: the application of knowledge and the academic language.

Within the category of ‘application of knowledge’, all viewpoints highlighting the disparity between researchers’ interests and societal problems were considered. For instance, as one researcher-manager explained, “*the biggest challenge is that the scientific research and the real problems are not the same thing*.” Another

interviewee emphasized, "*the challenge is to make the knowledge produced at the HEI relevant and have a significant impact on society*."

In the category of 'academic language', interviewees underscored the challenge of translating knowledge into a format understandable by society. One interviewee articulated, "*We need to find mechanisms that make the knowledge produced more accessible to the general public.*" Notably, researcher-managers predominated in this category, likely due to their recognition of the specialized language inherent in research, which may alienate those outside the academic realm. Reflecting this, a researcher-manager remarked, "*the communication department can contribute because researchers don't know how to do this.*" Similarly, another interviewee from the same group emphasized, "*with the appropriate language, the communication department can facilitate transfer of knowledge to society.*" It is a barrier to the demand mentioned by Benneworth, Pinheiro and Barrioluengo (2016), which is to foster knowledge sharing with society.

In addition to the aforementioned categories, two others emerged consistently in the discourse of various interviewees: the 'complexity of the university ecosystem' and 'the reluctance of researchers to provide access to the knowledge they generate'. Concerning the complexity of the ecosystem, it is pertinent to note that this study was conducted at two large universities situated in different cities in southern Brazil, both with extensive physical infrastructures, offering undergraduate, graduate, and extension programs in hybrid face-to-face and distance learning formats. An interviewee highlighted the presence of "*fiefdoms*" within the university, which hinder communication among internal areas. Another interviewee questioned, "*we encourage everything to be considered. But when everything is important, what is the priority?*"

Concerning the category 'the reluctance of researchers to provide access to the knowledge they generate', three references were made in the interviews, all from non-research managers. In this context, interviewees emphasized that "*researchers need to communicate more about their work beyond their bubble*" and noted that "*… while knowledge transfer actually occurs, it is often diffuse, scattered, and unrecognized*".

Two challenges were separately emphasized by two different interviewees. One pertains to the disparity in the perception of time and speed between academia and society. The other highlighted challenge concerns the complete absence of KS, with communication efforts primarily focused on university marketing initiatives aimed at attracting students. The table below summarises the challenges and their respective incidence rates. The number of challenges exceeds 15, as some interviewees mentioned multiple challenges even when asked to identify 'the most significant one'.

Table 1: Summary of the highlighted KS challenges and the incidence with which they were mentioned

Application of the knowledge produced/understanding the demands of society	8
Academic language	8
Complexity/size of the university ecosystem	4
Reluctance of researchers to provide access to the knowledge they generate	3
Speed and sense of urgency	1
There is no focus on KS	1

Notably the two most frequently mentioned challenges revolve around interactions with stakeholders, underscoring the significance of external engagement. Conversely, the remaining challenges predominantly concern internal university matters.

4.2 Stakeholders

When asked about the closest and most distant stakeholders regarding KS, interviewees provided a comprehensive list. Notably, the HEI students were identified as the closest stakeholders by 10 out of the 15 interviewees. Subsequently, mention was made of companies with which the HEIs maintain relationships, particularly through technology parks and research institutes. Other stakeholders mentioned were, in order of frequency: governments and other entities - e.g. the education ministry, councils, unions, and trade associations and: the internal university community and political leaders.

In the list of more distant stakeholders, the interviewees mentioned "*companies that have never had a relationship with the university.*" The industrial sector was noted as having the least engagement with HEIs. Additionally, the surrounding community and society were mentioned in a general manner. However, specific mentions included former students, high school students (potential future students), third-sector organizations, supply chain partners, companies and entities from municipalities geographically distant from the universities. It is important to note that both universities where the research was conducted are situated in large urban centres, with one being located in the state capital. The illustration below provides a representative overview of interviewees' perceptions of stakeholder proximity. Notably, there was no significant distinction between the responses of managers and researcher-managers in these questions.

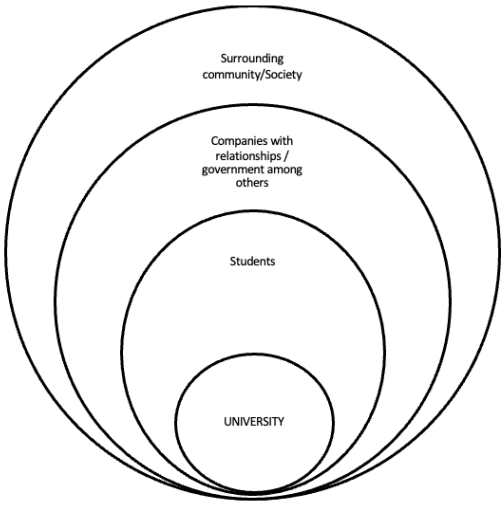


Figure 1: HEIs and their main stakeholders

4.3 Overcoming Limitations and Becoming Strategic

The research evaluated interviewee's perceptions of how communication departments contribute to the process of HEIs sharing knowledge with their stakeholders. Predominantly, the responses underscored a tactical/operational role for the communication departments, primarily focused on transmitting or converting knowledge. Specifically, 12 interviewees, including both the researcher-managers and managers, emphasized these tactical/operational aspects. Conversely, strategic actions were highlighted by only three - one manager and two researcher-managers.

The statement "*The communication department uses technical knowledge to make the university a relevant source*" reinforces the operational dimension of communication. Another interviewee highlighted: "*the communication department helps to map and organize content so that it can be used in different ways for the university, packaged for different stakeholders*". Additionally, five interviewees emphasized the marketing function of communication, being aimed solely at attracting new students to the HEIs: "*almost nothing to do with the transfer of knowledge, because it is very focused on capturing students*".

The perception of communication as a tacit/operational means or channel is evident in the following expressions: "*transposition of abstract knowledge,"* "*transferring in a correct way,"* "*translating what we do for the lay community*," and "*opening channels and establishing relationships with the traditional press."* Consequently, communication is perceived as a purely operational sector, lacking a strategic vision of its potential impact. The few managers (3) who mentioned strategic communication used expressions such as "*strategic role*" and "*being strategic,*" highlighting not only the function of translation or channel selection but also envisioning the communication department as being fully capable of "*engaging with diverse actors in a complex system."* When asked if the communication department play a greater role in the dissemination of knowledge from the HEIs to society, all the interviewees (15) answered affirmatively. Some supplemented their responses with phrases like "*very*," "*yes, if it is connected to management*," and "*there's definitely space to contribute more*."

Finally, the interviewees were asked about the most significant limitations hindering the effective contribution of communication departments. Equally, among both managers and researcher-managers, the most frequently mentioned limitation (8) was "*understanding the strategic role of communication.*" In this regard, most

interviewees emphasized that recognition rests primarily with the institution itself and its managers. Only one interviewee suggested that communication professionals themselves need to "*understand themselves as being strategic.*" Additionally, one interviewee noted that "*universities, as a whole, are very poorly managed, and in this regard (the communication department) it is no different."*

As a second limitation of communication departments in contributing to KS, scarcity of resources was cited (7). These resources encompass not only financial allocations for operations but also the shortage of suitably qualified staff. One argument put forth was that "*the communication department is primarily focused on areas with potential economic and financial impacts on the university*." It was also noted that *"communication professionals require highly specialized knowledge, necessitating a well-prepared communication team capable of handling substantial production volume."* In this context, interviewees emphasized the necessity for "*institutional investment decisions*" to ensure that communication departments have adequate resources and personnel with the requisite qualifications to fulfil their strategic function effectively.

The third most frequently cited limitation (6) was "*access to researchers*." Interestingly, this concern was raised by more researcher-managers (5) than managers (1), indicating recognition of their own constraints. Comments such as "*we need researchers to be trained to be attentive to communication*," "*scientists need to pay attention to the dissemination aspect*," and "*there needs to be greater dialogue between the research sectors and the contribution of the communication department*" reflect this sentiment.

Occasionally, other limitations were mentioned. They are: "*difficulty measuring results*", "*understanding the academic world and developing greater proximity*", "*lack of interest of parties outside the university"* and "*content being distributed through diverse channels*". In this sense, an interviewee mentioned that the communication department needs to be "*divided into sections"*, which would be a limitation. Below is a table with the limiting factors and their incidence during the interviews.

Table 2: Factors limiting the contribution of communication departments towards KS and their frequency

Limitation	Frequency
Understanding the strategic role of communication	8
Limited resources	7
Access to researchers	6
Difficulty measuring results, understanding the academic world and developing greater proximity, lack of interest of parties outside the university, *content being distributed through diverse channels*	1

Source: authors, 2024.

It should be noted that the total count of responses exceeds the number of interviewees, as some cited more than one limitation, even when asked to identify the most significant one. These factors probably are the reason that communication departments in HEIs are underutilized considering KS process as mentioned by Cidade and Oliveira (2023).

Despite possessing the expertise, communication departments in HEIs have thus far underutilized their potential contribution to the KS process (Cidade & Oliveira, 2023).

5. Conclusion, Limitations, and Future Research

According to the interviewees' perceptions, the communication department plays a crucial role in facilitating KS between HEIs and their various stakeholders, and could further enhance that contribution. However, despite its importance, this role is not widely recognized as strategic. Instead, they primarily view it as tactical/operational, focusing on determining dissemination methods. Consequently, most interviewees see the involvement of communication departments in the transfer process as contingent on the visibility it provides to developed projects. Only three interviewees highlighted a strategic role for communication in this process, indicating a potential gap in recognizing the broader impact and potential of communication departments within HEIs.

The majority of interviewees perceive several challenges that need to be addressed for KS to occur more intensely. These challenges include the complexity of the university ecosystem, the barrier of academic language, and the reluctance of researchers to share the knowledge they generate. Notably, academic language is particularly emphasized by the researcher-managers, highlighting the communication difficulties faced by

scientific researchers. The primary stakeholder with whom HEIs share the most knowledge is identified as the student body, followed by public/political bodies, companies, and society at large. However, it is noted that the general public, defined as society, is seen as the most distant from the knowledge produced by HEIs.

The most significant limitations hindering communication departments from making a greater contribution to the KS process include challenges related to understanding the strategic role of communication, time constraints, the limited number of professionals involved, their level of experience, and access to researchers. These factors collectively impede the communication department's ability to play a more impactful role in facilitating KS within HEIs.

This study paves the way for more in-depth investigations into the integration of communication departments within the university environment, as well as the construction of more assertive guidelines for the work of communication departments, to enable all the stakeholders, including society in general to make the most of the knowledge generated by the HEIs.

This study has successfully achieved its objectives. Firstly, it identified the primary challenges in the KS process of the HEIs in relation to their stakeholders, as perceived by the interviewed managers. Additionally, it delineated which stakeholders are considered closer and which are perceived as more distant in terms of KS. Furthermore, the study effectively mapped out the difficulties that must be overcome to alter this scenario. Overall, the study has provided valuable insights into the complexities of KS within HEIs and has laid the groundwork for addressing those challenges.

This research presents theoretical and practical contributions. As a theoretical contribution, the following stand out: 1) the identification of the challenges to KS with different stakeholders in HEIs; 2) the closest and most distant stakeholders to the HEIs; and, 3) the difficulty facing HEIs communication departments in this scenario. As a practical contribution, one can mention: 1) knowing the challenges, the dean can direct efforts to mitigate the disparity between researchers' interests and societal problems that were considered; and, 2) the HEIs understanding the strategic role of communication, can solve the problem of limited resources in this sector; a closer relationship between researchers and professionals in the communication department can be an alternative to leveraging the KS among HEIs and society.

This study has two limitations. Firstly, the interviews were conducted with managers from only two universities, thus reflecting the reality of those specific contexts. The research could be expanded to include other institutions, which may reveal different challenges and limitations. Secondly, interviews alone were used to understand how communication departments can contribute to KS in HEIs. Employing other data collection methods could enrich the analysis of this issue. For instance, a quantitative survey could increase the number of respondents and potentially uncover additional insights, while also opening avenues for exploring other research questions related to the topic.

References

Ahmad, and Karim, (2019), "Impacts of knowledge sharing: a review and directions for future research", *Journal of Workplace Learning*, Vol. 31 No. 3, pp. 207-230.

Al-Kurdi, O., El-Haddadeh, R. and Eldabi, T. (2018), "Knowledge sharing in higher education institutions: a systematic review", Journal of Enterprise Information Management, Vol. 31 No. 2, pp. 226-246.

Al-Kurdi, O., El-Haddadeh, R. and Eldabi, T. (2020), "The role of organisational climate in managing knowledge sharing among academics in higher education", International Journal of Information Management, Vol. 50, pp. 217-227.

Bardin, L. (2009) *Análise de conteúdo*. PUF: Paris.

Barker R. Comunicação estratégica integrada: uma perspectiva alternativa de comunicação integrada de marketing? (2013). Comunicação, Vol.39 (1), pp. 102–121.

Benneworth P, Pinheiro R, Sánchez Barrioluengo M., (2016). One size does not fit all! New perspectives on the university in the social knowledge economy. Sci Public Policy, Vol. 43(6), pp.731–735.

Bourne, L. (2009). Stakeholder relationship management. A maturity model for organisational implementation. Farnham: Gower.

Brockhaus, J. and Zerfass, A. (2022) "Strengthening the role of communication departments: A framework for positioning communication departments at the top of and throughout organizations", *Corporate Communications: An International Journal*, Vol. 27 No. 1, pp. 53-70.

Cidade, D. F., and Oliveira, M. (2023). "The interaction between organizational communication and knowledge management: A systematic literature review". Knowledge and Process Management, 1–12. https://doi.org/10.1002/kpm.1770.

Dal Buono, V. and Fortezza, F. (2017). "Universities' experience with brand. The role of design in managing university communication and branding", *The Design Journal*, Vol. 20, pp. 705-720.

Guest, G., Bunce, A. and Johnson, L. (2006) “How Many Interviews Are Enough?: An Experiment with Data Saturation and Variability”, *Field Methods*, Vol. 18, pp. 59-82.

Grigorescu A, Lupu MM, Al Zink F., (2014). Comunicação – vetor central na gestão do conhecimento. Gerenciar Estratégia J. Vol. 26 No. 4; pp. 538–548.

Hair, J. F *et al*. (2005). Análise Multivariada de Dados. Porto Alegre: Bookman.

Kohler, K. and Zerfass, A. (2019) "Communicating the corporate strategy: An international benchmark study in the UK, the USA, and Germany", *Journal of Communication Management*, Vol. 23 No. 4, pp. 348-374.

Krippendorff, K. (1980) *Content analysis*: an introduction to its methodology. Sage: Newbury Park.

Leonidou E, Christofi M, Vrontis D *et al*., (2020). An integrative framework of stakeholder engagement for innovation management and entrepreneurship development. *Journal of Business Research*; Vol. 119, pp. 245–258.

Miklosik, A., Evans, N., Hlavaty, I. (2023) Communicating knowledge-focus through websites of higher education institutions. *Journal of Information Science*, Vol. 49 No. 3, pp. 666–684.

Nonaka, I. (1994) “A dynamic theory of organizational knowledge theory”, *Organization Science*, Vol. 5 No. 1, pp. 14-37.

Riel, C. van B. M. (1995) *Principles of corporate communication,* Prentice Hall, Hemel Hempstead.

Saunders, M. N. K., Lewis, P. and Thornhill, A. (2019) *Research methods for business students*, 8. Ed., Pearson, New York.

Seiffert-Brockmann, J.; Einwiller, S.; Neda Ninova-Solovykh, N.; Wolfgruber, D., (2021). Agile Content Management: Strategic Communication in Corporate Newsrooms. *International Journal of Strategic Communication*, Vol. 15 No. 2, pp. 126-143.

Torres, A. A. L., Ziviani, F., & Silva, S. M. da., (2012). Mapeamento de competências: ferramenta para a comunicação e a divulgação científica. *Transinformação*, Vol. 24 No. 3, pp. 191–205.

Tseng, S. M. (2010) “The effects of hierarchical culture on knowledge management processes”, *Management Research Review*, Vol. 34 No. 5, pp. 595-608.

Wang, Y.-S., Lin, H.-H., Li, C.-R. and Lin, S.-J. (2014) “What Drives Students' Knowledge-Withholding Intention in Management Education? An Empirical Study in Taiwan”, *Academy of Management Learning & Education*, Vol. 13 No. 4, pp. 547-568.

Wereda W, Wozniak J., (2018). The way to organizational excellence of innovative enterprises through communication with stakeholders. In: Bratianu C, Zbuchea A, Vitelar A (eds) Strategica: Challenging the status quo in management and economics. Bucharest: Triton Publishing House. pp. 904–922.

The Role of Knowledge Engineering, Management and Media in the Knowledge Society: A Research Agenda

Flávia Pereira Conti, Gustavo Simas da Silva, Willian Ferreira de Andrade
Federal University of Santa Catarina (UFSC), Florianópolis, Brazil

flavia.conti@posgrad.ufsc.br
simas.gustavo@posgrad.ufsc.br
willianferreyra@gmail.com

Abstract: This study aims to explore the intersection of Knowledge Engineering, Management, and Media (KEMM) in enhancing innovation and competitive potential within Knowledge-Intensive Organizations (KIOs). The objective is to understand how these fields interact to optimize the management and dissemination of knowledge in the context of the Knowledge Society (KS). A qualitative methodology is employed, using a scoping review to assess interrelated phenomena and map existing literature. This approach involves an exploratory bibliographic strategy and an interpretative analysis to identify key concepts, theories, and gaps in knowledge. The results indicate that effective integration of KEMM significantly improves decision-making, organizational performance, and innovation. The cultural differences in knowledge management models are highlighted, contrasting the American focus on technology with the Japanese emphasis on socialization. It also underscores the need for balancing technological advancements with human skills to foster a sustainable and innovative organizational environment. In the discussion, the paper emphasizes the critical role of KEMM in navigating the complexities of a BANI world (brittle, anxious, non-linear, and incomprehensible) by enhancing resilience and adaptability among workers. The integration of emerging technologies such as AI, machine learning, and digital platforms is shown to facilitate knowledge sharing and collaborative innovation. The conclusion stresses the importance of a holistic approach to KEMM, suggesting that future research should focus on practical applications in real-world scenarios, including education and organizational learning. By leveraging KEMM, organizations can develop more effective business models and contribute to the creation of Human, Intelligent, and Sustainable Cities. This study provides a foundation for further investigations into the synergistic relationships between Engineering, Management, and Media in the knowledge-based economy.

Keywords: Knowledge Engineering. Knowledge Management. Knowledge Media. Knowledge Society.

1. Introduction

Knowledge is the driving force behind innovation, propelling progress at personal, community, and global levels (Kaźmierczak, 2017). The advent of Knowledge Society (KS) signifies the fusion of technological advancement with social development through creative and experiential education (Stehr, 2015). This society transcends mere information access, emphasizing the attribution of meaning and continual redefinition of achievements amidst complex interrelationships (Muños, Bohórquez, & Díaz, 2022).

The COVID-19 pandemic accelerated the characteristics of the Knowledge Society, reshaping the corporate landscape and emphasizing resilience and adaptability among workers. The concept of a BANI world (brittle, anxious, non-linear, and incomprehensible) underscores the need for flexible approaches to navigate complexities (De Godoy & Ribas Filho, 2021). Behavioral skills like resilience, empathy, and adaptability gained prominence, with organizational knowledge management and leadership playing pivotal roles in facilitating adaptation and fostering continuous learning (Nataliia & Olena, 2023).

In KS, knowledge acts as both an intangible asset and a co-production factor, with interdisciplinary approaches at the intersection of Knowledge Engineering (KE), Knowledge Management (KMa), and Knowledge Media (KMe) playing its own roles in driving innovation, enhancing decision-making, and optimizing organizational performance (Burgin, 2016).

The interplay among these areas is vital for effectively utilizing and disseminating intangible assets within organizations and society. Understanding the integration and synergy among Engineering, Management, and Knowledge Media is essential for effectively governing and leveraging intangible assets in Knowledge-Intensive Organizations (Zieba, 2021).

Hence, this work aims to explore how Knowledge Engineering, Management, and Media (KEMM) intersect and support each other in fostering innovative and competitive potential, particularly for Knowledge Intensive Organizations (KIOs), also proposing a research agenda in these areas.

2. Theoretical Background

2.1 Knowledge Engineering, Management and Media

The fields of Knowledge Engineering, Management, and Media focus on the effective management and utilization of knowledge within systems (organizations, communities, ecosystems, etc.). This interdisciplinary field combines principles of science and technology to improve the acquisition, storage, processing, and sharing of knowledge, as well as collaboration and innovation (Schreiber, 2000; Pacheco, 2007).

KMa enables organizations to leverage their intellectual capital and gain a competitive edge, involving the systematic collection, organization, and dissemination of knowledge to facilitate decision-making, problem-solving, and innovation (Vieira, 2020). Effective knowledge management practices can improve organizational performance, increase employee productivity, and promote a culture of continuous learning (De Carvalho, Ponciano & Bianchi, 2021).

Knowledge modeling and associated technological aspects, such as Knowledge Management Support Systems, are subjects of study in Knowledge Engineering, which is concerned with the development of systems that enable the capture, storage, processing, and retrieval of knowledge (Kendal & Creen, 2004).

Knowledge Media emerges from the convergence of computing, telecommunications, cognitive sciences, and learning sciences, focusing on the communication, dissemination, and sharing of knowledge, including digital platforms, social networks, and communication technologies, providing channels for interaction and learning within organizations (Muller & De Souza, 2020).

By interfacing these three areas, KIO represents a new organizational paradigm in the Knowledge Society, and the areas of Media, Management, and Knowledge Engineering are fundamental to their success and operation. These areas, as evidenced by the work of authors such as Günther and Cunha (2022), Bignetti (2002), and Nadai and Calado (2006), are complementary in terms of people, processes and technology, defining together the essence of KIOs in contemporary business environments.

2.2 Knowledge Society and Knowledge Intensive Organizations

The term "Knowledge-Intensive Organizations" (KIOs) refers to companies that rely heavily on knowledge for producing and offering products and services. These organizations are characterized by a strong base of intellectual skills among employees and effective knowledge management practices (Nadai & Calado, 2006).

To thrive, KIOs must constantly redefine boundaries and adopt new collaboration paradigms, such as business networks and innovation ecosystems. In this context, Knowledge Engineering Management and Media (KEMM) play a crucial role, enabling responsiveness to changing demands and opportunities. Investing in knowledge-based technologies and infrastructures is essential for maintaining competitiveness (Rossetti et al., 2008).

Macedo and Souza (2023) emphasize balancing technological and human aspects within KIOs. Promoting an environment that fosters technological growth while valuing employees' skills is key to long-term success. Operational workers should be granted autonomy, making them primary holders of practical knowledge, while managers provide guidance without imposing strict monitoring. A horizontal structure with low bureaucracy allows greater flexibility and effective communication. Saiti and Stefou (2020) note that flexible networks, open communication, and visionary leaders enhance employee satisfaction and innovation.

KIOs focus on customer experience, directing changes to improve service and deliver personalized products. They also face the challenge of leading in sustainable development, as sustainability practices drive innovation (De la Torre & Berbegal-Mirabent, 2020). These practices can be adopted internally to enhance operations and externally through collaborations with suppliers, extending positive impacts beyond the organization.

3. Methodology

In this study, a qualitative methodology is implemented, using a scoping review to assess the interrelated phenomena in the domain of Knowledge Engineering, Management, and Media. The adopted research strategy includes a bibliographic exploratory approach, intended to elucidate the object of study, and an interpretative methodology (Creswell, 2014). Qualitative research is particularly relevant when detailed exploration of complex nature topics or phenomena is required. This type of study refrains from using statistical methods, allowing for direct observations and interpretation of data.

The purpose of a scoping review is to map existing literature on a specific topic to identify key concepts, theories, sources, and gaps in knowledge. This type of review is particularly useful for emerging, complex research topics or those that have not yet been subject to comprehensive reviews. According to Munn et al. (2018), a scoping review undergoes five stages: identification of the research question; identification of relevant studies; selection of studies; data extraction; and presentation of results.

Following the five mentioned stages, this study aims to examine the interaction between Knowledge Engineering, Management, and Media, especially in the context of Knowledge-Intensive Organizations.

4. Results and Discussion

Regarding Knowledge Management models, there is a notable distinction between American and Japanese approaches, with the former focused on information technology and the latter centered on people and socialization. These divergences can be traced back to the Fordist (American) and Toyotist (Japanese) production models (Paula & Paes, 2022). The roots of these distinctions lie in cultural aspects, where Japan perceives key concepts differently (Mendehall & Oddou, 1986):

- Dualism: In the West, dualism, exemplified by concepts like good and bad, is often seen as a conflict zone, with the aim to eliminate one in favor of the other. However, for the Japanese, both coexist harmoniously, without the possibility of nullifying one for the other. This perspective results in different approaches to facing challenges, conducting negotiations, and perceiving company values.
- Contextuality: While in the West, the search for a sense of belonging often involves internal reflection before interacting with society, Eastern philosophy seeks its purpose in the external context. Easterners strive to fit into society and understand how they can contribute to the environment they are in. This promotes greater flexibility and a less individualistic mindset when facing challenges or diverse environments.
- Principle of flow: The idea that nothing is permanent, including organizational contexts, implies that there can be no rigid and immutable norms. As a result, members' obligations regarding the context are unlimited, and their responsibilities are ambiguous, guiding their actions according to the specific context. This perspective contributes to KM practices such as high loyalty, low turnover, and implicit control systems.
- Holism: Unlike the West, where analyzing the parts often precedes understanding the whole, Easterners approach information and contexts from a holistic view. They start the process intuitively before conducting a rational analysis of the parts. In organizations, this approach implies that managers must keep their teams connected to the company's mission to promote effectiveness and efficiency, stimulating the development of creative and innovative potential.
- Intuitive bias: Due to the understanding of the complexity of contexts and emphasis on the global view, Easterners do not seek total control and absolute understanding of the involved parts. They are not strictly focused on the analytical use of words nor overly rely on logical consistency. When the analytical process fails to solve challenges, they return to the whole, reflecting the true reality.

Eastern mental models have influenced widely-used Knowledge Management (KMa) models, aligning with traits needed in the BANI world. Nonaka and Takeuchi's (2008) SECI model highlights the bidirectional conversion between tacit and explicit knowledge as a competitive advantage. Macedo and Souza (2023) showed that this complementarity fosters innovation and adaptability but is hard to implement in cultures lacking knowledge sharing.

Davenport and Prusak (1998) categorized knowledge as tacit and explicit, aiming to enhance accessibility via structured systems, though it may downplay culture's role. Wiig's (1999) approach integrates knowledge management with strategy, focusing on processes and learning, needing cultural commitment. Choo's (1998) model prioritizes information management before knowledge management, improving efficiency but potentially limiting knowledge creation.

Effective knowledge management in KIOs requires aligning with Engineering and Media areas to avoid knowledge loss, using various approaches based on organizational context.

Examples of knowledge attributes in People, Processes, and Technologies.		
Axis	**Attribute**	**Description**
People	Knowledge managers	Individuals designated to oversee knowledge management within the organization, responsible for defining strategies, guidelines, and processes to optimize the creation, sharing, and application of knowledge.
	Communities of practices	Formal or informal groups of professionals who share common interests and expertise, providing a collaborative environment for the exchange of knowledge, experiences, and best practices.
	Training and communications	Training activities and communication programs aimed at developing knowledge management skills, promoting awareness of the importance of sharing and collaboration.
	Measurement and reward system	Establishment of metrics and indicators to assess the effectiveness of knowledge management practices, as well as the implementation of incentives and rewards to encourage engagement and contribution.
	Knowledge sharing culture	Promotion of an organizational culture that values and prioritizes knowledge sharing, encouraging collaboration, continuous, active, and lifelong learning, and collective creation.
	Knowledge consultants	Specialized professionals, usually external to the organization, designated to provide guidance, insights, and support in the application and dissemination of knowledge in organizational projects and activities.
Processes	Knowledge capture and reuse	Processes and procedures for identifying, capturing, and documenting knowledge generated in projects or past experiences, making it available for future use.
	Collaboration	Establishment of workflows and platforms that facilitate collaborative interaction between teams and individuals, promoting active exchange of information and ideas.
	Selection of good practices	Identification and promotion of best practices and lessons learned within the organization, aiming to optimize processes and future results.
	Content management	Efficient organization, storage, and categorization of documents and relevant information, making access and retrieval of knowledge more effective.
	Metrics and e reports	Establishment of performance indicators and generation of reports to assess the effectiveness of knowledge management activities, identify areas for improvement, and support decision-making.
	Change management	Implementation of strategies to manage organizational transitions resulting from the adoption of new knowledge management practices, ensuring a smooth transition and effective adoption.
Technology	Interface and user experience	Development of intuitive and user-friendly interfaces for knowledge management tools and platforms, aiming for ease of use and adoption by users.
	Community portals	Creation of online spaces where employees can gather, share information, participate in discussions, and access resources related to knowledge.
	Knowledge repositories	Establishment of centralized storage systems for documents, records, and information, facilitating quick and organized access to knowledge.
	Search, storage and support	Implementation of advanced search functionalities, indexing, and categorization to quickly locate relevant information, as well as providing efficient technical support.
	Collaboration spaces	Creation of digital environments that allow asynchronous or real-time collaboration, sharing of documents and ideas, promoting accessible interaction among members.

When establishing a knowledge ecosystem in KIOs, an environment is created that promotes the flow of knowledge among individuals, teams, and departments (Shaba et al., 2023). This ecosystem embraces the

integration of various knowledge management practices, technologies, and platforms to encourage continuous collaboration, sharing, and innovation. Leveraging emerging technologies such as artificial intelligence, machine learning, the metaverse, among others, can enhance the discovery, extraction, and application of knowledge in KIOs (Wang, Pauleen & Taskin, 2022). Indeed, digital transformation contributes in the long term to the value creation process (Di Vaio et al., 2021).

The interaction of these areas, illustrated in Figure 1, is also strongly influenced by digital transformation, which redefines the operations, value delivery, and interactions of KIOs with stakeholders (Erceg & Zoranović, 2022). This transformation encompasses the digitization, automation, and optimization of knowledge management processes, resulting in enhanced efficiency, agility, and innovation. Furthermore, it enables the adoption of emerging technologies such as blockchain and the Internet of Things to strengthen knowledge sharing, security, and traceability (Frozza, de Lima & da Costa, 2023).

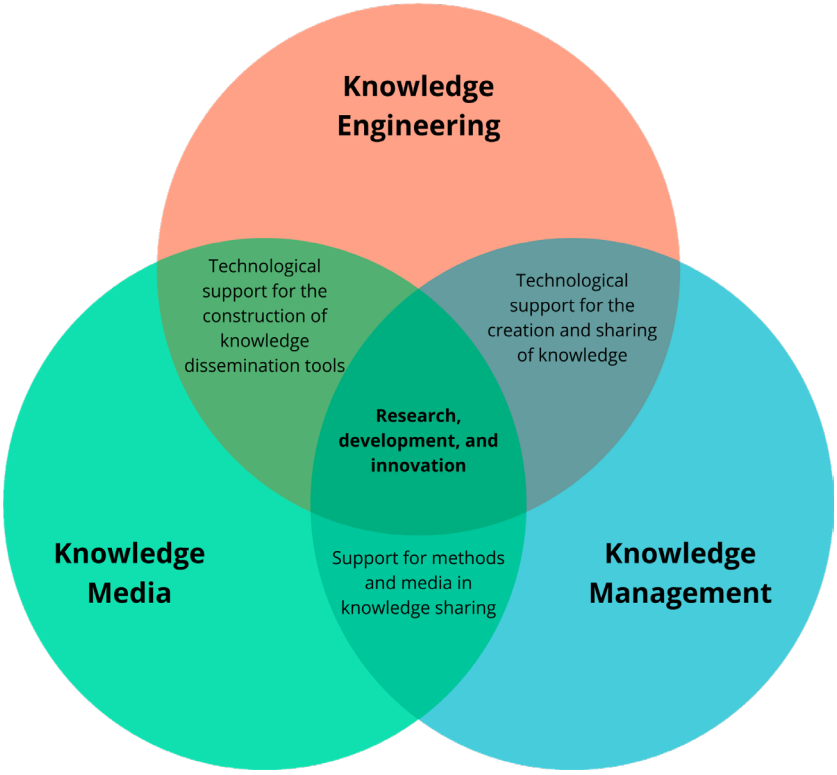


Figure 1: Interrelation between the areas of focus. Source: Adapted from Pacheco (2007).

In Knowledge-Intensive Organizations (KIOs), innovation thrives through KEMM by capturing, organizing, and disseminating knowledge assets. These areas provide infrastructure, methodologies, and tools to foster innovative ideas. Emerging technologies like augmented and virtual reality enhance this process by enabling immersive knowledge sharing and interactive collaboration (Wang, Pauleen & Taskin, 2022).

Humans, as co-creators, attribute meanings to reality through language and communication (Briggle & Christians, 2017). In the knowledge-based economy, Knowledge Management (KM) recognizes knowledge as a competitive advantage (Burgin, 2016). Knowledge Media and interdisciplinary approaches are crucial for understanding complexity. Online collaboration tools and social media enhance knowledge dissemination and problem-solving. Technologies like ontologies, Natural Language Processing (NLP), and Machine Learning (ML) aid in organizing and managing knowledge from diverse sources.

Engineering, KM, and Media extend beyond organizations, impacting broader contexts like Innovation Ecosystems and Smart, Human, and Sustainable Cities (Almeida, Doneda, & Da Costa, 2018). Amid challenges like information overload and AI, distinguishing "information" from "knowledge" in KEMM is vital. Expanding "cognition" emphasizes cognitive beings' roles in knowledge processes (Santos & Sousa, 2010).

Effective KEMM practices are crucial for KIO innovation and success, relying on the triad of People, Processes, and Technologies, with emphasis on "People".

4.1 The Central Role of People

The writers perceive that at the heart of any successful KEMM implementation is the human element. People are the primary drivers of knowledge creation, sharing, and utilization. They bring diverse perspectives, creativity, and expertise, which are indispensable for fostering innovation. Therefore, building a culture that values and promotes continuous learning, collaboration, and knowledge sharing is fundamental. This involves not only providing the necessary tools and technologies but also creating an environment where individuals feel empowered and motivated to contribute.

4.2 Building a Knowledge-Centric Culture

The authors believe that cultivating a strong organizational culture centered around knowledge is vital. This culture should emphasize values such as trust, openness, and mutual respect. By fostering a culture that encourages experimentation and tolerates failure as a learning process, organizations can create a safe space for innovation. Leaders play a crucial role in this regard by modeling knowledge-sharing behaviors, recognizing and rewarding contributions, and providing opportunities for professional development.

4.3 Integrating Processes and Technologies with Human Factors

While processes and technologies are essential components of KEMM, the authors perceive that their effectiveness is significantly enhanced when integrated with human factors. Processes should be designed to be user-friendly and supportive of the ways people naturally work and collaborate. Similarly, technologies should be selected and implemented with a focus on how they can best support human interactions and knowledge workflows. For instance, leveraging collaborative platforms and tools such as Microsoft Teams, Slack, and Trello, which facilitate real-time communication and seamless knowledge exchange, can greatly enhance productivity and innovation.

4.4 Creating an Enabling Environment

It was concluded that creating an enabling environment that supports KEMM practices is crucial. This includes not only the physical and digital workspaces but also the organizational policies and structures. An environment that promotes flexibility, autonomy, and cross-functional collaboration can significantly boost the effectiveness of KEMM initiatives. Moreover, aligning these initiatives with the broader strategic goals of the organization ensures that knowledge management efforts are purposeful and impactful.

4.5 The Synergistic Relationship of People, Processes, and Technologies

The authors believe that the synergistic relationship between people, processes, and technologies is what ultimately drives the success of KEMM practices. Each element of this triad supports and enhances the others, creating a holistic system that promotes continuous improvement and innovation. For example, well-designed processes and advanced technologies can facilitate knowledge capture and dissemination, but it is the people who apply this knowledge in creative and meaningful ways to solve problems and drive progress.

By focusing on the human element and building a culture and environment that supports KEMM practices, organizations can harness the full potential of their knowledge assets. The authors perceive that this approach not only enhances organizational performance and competitiveness but also contributes to the personal and professional growth of individuals, leading to a more engaged and innovative workforce.

5. Research agenda

In a world of knowledge creation and innovation, the authors perceive that working with interdisciplinary knowledge and the merging of different technologies are key factors influencing the main research areas. Drawing from the seminal works of Bernardi and Diamantini (1932) to recent discussions by Freire et al. (2021), the writers concluded that the intersection of multiple disciplines and the convergence of diverse technological domains foster new opportunities for collaborative research endeavors. The research agenda, with detailed topics following, seeks to explore the synergistic relationships between different disciplines, such as Engineering, Management, and Media, within the context of interdisciplinarity and technological convergence. By examining the ways in which these disciplines intersect and complement each other, the authors believe researchers can uncover novel insights and approaches to address complex societal challenges and technological advancements.

5.1 Sustainability and Social Responsibility

The imperative of sustainability and social responsibility permeates contemporary discourse, driving scholarly inquiries into the ethical, environmental, and socio-economic dimensions of human activities. As articulated by the Instituto Brasileiro de Governança Corporativa (IBGC, 2021) and the Brazilian Court of Audit (TCU, 2014, 2020), governance principles underscore the importance of responsible decision-making and accountability in corporate and public sectors. This topic aims to investigate how KEMM intersect in promoting sustainable practices, fostering social inclusion, and addressing pressing environmental concerns. By exploring innovative approaches to sustainability and social responsibility, researchers can contribute to the development of strategies that reconcile economic growth with environmental stewardship and social equity.

5.2 Governance and Ethics

The discourse on governance and ethics occupies a central position in contemporary discussions, reflecting growing concerns about transparency, accountability, and ethical conduct in organizational practices. Building upon the definitions provided by the Information Systems Audit and Control Association (ISACA, 2012) and the Brazilian Court of Audit (TCU, 2014, 2020), a research agenda covering governance themes seeks to examine the intricate relationship between governance, ethics, and organizational performance. By investigating how Engineering, Management and Media intersect in shaping governance structures and ethical frameworks, researchers can advance our understanding of the principles that underpin responsible decision-making and stakeholder engagement.

5.3 Digital Inclusion and Accessibility

The digital revolution has ushered in unprecedented opportunities for connectivity, innovation, and access to information. However, disparities in digital access and literacy persist, posing challenges to achieving universal inclusion and accessibility. In line with the discussions by ABBUD (2017) and Al-Ruithe et al. (2018), this research agenda aims to explore the intersection of Engineering, Management, and Media in promoting digital inclusion and accessibility. By examining strategies to bridge the digital divide, foster digital literacy, and ensure equitable access to digital resources, researchers can contribute to creating more inclusive and accessible societies.

5.4 Digital Transformation and its Impacts

The advent of digital technologies has precipitated a paradigm shift in various spheres of human endeavor, from business and governance to media and communication. As highlighted by TCU (2020) and Freire et al. (2021), digital transformation encompasses far-reaching implications for organizational structures, processes, and relationships. This research agenda seeks to investigate the multifaceted impacts of digital transformation on Engineering, Management, and Media domains. By analyzing the challenges and opportunities posed by digital disruption, researchers can inform strategies for navigating and harnessing the transformative power of digital technologies in diverse contexts.

6. Conclusion

Collecting data in these organizations is challenging due to their complex activities. However, constant efforts in data explanation and process improvement stimulate innovation.

Knowledge is complex and dynamic, influenced by social, cultural, and organizational contexts. Managing it requires understanding epistemological assumptions and embracing complexity for effective strategies (Bento, 2020).

Exploring interactions between Knowledge Engineering, Management, and Media within KIOs highlights their importance in the Knowledge Society. This study opens room for further reflection and future perspectives.

Future research should focus on practical applications of these concepts in real-world scenarios within KIOs. Strategies valuing knowledge as a co-production factor, new governance systems, and technologies like Virtual Reality, Augmented Reality, Metaverses, and AI can drive significant innovations.

Studying how KEMM can create comprehensive innovation ecosystems is crucial. Viewing knowledge as a shared resource ("commons") can lead to effective business models and support Human, Intelligent, and Sustainable Cities. Additionally, exploring KEMM's role in education and organizational learning is essential for

promoting agile learning and knowledge updates.

KEMM transcends organizational boundaries, applicable to governments and ecosystems. Understanding its role in driving collaboration, innovation, and knowledge dissemination is key to addressing global challenges.

This study encourages future investigations to enhance understanding and practical application of KEMM.

Acknowledgments

The present work was carried out with the support of the Coordination for the Improvement of Higher Education Personnel – Brazil (CAPES) – Financing Code 001.

References

Abbud, E. B. (2017). Governança colaborativa: uma abordagem teórica, empírica e prática em parques tecnológicos. Universidade Federal de Lavras.

Abel, M., & Fiorini, S. R. (2013). Uma revisão da engenharia do conhecimento: Evolução, paradigmas e aplicações. International Journal of Knowledge Engineering and Management (IJKEM), 2(2), 1-35.

Aires, R. (2020). Desenvolvimento de competências gerais para a sociedade em transformação digital: uma trilha de aprendizagem para profissionais do setor industrial [Dissertação de mestrado, Universidade Federal de Santa Catarina]. Florianópolis, SC.

Almeida, V. A. F., Doneda, D., & da Costa, E. M. (2018). Humane smart cities: The need for governance. IEEE Internet Computing, 22(2), 91-95.

Al-Ruithe, M., Benkhelifa, E., & Hameed, K. (2018). Data governance taxonomy: Cloud versus non-cloud. Sustainability, 10(1).

Ames, M. C. F. D. C., Serafim, M. C., & Zappellini, M. B. (2020). Phronesis in administration and organizations: A literature review and future research agenda. Business Ethics, 29(S1), 65–83.

Andersen, M.; Skjoett-Larsen, T. Corporate social responsibility in global supply chains. Supply Chain Management: An International Journal, [s. l.], v. 142:75-86, 2009.

Anderson, J. E., et al. (2020). Defining adaptive capacity in healthcare: A new framework for researching resilient performance. Applied Ergonomics, 87, 103111.

Anderson, J., Ross, A., & Jaye, P. (2013). Resilience engineering in healthcare: moving from epistemology to theory and practice. Proceedings of the fifth resilience engineering symposium. Em: Fifth Resilience Engineering Symposium. Soesterberg, NE.

Arksey, H., & O'Malley, L. (2005). Scoping studies: towards a methodological framework. International journal of social research methodology, 8(1), 19-32.

Arthur, J., Kristjánsson, K., & Vogler, C. (2021). Seeking the Common Good in Education Through a Positive Conception of Social Justice. British Journal of Educational Studies, 69(1), 101–117.

Bachmann, C., Habisch, A., & Die Ksmeie, C. (2017). Practical Wisdom: Management's No longer Forgotten Virtue. Journal of Business Ethics, 153(1), 147–165.

Belani, H., et al. (2022). Towards ontology-based requirements engineering for IoT-supported well-being, aging and health. In 2022 IEEE 30th International Requirements Engineering Conference Workshops (REW) (pp. 65-74).

Bento, F. C. (2020). Uma introdução crítica à pesquisa em gestão do conhecimento e desafios da complexidade. Revista Femass, (2).

Bento, F., Garotti, L., & Mercado, M. P. (2021). Organizational resilience in the oil and gas industry: A coping review. Safety Science, 133, 105036.

Bergerød, I. J., Braut, G. S., & Wiig, S. (2020). Resilience From a Stakeholder Perspective: The Role of Next of Kin in Cancer Care. Journal of Patient Safety, 16(3), e205.

Berghaus, S. (Year). Digital Maturity & Transformation Study.

Berghaus, S., & Back, A. (Year). Stages in Digital Business Transformation: Results of an Empirical Maturity Study.

Bignetti, L. P. (2002). O Processo de Inovação em Empresas Intensivas em Conhecimento. RAC, v. 6, n. 3, Set./Dez., 33-47.

Bordelau, F.-E., & Felden, C. (Year). Digitally Transforming Organisations: A Review of Change Models of Industry 4.0.

Bramley, G.; Power, S. Urban form and social sustainability: the role of density and housing type. Environment and Planning & design, [s. l.], v. 361: 30, 2009.

Briggle, A., & Christians, C. G. (2017). Media and communication. The Oxford handbook of interdisciplinarity, 2, 201-213.

Burgin, M. (2016). Theory of knowledge: structures and processes. World scientific.

Carter, C. R.; Jennings, M. M. Social responsibility and supply chain relationships. Transportation Research Part E: Logistics and Transportation Review, [s. l.], v. 381, p. 37-52, 2002.

Carter, C. R., Jennings, M. M. The role of purchasing in corporate social responsibility: a structural equation analysis. Journal of business Logistics, [s. l.], v. 251, p. 145-186, 2004.

Castells, M. (1997). An introduction to the information age. City, 2(7), 6-16.

Creswell, J. W. (2014). Investigação Qualitativa e Projeto de Pesquisa-: Escolhendo entre Cinco Abordagens. Penso Editora.
Conroy, M., et al. (2021). Using practical wisdom to facilitate ethical decision-making: a major empirical study of phronesis in the decision narratives of doctors. BMC Medical Ethics, 22(1), 1–13.
Davenport, T. H., & Prusak, L. (1998). Working knowledge: How organizations manage what they know. Harvard Business Press.
Davidson, C. N., & Savonick, D. (2017). Digital Humanities. The Oxford handbook of Interdisciplinarity, 159.
Davis, S. D., & Walton, T. B. (2004). Engineering knowledge. In Proceedings of the 42nd annual Southeast regional conference (pp. 406-407).
De Carvalho, T. M., Ponciano, E. S., & Bianchi, E. M. P. G. (2021). GESTÃO DO CONHECIMENTO EM EQUIPES DE TRABALHO: UM ESTUDO APLICADO EM EMPRESAS ASSOCIADAS AO NÚCLEO DE RELAÇÕES HUMANAS NA CIDADE DE ARAGUARI-MG. Revista Fatec Sebrae em debate-gestão, tecnologias e negócios, 8(14), 164-164.
De Godoy, M. F., & Ribas Filho, D. (2021). Facing the BANI world. International Journal of Nutrology, 14(2), 33-33.
De la Torre, R., & Berbegal-Mirabent, J. (2022). Knowledge-Intensive Organizations and Their Role in Promoting Sustainable Development. Administrative Sciences, 12(3), 100.
Di Vaio, A., et al. (2021). The role of digital innovation in knowledge management systems: A systematic literature review. Journal of business research, 123, 220-231.
Drucker, P. (1993). Post-Capitalist Society. HarperCollins.
Erceg, V., & Zoranović, T. (2022). Knowledge management and digital business transformation. Strategic Management-International Journal of Strategic Management and Decision Support Systems in Strategic Management, 27(2).
Ferrero, I., et al. (2020). Practical wisdom: A virtue for leaders. Bringing together Aquinas and Authentic Leadership. Business Ethics, 29(S1), 84–98.
Fowers, B. J., et al. (2021). Courage, Justice, and Practical Wisdom as Key Virtues in the Era of COVID-19. Frontiers in Psychology, 12.
Freire, P. de S., et al. (2021). Glossário: Governança Multinível do Conhecimento e da Aprendizagem e seus mecanismos de Universidade Corporativa em Rede e de Comunicação Dialógica. Editora CRV.
Frozza, T., de Lima, E. P., & da Costa, S. E. G. (2023). Knowledge Management and Blockchain Technology for Organizational Sustainability: Conceptual Model. Brazilian Journal of Operations & Production Management, 20(2), 1354-1354.
Gorman, G. G., & McCarthy, S. (2014). Business Development Support and Knowledge-Based Businesses. Journal of Intelligent Manufacturing.
Günther, H. F., & Cunha, C. J. C. de A. (2022). O SISTEMA DE LIDERANÇA NAS ORGANIZAÇÕES INTENSIVAS EM CONHECIMENTO. Perspectivas em Gestão & Conhecimento, João Pessoa, 12(número especial), 33-47.
Hall, J. G. (2012). Engineering knowledge engineering. Expert Systems, 29(5), 427-428.
Hess, C. (2007). Understanding knowledge as a commons.
Hosseini, M. R., Tahsildari, H., Hashim, M. T., & Tareq, M. A. (2014). The impact of people, process and technology on knowledge management. European Journal of business and Management, 6(28), 230-241.
IBGC - Instituto Brasileiro de Governança Corporativa. (2021). Disponível em: https://www.ibgc.org.br/quemsomos.
ISACA. (2012). COBIT 5: Governança e Gestão de TI da Organização. Rolling Meadows.
Kant, V., & Kerr, E. (2019). Taking stock of engineering epistemology: Multidisciplinary perspectives. Philosophy & Technology, 32, 685-726.
Kaźmierczak, D. (2017). Skills and Capabilities in the Knowledge Society [In] Ed. E. Smyrnova – Trybulska, E-Learning Vol.9 Effective Development of Teacher's Skills in the Area of ICT And E-Learning, Katowice – Cieszyn.
Kendal, S. L., et al. (2003). A Brief Overview of HyM: A Methodology for the Development of Hybrid Intelligent Information Systems. In SEKE (pp. 322-326).
Kolhbcher, F., & Mukai, K. (2007). Japan's learning communities in Hewlett-Packard Consulting and Integration. The Learning Organization: The International Journal of Knowledge and Organizational Learning Management, 14(1), 8-20.
Kristjánsson, K. (2015). Phronesis as an ideal in professional medical ethics: some preliminary positionings and problematics. Theoretical Medicine and Bioethics, 36(5), 299–320.
Macedo, M., & Souza, M. (2023). Ambientes de inovação: das pré-incubadoras as cidades inteligentes. Novas Edições Acadêmicas.
Machado, M. C., & Ferreira, A. P. L. (2022). Revisão sistemática da literatura sobre ontologias para modelos de negócio e processos na pecuária de corte. Revista Brasileira de Computação Aplicada, 14(2), 75-84.
Massingham, P. (2019). An Aristotelian interpretation of practical wisdom: the case of retirees. Palgrave Communications, 5(1), 123.
Masson, G. (2022). Ontoepistemologia na produção de conhecimento no campo da Educação. Práxis Educativa, 17.
Mendenhall, M. E., & Oddou, G. (1986). The cognitive, psychological and social contexts of Japanese management. Asia Pacific Journal of Management, 4, 24-37.
Mertins, K., Heisig, P., & Vorbeck, J. (Eds.). (2003). Knowledge management: Concepts and best practices (2nd ed.). Berlin: Springer.
Munn, Z., et al. (2018). Systematic review or scoping review? Guidance for authors when choosing between a systematic or scoping review approach. BMC medical research methodology, 18, 1-7.
Muños, A., Bohórquez, M., & Díaz, G. (2022). Sociedad del conocimiento y sociedad de la información: dos paradigmas para un mismo referente epistemológico para el avance científico y tecnológico. Revista de Filosofia, 22, 332-345.

Müller, F. M., & Souza, M. V. (2020). The role of knowledge media in network education. International Journal for Innovation Education and Research, 8, 76-93.
Nadai, F., & Calado, L. (2006). Uma análise crítica do termo 'organizações intensivas em conhecimento'. Revista Gerpros da Unesp, São Paulo, 1(2), 1.
Nataliia, H., & Olena, M. (2023). The Key Administrative Competencies Of Managers Required For Company Development In The Bani World. ECONOMICS-INNOVATIVE AND ECONOMICS RESEARCH JOURNAL, 11(1), 289-305.
Nomura, T., & Arai, K. (2002). Knowledge Management Process Model to Develop Knowledge Strategies: How to design Knowledge Media Networks for Successful Knowledge Management. Proceedings of the IEEE Workshop on Knowledge Media Networking (KMN'02), [S.l.], 1-7.
Pacheco, R. C. S. (2007). Engenharia, Gestão e Mídia do Conhecimento - Aula 3/3. Available at: https://pt.slideshare.net/rpacheco/engenharia-gesto-e-mdia-do-conhecimento-aula-33.
Paula, A. P. P. D., & Paes, K. D. (2022). Fordism, post-fordism, and cyberfordism: the paths and detours of Industry 4.0. Cadernos EBAPE. BR, 19, 1047-1058.
Rossetti, A., et al. (2008). A organização baseada no conhecimento: novas estruturas, estratégias e redes de relacionamento. Ciência da Informação, 37, 61-72.
Russell, S. (2016). Artificial Intelligence: A Modern Approach. Pearson.
Saaty, T. L. (2004). Decision making — the Analytic Hierarchy and Network Processes (AHP/ANP). Journal of Systems Science and Systems Engineering, 13(1), 1–35.
Saaty, T. L. (2008). Decision making with the analytic hierarchy process. International Journal of Services Sciences, 1(1), 83.
Saiti, A., & Stefou, T. (2020). Hierarchical organizational structure and leadership. In Oxford Research Encyclopedia of Education.
Santos, F. M. R., & Sousa, R. P. L. (2010). O conhecimento no campo de Engenharia e Gestão do Conhecimento. Perspectivas em Ciência da Informação, 15, 259-281.
Sarkis, J.; Hervani, A. A. Reverse Logistics and Social Sustainability. Corporate Social Responsibility and Environmental Management Corp. Soc. Responsib. Environ. Mgmt., [s. l.], v. 17, p. 337–354, 2010.
Saurin, T. A., & Carim Júnior, G. C. (2011). Evaluation and improvement of a method for assessing HSMS from the resilience engineering perspective: A case study of an electricity distributor. Safety Science, 49(2), 355–368.
Schallmo, D., Williams, C. A., & Boardman, L. (2017). Digital transformation of business models — Best practice, enablers, and roadmap. International Journal of Innovation Management, 21(08), 1740014. http://dx.doi.org/10.1142/s136391961740014x.
Schmid, B., & Stanoevska-Slabe, K. (1998). Knowledge media: An innovative concept and technology for knowledge management in the information age. In Beyond Convergence, 12th Biennal International Telecommunications Society Conference.
Schreiber, G. (2000). Knowledge engineering and management: the CommonKADS methodology. MIT press.
Shaba, E. et al. (2023). Adopting an Ecosystem Approach to Digitalization-driven Organizational Change? Actionable Knowledge from a Collaborative Project. Systemic Practice and Action Research, 1-20.
Sousa, Richard Perassi Luiz de. Mídia do conhecimento [recurso eletrônico]: ideias sobre mediação e autonomia/ Richard Perassi Luiz de Sousa. – 1.ed. – Dados eletrônicos. Florianópolis: SIGMO/UFSC,2019. 111p.: ils.
Stehr, N. (2015). Knowledge Society, History of.
Strozzi, F., et al. (2017). Literature review on the 'Smart Factory' concept using bibliometric tools. International Journal of Production Research, 55(22), 6572–6591.
Studer, R., Benjamins, V. R., & Fensel, D. (1998). Knowledge engineering: Principles and methods. Data & knowledge engineering, 25(1-2), 161-197.
Swartwood, J. (2020). Can we measure practical wisdom? Journal of Moral Education, 49(1), 71–97.
TCU, Tribunal de Contas da União. (2014). Referencial básico.
TCU. (2020). Referencial básico de governança aplicável a organizações públicas e outros entes jurisdicionados ao TCU (3a ed.). Brasília.
Vieira, T. O. (2020). O contributo da gestão de documentos na gestão do conhecimento nas organizações: uma abordagem exploratória. Em Questão, 327-350.
Wang, W. Y. C., Pauleen, D., & Taskin, N. (2022). Enterprise systems, emerging technologies, and the data-driven knowledge organisation. Knowledge Management Research & Practice, 20(1), 1-13.
Wiig, K. M. (1999). Knowledge Management: An Emerging Discipline Rooted in a Long History. Disponível em http://www.krii.com/downloads/km_emerg_discipl.pdf. Acesso em 03 de setembro de 2023.
Woodward, J. B., Shaw, M. L. G., & Gaines, B. R. (2006). The cognitive basis of knowledge engineering. In Contemporary Knowledge Engineering and Cognition: First Joint Workshop Kaiserslautern, Germany, February 21–22, 1991 Proceedings (pp. 194-221). Springer Berlin Heidelberg.
Woods, D. (2006). Essential Characteristics of Resilience. In Hollnagel, E., Woods, D. D., & Leveson, N. (Eds.), Resilience engineering: concepts and precepts. Aldershot, England; Burlington, VT: Ashgate.
Zieba, M. (2021). Understanding knowledge-intensive business services. Cham: Springer International Publishing.

Overview of Knowledge Sharing Concepts in a Project Environment: A Systematic Literature Review

Anikó Csepregi[1] and Viktória Papp-Horváth[2]
[1] University of Pannonia, Veszprém, Hungary
[2] Corvinus University of Budapest, Budapest, Hungary

csepregi.aniko@gtk.uni-pannon.hu
viktoria.horvath@uni-corvinus.hu

Abstract: Projects are considered to be temporary organisations (Lundin & Söderholm, 1995), so the non-permanent nature of the projects makes it even more important for the organisations to put a significant emphasis on knowledge sharing (KS). This paper aims to present an overview of the KS concept in project management (PM) by involving selected top journals of this research field. Furthermore, to create a KS theory map introducing subject areas related to KS concept with their relationships. Scopus database was used as a source and articles published in four journals (Q1 and Q2 ranked) were chosen: International Journal of Project Management, Project Management Journal, and International Journal of Managing Projects in Business; International Journal on Information Systems and Project Management. Our primary search resulted in 49 records over a 20-year time-period (2003-2022). 'Knowledge sharing' was applied as our primary search-word and the document type was limited only to 'articles', and regarding language, source type and article 'English' 'journal' 'articles' were applied as filters concerning the database. Systematic literature review (SLR) was conducted based on the steps of Okoli (2015) and was visualized by a PRISMA flow chart. The final sample included 36 articles based on a three-criteria selection process. Descriptive analysis was conducted on this sample, and it was also content analysed based on multiple aspects. The main subject areas related to KS concept resulted in a theory map, which visualizes influencing and influenced factors of KS based on the analysis of the past 20 years' articles from the selected top PM journals. The analysis revealed the overlaps and interrelationship amongst the influencing factors, which enables us to group them. These findings are useful for PM academics to place their current and future research in this KS theory map, or to identify possible gaps in the literature in this field. By being aware of the complex nature of KS, practitioners could make more focused decisions to foster the KS mechanisms in their projects.

Keywords: Knowledge Sharing, Project Management, Systematic Literature Review

1. Introduction

Searching for journal articles in English about knowledge sharing (in the title, abstract or keywords) in the Scopus database within the 17 journals listing "knowledge" in their names, but without any limitation regarding the year of publication or the subject area, the results showed that the number of articles is above 1.200 records (1.284). This draws attention on the relevance of knowledge sharing (KS) in journals related to knowledge. However, focusing on the KS concept by involving selected top project management journals could show a completely different picture.

Since the mid 1990's there was a growing attention in the scientific community towards the temporary forms of working constellations focusing on a special result, namely towards the projects, which were defined as temporary organisations (Lundin and Schöderholm, 1995; Söderlund, 2004; Beaume et al. 2009). The temporary nature of this endeavours together with the fact that projects consider a unique, complex, one-time task within the organisation, called significant attention towards KS regarding projects. It could be important at personal, project or organisational level as well. In the organisational context KS is of high importance since it involves transforming knowledge into a usable form for others, facilitating innovation or growth within organization (e.g., Ipe, 2003; Tsai et al. 2014). It is also recognized as essential for both large companies and SMEs, emphasizing its strategic significance across different organizational sizes (e.g., Wang and Noe, 2010; Anand et al. 2021). While the critical role of knowledge sharing in enhancing project performance is well-recognized, there remains a notable research gap in exploring those factors which have an influence on KS and which are influenced by it in project management context.

This paper could be connected to those research initiatives which try to combine the two scientific fields, namely knowledge management and project management (Brookes et al., 2006; Gomes et al. 2008) to understand the challenges of knowledge management, and more specifically KS, in projects (temporary organisations).

Despite the increasing number of publications, "*it is difficult to systematically synthesize, interpret, and apply the knowledge about knowledge sharing to project management (and other fields*)" (Ramaprasad and Prakash, 2009, p.1). Our investigation revealed that no systematic literature reviews have been conducted previously based on the database of high-quality project management journals, specifically focusing on the concept of KS

and its relationship with PM. Thus, this paper aims to present an overview of the KS concept in project management by involving selected top journals of this research area, and to create a KS theory map. The primary focus of the study is directly on KS activities, processes, models and mechanisms while articles which mention this in an inherent manner are excluded.

The paper starts with the introduction of the related theoretical background focusing on a brief overview of project management and KS. Research methodology part introduces the description and the steps of the applied systematic literature review. Results are introduced in two sections; the first part includes the descriptive analysis of the sample, while the content analysis focuses on the identified, related subject areas. Before the conclusion, the limitations and the further research areas are listed.

2. Theoretical Background

2.1 Knowledge Sharing

KS can be considered an important element of knowledge management practices (Meher et al. 2024). In terms of definitions of KS, it is mainly described as an activity during which information or other important content is shared (Bartol and Srivastava, 2002; Möller and Svahn, 2004; Li, 2010). However, Ipe (2003) sees KS between individuals as a process in which knowledge is transformed into a form that other individuals can understand, accept and use. Furthermore, KS can be realized not only through written correspondence or personal communication, but also by establishing relationships with others, or by capturing, documenting, or organizing knowledge for others (Cummings 2004; Pulakos et al. 2003). KS can be considered important for any team (e.g. project team), group or organization, as it focuses on individual, group, social, organizational, and technological cohesion (Nguyen, 2020). Previous studies have shown that KS has become a fundamental driver of innovation and growth within large organizations (e.g. Tsai et al. 2014; Wang and Noe, 2010). At the same time, the strategic importance of KS in the SME context has also been revealed by previous studies (Anand et al. 2021). This shows that KS can be interpreted at various levels and could be investigated in case of different organizational size. Knowledge sharing models are frameworks that help understand and analyse the factors influencing the effective dissemination of knowledge within an organization. These models consider elements such as organizational culture, communication channels, technological support, and individual motivations and barriers (e.g., Lin, 2007; Wang and Noe, 2010).

2.2 Knowledge Sharing and Projects (Temporary Organizations)

Lundin and Schöderholm (1995) described projects as temporary organisations within a permanent organisation. Because of the temporary nature of projects, KS has a special significance on different levels; amongst individuals within the project team, and amongst projects within the client organisation.

Ramaprasad and Prakash (2009) prepared the ontology of KS in project management focusing on the following aspects: (1) KS fostering methods, (2) KS fostering factors (e.g. individual, organizational, societal), (3) KS fostering functions (e.g. facilitators, barriers), (4) knowledge types (e.g. problem recognition, formulation, analysis, solution, prevention), and (5) the KS methods (e.g. orally, in writing).

Project knowledge can be shared through various KS mechanisms, and inter-project KS behaviours are influenced by various organizational features (e.g. organizational culture) (Wiewiora et al. 2013; Wiewiora et al. 2014). Focusing on the individual level, e.g on the leadership style, shared leadership through KS can enhance the success of projects (Imam and Zaheer, 2021). On the other hand, trust in the context of projects is also a widely researched topic and several contradictory results have been found (Buvik and Tvedt, 2017)

After the short theoretical background focusing on a brief overview of project management and KS, the paper continues with the applied systematic literature review regarding the KS concept in project management by involving selected top journals.

3. Research Methodology of the Literature Research (SLR)

Booth et al. (2012) distinguishes six forms of academic reviews: the literature review, the critical review, the integrative review, the mapping review/systematic map and the mixed studies review/ mixed methods. Templier and Paré (2015) only creates two forms; reviews which serve as background for an empirical study aiming to provide the theoretical context, and there are the stand alone reviews which could have the following purposes: describe, test, extend, and critique. Our review belongs to the combination of the literature and the mapping

review, and to the stand alone descriptive category. Four phases and eight steps of a successful systematic literature review (SL) are distinguished: PLANNING - (1) identify the purpose, (2) draft protocol and train the team, SELECTION – (3) apply practical screen, (4) search for literature, EXTACTION (5) extract data, (6) appraise quality, EXECUTION (7) synthesize studies, (8) write the review (Okoli, 2015; Okoli and Schabam, 2010).

The Scimago Journal & Country ranking page's (https://www.scimagojr.com/) publications database served as a starting point for the journal selection. The newest list available was the 2022 publication list at the time of our research (as of January 2024). The following filtering criteria was specified to narrow down the publication database: only journals were involved in our review, the word "project" had to be a part of the journal title, the journal had to fall into the SJR (SCImago Journal Rank) Best Quartile (Q1 and Q2), and the category of the journal had to belong to Business and International Management or Management of Technology and Innovation or Strategy and Management within the subject area of Business, Management and Accounting. As a result of our screening, 4 journal remained in the focus of our investigation:

- International Journal of Project Management (Q1, Elsevier UK, H index: 167, Published since: 1983-),
- Project Management Journal (Q1, Sage USA, H index: 55, Published since: 1998-),
- International Journal of Managing Projects in Business (Q2, Emerald UK, H index: 43, Published since: 2008-)
- International Journal of Information Systems and Project Management (Q2, UMinho Editoria Portugal, H index: 20, Published since: 2013-)[1].

Limited to the 4 selected professional project management journals, the process of selecting articles dealing with 'knowledge sharing' was also prepared on the Scopus database. The search for the term "*knowledge sharing*" was conducted in the title, abstract and keywords for each journal separately, and we limited the selection of articles in each journal to English journal articles (language, source type, article). Our primary screening resulted in 49 records (18 papers in IJPM, 12 papers in PMJ, 15 papers in IJMPB and 4 papers in IJISPM) over a 20-year time-period (2003-2022).

After checking the results of the primary search, one record was excluded because the search words ('knowledge sharing') could not be found in the title/abstract/keywords, that modified the number of records to 48.

Several authors emphasized the importance of the rigor of the search process (Booth et al., 2012, Vom Brocke et al., 2009), so we applied a selection criteria , based on which our primary sample was narrow down to the final sample (Table 2). In line with the originally defined research aim the following selection criteria was formed (Table 2).

Table 1: The selection criteria of journal articles (own compilation)

Selection criteria		Description of the selection criteria
Closely related to the research aim		Focus is on KS. Focus is on phenomenon which is influenced by KS. Focus is on phenomenon which influences/has an effect on KS. Focus is on KS appearing at certain project type. Focus is on KS appearing at certain organizational levels.
Moderately related to the research aim	After revision remaining in the final sample	Focus is on sharing uncertain information. Focus is on tangible KS mechanism. KS is introduced as part of a complex KM model.
	After revision excluded from the final sample	KS does not appear as a concrete process or method, just in general in agile environment. KS does not appear as a concrete process or method, just in general in software development environment.

[1] *Based on the journal homepages: https://www.sciencedirect.com/journal/international-journal-of-project-management, https://journals.sagepub.com/home/pmx, https://www.emerald.com/insight/publication/issn/1753-8378, https://www.sciencesphere.org/ijispm/*

Selection criteria	Description of the selection criteria
Not related to the research aim	Focus is not directly on KS and papers investigate this phenomenon in an inherent manner: Focus is on knowledge base building (KS is mentioned related to the implication) Focus is on balanced sharing with protection or knowledge hiding. Focus is on knowledge exchange. Focus is on the advances of the community of practice. Focus is on information and communication design. Focus is on knowledge transfer.

Based on the primary selection criteria (closely related to the research aim) 33 records were immediately selected to the final sample. Then, we categorized 5 records after the analysis to be moderately related to the research aims. These records were revised based on an extended criteria list and 2 records were removed out of the 5 from the sample. As a result, the final sample consisted of 36 records (14 papers in IJPM, 11 papers in PMJ, 10 papers in IJMPB and 1 paper in IJISPM).

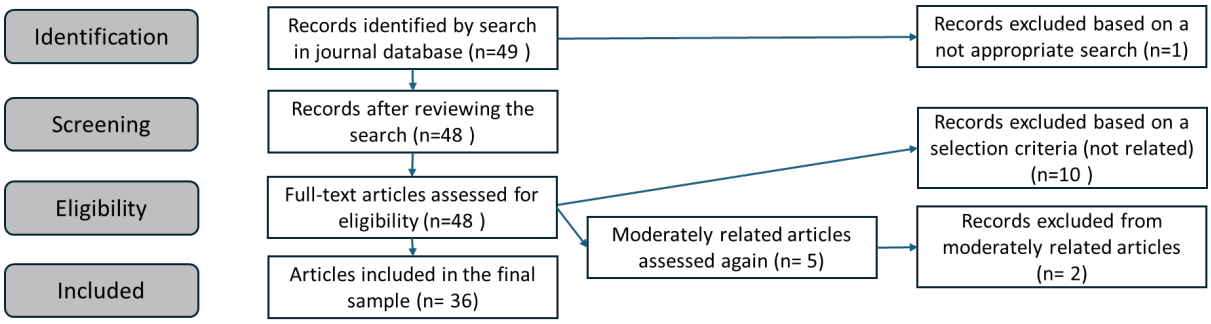


Figure 1: PRISMA flow chart of journal article selection (own compilation based on Gallagher et al., 2016, p.4)

4. Results

4.1 Descriptive Analysis

The earliest (3) articles in the literature selection were published in 2003, all in International Journal of Project Management. Comparing the two investigated decades we could see that there is a significant increase in the number of publications in this topic regarding the second decade: 8 articles between 2003 and 2012, 28 article from year 2013. The largest number of relevant papers, in the period under review, appeared in the year 2021 and 2022 immediately after the breakout of the pandemic with 5-5 articles. The popularity of the topic has increased in recent years, which highlight of investigating the background of this phenomenon (Table 3)

Table 2: Statistics based on publication interval (own compilation)

Year of publication	2003-2007	2008-2012	2013-2017	2018-2022
No. of publication	4	4	15	13

In the Q1 ranked journals altogether 25 articles were published in the investigated topic, compared to the 11 in the two Q2 ranked ones. Based on this, it could be claimed that this topic still belongs to the relevant research areas of the project management profession.

The most common author composition form was the two-author format with 15 records of the sample. Only five out of the 36 investigated papers were submitted by an individual author, so 31 was prepared in bigger or smaller research groups (3 authors in 8 cases, 4 authors in 6 cases, and 5 authors in 2 cases).

As of 9th January 2023, altogether 2066 citations were recorded in the Scopus database regarding the articles of our final sample. There were six articles with more than 100 citations. All of them were published in IJPM (Q1 ranked journal) between 2003 and 2014 by multi-author groups (Table 4).

Table 3: TOP6 most cited papers (own compilation)

Authors	Year	No of citations

Koskinen, Pihlanto, Vanharanta	2003	283
Park, Lee	2014	228
Fernie, Green, Weller, Newcombe	2003	198
Liebowitz, Megbolugbe	2003	147
Wiewiora, Trigunarsyah, Murphy, Coffey	2013	140
Pemsel, Wiewiora	2013	132

The final sample consists of one SLR, two theoretical papers, nine case studies, the remaining presents results of qualitative (nine records) and quantitative studies (15 records).

4.2 Content Analysis

During our content analysis, the articles were reviewed with a special focus on the theoretical design of the research and the research findings. After a thorough reading of the articles, we collected those factors that the authors mentioned in their works due to their connection with KS.

KS is a complex phenomenon so revealing the exact relationship with other subject areas could be a difficult task, so we grouped the identified factors into two categories; those which have an effect on KS and those which are influenced by KS. Based on that our research resulted in a KS theory map.

4.2.1 Factors Having an Effect on the Knowledge Sharing in Project Management

In our research the identified subject areas are usually independent variables which have an impact on KS and only a few of them are mediating variables. Altogether three significant subject areas have emerged: (1) leadership, (2) trust and (3) organizational culture.

(1) Leadership related subject area

Four articles highlighted different forms of leadership which are contributing to KS. These are as follows: servant (article in our sample: #4, see Appendix 1.), shared (#28), ethical (#34) and knowledge leadership (#8) More articles focus on the project manager's KS attitude (#21). One article highlights that knowledge leadership could contribute to KS through social capital (#8). Social capital as an important factor was also mentioned in other two articles (#9, #22). It could be seen that many researchers draw a direct link between the project manager's leadership and KS within the project team. (e.g. Imam and Zaheer, 2021; Pemsel and Wiewiora, 2013)

(2) Trust related subject area

Trust was the most frequently appearing factor in the analysed articles. Its contribution to KS was highlighted five times by itself (#5, #25, #26, #29, #33) and three times together with other factors (#24, #27, #32), from which language (#24, # 27) appeared twice. Trust, security and informal collaboration are forming a milieux, which enables KS (#27), and psychological safety was also mentioned as a factor in an article (#36). Together with trust the interpersonal relation as a factor (#24) is also described. Motivation was mentioned together with trust (#24) and the role of motivation was also highlighted in another article (#35). (e.g. Buvik and Tvedt, 2017; Park and Lee, 2014)

(3) Organizational culture related subject area

Organisational culture and organisational cultural characteristics were mentioned in four articles (#1, #3, #19, #29) as a contributing / enabling factor of KS. The cultural values' effect on the formal and especially on the informal KS practices are highlighted. One article used the competing values framework (#29) to underpin how different organisational culture types are supporting KS mechanisms (e.g Mueller, 2015; Wiewiora et al., 2013).

4.2.2 Factors Being Influenced by Knowledge Sharing in Project Management

The literature treats the impact of KS on project team performance as a kind of evidence, which is underpinned by the fact that significantly less journal articles of the giving sample are dealing with the dependent variables which are influenced by KS. Eight articles were identified out of the final sample which investigated the KS's effects on another factor (dependent variable); two of them connected KS to the project success, one to the success and quality of the project portfolio and two to the project team performance. Although leadership is

usually an input factor of KS, but one article of the sample introduced KS's contribution (as an enabling factor) to distributed leadership through supporting the decision-making process within the project team. The quality of the project partnership and uncertainty management were both mentioned once.

So based on the final sample analysis it could be said that there is a significantly bigger interest in the scientific community towards those factors which influence KS than on those which are its output factors.

4.2.3 Knowledge Sharing Theory Map (in project management) and Discussion

Our content analysis resulted in a KS theory map introducing the main subject areas related to KS concept and their interrelationships, and our results were depicted on the following visual map (Figure 2).

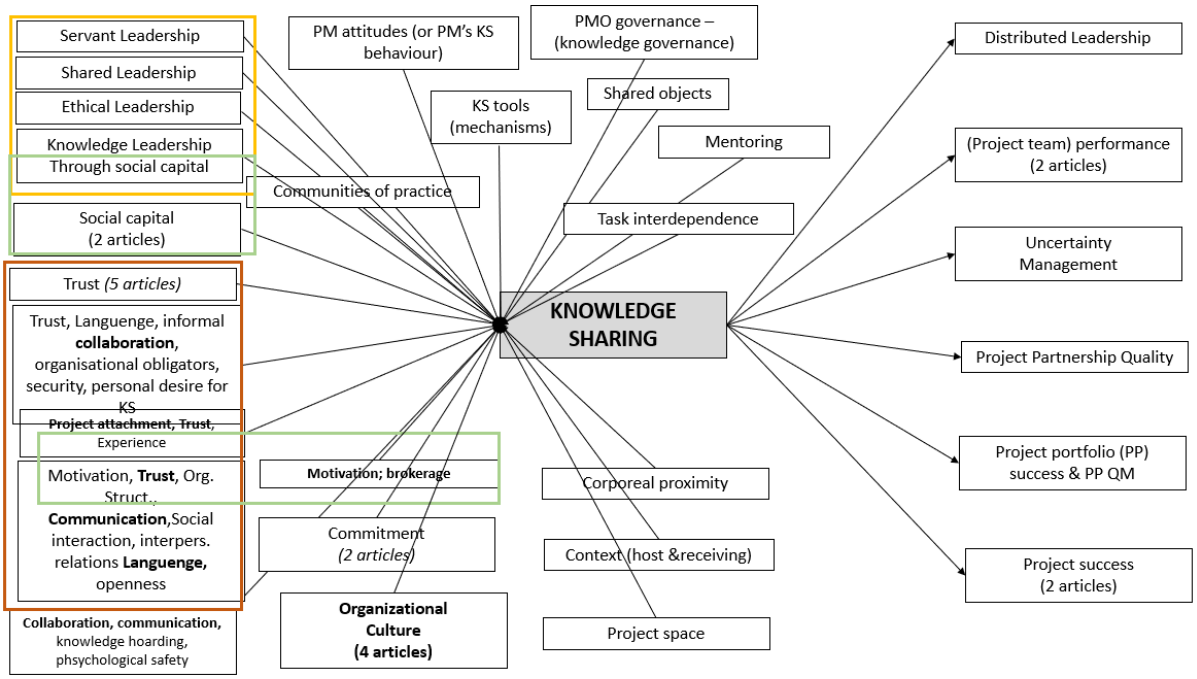


Figure 2: Knowledge Sharing Theory Map (own compilation)

Previous systematic literature reviews covered publications not only on KS but also involved innovation from 1973 to 2017 based on articles from the Scopus and Web of Science databases (Castaneda and Cuellar, 2020). While others focused on the SME context and involved knowledge transfer as well besides KS and investigated article between 1998 and 2018 based on the Scopus database (Anand et al. 2021). In project context, the number of SLR based publications in this topic is quite limited, although Zahedi et al. (2016) in their study were focusing on the challenges and practices of KS and they identified six themes connected to this topic: management, team structure, work processes/ practices, team cognition, social attributes, and technology.

5. Limitations and Further Research

The quality of the present study's methodology was ensured through the deliberate selection of high-ranking journals, confined to those classified within the top tiers of academic quality (Q1 and Q2 rankings). Consequently, there exists a tendency for publications within the scope of this study to experience delays. Conversely, forthcoming topics are frequently found in online articles or presented at conferences. Hence, to mitigate this limitation of the study in future research endeavours, it is advisable to broaden the database filter to include conference proceedings.

Expanding the sample size is of high importance, given that the current study only encompasses a 20-year timeframe (2003-2022), while publications both predate 2003 and extend beyond 2022.

This article primarily delves into elucidating the relationships between factors influencing KS. However, it is important to explore the interplay among these influencing factors further. Moreover, it may prove beneficial to categorize both influencing and influenced factors according to pertinent theoretical frameworks.

6. Conclusion

This paper aimed to provide an overview of the KS concept in project management covering the last two decades (2003-2022) focusing directly on KS activities, processes, models, and mechanisms. For the systematic literature review four top (Q1- and Q2-ranked) journals of project management were selected, and our final sample was narrowed down to 36 records based on our predefined selection criteria. After the conducted descriptive and content analysis, it can be highlighted that authors of the top PM journals have basically put more emphasis on examining the factors that promote and contribute to KS, and significantly less attention has been paid to the factors that are influenced by KS.

Based on the identified factors, three main subject areas were identified (leadership, trust, and organizational culture) which were most mentioned in the articles as factors having an influence on KS. Although there is a much smaller number of sample elements in the case of those factors, which are influenced by KS, but project success and the performance of the project team can be observed here as recurring subject areas. Our findings highlighted the most important subject areas and the KS theory map could serve as a guidance for future research to find the possible connections between related topics or to identify potential new research gaps.

References

Anand, A., Muskat, B., Creed, A., Zutshi, A. and Csepregi, A. (2021) "Knowledge sharing, knowledge transfer and SMEs: evolution, antecedents, outcomes and directions", *Personnel Review,* Vol 50, No. 9, pp 1873-1893.

Bartol, K.M. and Srivastava, A. (2002) "Encouraging knowledge sharing: The role of organizational reward systems", *Journal of Leadership and Organizational Studies*, Vol 9, No. 1, pp 64-76.

Beaume, R., Maniak, R. and Midler, C. (2009) "Crossing innovation and product projects management: A comparative analysis in the automotive industry", *International Journal of Project Management,* Vol 27, No. 2, pp 166-174.

Booth, A., Papaioannou, D. and Sutton, A. (2012) *Systematic approaches to a successful literature review*, Sage, London.

Brookes, N. J., Morton, S. C., Dainty, A. R. J. and Burns, N. D. (2006) "Social processes, patterns and practices and project knowledge management: A theoretical framework and an empirical investigation", *International Journal of Project Management,* Vol 24, No. 6, pp 474-482.

Buvik, M.P. and Tvedt, S.D. (2017) "The influence of project commitment and team commitment on the relationship between trust and knowledge sharing in project teams", Project Management Journal, Vol 48, No 2, pp 5-21.

Castaneda, D.I., and Cuellar, S. (2020) "Knowledge sharing and innovation: A systematic review", Knowledge and Process Management, Vol 27, No 3, pp 159-173.

Cummings, J.N. (2004) "Work groups, structural diversity, and knowledge sharing in a global organization", *Management Science.* Vol 50, No. 3, pp 352-364.

Fernie, S., Green, S.D., Weller, S.J. and Newcombe, R. (2003) "Knowledge sharing: context, confusion and controversy", *International Journal of Project Management*, Vol 21, No 3, pp 177-187.

Gallagher, K. E., Kadokura, E., Eckert, L. O., Miyake, S., Mounier-Jack, S., Aldea, M., Ross, D. A. and Watson-Jones, D. (2016) "Factors influencing completion of multi-dose vaccine schedules in adolescents: a systematic review", BMC Public Health, Vol 16, No. 1, pp 1-17. https://doi.org/10.1186/s12889-016-2845-z

Gomes, F., Oliveira, M. and Chaves, M. S. (2018) "An analysis of the relationship between knowledge sharing and the project management process groups", *Knowledge and Process Management,* Vol 25, No. 3, pp 168-179.

Imam, H., and Zaheer, M.K. (2021) "Shared leadership and project success: The roles of knowledge sharing, cohesion and trust in the team", *International Journal of Project Management*, Vol 39, No 5, pp 463-473.

Ipe, M. (2003) "Knowledge sharing in organizations: A conceptual framework", *Human Resource Development Review*, Vol 2, No. 4, pp 337-359.

Koskinen, K.U., Pihlanto, P. and Vanharanta, H. (2003) "Tacit knowledge acquisition and sharing in a project work context", *International Journal of Project Management*, Vol 21, No 4, pp 281-290.

Li, W. (2010) "Virtual knowledge sharing in a cross-cultural context*", Journal of Knowledge Management*, Vol 14, No. 1, pp 38-50.

Liebowitz, J., & Megbolugbe, I. (2003) "A set of frameworks to aid the project manager in conceptualizing and implementing knowledge management initiatives", *International Journal of Project Management*, Vol 21, No 3, pp 189-198.

Lin, H. F. (2007) "Knowledge sharing and firm innovation capability: an empirical study", International Journal of manpower, Vol 28, No 3/4, pp 315-332.

Lundin, R. A. and Söderholm, A. (1995) "A theory of the temporary organization", *Scandinavian Journal of Management*, Vol 11, No 4, pp 437-455.

Meher, J. R., Nayak, L., Mishra, R. K. and Patel, G. (2024) "Impact of organizational learning culture on organizational effectiveness: A serial mediation analysis with knowledge sharing and employee competencies", *VINE Journal of Information and Knowledge Management Systems*, Vol 54, No. 2, pp 324-338.

Möller, K. and Svahn, S. (2004) "Crossing East-West boundaries: Knowledge sharing in intercultural business networks", *Industrial Marketing Management,* Vol 33, No. 3, pp 219-228.

Mueller, J. (2015) “Formal and informal practices of knowledge sharing between project teams and enacted cultural characteristics”, *Project Management Journal,* Vol 46, No 1, pp 53-68.

Nguyen, T.M. (2020) “A review of two psychological models in knowledge sharing: Current trends and future agenda”, *VINE Journal of Information and Knowledge Management Systems*, Vol 51, No. 4, pp 533-549.

Okoli, C. and Schabram, K. (2010) “A guide to conducting a systematic literature review of information systems research”. http://dx.doi.org/10.2139/ssrn.1954824

Okoli, C. (2015) “A guide to conducting a standalone systematic literature review”, *Communications of the Association for Information Systems*, Vol 37, pp 43-52.

Park, J.G. and Lee, J. (2014) “Knowledge sharing in information systems development projects: Explicating the role of dependence and trust”, *International Journal of Project Management*, Vol 32, No 1, pp 153-165.

Pulakos, E.D., Dorsey, D.W. and Borman, W.C. (2003) “Hiring for knowledge-based competition”, in Jackson, S.E., Hitt, M.A., Denisi, A.S. (eds.) Managing knowledge for sustained competitive advantage: Designing strategies for effective human resource management. Jossey-Bass, San Francisco, pp 155-176.

Pemsel, S., and Wiewiora, A. (2013) “Project management office a knowledge broker in project-based organisations”, *International Journal of Project Management*, Vol 31, No 1, pp 31-42.

Ramaprasad, A. and Prakash, A. N. (2009, January) “Fostering knowledge sharing in project management”, in 2009 42nd Hawaii International Conference on System Sciences, IEEE, pp 1-10.

Shenhar, A. and Dvir, D. (2007) “Project management research: The challenge and opportunity”, *Project Management Journal*, Vol 38, No 2, pp 93-99.

Söderlund, J. (2004) “Building theories of project management: Past research, questions for the future”, *International Journal of Project Management,* Vol 22, No. 3, pp 183-191.

Templier, M., Paré, G. (2015) “A Framework for Guiding and Evaluating Literature Reviews”, *Communications of the Association for Information Systems, Vol* 37, Article 6.

Tsai, Y. H., Ma, H. C., Lin, C. P., Chiu, C. K.,and Chen, S. C. (2014) “Group social capital in virtual teaming contexts: A moderating role of positive affective tone in knowledge sharing”, *Technological Forecasting and Social Change*, Vol 86, pp 13-20.

Vom Brocke, J., Simons, A., Niehaves, B., Riemer, K., Plattfaut, R. and Cleven, A. (2009) “Reconstructing the giant: on the importance of rigour in documenting the literature search process”, ECIS. Verona: 17th European Conference on Information Systems (ECIS), pp 2206-2217.

Wang S. and Noe, R.A. (2010) "Knowledge sharing: A review and directions for future research", *Human Resource Management Review*, Vol 20, No. 2, pp 115-131.

Wiewiora, A., Murphy, G., Trigunarsyah, B. and Brown, K. (2014) “Interactions between organizational culture, trustworthiness, and mechanisms for inter-project knowledge sharing”, *Project Management Journal*, Vol 45, No 2, pp 48-65.

Wiewiora, A., Trigunarsyah, B., Murphy, G., and Coffey, V. (2013) “Organizational culture and willingness to share knowledge: A competing values perspective in Australian context”, *International Journal of Project Management*, Vol 31, No 8, pp 1163-1174.

Zahedi, M., Shahin, M. and Babar, M.A. (2016) “A systematic review of knowledge sharing challenges and practices in global software development”, *International Journal of Information Management,* Vol 36, No 6, pp 995-1019.

Appendix 1.

#	Authors	Title	Year	Source title
1	Mueller J.	Formal and informal practices of knowledge sharing between project teams and enacted cultural characteristics	2015	Project Management Journal
2	Martinez Sanz M.M.; Ortiz-Marcos I.	Dimensions of knowledge governance in a multi-PMO project context	2020	International Journal of Managing Projects in Business
3	Wiewiora A.; Trigunarsyah B.; Murphy G.; Coffey V.	Organizational culture and willingness to share knowledge: A competing values perspective in Australian context	2013	International Journal of Project Management
4	Nauman S.; Bhatti S.H.; Imam H.; Khan M.S.	How Servant Leadership Drives Project Team Performance Through Collaborative Culture and Knowledge Sharing	2022	Project Management Journal
5	Park J.-G.; Lee J.	Knowledge sharing in information systems development projects: Explicating the role of dependence and trust	2014	International Journal of Project Management
6	Terje Karlsen J.	Project owner involvement for information and knowledge sharing in uncertainty management	2010	International Journal of Managing Projects in Business
7	Alves J.L.; Nadae J.; Carvalho M.M.	Knowledge management enablers and barriers: exploring the moderating effect of communication barriers	2022	International Journal of Managing Projects in Business
8	Zhang L.; Cheng J.	Effect of knowledge leadership on knowledge sharing in engineering project design teams: The role of social capital	2015	Project Management Journal
9	Han J.; Hovav A.	To bridge or to bond? Diverse social connections in an IS project team	2013	International Journal of Project Management
10	Koskinen K.U.; Pihlanto P.; Vanharanta H.	Tacit knowledge acquisition and sharing in a project work context	2003	International Journal of Project Management
11	Liu G.H.W.; Huang Chua C.E.; Hu Y.	Partnership in Recruitment Process Outsourcing Projects: The Outsourcing Firm Perspective	2021	Project Management Journal
12	Vakkayil J.D.	Learning through shared objects in outsourced software development	2011	International Journal of Managing Projects in Business
13	Jugdev K.; Wishart P.	Mutual caring - Resolving habituation through awareness: Supporting meaningful learning from projects	2014	Project Management Journal
14	Solli-Sæther H.; Karlsen J.T.; Van Oorschot K.	Strategic and cultural misalignment: Knowledge sharing barriers in project networks	2015	Project Management Journal
15	Koskinen K.U.; Aramo-Immonen H.	Remembering with the help of personal notes in a project work context	2008	International Journal of Managing Projects in Business
16	Ruuska I.; Vartiainen M.	Characteristics of knowledge sharing communities in project organizations	2005	International Journal of Project Management
17	Adenfelt M.	Exploring the performance of transnational projects: Shared knowledge, coordination and communication	2010	International Journal of Project Management
18	Liebowitz J.; Megbolugbe I.	A set of frameworks to aid the project manager in conceptualizing and implementing knowledge management initiatives	2003	International Journal of Project Management
19	Agarwal U.A.; Dixit V.; Nikolova N.; Jain K.; Sankaran S.	A psychological contract perspective of vertical and distributed leadership in project-based organizations	2021	International Journal of Project Management
20	Jiao Y.; Saeed M.A.; Fu S.; Wang X.	How knowledge sharing contributes to project portfolio success: Empirical analysis of construction firms in China	2020	International Journal of Managing Projects in Business
21	Pemsel S.; Wiewiora A.	Project management office a knowledge broker in project-based organisations	2013	International Journal of Project Management
22	Lee H.; Park J.-G.; Lee J.	Knowledge sharing in ISD projects: role of task interdependence and social capital	2021	International Journal of Managing Projects in Business
23	Fernie S.; Green S.D.; Weller S.J.; Newcombe R.	Knowledge sharing: Context, confusion and controversy	2003	International Journal of Project Management
24	Iftikhar R.; Lions C.	Interorganizational knowledge sharing barriers and enablers: the case of Peshawar Bus Rapid Transit project	2022	International Journal of Managing Projects in Business
25	Ding Z.; Ng F.; Li J.	A parallel multiple mediator model of knowledge sharing in architectural design project teams	2014	International Journal of Project Management
26	Takahashi S.; Takahashi V.P.	Analysis of front end dynamic in the value co-creation with multiple stakeholders	2022	International Journal of Managing Projects in Business
27	Olaniran O.J.	Barriers to Tacit Knowledge Sharing in Geographically Dispersed Project Teams in Oil and Gas Projects	2017	Project Management Journal
28	Imam H.; Zaheer M.K.	Shared leadership and project success: The roles of knowledge sharing, cohesion and trust in the team	2021	International Journal of Project Management
29	Wiewiora A.; Murphy G.; Trigunarsyah B.; Brown K.	Interactions between organizational culture, trustworthiness, and mechanisms for inter-project knowledge sharing	2014	Project Management Journal
30	Bosch-Sijtsema P.M.; Tjell J.	The concept of project space: Studying construction project teams from a spatial perspective	2017	International Journal of Project Management
31	Eriksson P.E.; Leiringer R.; Szentes H.	The Role of Co-Creation in Enhancing Explorative and Exploitative Learning in Project-Based Settings	2017	Project Management Journal
32	Nesheim T.; Hunskaar H.M.	When employees and external consultants work together on projects: Challenges of knowledge sharing	2015	International Journal of Project Management
33	Buvik M.P.; Tvedt S.D.	The Influence of Project Commitment and Team Commitment on the Relationship between Trust and Knowledge Sharing in Project Teams	2017	Project Management Journal
34	Bhatti S.H.; Kiyani S.K.; Dust S.B.; Zakariya R.	The impact of ethical leadership on project success: the mediating role of trust and knowledge sharing	2021	International Journal of Managing Projects in Business
35	Terhorst A.; Lusher D.; Bolton D.; Elsum I.; Wang P.	Tacit Knowledge Sharing in Open Innovation Projects	2018	Project Management Journal
36	Swart, K.; Bond-Barnard, T.; Chugh, R.	Challenges and critical success factors of digital communication, collaboration and knowledge sharing in project management virtual teams: a review	2022	International Journal of Information Systems and Project Management

Identifying The Knowledge Spillover Hotspot and its Role in Neighbouring Country Innovation

Raymond Darfo-Oduro and Jan Stejskal
Institute of Economic Sciences, Faculty of Economics and Administration, University of Pardubice, Pardubice, Czech Republic

raymond.darfo-oduro@upce.cz
jan.stejskal@upce.cz

Abstract: The question on how to finance innovation activities of countries has taken a center stage in economic policy discussions in countries and among regional bodies. Such discussions require a policy direction to present alternative ways of financing innovation activities at lower cost in the face of dwindling resource available to countries and regional bodies for innovation activities. One important way of dealing with this challenge is to invest the limited resources in countries and sectors with the potential of higher knowledge spillover to benefit other countries and sectors. In this study therefore, we investigate to determine the knowledge spillover hotspot countries in Europe and how they affect neighbouring country's innovation performance. For the purposes of policy to improve innovation performance in Europe, the knowledge spillover hotspot countries will guide European regional bodies to concentrate innovation investments in countries with the potential of high knowledge spillovers for the benefit of other countries. The study specifically investigated R&D spillover and explicit knowledge spillover hotspots in the manufacturing sectors of Europe and their effects. Data for the study is unstructured and sourced from the World bank with the longest spans being 2005 to 2020 and shortest being 2013 to 2017. In all, nine countries were sampled based on data availability for the study. These countries include Poland, Germany, Slovakia, Slovenia, Lithuania, Belgium, France, Spain and Czech Republic. The study employed panel data analysis. Based on the Hausman test, fixed effect model was chosen as against random effect model. The results of the study show that after controlling for institutional and economic factors and ensuring robustness against heteroskedasticity and autocorrelation R&D spillover hotspots in Europe include Germany and Slovakia whereas explicit knowledge spillover hotspots are Poland, Slovenia, Lithuania and France. The results of the study have shown that the relationship between knowledge spillover from the hotspot countries and surrounding country's innovation varies. For some of the hotspots, the relationship is linear whilst in others the relationship is nonlinear. The study also confirm that explicit knowledge is more susceptible to Knowledge spillover.

Keywords: Spillover, Innovation, Knowledge, Hotspot, R&D

1. Introduction

The choices firms and countries make in improving innovation activities and performance will usually come at great cost. This is probably because resources for innovation activities are continually becoming difficult to come by. Generally, countries and firms have relied on several sources to finance innovation activities which have come at great cost (Valencia-Arias et al., 2024; Yılmaz, Bıyıklı, & Demir, 2023). In the innovation literature, knowledge spillover has become an important source through which firms and countries can improve their innovation activities and performance. Knowledge spillover, unlike knowledge transfer, which is a cross party collaboration and compensation, this involves external benefit derived from another agents' investment in knowledge creation (Ko & Liu, 2015). Knowledge spillover has therefore become an important source of input for most firms and countries in their knowledge creation activities. Policy responses to the need to improve innovation and productivity of firms have centered on a hand full of policy tools such as tax credits, subsidies, and R&D expenditures. These tools, even though, have been largely effective, come with their attendant limitation of cost. A large majority of countries and firms have made gains from knowledge spillover. Such spillovers have occurred even where no formal collaborative arrangements have been made between firms and between countries to transfer knowledge (Agarwal, Audretsch, & Sarkar, 2010). These R&D gains come in free without any compensation to the originator of the knowledge and may therefore serve as a cheaper source of input for innovation. It is a long-held view that Knowledge spillover is an important source of innovation performance, however, the literature also recognises the importance of capacity of firms and countries to absorb and utilize these free flowing knowledge to enhance innovation performance (Xie, Zou, & Qi, 2018). Empirical studies, even though, have acknowledged the important role of Knowledge spillover, the benefits of firms and countries relying on such externalities as an important source of R&D input for innovation have not been fully explored. It is rather the case that empirical studies have linked knowledge spillover to firms' productivity mainly (Audretsch & Belitski, 2020) and not innovation.

The European region remains one of the regions with high innovation performance disparities among countries (Dobrotă, Marcu, Siminică, & Nețoiu, 2019). Other studies have explored how innovation lagging countries could

rely on neighbouring countries with high innovation performance as a way of reducing these disparities (Noni, Orsi, & Belussi, 2018). To find alternative, cheaper, and reliable strategies of financing innovation activities of lagging countries, knowledge spillover from knowledge rich countries cannot be overlooked. An important way to address these innovation challenges is to rely on knowledge spillover from knowledge rich countries to less endowed countries. However, identifying the knowledge spillover hotspots as a source of innovation input remains obscured from prior literature. In this study therefore, we aim to identify the knowledge spillover hotspots in Europe to support knowledge innovation activities in the European region.

2. Theoretical Review

This section of the study presents a review of the literature on R&D and explicit knowledge spillover and how these externalities affect innovation performance.

2.1 Knowledge Spillover

Ordinarily firms and countries expend their own resources in the creation of innovation. However, in the creation of innovation some firms and countries are unable to fully appropriate the gains of their innovation activities. The part of the innovation that is not appropriated by the originator feeds into some other agents' knowledge production function as an input in the form of knowledge spillover. Prior literature has explained that inter-firms/country knowledge flow defines knowledge spillover (Bernal, Carree, & Lokshin, 2022). The literature on knowledge spillover splits knowledge spillover into tacit and explicit, depending on the type of knowledge involved (Bernal, Carree, & Lokshin, 2022). The literature on innovation distinguishes between tacit and explicit knowledge and the literature is reviewed along these lines. The literature on knowledge spillover distinguishes between knowledge spillover and a closely related concept, knowledge transfer. Knowledge transfer is the flow of knowledge from an originator of innovation to the intended economic agents (Scarra & Piccaluga, 2022) whereas knowledge spillover is an externality and therefore an unintended flow of knowledge resources from an originator of knowledge to another economic agent without a commensurate compensation (Henderson, 2007). The latter is the focus of this study and is given further attention in this study.

2.2 R&D and Explicit Knowledge Spillover

Knowledge spillover has been well documented in the innovation literature. In the formulation of growth models, knowledge spillover is considered an important determinant (Henderson, 2007; Romer, 1990). Knowledge spillover has been known to be influenced by several factors that either enhance the flow or reduce the flow of knowledge. The distribition of knowledge spillover poles is not even as it is based on the presence of certain essential factors. In the literature, authors have found for example that knowledge spillover has a distance decay (Lucas & Rossi-Hansberg, 2002; Ciccone & Hall, 1996) suggesting that spatial distance between the knowledge source and neighbouring areas determine whether or not the source of the knowledge will be a source of knowledge spillover. In a study by Jasimuddin, Li and Perdikis, (2015), the authors showed that colocation is important to knowledge spillover. It is also known that firms that are colocated bring something more than just proximity. In a study conducted by Cohen and Levinthal (1990), colocation was used rather as proxy for technology relatedness. The authors revealed that knowledge spillover is partly explained by the extent which the firms involved are related. Knowledge spillover is therefore a function of the relationship between the source of innovation and the potential beneficiary of knowledge spillover. Other studies have also focused on the role played by absorptive capacity in knowledge spillover. In a study by Zhao, Jiang, and Wang, (2019), the authors showed that the relationship between knowledge spillover and green economy is positively moderated by absorbtive capacity of the receiver. The authors explained that spillover knowledge is directed at enterprises which can use their absorptive capacity to digest and use the advance technologies. In some instances potential beneficiaries of neighbouring knowledge have not shown interest in adopting available technologies.

The type of knowledge has been observed as an important variable in determining knowledge spillover. In the knowledge spillover literature, two main types of knowledge is discussed, tacit knowledge and explicit knowledge. Tacit knowledge has been considered as task oriented know how embedded in the operational routine of firms and their network (Nahapiet & Ghoshal). Authors such as Lam (2000) and Acs, et al (2009) showed that these characteristics of tacit knowledge makes it more difficult for knowledge spillover relative to explicit knowledge. This is in contrast with explicit knowledge which is codified and detached from the originator of the knowledge and therefore makes spillover relatively easier through oral explanations and written works

(Fu, 2012). Studies on knowledge spillover emphasises the ease with which knowledge can be appropirated is a hindrance to knowledge spillover. Considering the nature of these types of knowledge, tacit knowledge which is attached to the originator of knowledge and the detached explicit knowledge transitted by word of mouth and written works, it is argued that explicit knowledge is more suceptible to knowledge spillover relative to tacit knowledge (Xiang, Cai, Lam, & Pei, 2013). The literature on knowledge spillover has an indepth account on the measurement and flow of explicit knowledge. Even though explicit knowledge is recognised as knowledge that is easy to diffuse relative to tacit knowledge, its measurement has proven to be daunting. Principally, explicit knowledge has been measured by patent citation (Gomes-Casseres, Hagedoorn, & Jaffe, 2006; MacGarvie, 2005; Hu & Jaffe, 2003; Jaffe, Trajtenberg, & Henderson, 1993). Because explicit knowledge is transmited using orderly and formal language (Polanyi, 1966), it lends itself well to spillovers (Fallah & Ibrahim, 2004). Based on the position of the prior literature, the following hypothesis is postulated for testing:

H: There is a significant explict knowledge spillover among European countries

In a study conducted to assess managerial knowledge spillover through the diffusion of managerial practices, Fu (2012) showed that managerial knowledge is both explicit and tacit in nature. Fu (2012) showed that such knowledge geographically bound and the effect of the spillover is greater at the clusters and managerial system level. In this study, apart from explicit knowledge, we also review literature on R&D spillover. R&D of firms are investments into both tacit and explicit knowledge creation activities. We therefore expect R&D spillover to retain the traits of both tacit and explicit knowledge spillover. A study by Spithoven and Merlevede (2023) assessed the productivity impact of R&D and FDI spillovers. The findings showed that R&D spillover is a significant contributer of productivity. In other studies, findings have shown that cross border R&D spillover have contributed to innovation performance in neighbouring countries. For example in a study conducted by Coe and Helpman (1995), the authors showed that foreign R&D has been important in improving the domestic productivity. In a related study, the Coe, Helpman and Hoffmaister (2009) confirmed the findings of Coe and Helpman (1995) even after controlling for institutional factors and human capital. R&D spillover has also been observed to be a function of volume of trade flows. In a study by (Keller, 2004) it was revealed that international R&D spillover is a function of international trade volume. The colocation of countries and trade among countries is therefore a condition nevessary for international R&D spillover. Based on the prior literature thefore, we postulate the following hypothesis for testing:

H: There is a significant R&D spillover among European countries

3. Methodology

In this study was sought to determine the knowledge spillover hotspot countries in Europe. The sampled countries for the study are based on data availability. Nine European countries including Poland, Slovakia, Slovenia, Lithunia, France, Spain, Germany, Belgium and France form the study sample based on data availability. Data for the study is sourced from the World Bank spanning 2005 to 2020. The data sourced includes data on variables such as value addition in the manufacturing sectors as a measure of innovation output. The study also sourced data on R&D in the manufacturing sectors of the respective countries. The study also sourced data on economic and institutional factors. The economic variables include variables such as trade openness, GDP per capita and labour force participation rate. Data on institutional factors include rule of law, political stability, broadband internet subscription, globalization index and property right index. Dependent variable is value addition in the manufacturing sector of the sampled countries. This variable is a measure of innovation. This agrees with prior literature which have generally used value addition or variant of value addition such as productivity and other innovation outcomes (Audretsch & Belitski, 2020). Value addition is also considered as an independent variable and as a measure of explicit variable. This should not be confusing as the dependent variable (value addition) of one country is regressed on explicit knowledge (value addition) of other countries. *see equation 1.* R&D of countries is measured R&D intensity of countries which is a proportion of R&D to the country's GDP.

To ensure that our estimate of spillover is unbiased control variables are introduced. These control variables are the economic and institutional factors.

The estimation technique for the study is multiple regression analysis. This is consistent with studies on knowledge spillover (Audretsch & Belitski, 2020; Nonic, Orsi, & Belussi, 2018; Coe, Helpman, & Hoffmaister, 2009). The study models the equation to determine the countries that are spillover hotspots.

$$lvman_{it} = \beta_1 lMR\&D_{jt} + \beta_2 lMR\&D_{it} + \beta_3 Con_{it} + \alpha_0 + U_{it} \quad (1)$$

Equation 1 presents a model for R&D knowledge spillover between countries. The dependent variable is the logarithmic transformation of value addition in the manufacturing sector of countries. Country is represented by the subscrit *i* whilst *t* is the time dimension of the variables. β are the regression coefficients, $lMR\&D$ is the logarithmic transformation of R&D expenditure of the manufacturing sector of spillover country where the subscript is *jt* and beneficiary country if the subscript is *it*. Con represents vector of control variables which are economic and institutional factors. α_0 is the individual effect which at this point may or may not be correlated with the explanatory variables depending on the outcome Hausman test. *U* is the random error term.

$$lvman_{it} = \beta_1 lvman_{jt} + \beta_2 lMR\&D_{it} + \beta_3 Con_{it} + \alpha_0 + U_{it} \quad (2)$$

In equation 2 the study seek to model explicit knowledge spillover between countries in Europe. The explanation of the model remains the same as equation 1 with the exception that the first right hand side variable is the explicit knowledge of spillover countries. The variables of interest in estimating knowledge spillover in equation 1 and 2 are $lMR\&D_{jt}$ and $lvman_{jt}$respectively. These are the spatial lag variables that measure the effect of one country's innovation activities on other countries innovation output. Knowledge spillover must necessarily have a positive effect on innovation of the beneficiary country or sector (Noni, Orsi, & Belussi, 2018). The criteria for determination of knowledge spillover in equation 1 and 2 is that β_1 must be positive and significant. If the Hausman test suggests a correlation between the explanatory variables and the individual effect (X, α) = 0 then a fixed effect model where the individual effect becomes a parameter to be estimated used. On the other hand where the Hausman test shows no correlation between explanatory variables and the individual effect (X, α) $\neq 0$ a random effect model is used where the random error term then becomes Ϣ = $\alpha_0 + U_{it}$.

3.1 Robustness Checks

In the study, we have implemented several strategies to improve the robustness of the study results. The use of panel data and analysis techniques improves the robustness of the result. With panel data we combine both cross sectional and time series. This is more informative as it allows the study to follow behaviour of the variables over time. The panel data analysis technique also allowed us to account for the individual effect of the data structure which is critical to ensure efficiency of the model. In this study also we use robust standard error to ensure that the model is robust against heteroskedasticity and autocorrelation.

Table 1: Variables and Description

Variables	Description
lpmrd	Log of R&D from manufacturing sector of Poland
lgmrd	Log of R&D from manufacturing sector of Germany
lsmrd	Log of R&D from manufacturing sector of Slovakia
lslmrd	Log of R&D from manufacturing sector of Slovenia
llmrd	Log of R&D from manufacturing sector of Lithuania
lbmrd	Log of R&D from manufacturing sector of Belgium
lfmrd	Log of R&D from manufacturing sector of France
lspmrd	Log of R&D from manufacturing sector of Spain
lcmrd	Log of R&D from manufacturing sector of Czech Republic
lrdman	Log of R&D of spillover beneficiary country
ltop	Log of trade openness
lrl	Log of rule of law
lps	Log of political stability
lbbs	Log of broadband internet subscription
lglx	Log of globalization index
lgdpc	Log of GDP per capita
llfpr	Log of labour rate participation rate
lprind	Log of property right index
lvman	Log of value addition in the manufacturing sector in spillover beneficiary country
lgvman	Log of value addition in the manufacturing sector in Germany
lslvman	Log of value addition in the manufacturing sector in Slovakia
lslevman	Log of value addition in the manufacturing sector in Slovenia
llvman	Log of value addition in the manufacturing sector in Lithuania
lbvman	Log of value addition in the manufacturing sector in Belgium
lfvman	Log of value addition in the manufacturing sector in France
lspman	Log of value addition in the manufacturing sector in Spain
lcvman	Log of value addition in the manufacturing sector in Czech Republic

4. Results and Discussions

In this study, we investigate knowledge spillover among selected countries in Europe. The results present analysis on knowledge spillover from countries with focus on tacit, explicit and R&D. In this section of the study, we present results on R&D spillover among selected European countries.

Table 2: R&D spillover in Manufacturing Sector

Depvar: lvman	**Model 1: Fixed effect (within effect)**		**Model 2: Random Effect (GLS regression)**	
Variables	Coefficients	Std.err	Coefficients	Std. err
lpmrd	0.0334443**	0.0169857	-0.0100191	0.0148073
lgmrd	0.0259228**	0.0104247	0.010595	0.0098405
lsmrd	0.2830048***	0.0771217	0.1754464***	0.0450647
lsmrd^2	-0.0218772***	0.0065201	-0.0108072***	0.0042104
lslmrd	-0.0187662***	0.0071672	-0.0271573***	0.0069395
llmrd	-0.0926193**	0.048655	-0.0585549	0.0439248
lbmrd	-0.0449289**	0.0202088	-0.0545785**	0.0235351
lfmrd	-0.0033951	0.0094567	-0.0188528*	0.0100296
lspmrd	-0.0426425	0.0330766	-0.0585246*	0.0348552
lcmrd	-0.095864	0.1082084	0.0587651	0.0802267
lrdman	0.2192806*	0.1504288	0.2142387***	0.0279487
lrdman2	-0.0197886**	0.0110369	-0.0046694***	0.0016339
ltop	0.5180425***	0.1153108	0.4356211***	0.0684282
lrl	-0.0386761	0.3218812	-0.6337466***	0.1391126
lps	-0.0065939	0.011624	0.0375302***	0.0134325
lbbs	-0.0426492	0.0378756	0.0409689***	0.0185897
lglx	0.2000631*	0.826558	-1.818953***	0.6223957
lgdpc	0.1324167**	0.1594226	0.0418238***	0.0110173
llfpr	0.5655756	0.7537834	2.345537***	0.4059803
lprind	-0.1657463	0.1182489	-0.4636994***	0.1207446
cons	-5.285852*	4.190211	0.6139151	3.667772
Fixed effect	yes	yes	no	no
Random effect	no	no	yes	yes
R-squared:			**R-squared:**	
Within:	0.7613		Within:	0.5062
Between:	0.4911		Between:	0.9971
Overall:	0.5774		Overall:	0.9752
F-statistics	Prob		Wald Chi square	Prob
6.38	0.000000		1890.35	0.000000

****P<0.01, **P<0.05, *P< 0.1. All variables in the logarithm transformation*

In Table 2 we present results on R&D spillover among manufacturing sectors of nine selected European countries. The results present two variants of analysis, fixed effect and random effect. Both models confirm our hypothesis that there is R&D spillover in the manufacturing sector of countries. In the fixed effect model Germany and Poland have R&D spillover but R&D spillover from Slovakia exhibits a quadratic effect with an inverted U-shaped relationship. In Slovakia increasing R&D intensity increases R&D spillover but beyond a minimum level of R&D intensity the effect of R&D knowledge spillover is negative. There is no R&D spillover from Slovenia, Lithuania, Belgium, France Spain and Czech Republic. On the contrary the random effect analysis proves that the only country that is a source of R&D spillover is Germany. All other countries are not R&D spillover hotspots.

Table 3 Hausman Test

Hausman test	Chi square	Prob Chi square
H_0: REE	84.73	0.000000***

Hausman test in Table 3 is employed in selecting between the fixed effect and the random effect model under the null hypothesis that random effect is the efficient model. The Chi square test results shows a significant chi square statistic. The null is therefore rejected for the alternative hypothesis that the fixed effect model is the ideal estimation technique. The fixed effect model from Table 3 has a total variability of 57.7% which decomposes into a within effect variability of 76.13% and between effect variability of 49.1%.

Table 4: R&D Spillover in Manufacturing Sector

Depvar: lvman	Model 1: Fixed effect (within effect)	
Variables	Coefficients	Robust Std.err
lpmrd	0.0334443	0.0187714
lgmrd	0.0259228*	0.0081312
lsmrd	0.2830048***	0.0503231
lsmrd^2	-0.0218772***	0.0054774
lslmrd	-0.0187662**	0.0064493
llmrd	-0.0926193*	0.0547024
lbmrd	-0.0449289***	0.0104878
lfmrd	-0.0033951	0.0074511
lspmrd	-0.0426425*	0.0255217
lcmrd	-0.095864	0.0725371
lrdman	0.2192806	0.1763865
lrdman2	-0.0197886	0.0139775
ltop	0.5180425***	0.1286616
lrl	-0.0386761	0.2579393
lps	-0.0065939	0.0076186
lbbs	-0.0426492	0.0525321
lglx	0.2000631	0.2872693
lgdpc	0.1324167	0.1051878
llfpr	0.5655756	0.7965869
lprind	-0.1657463	0.1185255
cons	-5.285852	3.35003
Fixed effect	yes	yes
R-squared		
Within:	0.7613	
Between:	0.4911	
Overall:	0.5774	
Prob(F-stat)	0.00000	

****P<0.01, **P<0.05, *P< 0.1. All variables in the logarithm transformation*

Table 4 presents robust fixed effect analysis with robust standard errors. These standard errors are robust against heteroskedasticity and autocorrelation. The results confirm the hypothesis that R&D spillovers occur between manufacturing firms in the sampled European countries. Specifically, R&D spillover Germany and Slovakia but none other from the study sample is a knowledge spillover hotspot.

In Table 5 we present the results on explicit knowledge spillover among nine sampled European countries. Model 1 in Table 5 presents the fixed effect model (within effect). The results of the study confirm the hypothesis that explicit knowledge spillover occurs among countries. Our findings show that explicit knowledge spillover from

Poland and Slovenia and France are a quadratic U-shaped relationship. The positive and significant explicit knowledge spillover from Spain is an indication that Spain is a knowledge spillover hotspot. Countries such as Germany Slovakia, Belgium and Czech Republic show no evidence of being explicit knowledge hotspot. As a variant of the fixed effect model, the random effect GLS model in Table 5 shows a similar result that confirms the hypothesis that intercountry explicit knowledge spillover in the manufacturing sector of the sample countries.

Table 5: Explicit knowledge spillover

Depvar: lvman	**Model 1: Fixed effect (within effect)**		**Model 2: Random Effect (GLS regression)**	
Variables	Coefficients	Std.err	Coefficients	Std. err
lpvman	50.86762***	9.568013	49.82592***	11.06921
lpvman2	-8.983034***	1.69918	-8.804508***	1.965431
lgvman	-1.106573***	0.2535892	-1.00138***	0.1920762
lslvman	-0.0580992	0.0637219	-0.0167657	0.0703469
lslevman	24.00535***	9.221881	20.1129**	10.08939
lslevman2	-4.111062***	1.581243	-3.421326**	1.726595
llvman	17.47348***	0.0976156	17.32109***	0.0937914
lbvman	-37.09157***	7.715917	-27.95311***	8.155758
lbvman2	7.166371***	1.480547	5.393298***	1.569189
lfvman	71.62699***	14.33979	68.88908***	13.36702
lfvman2	-14.96662***	3.010636	-14.4334***	2.811215
lspman	0.4321655**	0.1840867	0.2369016	0.1813967
lcvman	-0.2226295**	0.1118284	-0.0687529	0.1077598
lrdman	-0.0067927	0.0092327	0.0052414	0.0039179
ltop	0.000317	0.0883127	0.0335652**	0.0166246
lrl	-0.0345224	0.0255064	-0.0428913**	0.0197098
lps	-0.0032511	0.005434	-0.0057351	0.0061859
lbbs	-0.0096819	0.0217878	0.0013549	0.0043363
lglx	0.2818573	0.4831154	-0.2233576	0.1809568
lgdpc	0.3339777***	0.0658472	0.0014159	0.0024093
llfpr	-1.095911***	0.3817812	-0.2515461**	0.1071945
Lprind	-0.0764222	0.0620404	0.0647073	0.0567142
Cons	-174.8567***	21.78542	-173.8514***	22.2945
Fixed effect	yes	yes	no	no
Random effect	no	no	yes	yes
R-squared:			**R-squared:**	
Within:	0.9999		Within:	0.9998
Between:	0.3507		Between:	0.9999
Overall:	0.7781		Overall:	0.9998
F-statistics	Prob		Wald Chi square	Prob
14107.49	0.000000		208572.90	0.000000

****P<0.01, **P<0.05, *P< 0.1. All variables in the logarithm transformation*

The results show that Poland, Slovenia, and France show an inverted U-shaped relationship indicating that these are spillover hotspots but after a maximum level explicit knowledge is reached, explicit knowledge falls leading to a fall in value addition. Lithuania and Spain also showed evidence of being spillover hotspot. Germany, Slovakia, Belgium, and Czech Republic showed no signs of being a knowledge spillover hotspot.

Table 6: Hausman Test

Hausman Test	**Chi Square**	**Prob Chi Square**
H_0: REE	34.89	0.0397**

****P<0.01, **P<0.05, *P< 0.1. All variables in the logarithm transformation*

The choice between the fixed effect model and the random effect model is determined by the Hausman test. The test is conducted under the hypothesis that the random effect estimate is more efficient. The Chi Square test shows that the test is significant. This rejects the random effect estimates in favour of the fixed effect model as shown in Table 6.

From Table 7 below value added in the manufacturing sectors of Poland, France and Slovenia are significant and are polynomial in degree 2. This indicates that these are knowledge spillover hotspots. However, the quadratic relationship observed indicates that the size of the explicit knowledge matters. An excessively high explicit knowledge spillover reduces knowledge spillover to neighbouring countries. At lower levels of explicit knowledge, the effect of knowledge spillover from Poland, Slovenia and France are high. The study results also show a positive and significant coefficient for explicit knowledge coefficient for Lithuania. This is an indication that Lithuania is a knowledge spillover hotspot.

The results from Table 7 also shows however, that coefficients of explicit knowledge spillover for countries such as Slovakia, Czech Republic, Spain Germany and Belgium are either not significant, negative or U shaped. These indicate the absence of evidence to suggest these countries are knowledge spillover hotspots.

Table 7: Explicit Knowledge Spillover

Depvar: lvman	**Model 1: Fixed effect (within effect)**	
Variables	Coefficients	Robust Std.err
lpvman	50.86762***	6.067932
lpvman2	-8.983034***	1.080955
lgvman	-1.106573***	0.2097516
lslvman	-0.0580992	0.0650751
lslevman	24.00535*	10.6692
lslevman2	-4.111062*	1.837527
llvman	17.47348***	0.0852749
lbvman	-37.09157***	9.289062
lbvman2	7.166371***	1.799445
lfvman	71.62699***	19.29418
lfvman2	-14.96662***	4.02786
lspman	0.4321655	0.2744186
lcvman	-0.2226295	0.1583966
lrdman	-0.0067927	0.0049045
ltop	0.000317	0.0957677
lrl	-0.0345224	0.0250901
lps	-0.0032511	0.0022954
lbbs	-0.0096819	0.0245747
lglx	0.2818573	0.4935258
lgdpc	0.3339777***	0.0584505
llfpr	-1.095911**	0.4584305
Lprind	-0.0764222	0.0585246
Cons	-174.8567***	15.72513
R-squared:		
Within:	0.9999	
Between:	0.3507	
Overall:	0.7781	
Prob(F-stat)	0.000000	

****P<0.01, **P<0.05, *P< 0.1 variables in the logarithm transformation.*

5. Discussions

The findings of the study confirm the position of the literature that R&D spillover has been a major contributor to productivity. Whereas in the study by Spithoven and Merlevede (2023) the authors showed that knowledge spillover contributes to improving productivity of firms, the findings of the current study shows likewise that

there is international R&D spillover to some domestic economies. It is worth mentioning that even though there is evidence that most of the countries are R&D spillover pole in agreement with the position of the literature, there are some exception to this expectation. Countries that are not Knowledge spillover pole could be explained by the reason that the conditions for such knowledge spillover are not present. Henderson (2007) and Romer (1990) highlighted the important precursors for knowledge spillover such as proxity, relatedness of technology among others. Countries that could not be identified as R&D spillover poles most likely lack the determining factors. Considering the closeness of these countries one would expect that, the argument that proximity is a determinant of knowledge spillover (Jasimuddin, Li and Perdikis, 2015) will apply. However, the important point to note here is that colocation as explained by Cohen and Levinthal (1990) is not just an issue of proximity but also relatedness of technology. The study also shows that generally international R&D spillover is more improtant than any other factor in explaining value addition in the manufacturing sectors of the selected European countries. This could suggest the possibility that knowledge among these countries are related or the proximity among the countries has made these countries more reliant on themselves for innovation inputs. It may be expected that the closer countries are the higher international R&D spillover will be. However, the findings of the study showing only two R&D spillover hotspot, Germany and Slovakia may be enough to disprove that. What may be accounting for this can include limited trade relationship among the countries. As Keller (2004) has shown the volume of trade among the countries is important for knowledge spillover. Absorptive capacity of countries could also be a determinant of R&D spillover hotspot. It is noteworthy to state that the results of the study shows that Slovakia R&D intensity exhibit a quadratic (inverted U shaped) relationship with value addition in neighbouring countries. This could point to the role of absorptive capacity of neighbouring countries to the spillover. At lower levels of R&D intensity in Slovakia, neighbouring countries are ready to take on knowledge from Slovakia after a maximum level any extra R&D spillover is not absorbed by the neighbouring countries.

The study's confirmation that there is significant explicit knowledge spillover among European countries is in line with what the literature suggests (Spithoven & Merlevede, 2023). Explicit knowledge, according to Fallah and Ibrahim (2004) are easily transmitted because of its codifies nature. It is important to state however, that findings of the study also confirms that in the absence of the essential factors knowledledge spillover does not occur. It is also striking in the study findings is that countries that are R&D spillover spillover poles such as Poland and Slovakia showed no evidence of being an explicit knowledge spillover poles. This is an indication that the various types of knowledge may behave differently. Countries in contiguity as has been revealed have shown no sign explicit knowledge spillover. This casts doubts on the colocation assumption (Jasimuddin, Li & Perdikis, 2015) for knowledge spillover. What is also important with study findings worth mentioning is that in most of the explicit knowledge spillover hot spots an extremely volume of explicit knowledge reduces knowledge spillover. We interpret that to mean the lack to absorptive capacity on the part of beneficiary countries. This may explain why some large economies with a very vibrant R&D and explicit knowledge sector may not be knowledge spillover hot spot. This is in agreement with Zhao, Jiang, and Wang (2019) who showed a positive moderating effect of absorptive capacity in the relationship between knowledge spillover and green economy. The findings of this study will therefore mean that countries could be doing well with the R&D and explicit knowledge but the extent to which there will be knowledge spillover depends on factors including the absorptive capacity of the receiver. Major economies with large R&D and explicit knowledge which have not proven to be knowledge spillover hot spot could be explained by the fact that perhaps their neighbouring countries do not have the required absorptive capacity to take up the floating knowledge.

6. Conclusions

In this study we have investigated the knowledge spillover hotspots in Europe. Specifically, the study focused on R&D and explicit knowledge spillover hotspots in Europe. The main results reported by large portion of the prior literature are confirmed by the findings of the current study. The study findings are robust, taking into consideration heterogeneity of the different countries, heteroskedasticity and autocorrelation, we conclude that knowledge spillover hotspots in Europe differ based on the type of knowledge considered. After controlling for economic and institutional factors, the fixed effect model showed that R&D spillover hotspot countries in Europe include Poland, Slovenia, Lithuania, France, and Spain. Germany, Slovakia, Czech Republic, and Belgium fell short of being classified as knowledge spillover hotspot. To further ensure robustness to deal with the possibility of autocorrelation and heteroskedasticity, the results showed that Germany and Slovakia are the only countries that show evidence of R&D spillover hotspot. In the case of explicit spillover, the study concludes that Poland, Slovenia, Lithuania, France and Spain show evidence of being knowledge spillover hotspots. This allows

us to make the conclusion in agreement with the position of the prior literature that explicit knowledge by their nature are more susceptible to spillovers.

It is also concluded that knowledge spillover hotspot countries in Europe have contributed to innovation performance of their neighbour.The study also concludes that knowledge spillover is generally not linear for most knowledge spillover hotspots. Knowledge spillover from Slovakia, Slovenia, and France have an inverted U-shaped relationship whereas it is linear for countries such as Germany and Lithuania. In the case of Germany and Lithuania the size of R&D and Explicit knowledge has proportionally the same effect on knowledge spillover. However, the study, based on its findings conclude that in the case of knowledge spillover hotspot countries such as Slovakia, Slovenia and France knowledge spillovers are influenced by the volume of knowledge. We further conclude that above a certain minimum level of knowledge, knowledge spillover begins to reduce which can be interpreted as absorptive capacity constraints in the receiving countries. The implication of the study to European countries is that knowledge sharing among these countries has the potential of reducing the cost of R&D and innovation activities.

Acknowledgement

This work was supported by the Student Grant Competition of the University of Pardubice SGS_2024_013

Reference

Agarwal, R., Audretsch, D., & Sarkar, M. (2010). Knowledge spillovers and strategic entrepreneurship. *Strategic Entrepreneurship Journal, 4*(4), 271–283.

Audretsch, D., & Belitski, M. (2020). The role of R&D and knowledge spillovers in innovation and productivity. *European Economic Review, 123*(103391), 1-24.

Bernal, P., Carree, M., & Lokshin, B. (2022). Knowledge spillovers, R&D partnerships and innovation performance. *Technovation, 115*(102456).

Dobrotă, C. E., Marcu, N., Siminică, M., & Neţoiu, L. M. (2019). Disparities, gaps and evolution trends of innovation, as a vector. 22(4), 174. *Romanian Journal of Economic Forecasting, 22*(4), 174-184.

Fallah, M. H., & Ibrahim, S. (2004). Knowledge spillover and innovation in technological clusters. *IAMOT 2004 Conference*, (pp. 1-16). Washington, DC.

Fu, X. (2012). Foreign Direct Investment and ManagerialKnowledge Spillovers through the Diffusionof Management Practices. *Journal of Management Studies, 49*(5), 971-999.

Gomes-Casseres, B., Hagedoorn, J., & Jaffe, A. (2006). Do alliances promote knowledge flows. *Journal of Financial Economics, 80*(1), 5-33.

Henderson, J. (2007). Understanding knowledge spillovers. *Regional Science and Urban Economics, 37*, 497 508.

Hu, A., & Jaffe, A. (2003). Patent citation and international knowledge flows: the case of Korea and Taiwan. *International Journal of Industrial Organization, 21*, 849–880.

Jaffe, A., Trajtenberg, M., & Henderson, R. (1993). Geographic localization of knowledge spillovers as evidenced by patent citations. *Quarterly Journal of Economics, 108*, 578–598.

Keller, W. (2004). International technology diffusion. *Journal of Economic Literature, 42*(3), 752–782.

Ko, W., & Liu, G. (2015). Understanding the Process of Knowledge Spillover: Learning to become Social Enterprise. *Strategic Entrepreneurship Journal, 9*, 263–285.

MacGarvie, M. (2005). The determinants of international knowledge diffusion as measured by patent citations. *Economic Letters, 87*(1), 121–126.

Nahapiet, J., & Ghoshal, S. (n.d.). Social capital, intellectual capital, and the organizational advantage. *Academy of Management Review , 23*(2), 242–266.

Noni, I., Orsi, L., & Belussi, F. (2018). The role of collaborative networks in supporting the innovation performances of lagging-behind European regions. *Research Policy, 47*, 1-13.

Polanyi, M. (1966). *The tacit dimension.* Garden City, NY: Doubleday & Co.

Scarra, D., & Piccaluga, A. (2022). The impact of technology transfer and knowledge spillover from Big Science: a literature review. *Technovation, 116*.

Valencia-Arias, A., Patiño-Toro, O. N., Coronado, M. H., Bernal, O. V., & Marquina, E. Z. (2024). Knowledge Management in Small and Medium Enterprises: Literature Review and Research Agenda. *Scientific Papers of the University of Pardubice, Series D: Faculty of Economics and Administration, 32*(1), 1-16.

Xiang, X., Cai, H., Lam, S., & Pei, Y. (2013). International knowledge spillover through co-inventors: An empirical study using Chinese assignees' patent data. *Technological Forecasting & Social Change, 80*(1), 161-174.

Xie, X., Zou, H., & Qi, G. (2018). Knowledge absorptive capacity and innovation performance in high-tech companies: A multi-mediating analysis. *Journal of Business Research, 88*, 289–297.

Yılmaz, E., Bıyıklı, S., & Demir, C. (2023). Impacts of Technology on Economic Growth: With Difference Between Tourism Countries and Industry Countries Aspect Based on Extended Solow Growth Model. *Scientific Papers of the University of Pardubice Series D: Faculty of Economics and Administration, 31*(1), 1-14.

Shaping the Knowledge Worker Through a *T-Shaped Skills Profile* Framework

Hendrik Jan de Weerd, Yasmina Khadir and Pascale Peters
Nyenrode Business University, Breukelen, The Netherlands

rikdeweerd@gmail.com
y.kpoggi@nyenrode.nl
p.peters@nyenrode.nl

Abstract: The paper revisits the concept of knowledge workers using the lens of a *T-shaped skills profile*. This framework combines breadth and depth of a worker's knowledge with their skill durability. The T-shaped skill profile represents an individual who combines deep expertise in a field (the vertical bar of the T) with a broad understanding across multiple disciplines (the horizontal bar). This metaphor emphasizes the balance between specialized knowledge and not specialized one. To enhance this approach, a time dimension accounting for the perishability of skills, is integrated. Indeed, the unprecedented changes the last Covid-19 pandemic have brought about in work habits and culture seem to forecast the working habits of the future. Changes, such as a less work-centric behavior and higher flexibility demands, necessitate a better understanding these knowledge workers. 10 interviews have been conducted with knowledge workers from various organizations and sectors. Results show an original inverted pyramid T-shaped skills profile featuring a time dimension following this pattern: (i) Contextual level – Semi durable skills and knowledge; (ii) Foundational level – durable skills and knowledge; (iii) Specialist level – Perishable skills and knowledge. New insights on the nature of these knowledge workers are also provided. This paper contributes to theory by bridging two interesting concepts: the traditional eclectic approach to knowledge workers and the T-shaped skill profile. This research provides valuable insights to managers, supporting the development of effective policies and structures to retain and motivate these specialized employees.

Keywords: Knowledge Workers; T-Shaped Skills Profile; Skill Depth; Skill Breadth.

1. Introduction

Understanding the competencies of workers in terms of breadth, depth and their potential for innovation has been an ongoing problem in organizations (AlEssa and Durugbo, 2022; Birkinshaw et al, 2020). This is particularly the case for knowledge workers (KWrs) who add significant value to organizations' mission (Kaur, Gupa, Singh et al, 2019; Newell, 2015; Drucker, 1959, 1999). Millar et al (2017) argue that leading KWrs requires different leadership structures recognizing that these workers present different identities (Sveningson and Alvesson, 2003). Additionally, the level of knowledge depth (or expertise) and knowledge breadth (or general business knowledge) vary among workers. Understanding this peculiarity is conditional to organizational creativity (Mannucci and Yong, 2018) and thus innovation. As knowledge workers' skills are perishable (Arbesman, 2012), aligning these with corporate objectives calls for a strategic approach that harness the potential of the workforce (Muzam, 2023). Echoing Peter Drucker's (1959) prophetic statement which declares that leading KWrs will be the greatest management challenge of the 21st century, Issahaka and Lines (2021) note that scant progress has been made in addressing this issue. Instead, scholarly discourse has often consisted of normative and fragmented propositions. A better understanding of these workers in terms of knowledge depth and knowledge breadth, and the relevance of their skills along a time continuum, is a possible avenue that this study examines through the T-shaped skills profile. The time dimension or skill perishability factor is paramount within the current economic landscape (Harris and Spencer, 2019; Bansal, Reinecke, Suddaby et al, 2022).

Extant literature acknowledges the fuzzy character of the knowledge worker and the challenges in 'defining it' (Alvesson, 2001; Surawski, 2019). For example, Davenport (2005) conceptualizes the knowledge worker from an individual point of view (e.g., having a high degree of education) while Surawski (2019) argues that KWrs are specialists that require trust to achieve specific goals. Drucker (1994) is concerned by KWrs at work where they primarily use knowledge and information to complete their tasks. Following a study on the nature of knowledge work, Pyöriä (2005) concludes that the existing literature lacks a satisfactory definition capable of encompassing all dimensions of knowledge work.

To address this issue recent studies have highlighted the potential a framework such as the T-shaped skills profile promises. The T-shaped skills profile is a framework that supports a representation of individuals' skills breadth and depth (Heikkinen, 2018; Saukkonen and Kreus, 2022). The horizontal bar to the T encompasses broad competencies that allow knowledge workers to integrate knowledge across multiple domains. The vertical segment signifies depth in a specific domain or expertise area. It represents specialized skills and knowledge that make workers specialists in their fields. Finally, a third dimension is considered: time. This dimension is expressed by the skill durability model introduced by IBM and discusses skills in terms of durability (Malik, 2020).

This paper aims to contribute to the discussion on knowledge workers management and leadership within an increasingly complex work environment. More specifically, the focus is on KWrs' evolving skills, capabilities, want and needs. To gain deeper insights on the unique attributes of these workers and their engagement with organizational requirements, T-

shaped skills profile is implemented. This research seeks to examine how knowledge workers evolving organizational and personal dimensions are understood through the T-shaped skills profile. The following three sub-research questions facilitate the study:

1. How do knowledge workers engage with the organization they work for?
2. What are knowledge workers' generic/durable capabilities and their contextual/semi-durable capabilities?
3. What are knowledge workers' specialistic/perishable capabilities?

The following sections present a conceptual framework and summarize the research method. This is followed by a discussion of the results, culminating in a final framework with corresponding explanations. The paper concludes with a discussion and conclusion section.

2. Conceptual Framework

2.1 Knowledge Workers

Introduced in 1959 by Drucker, the concept of KWr remains highly relevant in today's organizational landscape (e.g., Muzam, 2023; Issahaka and Lines, 2021). Although no consensus has been reached in literature regarding their definition, numerous attempts have been made to delineate KWrs. Davenport (2005) challenged Drucker's (1959) original definition, emphasizing that KWrs' work is characterized by "thinking for a living" rather than merely knowing more about their job compared to other people in the organization. Kidd (1994) highlighted the non-routine nature of KWrs' work, where they create their own processes, necessitating experiential learning. More recently, Surawski (2019) refined the definition, portraying KWrs as individual engaged in cognitive tasks demanding a broad knowledge base, complex problem-solving skills, and autonomy. Surawski (2019) also echoes Drucker's perspective, emphasizing the shift toward specialization, expertise, and the need for novel management paradigms to enhance productivity. However, Waizenegger et al (2020) extended the term KWrs to include remote workers leveraging information technology during the pandemic, aligning with Davenport's (2005) view. This juxtaposition of definitions has contributed to confusion in the field over the past two decades.

Drucker (1959) was among the pioneering management scholars to anticipate the rise of these forward-thinking specialists. KWrs demand effective leadership while simultaneously navigating self-management. Subsequently, Davenport (2005) acknowledged workers who consistently interact with knowledge within an environment profoundly impacted by the surge in information technology. This scenario necessitates novel management approaches. In Drucker's (1999) view, the term KWr highlights the transition from traditional labor to intellectual work. He further emphasized the critical role of KWrs' productivity in the global economy, already foreshadowing the contextual challenges organizations must address. An empirical study conducted by Zhan et al (2013) describes these continually evolving circumstances surrounding KWrs, circumstances driven by technological advancements and the necessity for their skill updates. Despite the numerous scholarly contributions attempting to 'define' the KWrs' context, both Pyöriä (2005) and Surawski (2019) noted that there is (still) a lack of a structured framework that fully encapsulates the roles and attributes of KWrs within changing economies.

2.2 The T-Shaped Skills Profile Development

Originally introduced by David Guest in 1991, the T-shaped skills profile was developed to address organizations' need for talented workers amidst the 1990s' economic and technological turmoil in the U.S. Prominent industry figures like Tim Brown, Chief Executive Officer of IDEO, have endorsed this T-shaped skills profile, viewing it as essential for fostering innovation and interdisciplinary collaboration (Hansen, 2011). The T-shaped skill sprofile is a framework or model that helps delineate workers' skills in term of expertise or knowledge depth and general knowledge or knowledge breadth. This framework also gained popularity among scholars and is used to discuss the multidisciplinary nature of academic research networks and their 'T-shapedness' (Turner et al, 2019). In his PhD dissertation, Heikkinen (2018) explored the concept of T-shaped professionals to understand the knowledge Finnish students should acquire to remain relevant at work in the future. His work highlighted the importance of equipping knowledge workers with the ability to navigate diverse contexts and collaborate effectively across disciplines.

Despite the many promises the T-shaped skills profile holds, its descriptive and fragmented nature, coupled with a top-down perspective, falls short of capturing the dynamics of the modern workplace (Heikkinen, 2018). The model oversimplifies the multifaceted skills needed today and overlooks context as a crucial influence factor. In response, alternative solutions (i.e., different skill profile shapes) have been proposed (e.g., Elayan, Hayajneh, Abdellatif et al, 2022). The T-shaped skills profile continues to be a focal point in discussions about professional competency, highlighting the importance of both deep domain-specific expertise and broad interdisciplinary knowledge. Addressing these limitations, Saukkonen and Kreus (2023) introduced the T2-model. This framework conceptualizes individuals as possessing depth in a specific domain (the vertical

line of the T) complemented by breadth across various disciplines (the horizontal line). This horizontal dimension is vital for fostering collaboration, cross-disciplinary understanding, and adaptability in dynamic work environments. Overall, the framework shows that the ideal KWr shows an ability to integrate business expertise with technological skills, balancing both technical and social components within a broader system (Figure 1)

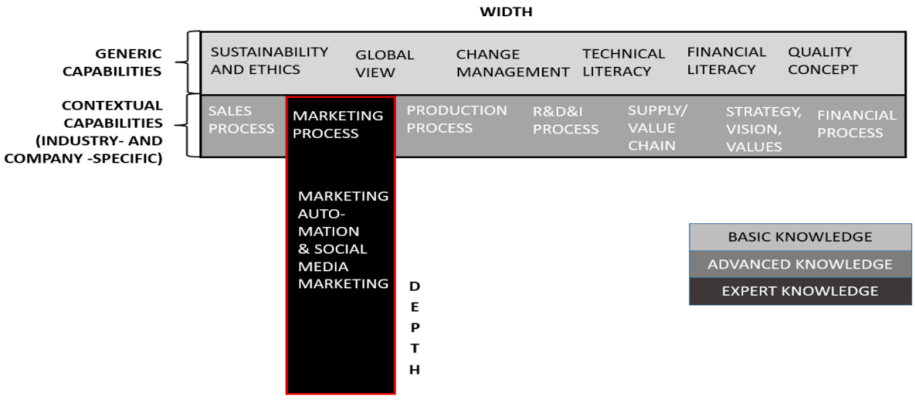


Figure 1: T2-shape skills profile for a digital marketing lead (From Saukkonen, and Kreus, 2022, p. 1039)

2.3 The Perishability Factor

Drucker (1999) emphasized the significance of continuous learning and teaching within one's field of expertise as a key contributor to a knowledge worker's productivity. Considering evolving job market demands and the constant need for fresh skills in the workplace, employees must continually enhance their capabilities (Muzam et al., 2023). Harris and Spencer (2019) recognize the changing employment landscape and stress the need for employees to re-skill and develop. The authors added that this situation has led companies to broaden and innovate their learning resources and modify their approaches to workplace strategy. This prompted organizations to make the integration of new learning systems a rapidly expanding area in Human Resources investment. In addition, humans can forget knowledge (Baddeley, 2013), tendency that becomes problematic conspires with the increasing pace of change. This predicament forces an acknowledgement of the idea of 'skill perishability' when attempting to visualize KWrs. The skill profile categorization proposed by IBM offers a clear framework that aligns well with the T2-model developed by Saukkonen and Kreus (2022). Skill perishability also presents a fit with Drucker (1985) who stated that what individuals have learned by age 21 will begin to become obsolete five to ten years later and will have to be replaced or at least, refurbished by new learning, new skills, and new knowledge.

This study adopts the following approach conceptualized within the T2-model:

i. Durable skills last for more than 7.5 years. This group of skills includes more foundational skills such as design thinking, project management practices, effective communication, and leadership. These skills can be positioned in the horizontal bar of the T shape.
ii. Semi-durable skills last between 2.5 to 7.5 years. This category often includes frameworks that form the base for field-specific technologies, processes, and tools. These skills can be positioned in the horizontal bar, below the top line of the T shape.
iii. Perishable skills last less than 2.5 years. These skills include specific technology skills frequently updated, organization-specific policies, tools, and specialized processes. These skills can be positioned in the vertical bar of the T shape.

3. Method

This study strives to understand KWrs' lived experiences in working situations. These are viewed as dynamic, shaped through interactions within their evolving professional environments. The subjective and context-dependent nature of these experiences calls for qualitative research (Creswell and Creswell, 2023). A semi-structured interview was designed to capture the nuanced and varied experiences of 10 KWrs based in The Netherlands, aged between 30 to 55 years old. The respondents were identified within the researchers' personal network. The interview guide structure was inspired from the T2-model from Saukkonen and Kreus (2023). To facilitate the conversation and obtain rich data, interviewees were asked to describe a positive experience in managing a project and a negative one. Following the description of the positive project, the researchers stimulated a conversation around broad generic skills, contextual skills and expert skills, making sure to cover all dimensions of the T2-model.

Data analysis followed Brooks and King's (2014) thematic analysis method, moving from an open, exploratory phase to focused categories centered on the KWrs' perspective, but within the categories of the T2-model Brooks and King's (2014) method supports the use of a preliminary framework to analyze the date. In this instance, the T2-model was used only during the selective coding stage to develop the final template that encapsulates foundational, contextual and expert skills respectively. Beyond Brook and King's (2014) recommendation, researchers identified patterns in respondents' responses that supported the use of a framework such as the T2-model. In discussing their most rewarding career projects or periods, respondents consistently shared the following insights. In the following order, respondents:

1. Perceived competence growth, fostered through collaborative knowledge/skill acquisition, which was crucial for task performance.
2. Internalized corporate objectives aligned with their own values, morals, and ambitions.
3. Gained adequate autonomy over resources, authority, and strategic/tactical information over time.
4. Exhibited pride, commitment, and drive within a context of entrepreneurial management (as described by Drucker in 1985).
5. Focused their tactical decisions on preserving value and future development, balancing innovation with risk mitigation.
6. Engaged in in-situ development of essential expertise (referred to as "the T's tip") via experimentation and collaboration.
7. Believed that management trust was rooted in the worker's track record and their effective ability to create value.

These seven patterns reveal a tri-level framework, delineating an evolving profile and visual representation of the KWr. This approach supports then the use of framework as a guiding structure for making sense of the data. In the final coding stage, the identified codes were refined into major themes, providing contrasts with established academic models. The T2 model by Saukkonen and Kreus (2023) was employed to categorize the findings into foundational, contextual, and specialist skill levels.

4. Results

The results of this study are provided hereafter, summarized in Figure 2. The elongation of the contextual level (the pointy part of the figure) challenges the traditional proportions of the T2-model or the original T-shaped skills profile. This research results propose a modified visualization as an inverted triangle, which more accurately represents the skill distribution and acquisition in contemporary knowledge workers (Figure 2). The items of this figure are explained hereafter.

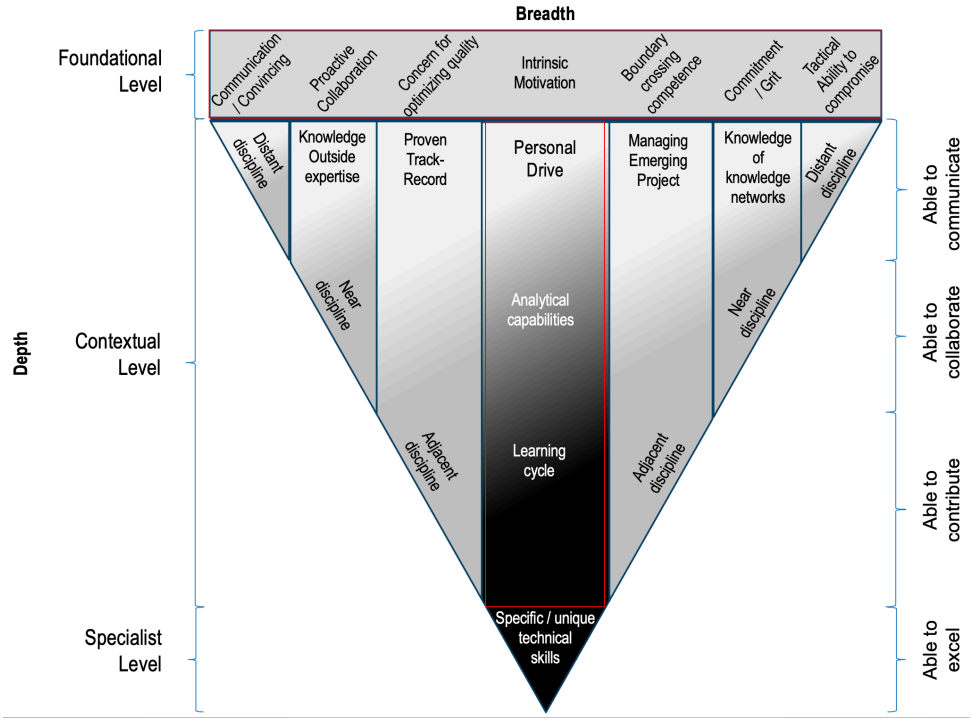


Figure 2: Modified T-shaped skills as inverted triangle illustrating contemporary knowledge workers

4.1 The Foundational Level

The Foundational Level (Durable Skills and Knowledge) encompasses a variety of essential and distinct skills and traits that contribute to the economic relevance of KWrs within an organization. The different dimensions composing this level are presented hereafter.

Communication and Convincing Skills: KWrs skillfully combine persuasive communication with their deep professional expertise to drive progress in collaborative projects and initiatives. A cancer research laboratory specialist aptly likened the process of seeking approval to "a bit like a game"—a strategic challenge to make it appealing to management. KWrs navigate the delicate balance between substance and influence, ensuring that their ideas resonate and propel organizational success.

Proactive Collaboration: Respondents shared that active engagement and collaboration characterize their interactions. They engage in a dynamic exchange of advice, embodying both learning and teaching principles, as emphasized by Drucker (1985; 1999). These KWrs adeptly navigate organizational hierarchies, leveraging informal networks, and harnessing the collective strengths of diverse teams. Hence, KWrs thrive in an ecosystem of shared knowledge, where their interactions foster growth, innovation, and collective success.

Concern for Optimizing Productivity and Quality. KWrs take proactive steps to enhance both their personal productivity and the organizational output within their functional domain. This proactive behavior is triggered by a combination of sufficient knowledge and genuine concern. Drucker (1959; 1999) and Kidd (1994) support this perspective, which diverges from Davenport (2005). In essence, when KWrs possess the right knowledge and care deeply about their work, they become catalysts for positive change, challenging the status quo and driving progress in their organizations.

Intrinsic motivation. In line with Drucker's (1959; 1999) management theory lies a counterpoint to external management as a mean of behavior control or motivation. The empirical evidence resonates with self-determination theory (Ryan and Deci, 2000), underscoring that autonomy, competence and relatedness are conditional to KWrs. It does not matter whether the emphasis lies on group affiliation or individual self-actualization as mentioned by a defense infrastructure specialist.

Boundary-Crossing Competence: In line with Heikkinen (2018) and Saukkonen and Kreus (2022), results show that KWrs rely on a unique capacity to bridge disciplinary and organizational divides, enabling seamless adaptation and knowledge integration across diverse domains.

Commitment/Grit: KWrs exhibit *grit*. They proactively orchestrate their deep involvement and demonstrate a willingness to endure discomfort in pursuit of their goals. Their unwavering dedication is evident through phrases like "have to," "committed," "our motto," and "stand for."

Ability to compromise: KWrs exhibit a strategic behavior that prioritizes immediate tangible value, while intentionally deferring uncertain aspects for future iterations. Rather than rigidly pursuing an "all or nothing" approach, KWrs strategically balance short-term impact with long-term adaptability and growth.

Davenport's (2005) emphasis on the analytical aspects of knowledge workers within a repetitive context differs significantly from the findings, which underscore the importance of non-routine work and intrinsic motivation.

4.2 The Contextual Level

The Contextual Level (Semi-durable Skills and Knowledge) plays a pivotal role in KWrs' productivity and innovation capabilities intricately tied to specific organizational contexts. The different dimensions composing this level are presented hereafter.

Knowledge Beyond Expertise: KWrs need to possess a nuanced understanding of adjacent fields to ensure high-quality and effective service delivery. This multidisciplinary approach not only broadens their expertise but also enhances their capacity to explore, analyze, and hypothesize. Importantly, this horizontal expansion of skills challenges the conventional T-shaped model, emphasizing the value of a wider knowledge base. Within this multidimensional perspective, KWrs connect insights across domains, fostering innovation, and breaking down silos within organizations.

Proven Track Record: Knowledge work inherently involves novelty, and some skills must be acquired on-the-fly. Whether KWrs receive the necessary support and autonomy hinges on the established level of trust, which is influenced by their demonstrated success and the promise of future reciprocity.

Personal Drive: A significant finding in this study is that the concept of drive resides within the contextual layer. It can be best understood as an innate ability to stay motivated, which becomes evident when not hindered by context-dependent organizational elements. This perspective aligns with Entrepreneurial Management, as defined by Drucker (1985), which highlights the essential conditions for fostering innovation as positive and sustaining factors. Additionally, Herzberg's (1968)

list of Hygiene factors in the Two-Factor theory outlines what must be in place within a work context to sustain an employee's drive. Furthermore, respondents explained that the emotional connection between work and the situation at hand is shaped by a delicate interplay of pride and shame.

Managing emergent project Skills: Unlike traditional project management, where projects are meticulously planned and executed, respondents had to face a different challenge: managing the emergence of projects. This aspect, although it may appear to align with Davenport (2005), spotlights the non-routine nature of KWrs' work. It is not about adhering to routine project management protocols; rather, it is about cultivating innovation momentum and seizing opportunities as they arise. Results show that KWrs thrive in the dynamic interplay of creativity, adaptability, and forward-thinking.

Knowledge of Knowledge Networks: KWrs leverage networks for productivity, placing tacit knowledge and interpersonal connections above rigid formal organizational structures. This underscores the significance of informal relationships and personal initiative in navigating complex organizations. As an Information and Technology architect puts it, success often hinges on "knowing the right people who do know."

4.3 The Specialist Level

The Specialist Level, symbolized by the vertical bar of the T-shaped skills profile, centers on the most perishable and defining aspect of a KWrs' profile: specialist skills and knowledge. As Drucker (1999) described, KWrs are experts in their respective fields, inherently making them specialists. Their specialized expertise is pivotal for high-value productivity within organizations. The following codes emerged from the study.

Analytical Capability: Consistently, respondents exhibit robust analytical skills within their specialized domains. These skills are essential for comprehending complex challenges and driving continuous improvement in respondents' specific work areas.

Learning Cycle: Respondents explained that they manage their own dynamic learning cycle, leveraging their network for knowledge assimilation, setting up experiments, and actively seeking feedback. This process emphasizes Drucker's (1999) view on the necessity of continuous learning and teaching in knowledge work.

Creation of Business Functionality: Respondents play an ever-expanding role in innovating and enhancing corporate value propositions. They frequently lead the charge in creating new services or improving existing ones. When the complexity of a business function surpasses a certain threshold, optimization becomes achievable primarily through the expertise and insights of KWrs. Their ability to navigate intricate challenges and drive strategic improvements is pivotal for organizational success.

Specific / Unique Technical Knowledge: Contrary to the conventional understanding of specialization (Heikkinen, 2018), our findings reveal that respondents often combine multiple skills to create unique value. This creatively combined expertise poses staffing challenges and underscores the nuanced nature of respondent's specialization. This is the case both for a deep expertise in a single niche and a blend of skills that create unique capabilities driving business innovation.

5. Discussion and Conclusion

This study attempts to shed more light on the opaque concept of KWrs using a T-shaped skills profile. The ambiguity surrounding the broad use of the KWr label within the working environment has hindered progress in research in this field. After Davenport's (2005) seminal publication, subsequent research has often resorted to short-lived lists and descriptions of niche situations (e.g., Surawski, 2019). This research shows for the first time a structured and holistic vision through the T-shaped skill profile that makes a KWr a special type of employee.

Data underscores the value of boundary crossing skills (Hansen, 2011) but finds that these and their adjacent skills go dormant without the drive to apply them. While Heikkinen (2018) focuses on educating students about boundary crossing, this study delves deeper in this phenomenon and explores the contextual requirements for effective utilization of skills. The impact of organizational context on KWrs is transformative. The T-shaped skill profile has evolved into an inverted triangle (Figure 2). Contrary to the belief that specialization equates to expertise in a single niche, our study reveals that unique value often arises from a combination of skills as suggested by Saukkonen and Kreus (2022). Interviewees, while not top experts in any single skill, occupy their own crossroads, deriving value from the intersection of multiple abilities. Their unique value was derived from an intersection of several skills, of which the core to their discipline took centerstage.

A second original finding is that this study delves into the intricate components of specialist-level expertise or skill depth identified in the data as *analytical capability, specific technical knowledge, and self-management of their learning cycle, oriented towards the creation of new business functionality*. Moreover, the dynamic underpinning how these skills become

relevant or qualify a worker as a knowledge worker, is revealed. The most valuable, specialized, and perishable skillset—the one forming the tip of the inverted triangle—is cultivated during KWrs' *quests*. Skills from adjacent disciplines are not merely accessed indirectly but are actively assimilated to a significant extent. The learning cycle of a KWr seems to move their skills and knowledge set laterally as well, it is not restricted to vertical motion. A significant finding highlights that KWrs undertake a quest, actively seeking to broaden their knowledge beyond existing boundaries. This insight aligns with Kidd's (1994) perspective on non-routine, analytical knowledge work. Similarly, Drucker's approach emphasizes that KWrs possess deeper job-related expertise compared to others in the organization. As a result, the KWr label specifically pertains to those actively involved in knowledge work as described in this study. Moreover, it is important to observe that KWrs do not proactively engage with their organizations unless the fundamental conditions that stimulate motivation (or drive), are present. It is essential for employees within a business function to be empowered to communicate, collaborate, and contribute to the corporate strategy. However, the responsibility ultimately lies with the KWrs to surpass this baseline by fostering innovation and optimization. Indeed, data shows that leader's micromanagement is counterproductive. This study presents two main limitations. (i) Data is extracted from a small number of respondents (n=10) (ii) solely based in The Netherlands. Further research should be conducted in different settings and with a greater number of respondents. Research can also focus in turn on different dimensions of the framework and identify, for example, what should foundational skills composed of.

References

AlEssa, H.S., Durugbo, C.M. (2022) "Systematic review of innovative work behavior concepts and contributions", *Management Review,* Q 72, pp. 1171–1208. https://doi.org/10.1007/s11301-021-00224-x.

Alvesson, M. (2001) "Knowledge work: Ambiguity, image and identity", *Human relations*, Vol. 54 No. 7, pp. 863-886. https://doi.org/10.1177/0018726701547004.

Arbesman, S. (2012) "Truth decay: the half-life of facts", *New Scientist*, Vol. 215, No. 2883, pp. 36-39, https://doi.org/10.1016/S0262-4079(12)62454-3 .

Baddeley, A. (2013). *Essentials of Human Memory.* Psychology Press.

Bansal, P., Reinecke, J., Suddaby, R., and Langley Ann (2022) "Temporal work: The strategic organization of time", *Strategic Organization*, Vol. 20 No. 1, pp. 6-19. https://doi.org/10.1177/14761270221081332

Birkinshaw, J., Cohen, J., and Stach, P. (2020) "Research: Knowledge Workers Are More Productive from Home", *Harvard Business Review*. Research: Knowledge Workers Are More Productive from Home (hbr.org).

Brooks, C., Sangiorgi, I., Hillenbrand, C., and Money, K. (2018) "Why are older investors less willing to take financial risks?" *International Review of Financial Analysis*, Vol. 56, pp. 52-72. https://doi.org/10.1016/j.irfa.2017.12.008.

Brooks, J., and King, N. (2014) "Doing template analysis: Evaluating an end-of-life care service", *Sage Research Methods Cases*. http://eprints.hud.ac.uk/id/eprint/19707/.

Creswell, J.W. and Creswell, J.D., 2023. *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. 6th ed. Thousand Oaks, CA: SAGE Publications.

Davenport, T.H. (2005) Thinking for a Living: How to Get Better Performances *and Results from Knowledge Workers*, Harvard Business Press, Cambridge, MA.

Drucker, P. F. (1959). *The landmarks of tomorrow.* Harper and Row.

Drucker, P.F. (1985). *Innovation and Entrepreneurship.* Harper and Row.

Drucker, P.F. (1994) *Post-Capitalist Society*, Routledge, New York

Drucker, P. F. (1999) "Knowledge-worker productivity: The biggest challenge", *California Management Review*, Vol. 41 No. 2, pp. 79-94.

Elayan, M.B., Hayajneh, J.A.M., Abdellatif, M.A.M., and Abubakar, A.M. (2022) "Knowledge-based HR practices, π-shaped skills, and innovative performance in the contemporary organizations. *Kybernetes*, Vol. 52 No. 9, pp. 3102-3118. https://doi.org/10.1108/K-08-2021-0737

Guest, D. (1991, September 17). The hunt is on for the renaissance man of computing. Independent [London].

Hansen, M. T. (2011). *IDEO CEO Tim Brown: 'T-shaped Stars' - The Backbone of IDEO's Collaborative Culture*. Available at: IDEO CEO Tim Brown (Accessed: 11 March 2024).

Harris, S. and Spencer, E. (2019). Sierra-Cedar 2016–2017 HR survey white paper. Retrieved from www.sierra-cedar.com/2018/09/12/the-sierra-cedar-2018-2019-hr-systems-survey-white-paper-21st-annualedition-is-now-available/

Heikkinen, K. (2018) Studio-based higher education for T-shaped knowledge workers. Doctoral Thesis. Oulu University of Applied Sciences. Available at: http://urn.fi/URN:ISBN:978-952-335-244-0 (Accessed: 7 March 2024).

Herzberg, F. (1968) "One more time: How do you motivate employees?" *Harvard Business Review*, Vol. 46, No. 1, pp. 53-62.

Issahaka, A.W. and Lines, R. (2021) "Research literature on leadership of knowledge workers: where are we, and where should we be heading?", *Journal of Intellectual Capital,* Vol. 22, No. 1, pp. 122-148. https://doi.org/10.1108/JIC-10-2019-0240.

Kaur, S., Gupta, S., Singh, S.K. and Perano, M. (2019) "Organizational ambidexterity through global strategic partnerships: a cognitive computing perspective", *Technological Forecasting and Social Change*, Vol. 145, pp. 43-54.

Kidd, A. (1994) "The marks are on the knowledge worker", In Proceedings of the SIGCHI conference on Human factors in computing systems (pp. 186-191). https://dl.acm.org/doi/pdf/10.1145/191666.191740

Malik, S. (2020) *Skills transformation for the 2021 workplace.* [online] Available at: Skills Transformation For The 2021 Workplace - IBM Learning Blog Accessed: 15 March 2024)

Mannucci, P. V., and Yong, K. "The differential impact of knowledge depth and knowledge breadth on creativity over individual careers", *Academy of Management Journal,* Vol. 61 No. 5, pp. 1741-1763. https://doi.org/10.5465/amj.2016.0529

Millar, C.C.J.M., Chen, S. and Waller, L. (2017) "Leadership, knowledge and people in knowledge intensive organizations: implications for HRM theory and practice", *International Journal of Human Resource Management*, Vol. 28, No. 2, pp. 261-275.

Muzam, J. (2023) "The challenges of modern economy on the competencies of knowledge workers", *Journal of the Knowledge Economy,* Vol. 14, pp. 1635-1671, https://doi.org/10.1007/s13132-022-00979-y

Muzam, J., Bendkowski, J., Mah, P. M., and Mudoh, P. (2023) "The state-of-the-art of modern workplace learning: an applied assessment method of a pre-train deep learning on modern learning tools", *The Learning Organization*, Vol. 30, No. 5, pp. 607-629. DOI 10.1108/TLO-01-2023-0019

Newell, S. (2015) "Managing knowledge and managing knowledge work: what we know and what the future holds", *Journal of Information and Technology*, Vol. 30, pp. 1–17, https://doi.org/10.1057/jit.2014.12.

Pyöriä, P. (2005) "The concept of knowledge work revisited", *Journal of knowledge management*, Vol. 9 No. 3, pp. 116-127. DOI 10.1108/13673270510602818

Reinhardt, W., Schmidt, B., Sloep, P., and Drachsler, H. (2011) "Knowledge worker roles and actions—results of two empirical studies", *Knowledge and process management*, Vol. 18 No 3, pp. 150-174.

Ryan, R. M., and Deci, E. L. (2000) "Intrinsic and extrinsic motivations: Classic definitions and new directions", *Contemporary Educational Psychology*, Vol. 25, No. 1, pp. 54-67. https://doi.org/10.1006/ceps.1999.1020

Saukkonen, J., and Kreus, P. (2022) "T-shaped capabilities of the next generation: Prospecting for an improved model", Proceedings of the European Conference on Knowledge Management, Vol. 23 No. 2, pp. 1032-1041. https://doi.org/10.34190/eckm.23.2.369

Surawski, B. (2019) "Who is a "knowledge worker"–clarifying the meaning of the term through comparison with synonymous and associated terms", *Management*, Vol. 23 No 1, pp. 105-133.

Turner, D., Serrano, D., Stroulia, E., and Lyons, K. (2019). A T-shaped Measure of Multidisciplinary in Academic Research Networks: The GRAND Case Study. In H. Yang and R. Qiu (Eds.), *Advances in Service Science* (pp. 4). INFORMS-CSS 2018. Springer Proceedings in Business and Economics. Springer, Cham. DOI: 10.1007/978-3-030-04726-9_4.

Waizenegger, L., McKenna, B., Cai, W., and Bendz, T. (2020) "An affordance perspective of team collaboration and enforced working from home during COVID-19", *European Journal of Information Systems*, Vol. 29, No 4, pp. 429-442, https://doi.org/10.1080/0960085X.2020.1800417.

Zhan, Y., Tan, K. H., Ji, G., Chung, L., and Chiu, A. S. F. (2013), "Green and lean sustainable development path in China: Guanxi, practices and performance", *Resources, Conservation and Recycling*, Vol. 74, pp. 39-47. https://doi.org/10.1016/j.resconrec.2016.02.006

Investigating Knowledge Translation Dynamics for a Multi-Agency Response to Gender-Based Abuse

Claudine Donnellan, Niall Corcoran and Matthew Cannon
Technological University of the Shannon, Limerick, Ireland

claudine.donnellan@tus.ie
niall.corcoran@tus.ie
matthew.cannon@tus.ie

Abstract: Domestic, sexual, and gender-based abuse (DSGBA) is a complex societal issue with implications for individuals, families, and communities. According to the World Health Organisation, violence remains a pervasive problem, affecting one in three women globally. Addressing this complex issue requires the coordinated efforts of all agencies involved in the intervention and prevention of DSGBA. Despite shared goals, these agencies predominantly operate independently, resulting in the development of their own knowledge bases. Recognising the negative implications of agencies developing isolated knowledge bases for service users and society, this Action Research study adopts an integrated knowledge translation approach to investigate the knowledge production and transfer processes among multi-agency practitioners and academics engaged in the DSGBA field. The study introduces a virtual community of practice (vCoP) as a dynamic knowledge management system, aiming to evaluate its effectiveness in facilitating knowledge translation and bridging the research-to-practice gap. Employing a mixed-methods approach, the study combines quantitative and qualitative measures to explore knowledge transfer dynamics. Surveys, focus groups, interviews, user metrics, and content analysis provide a comprehensive understanding of community participation and interaction within a vCoP. Beyond traditional analysis methods, this study incorporates natural language processing techniques to uncover patterns, themes, and sentiments, facilitating the knowledge translation process. By extracting and translating insights from the vCoP discussion forums, the research aims to produce actionable resources such as best practices, academic papers, and policy guidelines, bridging the research-to-practice gap. The study aims to contribute a framework for implementing multi-agency vCoP, offering insights that could be adapted and applied in similar contexts. In addition, it seeks to address knowledge production and translation issues by fostering improved collaboration between academia and practitioners. The enhanced understanding of knowledge transfer dynamics within the DSGBA vCoP has the potential to influence positive change in decision-making processes and best practices, leading to more effective interventions and services combatting DSGBA.

Keywords: Virtual Community of Practice, Knowledge Translation, Evidence-Based Practice, Interprofessional Collaboration

1. Introduction

Gender-based violence encompasses physical, sexual, and psychological forms, impacting individuals irrespective of age, gender, culture, or socio-economic background, rendering it a critical public health issue (Greville et al., 2023). The World Health Organisation (WHO) reports that globally, one in three women experiences physical or sexual violence in their lifetime, highlighting the pervasive nature of gender-based violence (WHO, 2018). Recent studies by Women's Aid reveal ongoing issues, with one in five young women and one in eleven young men experiencing intimate partner abuse in Ireland (Womens Aid, 2021). Evaluating the economic cost of domestic, sexual, and gender-based abuse (DSGBA), Forde and Duvvury (2021) estimated a woman's journey to safety in Ireland at €113,475, equating to an annual economic cost of €2.7 billion. Ireland has responded to DSGBA through legislative measures, including the Criminal Law (Sexual Offences) Act 2017 and the Domestic Violence Act 2018, in addition to ratifying the Istanbul Convention in 2019 and implementing its third national DSGBA strategy called *Zero Tolerance* (DoJ, 2022). Despite legal advancements, a victim's journey to safety in Ireland remains non-linear (Safe Ireland, 2023). The fragmented DSGBA landscape and the lack of cohesive knowledge translation may also highlight a potential research-to-practice gap (DoJ, 2022).

The effective management of knowledge is central to navigating the complex multi-agency DSGBA landscape. According to Venkatraman and Venkatraman (2018), knowledge management involves generating, capturing, storing, and disseminating knowledge for competitive advantage. Knowledge management systems, often leveraging information technology, are crucial in supporting knowledge-sharing and transfer activities (Nezafati et al., 2023). This knowledge management focus requires a knowledge translation (KT) approach, an iterative process concerned with putting research knowledge into practice to bridge the research-to-practice gap (Leggat et al., 2021). WHO (2023) defines KT as "the synthesis, exchange, and application of knowledge by relevant stakeholders to accelerate the benefits of global and local innovation in strengthening health systems and improving people's health". The Canadian Institutes of Health Research (CIHR) identified two categories of knowledge translation, integrated knowledge translation (iKT) and end-of-funding knowledge translation (CIHR, 2019). iKT focuses on knowledge production by involving knowledge consumers in identifying research gaps,

data collection, analysis, dissemination, implementation, and reflection (Leggat et al., 2021). In contrast, end-of-funding KT addresses knowledge transfer problems (Bowen and Graham, 2013).

Communities of Practice (CoP) and virtual Communities of Practice (vCoP) have emerged as effective mechanisms for knowledge management and inter-agency collaboration (Habash, 2019). vCoP evolved from traditional CoP, leveraging collaborative technologies for member engagement (Sims, 2018). Rooted in situational learning theory, CoP emphasise that learning occurs in social groups through collaborative participation and relationships (Lave and Wenger, 1991). Wenger-Trayner and Wenger-Trayner (2015) define a CoP as a group of people who share an interest in a domain of human endeavour and engage in the process of collective learning that creates bonds between them. CoP and vCoP are distinct from other learning environments in three elements: domain, community, and practice (Wenger, McDermott and Snyder, 2002). vCoP foster learning anytime and anywhere as they transcend geographical boundaries (Greville et al., 2023), and their global reach introduces diverse perspectives (Michaelides, Tickle and Morton, 2010). Cost-effective and resourceful, vCoP share rich media resources and may prevent professional isolation (Ford et al., 2015). However, challenges arise in maintaining personal connections and engagement, necessitating a balanced and structured approach to their setup and management (Valenti and Sutton, 2020).

A review of the literature highlights vCoP as a tool for evidence-based practice (EBP) (O'Brien and Richey, 2010) and evidence-informed practice (EIP) (Rolls et al., 2016). EBP values research and practical experience, although it prioritises scientific evidence in decision-making (O'Brien and Richey, 2010). Evidence supports vCoP effectiveness for EBP within clinical settings as a cost-effective solution to improve the quality of care (Sahay et al., 2022), standardise best practices (Chu et al., 2021), or implement research-based interventions (O'Brien and Richey, 2010). However, EBP implementation faces challenges due to cultural, resource, professional, organisational, or geographical factors (Linkewich et al., 2022). Valaitis et al. (2011) suggest that vCoP can be a valued resource for occupations with limited professionals. Noting that vCoP should be designed around practical issues to enhance collaboration, Graaf and Ratliff (2018) argue that EIP is more applicable to community-based human service professionals. EIP is an iterative process incorporating evidence, expertise, resources, and preferences (Kumah et al., 2019). While vCoP can support EIP, knowledge brokers are crucial for successful implementation (Hajisoteriou, Karousiou and Angelides, 2018). Knowledge brokers are nominated individuals who aim to bridge the gap between research and practice by facilitating connections between knowledge consumers and producers. Their responsibilities include promoting knowledge sharing, building links between research findings and practical applications, and summarising relevant research (Hennessy et al., 2013).

O'Brien and Richey (2010) highlight vCoP as an effective mechanism for resource development, facilitating the generation of educational materials and best practice guidelines. These resources are designed for dissemination within the professional community, aiding knowledge transfer, decision-making, and practice standardisation. An illustration of the application of vCoP for resource development can be found in the Elements of Success in Family Planning Programme vCoP, hosted on the WHO Gateway (Richey and Salem, 2008). This vCoP demonstrates a structured approach through collaborative efforts, resulting in tailored resources for family planning programme managers. According to O'Brien and Richey (2010), the model's success lies in task allocation, defined timelines, and focused discussion forums.

vCoP also serve as an effective platform for professional development, enabling collaborative learning (Hajisoteriou, Karousiou and Angelides, 2018). O'Brien and Richey (2010) also emphasise the global role of vCoP in professional development, demonstrated by the Global Alliance for Nursing and Midwifery (GANM) on the WHO Gateway. GANM used their vCoP to disseminate an educational module on cervical cancer detection, targeting regions with limited resources. Hajisoteriou, Karousiou and Angelides (2018) advocate for collaborative projects and reflective practices within vCoP to support professional development. Nguyen et al. (2019) note that vCoP serve as a platform to support innovation, as observed with HOBE+, a community dedicated to innovating primary care in Spain. HOBE+ (1627 members) yielded 48 submissions with 133 ideas, 23 of which were approved for implementation. Success is attributed to a structured framework, active facilitators, clear objectives, and two working groups focused on idea management and innovation (Abos Mendizabal, Nuño Solinís and Zaballa González, 2013).

Critical success factors for achieving an effective vCoP were identified from the literature. One key factor is knowledge-sharing behaviour (KSB), which involves the willingness, attitude, and actions towards sharing knowledge (Tan and Ramayah, 2018). However, fostering a willingness to share knowledge remains a consistent challenge in vCoP (Hernández-Soto, Gutiérrez-Ortega and Rubia-Avi, 2021). Various motivational factors influencing knowledge-sharing intention were identified, and these are categorised into individual cognition,

interpersonal interaction, and organisational effort (Cheung, Lee and Lee, 2013). Hernández-Soto, Gutiérrez-Ortega and Rubia-Avi (2021) extend this classification, highlighting personal factors, particularly pro-community and altruistic behaviour, as precursors to knowledge sharing. The complexity of knowledge-sharing dynamics in vCoP highlights the importance of considering individual motivations and community dynamics for sustained engagement and collaboration (Haas et al., 2020).

Trust is a critical factor in shaping community engagement within vCoP, influencing knowledge-sharing behaviour and member participation (Hennekam et al., 2020). Social cognitive theory (SCT) outlines a three-stage trust development process: economy-based, information-based, and identification-based, that impacts personal factors and behaviour. Hsu et al. (2007) explain that this sequential trust process is situationally dependent and not progressively smooth, emphasising the substantial impact of identification-based trust on KSB, which is attributed to emotional investment. Sharratt and Usoro (2003) categorise trust into integrity, benevolence, and competence and support its impact on KSB, but acknowledge that integrity trust holds greater significance for knowledge-sharing intention. The absence of face-to-face contact in vCoP poses challenges to trust development (Lev-On and Adler, 2013), impacting social presence and sense of belonging (Ikioda et al., 2013). However, the findings from these studies may be influenced by characteristics, such as age, attitude, and profession, as some professions may use technology more for day-to-day tasks than others.

Ford et al. (2015) highlight the importance of knowledge brokers in fostering community engagement in vCoP, and Haas et al. (2020) stress the critical role of facilitators in providing administrative support, encouraging community engagement, and ensuring value to members. Facilitators prove valuable in bridging gaps in multidisciplinary or geographically dispersed vCoP by facilitating effective communication (Greville et al., 2023). Lin (2017) adds that facilitators, leading by example, significantly influence community engagement, underscoring the need for a balanced approach between facilitator-led initiatives and organic community activities.

Evaluation is vital for assessing the value and performance of vCoP and understanding online user behaviour. Evans and Mathur (2005) found that online surveys aid demographic exploration or member feedback collection within vCoP. They offer benefits such as low cost, convenience, reach, and quick execution. However, limitations arise from potentially low response rates attributed to the inundation of emails and perceived time efficiency. Cook-Craig and Sabah (2009) used online surveys on the Israeli Social Worker Gateway vCoP, achieving a 33.67% response rate. However, the study lacked in-depth trend analysis or correlations among variables. Semi-structured interviews offer qualitative insights into participants' perceptions or experiences in a vCoP. Lev-On and Adler (2013) used them to gauge members' perceptions in the same Israeli community. However, challenges in quantifying engagement levels emerged, impacting the study's depth. Website analytics are crucial for understanding community engagement within vCoP (Cook-Craig and Sabah, 2009). Metrics include the number of logins, forum interactions, and downloads to provide insights on vCoP performance and user behaviour. Cook-Craig and Sabah (2009) evaluated website analytics, revealing insights into lurker participation. However, the analysis lacked granularity, such as explaining user surges and addressing these aspects would have provided more significant insights.

The literature underscores the integration of EBP and EIP within vCoP. However, a gap exists in assessing the adoption of EBP versus EIP among vCoP member segments, hindering understanding of their differential uses. Moreover, the practical application of knowledge acquired within vCoP lacks evaluation, impeding assessment of its real-world impact. vCoP primarily focus on discussion forums, neglecting diverse content formats such as webinars. Furthermore, a standardised approach to data mining and limited information on data cleansing and exploratory data analysis impede thorough analysis, yielding generic findings. The literature also lacks evaluations of multi-agency vCoP for knowledge translation in the non-profit sector. Furthermore, Action Research (AR) use in evaluating multi-agency vCoP for knowledge translation is underexplored. These gaps call for comprehensive assessments in vCoP studies, warranting an AR study to evaluate a multi-agency vCoP for knowledge translation in the DSGBA field. This study is being conducted in collaboration with Haven Horizons, an Irish non-profit group that advocates for inter-agency collaboration to bridge the research-to-practice gap and support the intervention and prevention of DSGBA.

2. Research Design

The study employs an AR methodology, a collaborative research approach that involves the researcher at every stage of the process. Central to AR is the cyclic process of action and reflection, distinct from traditional research

methodologies, as it promotes the acquisition of tacit knowledge through critical reflection (Masters, 1995). The study adopts a five-stage cyclical AR process adapted from Susman and Evered (1978), as shown in Figure 1.

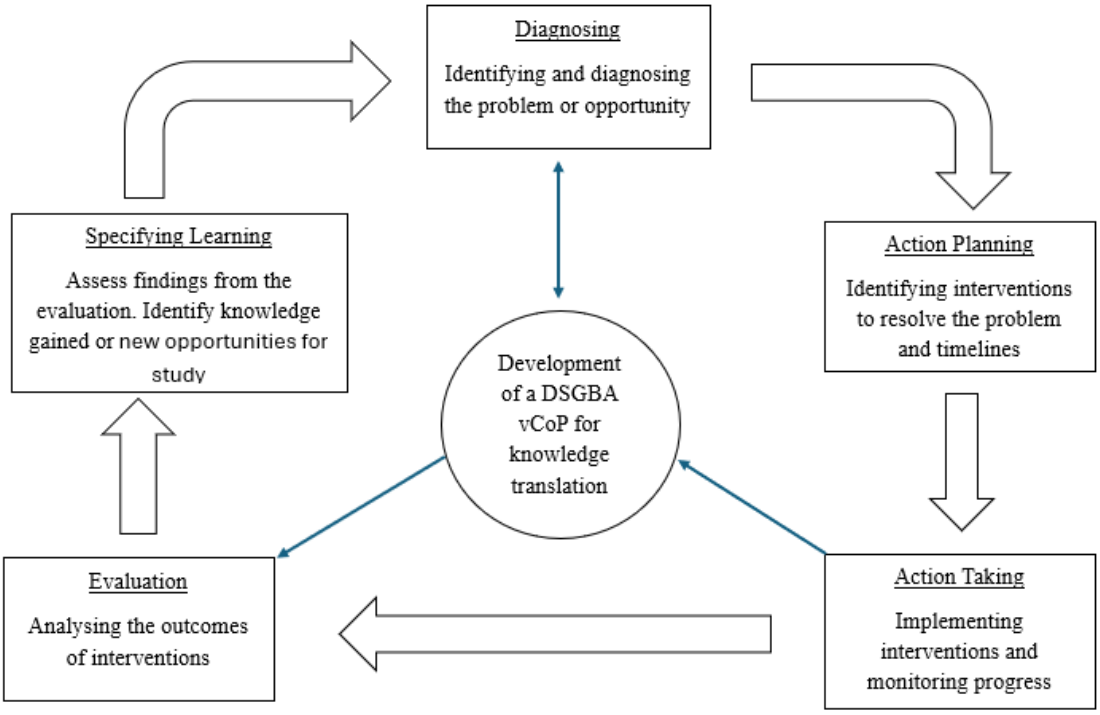


Figure 1: Five-Stage Action Research Model

The first phase of the AR process, diagnosing, focuses on identifying the problem, which then serves as the research focus. For this study, the literature review served as a mechanism for determining the barriers and motivations of using a vCoP to facilitate knowledge translation among professionals in the DSGBA field. The findings formed the basis for developing a conceptual framework (see Figure 2), which informed the research objectives, questions, and subsequent action-planning and action-taking stages.

The next stage of the AR process, action planning, involves identifying, developing, and scheduling interventions to address the problems identified in the diagnosing phase. Knowledge brokers and Haven Horizons are involved in the planning phase, outlining a quarterly roadmap of activities to support community engagement. The action-taking phase focuses on implementing the planned interventions and monitoring progress. This includes conducting focus groups with knowledge brokers, launching the DSGBA vCoP, developing a database of relevant contacts, and issuing marketing campaigns to attract members. Applying an iKT approach, the DSGBA vCoP membership will comprise multi-agency practitioners and academics to support bridging the gap between research and practice, aligning with EBP and EIP. Discussion forums and webinars will be initiated to foster engagement, and resources will be designed to support knowledge sharing. Furthermore, natural language processing (NLP) techniques such as aspect-based sentiment analysis (ABSA) and topic modelling will be implemented to extract insights from vCoP discussions. Topic modelling uses statistical methods to determine the frequency of words within the text to identify topic patterns (Murshed et al., 2023). Topic analysis aims to identify hidden topics to improve knowledge production and transfer issues, while ABSA serves as a tool to gain deeper insight into emotions towards entities or topics (Nazir et al., 2020). ABSA is a robust tool for analysing discussion forum content and evaluating the application of knowledge acquired within the vCoP. The observed patterns will help to understand the vCoP efficacy in bridging the research-to-practice gap and use of EBP or EIP. Data extracted from the topic analysis and ABSA will support the evaluation phase of the AR cycle.

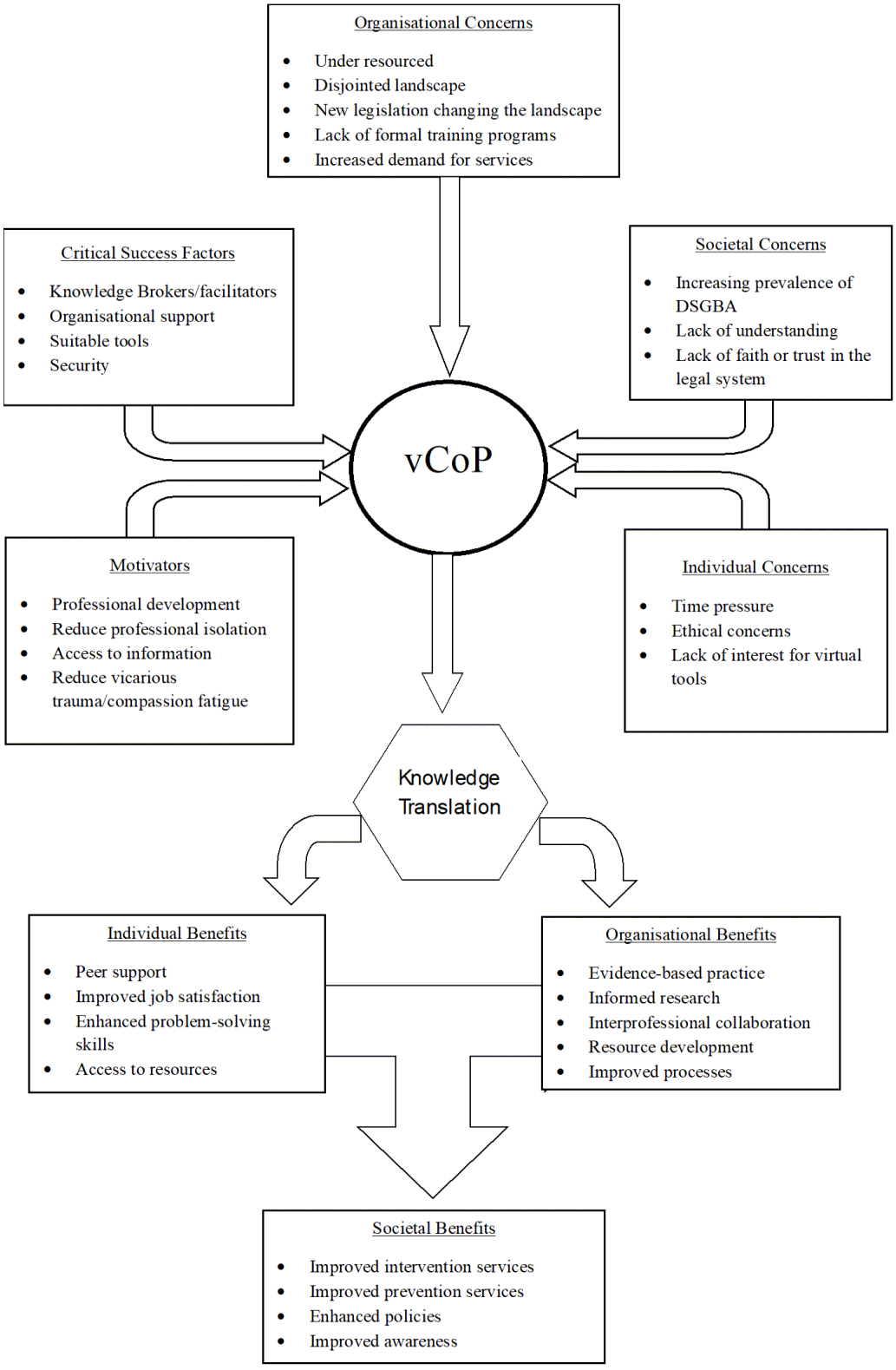


Figure 2: Conceptual Model

Evaluation of interventions is important to determine their effectiveness. Quarterly online surveys will be conducted to gather member feedback and monitor trends, supplemented by user statistics. The specifying learning phase assesses the findings from the evaluation phase to identify knowledge and contribute to theory development. To maintain research rigour, Corcoran and Duane (2017) recommend using a reflective diary to document methods, interventions, observations, and experiences throughout the research process. Reflective

journaling is used in this study to ensure research rigour and embrace the reflective practice. In summary, this study uses an AR methodology to enhance understanding and practice in the DSGBA field while contributing to scholarly dissemination and accredited academic programme development through diagnosing, action planning, action taking, evaluation, and specifying learning phases.

3. Implementation and Initial Findings

In preparation for the launch of the DSGBA vCoP, project documentation was developed to streamline project organisation, task coordination, and communication with Haven Horizons as part of the action-taking phase. This included creating a platform requirements document outlining essential features, integration requirements, and the aims and objectives of the DSGBA vCoP. Additionally, comprehensive documentation was generated to establish thematic areas, inquiry protocols, and content frameworks for conducting focus groups, interviews, and online surveys to gather feedback from community members and knowledge brokers. Creating a contact database was necessary to facilitate user engagement within the DSGBA vCoP. This involved identifying suitable organisations and job roles and manually extracting contact details from websites and digital documents. The resulting database included 320 direct contacts spanning diverse professions, such as solicitors, academics, and support services. A ten-week marketing plan was devised to assist Haven Horizons in post-launch promotional activities for DSGBA vCoP membership acquisition. This plan included social media postings, general newsletter content, and personalised email invitations.

Several platforms were evaluated to identify one that aligned with project requirements and budget. Heartbeat emerged as the preferred choice due to its functionality, user-friendly interface, and cost-effectiveness. Heartbeat is a platform for online communities that has an easy-to-use interface that lets people build and run their communities (Olayiwola, 2023). An FAQ document on Heartbeat features was developed to support Haven Horizons onboarding. Knowledge brokers from various professional backgrounds were recruited in collaboration with Haven Horizons to ensure representation across domains. An email campaign was launched to 38 individuals in September 2023, resulting in 26 acceptances by December 2023. Focus groups were then organised with vCoP knowledge brokers to discuss the motivators and barriers to knowledge sharing and inter-agency collaboration in the DSGBA field. Three focus groups were organised across March and April 2024 with 19 participants, detailed in Figure 3.

		Years of Experience					
Role	**Total Numbers**	0-4	5-10	11-15	16-20	21-30	31-40
Academic	3		2			1	
Practitioner	10	4	1	1	1	2	1
Lived Experience	6	3	1	1	1		
	19	7	4	2	2	3	1

Figure 3: Focus Group Participant Overview

The researcher facilitated the focus group sessions, and recordings were transcribed for NVivo thematic analysis. Findings revealed key insights regarding inter-agency collaboration. Participants identified staff turnover as a significant challenge, leading to disruptions in collaboration efforts, causing continuity issues and requiring time for new members to integrate into DSGBA networks. The absence of clear policies and procedures hindered collaboration efforts, with reliance on individual initiative rather than institutional support. Workload pressures also constrained participants' ability to engage in collaborative initiatives. Despite these challenges, participants recognised the value of inter-agency collaboration in facilitating knowledge-sharing and learning from diverse practices. The absence of standardised services across regions underscored the importance of sharing best practices and developing a common language within the vCoP. Strategies such as local networks and resource development were identified as effective means of supporting collaboration and addressing service gaps. Furthermore, academic participants viewed the vCoP as a platform for extracting information for academic pursuits. In contrast, practitioners and individuals with lived experiences emphasised the importance of peer learning, knowledge exchange, and the development of a common language across the agencies. The virtual nature of the vCoP was perceived as advantageous, offering accessibility and opportunities for relationship-building across diverse stakeholders. However, sustained engagement was viewed as contingent upon participants perceiving tangible benefits, whether in the form of resources, knowledge acquisition, or networking opportunities. DSGBA vCoP members are expected to experience enhanced collaboration,

knowledge-sharing, and networking opportunities, which will ultimately improve service delivery and professional development.

4. Summary

Gender-based violence remains a pressing global issue, persistently prevalent in Ireland. The Irish Zero Tolerance strategy underscores the necessity of an inter-agency approach to combat DSGBA. Effective knowledge management is important in this complex environment to facilitate seamless knowledge sharing among stakeholders. A review of the literature suggests that a vCoP holds the potential for knowledge translation among DSGBA professionals and agencies. By providing a platform for practitioners and academics to connect and collaborate without geographical, political, or financial barriers, the vCoP fosters interaction, discussion, mutual learning, and the application of research in real-world settings. This aids in bridging the gap between research and practice, fostering a collaborative environment conducive to interprofessional cooperation in combating DSGBA. However, building trust through online communities remains a significant challenge. In addition, the literature identifies research gaps, particularly in understanding knowledge translation dynamics within non-profit vCoP. An Action Research approach is used to establish a multi-agency DSGBA vCoP as a knowledge management system to address these gaps. This methodology, complemented by sentiment analysis techniques, aims to provide insights into knowledge translation processes within the vCoP. The outcomes may include the development of a framework for managing vCoP in multi-agency settings and contributions to understanding knowledge translation dynamics using NLP techniques.

References

Abos Mendizabal, G., Nuño Solinís, R. and Zaballa González, I. (2013) "HOBE+, a case study: a virtual community of practice to support innovation in primary care in Basque Public Health Service", *BMC Family Practice*, Vol. 14, No. 1, pp 1-10.

Bowen, S. and Graham, I. D. (2013) "Integrated knowledge translation", In: Straus, S. E., Tetroe, J. & Graham, I. D. (eds.) *Knowledge Translation in Health Care*. John Wiley & Sons, Ltd.

Cheung, C. M. K., Lee, M. K. O. and Lee, Z. W. Y. (2013) "Understanding the continuance intention of knowledge sharing in online communities of practice through the post-knowledge-sharing evaluation processes", *Journal of the American Society for Information Science and Technology*, Vol. 64, No. 7, pp 1357-1374.

Chu, H., Gresh, A., Bolanos, V. and Reynolds, N. (2021) "Content analysis of the Global Alliance for Nursing and Midwifery discussion forum: an online community of practice", *Revista Latino-Americana De Enfermagem*, Vol. 29, No. pp e3431.

CIHR (2019) “Guide to Knowledge Translation Planning at CIHR: Integrated and End-of-Grant Approaches”, [online], Canadian Institutes of Health Research, https://cihr-irsc.gc.ca/e/45321.html.

Cook-Craig, P. G. and Sabah, Y. (2009) "The role of virtual communities of practice in supporting collaborative learning among social workers", *British Journal of Social Work*, Vol. 39, No. 4, pp 725-739.

Corcoran, N. and Duane, A. (2017) "Evaluating an action research design for an information systems study", Paper read at European Conference on Research Methodology for Business and Management Studies, Dublin, June.

DoJ (2022) "Zero Tolerance - Third National Strategy on Domestic, Sexual & Gender-Based Violence 2022-2026", Department of Justice, Ireland.

Ford, J. R., Korjonen, H., Keswani, A. and Hughes, E. (2015) "Virtual communities of practice: can they support the prevention agenda in public health?", *Online Journal of Public Health Informatics*, Vol. 7, No. 2, pp e222.

Forde, C. and Duvvury, N. (2021) "Assessing the Social and Economic Costs of DV", Centre for Global Women’s Studies, NUIG, Ireland.

Graaf, G. and Ratliff, G. A. (2018) "Preparing Social Workers for Evidence-Informed Community-Based Practice: An Integrative Framework", *Journal of Social Work Education*, Vol. 54, No. sup1, pp S5-S19.

Greville, H., House, W., Tarrant, S. and Thompson, S. C. (2023) "Addressing Complex Social Problems Using the Lens of Family Violence: Valuable Learning from the First Year of an Interdisciplinary Community of Practice", *International Journal of Environmental Research and Public Health*, Vol. 20, No. 4, pp 3501.

Haas, A., Abonneau, D., Borzillo, S. and Guillaume, L. P. (2020) "Afraid of engagement? Towards an understanding of engagement in virtual communities of practice", *Knowledge Management Research and Practice*, Vol. 19, No. 2, pp 169-180.

Habash, R. (2019) "G9toengineering: A virtual community of practice in knowledge creation", Paper read at IEEE Global Engineering Education Conference (EDUCON), Dubai, United Arab Emirates, 8-11 April.

Hajisoteriou, C., Karousiou, C. and Angelides, P. (2018) "INTERACT: building a virtual community of practice to enhance teachers' intercultural professional development", *Educational Media International*, Vol. 55, No. 1, pp 15-33.

Hennekam, S., Macarthur, S., Bennett, D., Hope, C. and Goh, T. (2020) "Women composers’ use of online communities of practice to build and support their careers", *Personnel Review*, Vol. 49, No. 1, pp 215-230.

Hennessy, C., Anderson, S. E., Cornes, M. and Manthorpe, J. (2013) "Toolkit: Developing a Community of Practice: Using Communities of Practice to improve front line collaborative responses to multiple needs and exclusions", Revolving Doors Agency, King's College London, London.

Hernández-Soto, R., Gutiérrez-Ortega, M. and Rubia-Avi, B. (2021) "Key factors in Knowledge Sharing Behavior in Virtual Communities of Practice: A Systematic Review", *Education in the Knowledge Society*, Vol. 22, No. 1, pp e22715.

Hsu, M.-H., Ju, T. L., Yen, C.-H. and Chang, C.-M. (2007) "Knowledge sharing behavior in virtual communities: The relationship between trust, self-efficacy, and outcome expectations", International Journal of Human-*Computer Studies*, Vol. 65, No. 2, pp 153-169.

Ikioda, F., Kendall, S., Brooks, F., Liddo, A. D. and Shum, S. B. (2013) "Factors That Influence Healthcare Professionals' Online Interaction in a Virtual Community of Practice", *Social Networking*, Vol. 2, No. 4, pp 174-184.

Kumah, E. A., McSherry, R., Bettany-Saltikov, J., Hamilton, S., Hogg, J., Whittaker, V. and Van Schaik, P. (2019) "PROTOCOL: Evidence-informed practice versus evidence-based practice educational interventions for improving knowledge, attitudes, understanding, and behavior toward the application of evidence into practice: A comprehensive systematic review of undergraduate students", *Campell Systematic Reviews*, Vol. 15, No. 1-2, pp e1015.

Lave, J. and Wenger, E. (1991) *Situated Learning: Legitimate Peripheral Participation*, Cambridge University Press, Cambridge.

Leggat, F. J., Wadey, R., Day, M. C., Winter, S. and Sanders, P. (2021) "Bridging the Know-Do Gap Using Integrated Knowledge Translation and Qualitative Inquiry: A Narrative Review", Qualitative Research in Sport, *Exercise and Health*, Vol. 15, No. 2, pp 188-201.

Lev-On, A. and Adler, O. (2013) ""Let Us Talk to People, Not to Computers": Obstacles for Establishing Relationships and Trust in Social Workers' Online Communities of Practice", Paper read at 5th IFIP WG 8.5 International Conference, Koblenz, Germany, September 17-19.

Lin, C. Y.(2017) "Conceptions of using social networking sites as a tool to facilitate learning: A phenomenographic study of university students' and faculty members' perspectives". Doctor of Education Dissertation, University of Technology Sydney.

Linkewich, E., Quant, S., Bechard, L. and Donald, M. (2022) "Using a Virtual Community of Practice to Support Stroke Best Practice Implementation: Mixed Methods Evaluation", *JMIR Formative Research*, Vol. 6, No. 4, pp e31827.

Masters, J. (1995) "The History of Action Research' in I. Hughes (ed)", *Action Research Electronic Reader*. Sydney: The University of Sydney.

Michaelides, R., Tickle, M. and Morton, S. C. (2010) "Online communities of practice for innovation and knowledge transfer: A case study in the U.K.", Paper read at IEEE International Conference on Management of Innovation & Technology, Singapore, 2-5 June.

Murshed, B. A. H., Mallappa, S., Abawajy, J., Saif, M. A. N., Al-Ariki, H. D. E. and Abdulwahab, H. M. (2023) "Short text topic modelling approaches in the context of big data: taxonomy, survey, and analysis", *Artificial Intelligence Review*, Vol. 56, No. pp 5133-5260.

Nazir, A., Rao, Y., Wu, L. and Sun, L. (2020) "Issues and Challenges of Aspect-based Sentiment Analysis: A Comprehensive Survey", *IEEE Transactions on Affective Computing*, Vol. 13, No. 2, pp 845-863.

Nezafati, N., Shokouhyar, S., Razaghi, S., Moradi, H. and Jafari, S. (2023) "Promoting knowledge sharing performance in a knowledge management system: do knowledge workers' behavior patterns matter?", *VINE Journal of Information and Knowledge Management Systems*, Vol. 53, No. 4, pp 637-662.

Nguyen, G., Dlugolinsky, S., Bobák, M., Tran, V., García, Á. L., Heredia, I., Malík, P. and Hluchý, L. (2019) "Machine Learning and Deep Learning frameworks and libraries for large-scale data mining: a survey", *Artificial Intelligence Review*, Vol. 52, No. 1, pp 77-124.

O'Brien, M. and Richey, C. (2010) "Knowledge Networking for Family Planning: The Potential for Virtual Communities of Practice to Move Forward the Global Reproductive Health Agenda", *Knowledge Management & E-Learning*, Vol. 2, No. 2, pp 109.

Olayiwola, W. (2023) "Heartbeat.chat Review: An In-Depth Analysis", [online], Group Leads Blog, https://blog.groupleads.net/heartbeat-chat-review/.

Richey, C. and Salem, R. (2008) "Key Points Population Reports Elements of Success in Family Planning Programming Series J, Number 57 Family Planning Programs", *Population Reports*, Vol. J, No. 57, pp 1-28.

Rolls, K., Hansen, M., Jackson, D. and Elliott, D. (2016) "How Health Care Professionals Use Social Media to Create Virtual Communities: An Integrative Review", *Journal of Medical Internet Research,* Vol. 18, No. 6, pp e166.

SafeIreland (2023) "No Going Back", [online], Ireland: Safe Ireland, https://www.safeireland.ie/no-going-back/.

Sahay, A., Mittman, B. S., Gholami, P., Lin, S. and Heidenreich, P. A. (2022) "How successful was the use of a community of practice for the implementation of evidence-based practices for heart failure within the United States Department of Veterans Affairs: Insights from a formative evaluation", *Health Research Policy and Systems*, Vol. 20, No. 1, pp 79.

Sharratt, M. and Usoro, A. (2003) "Understanding Knowledge-Sharing in Online Communities of Practice", *Electronic Journal on Knowledge Management*, Vol. 1, No. 2, pp 187-196.

Sims, J. M. (2018) "Communities of practice: Telemedicine and online medical communities", T*echnological Forecasting and Social Change*, Vol. 126, No. pp 53-63.

Susman, G. I. and Evered, R. D. (1978) "An assessment of the scientific merits of action research", *Administrative Science Quarterly*, Vol. 23, No. 4, pp 582-603.

Tan, C. N. L. and Ramayah, T. (2018) "Exploring the individual, social and organizational predictors of knowledge-sharing behaviours among communities of practice of SMEs in Malaysia", *Journal of Systems and Information Technology*, Vol. 20, No. 3, pp 375-399.

Valaitis, R. K., Akhtar-Danesh, N., Brooks, F., Binks, S. and Semogas, D. (2011) "Online communities of practice as a communication resource for community health nurses working with homeless persons", *Journal of Advanced Nursing*, Vol. 67, No. 6, pp 1273-1284.

Valenti, S. and Sutton, S. (2020) "Strengthening Virtual Communities of Practice (VCoPs): An Evidence-Based Approach", *Journal of Education for Library and Information Science*, Vol. 61, No. 1, pp 106-125.

Venkatraman, S. and Venkatraman, R. (2018) "Communities of Practice Approach for Knowledge Management Systems", *Sytems*, Vol. 6, No. 4, pp 36.

Wenger-Trayner, E. and Wenger-Trayner, B. (2015) “Communities of practice a brief introduction”, [online], https://www.wenger-trayner.com/introduction-to-communities-of-practice/.

Wenger, E., McDermott, R. A. and Snyder, W. (2002) *Cultivating Communities of Practice: A Guide to Managing Knowledge*, Harvard Business School Press, Boston.

WHO (2018) "Violence Against Women Prevalence Estimates 2018", World Health Organisation, Geneva.

WHO (2023) “Knowledge Translation and Evidence”, [online], https://www.paho.org/en/evidence-and-intelligence-action-health/knowledge-translation-and-evidence.

WomensAid (2021) "Yes it’s Abuse: Young people’s understandings of and attitudes to intimate relationship abuse", Women's Aid, Ireland.

Subsequent Measurement of Goodwill: The Influence of Activity Sectors and Business Digitalisation

Mónica D'Orey[1] and Carla Carvalho[2]
[1]Porto Accounting and Business School, Polytechnic Institute of Porto, Porto, GOVCOPP, University of Aveiro, Aveiro, Portugal
[2]Aveiro Institute of Accounting and Administration of Aveiro University, GOVCOPP, University of Aveiro, Aveiro, Portugal

orey@iscap.ipp.pt
carla.carvalho@ua.pt

Abstract: In 2020, the International Accounting Standards Board (IASB) published the Discussion Paper (DP)/2020/1 - *Business Combinations - Disclosures, Goodwill and Impairment*, to receive contributions on more useful disclosures about business combinations, bringing the issue of the subsequent measurement of goodwill back into the discussion. When analysing the comment letters from preparers by sector of activity, in some sectors (Automotive, Banking, Luxury Goods, Household Appliances, Energy and Technology) no preparer prefers the impairment-only model, which suggests that perhaps, in these industries, this model is not appropriate. Some respondents say that the pace of change in technology, customer preference, competition in the market and substitute products, among others, contribute to the loss of value of goodwill acquired over time and that it is systematically replaced by internally generated goodwill (D'Orey and Carvalho, 2023). This study aims to identify the main criticisms of goodwill accounting and to analyse the influence of the sector of activity and level of business digitalisation on the subsequent measurement of goodwill. To this end, semi-structured interviews were conducted with Portuguese preparers, auditors and financial analysts. The study makes it possible to compare the perception of Portuguese stakeholders on the subsequent measurement of goodwill and to understand whether the sector of activity and the level of digitalisation of the business influence the subsequent measurement of goodwill, a pioneering aspect in goodwill research. This study contributes to the debate on the subsequent measurement of goodwill, identifying new practical and conceptual arguments adjusted to current business models, highly influenced by digital transformation, in a legal context that is still very little explored, as is the case in Portugal.

Keywords: Goodwill; Impairment; Amortisation; Subsequent Measurement; Activity Sector; Digitalisation

1. Introduction

According to IFRS 3 - *Business Combinations*, goodwill represents the excess of the purchase price over the fair value of the identifiable net assets in a business combination. A company can generate goodwill internally or acquire it during a business combination. However, only the acquired goodwill is recognised in the acquirer's balance sheet and internally generated goodwill is not recognised as an asset.

The subsequent measurement of goodwill is a topic that has generated successive discussions over time, due to its complex nature and the important impact it has on financial statements and decision-making. In 2020, the IASB published DP/2020/1, to gather input on more useful disclosures about business combinations, bringing the controversial issue of impairment testing versus goodwill amortisation back into the discussion.

As mentioned by the IASB (2020a) in the DP, some of the stakeholders' concerns about goodwill relate to the fact that investors don't get enough information about acquisitions and their subsequent performance, and that goodwill impairment losses are recognised at low values and too late.

Therefore, this study aims to identify the main criticisms of goodwill accounting, based on semi-structured interviews with Portuguese experts, and to analyse whether the sectors of activity and the level of business digitalisation influence the subsequent measurement of goodwill, a pioneering aspect in goodwill research.

In order to contribute to the debate around the measurement of goodwill and to meet the IASB's call (IASB, 2020a) for new proposals and arguments on how to account for goodwill, we carried out this research through interviews, to obtain an overview of the perception of Portuguese stakeholders on the measurement of goodwill, thus allowing a more in-depth look at the subject under analysis.

The study is organised as follows. After this first section of the introduction, section 2 presents the theoretical basis of the research. Section 3 explains the methodology used to conduct and analyse the interviews. Section 4 presents and analyses the results of the interviews and section 5 presents the main conclusions of the study.

2. Background

2.1 Accounting for Goodwill

According to IFRS 3, companies must test goodwill for impairment annually, but stakeholders have differing opinions on the effectiveness of this test (D'Orey and Carvalho, 2023). In March 2024, the IASB published for public comment the Exposure Draft (ED) - *Business Combinations -Disclosures, Goodwill and Impairment*. The ED contains proposed amendments to IFRS 3 and IAS 36 - *Impairment of Assets*, suggesting improvements to the disclosure of information on company acquisitions.

Although some parties have suggested reintroducing the amortisation of goodwill (D'Orey and Carvalho, 2023), the IASB has chosen to maintain the impairment-only approach, as there is no clear evidence that amortisation would significantly improve the information provided to investors (IASB, 2020a). The IASB also tried to define a more effective impairment test but concluded there is no suitable and economically viable alternative to the current test. The new disclosure requirements are expected to provide investors with relevant information on the performance of acquisitions.

2.2 Literature Review

2.2.1 Main Criticisms of Goodwill Measurement

The main criticisms of the initial measurement of goodwill emphasise its subjectivity and potential manipulation by management, allowing its value to be overestimated (Hamberg et al., 2010; Li et al., 2017). Thus, the strategic allocation of the cost of an acquisition favours goodwill over other assets subject to depreciation (Bugeja and Loyeung, 2015; Zhang and Zhang, 2017). Linsmeier et al. (2020) identify three components of goodwill - expected synergies, going concern value and overpayment - the latter being associated with a greater risk of future impairment losses. Due to the heterogeneity of these components, it is difficult to apply a single appropriate treatment to all entities.

Goodwill impairment tests are complex and costly, favouring the untimely recognition of losses (Noland et al., 2013; Plotnikov and Plotnikova, 2019), which undermines investors' perception of companies' financial health (André et al., 2017; Ashmarina et al., 2020; Gray et al., 2016; Noland et al., 2013).

Timely recognition of goodwill impairment losses is crucial for the relevance of financial statements. However, the literature shows that the recognition of these losses is not timely, leading to inflated goodwill values (Bepari and Mollik, 2017; Li and Sloan, 2017; Pechlivanidis et al., 2022).

2.2.2 The Subsequent Measurement of Goodwill for Preparers, Auditors and Financial Analysts

Agency theory predicts that managers will use write-offs of unverifiable assets in financial reports to maximise advantages (Ramanna and Watts, 2012). Additional studies emphasise that cultural aspects affect the application of controversial accounting standards (André et al., 2016; Mazzi et al., 2017), with the Chief Financial Officer (CFO) and management being able to account for write-offs taking into account, not only financial and economic conditions, but also their individual, business and cultural interests and the characteristics of the external auditor (Ferramosca and Allegrini, 2021).

Thus, preparers tend to take advantage of the flexibility allowed in the subsequent measurement of goodwill, either to overestimate or anticipate a goodwill impairment loss or to increase results when they are close to the limit for avoiding impairment. Despite the importance of impairment tests to ensure the timely recognition of losses and accounting conservatism (Amiraslani et al., 2013; Roychowdhury and Martin, 2013), their application requires the use of estimates, assumptions and unverifiable cash flow projections, making

assessment by auditors and regulators difficult (Hayn and Hughes, 2006; Hilton and O'Brien, 2009; Li and Sloan, 2017; Ramanna and Watts, 2012). There are therefore auditors reporting that goodwill impairment losses are not always recorded, although it would be appropriate to do so (Saastamoinen et al., 2020).

The disclosure of the assumptions used in impairment tests also varies widely (Amiraslani et al., 2013). Consequently, the role of auditors in ensuring the objectivity and transparency of impairment tests is more pronounced, being one of the areas in which professional scepticism is most evident (Chambers and Finger, 2011), referenced in the inspection reports of the Public Company Accounting Oversight Board (PCAOB) as an audit deficiency (Ayres et al., 2019).

Given that goodwill impairment tests are comparable to a company's valuation, transparency in the respective disclosures is very useful to analysts, reducing the divergence between them and managers (Andreicovici et al., 2019). However, studies show that analysts tend to ignore goodwill and impairment losses in their valuation models and rarely use the information disclosed about goodwill to adjust their projections of future cash flows (Cascino et al., 2021; Durocher et al., 2022; Schatt et al., 2016). This is because the inconsistent application of IAS 36 and the generic nature of the associated disclosures does not result in quality information to assess the performance of each acquisition and verify whether the expected synergies have been achieved (Andreicovici et al., 2019; Durocher et al., 2022). There are, however, other analysts who use information on goodwill and impairment losses, despite being disappointed with the quality of those disclosures (Silvola et al., 2024).

2.2.3 Influence of Activity Sectors and Business Digitalisation on the Subsequent Measurement of Goodwill

Economic sectors with high growth and innovation rates can face unique challenges in assessing goodwill, due to rapid technological obsolescence and changing consumer preferences (Bugeja and Gallery, 2006; Gray et al., 2016; Plotnikov and Plotnikova, 2019).

Digital technologies have transformed industries (Dal Mas et al., 2020), introducing "Industry 4.0" or the "smart factory" (Lasi et al., 2014). Digital platforms have created a new "business ecosystem" (Presch et al., 2020), with digital infrastructures such as data analysis, cloud computing and 3D printing accelerating their expansion (Huang et al., 2017). The digital transformation has affected the creation, delivery and capture of value in almost every sector, giving rise to new business models such as frugal innovation and the circular economy (Vaska et al., 2021). The widespread use of digital technologies and the efficient use of information increase productivity, reduce costs and increase efficiency, generating a multiplier effect for economic development (Ullberg et al., 2021).

The subjectivity inherent in the measurement of goodwill often involves estimates and judgements, which can lead to significant variations in reported values between similar companies (Gray et al., 2016; Noland et al., 2013). This subjectivity is especially problematic in the current context, with the development of the digital economy offering the opportunity to expand the factors that influence the formation of goodwill (Tiesheva and Smyrnov, 2023). These authors demonstrate a lack of public understanding of digital goodwill, despite the evident paradigmatic changes in the formation of company value in the digital economy.

The digitalisation of business has a growing impact on goodwill through both digital transformation and the valuation of digital intangibles. Companies that invest significantly in technology and digitalisation tend to have higher goodwill values, reflecting expectations of future economic benefits derived from their digital capabilities (Plotnikov and Plotnikova, 2019; Yang et al., 2024). However, recognising digital intangible assets, such as software and online platforms, can complicate the measurement of goodwill, requiring new valuation and impairment methods (Ashmarina et al., 2020) to better reflect the value of digital assets (Tiesheva and Smyrnov, 2023).

3. Methodology and Sample

This study aims to identify the main criticisms of goodwill accounting and to analyse the influence of the sector of activity and the level of business digitalisation on the subsequent measurement of goodwill, from the perspective of different Portuguese stakeholders, a pioneering aspect in goodwill research.

To this end, the following research questions were defined:

1. What are stakeholders' perceptions of the subsequent measurement of goodwill and why?
2. Does the sector of activity influence the subsequent measurement of goodwill and why?
3. Does the level of business digitalisation influence the subsequent measurement of goodwill and why?

For this purpose, twelve individual semi-structured interviews (Ruslin et al., 2022) were carried out with Portuguese stakeholders who have extensive knowledge of goodwill in their respective areas of expertise, namely: four auditors from Big-4 and two auditors from large non-Big-4 audit firms; four preparers of IFRS financial statements (three from EURONEXT-LISBON listed companies and one from an unlisted company); and 2 financial analysts. The interview script was prepared based on the DP of the IASB and the literature review.

The interviews were conducted between 12/3/2024 and 23/5/2024, in person or online, and lasted a total of 1,170 minutes. All the interviews were recorded, with the prior authorisation of the interviewees, and then transcribed into a content analysis grid.

When selecting the individuals in the sample, it was considered a fundamental requirement that the interviewees had extensive professional experience in their current role, guaranteeing their mastery of the subject under study, which in itself is highly complex and subject to successive regulatory changes. The auditors interviewed (A1, A2, A3, A4, A5 and A6) are partners in their firms and have between 23 and 30 years of professional experience. The preparers (PA, PB, PC and PD) also have between 24 and 26 years of experience and are responsible for the financial reporting of companies with significant goodwill on their balance sheets. Finally, the financial analysts (AA and AB) have between 21 and 30 years of professional experience as credit analysts for large companies, working for two large Portuguese banks.

4. Analysis and Discussion of Results

4.1 Stakeholders' Perception of the Subsequent Measurement of Goodwill

4.1.1 Criticism of the Current Model for Subsequent Measurement of Goodwill

The preparers of the financial statements pointed out several criticisms of the current goodwill measurement model, based on impairment-only. According to the preparer PA, the subsequent measurement of goodwill involves complex judgements due to the difficulty of predicting the future of the business and frequent internal restructuring. PD emphasised the great speed of change, which makes it uncertain whether the objectives and synergies expected when acquiring a business will remain relevant over time. Impairment tests are considered to be highly subjective, making it difficult to assess cash-generating units, especially when businesses are integrated differently than initially anticipated (PC and PD).

Another criticism of the impairment-only model is that goodwill impairment losses are irreversible, which can lead to the late accounting of these losses in the hope of a future improvement in business performance. The preparers were unanimous in stating that goodwill impairment losses are not recorded in a timely manner, adding PB that the impairment-only model does not balance income and expenses in the same economic period.

The complexity of impairment tests and the sophistication of valuation models are highlighted by auditors, especially those in favour of amortisation, arguing that the tests are based on subjective future projections, susceptible to earnings management (A2, A3, A4, A6). Managers prefer impairment-only because of its discretion, while technical preparers prefer amortisation because it is less subjective, resulting in information asymmetries (A3).

The pessimistic or optimistic culture of management impacts the estimation of future cash flows, more than the discount rate itself. Optimistic managements tend to set ambitious budgets, while prudent managements prefer conservative forecasts, generating different results, particularly in sensitivity analyses and impairment tests for the same company (A2).

The definition of cash-generating units (CGUs) for allocating goodwill is also critical. Especially in fast-moving sectors, business changes can detach the goodwill initially attributed to a CGU from that unit's current products, even though it continues to generate profits (A2, A4).

The irreversibility of goodwill impairment losses is also criticised, because recognising a loss implies admitting recognising such losses, and their accounting is postponed, even though business synergies dissipate over time, not justifying the perpetuation of goodwill (A2, A4).

The auditors report that, in terms of disclosures, the tendency is to disclose as little as possible, with A4 stating, "*When we ask a listed company to increase its disclosures, they compare it to the benchmark. If other companies don't disclose, they don't either, especially when compared to Portuguese and European listed*

companies in the same sector." Auditor A2 emphasises: "*Increasing disclosures can exacerbate the problem, as unverifiable information can lead managers to provide inaccurate data, introducing more noise and compromising the reliability of financial information*."

The financial analysts interviewed, with experience in companies using the IFRS (impairment-only model) and Portuguese standards (amortisation of goodwill), have different opinions on the importance of goodwill. For AB, the importance depends on the weight of goodwill in the entity's equity, while for AA it depends on the weight of goodwill in the company's total assets, equity and financial autonomy.

Analysts tend to exclude goodwill from their analyses because they consider it to be an asset of questionable realisation. According to AB, the exclusion is made to assess the company's ability to meet its obligations assuming no realisation of goodwill. AA, on the other hand, analyses operating flows before depreciation to avoid distortions and tests extreme scenarios, such as the total exclusion of goodwill, to understand the impact in adverse situations.

Both analysts criticised the insufficient disclosures in the impairment-only model. AB pointed out the lack of clarity and indicators in the information disclosed and highlighted the manipulation and delays in recording impairment losses. For AA, the accounting of impairment losses reflects flaws in the projections, suggesting unexpected events that require investigation.

4.1.2 Preference for the Subsequent Goodwill Measurement Model

Financial preparers and auditors have varying opinions on the subsequent measurement model for goodwill, with criticism of the impairment-only model and diverse preferences for amortisation followed by impairment testing.

Three preparers (PA, PB, PD) prefer the amortisation model, followed by impairment tests, when necessary, while another (PC) prefers the impairment-only model. PB, in favour of amortisation, argues that the goodwill initially recorded may no longer reflect reality due to market changes, but the tendency is to delay recognition of impairment, so he is always wary of high goodwill values on the balance sheet.

PC, on the other hand, defends impairment-only, stating that this model reflects the market valuation of the business, unlike amortisation, which distances the group's book value from its market valuation. Therefore, managers look at the market price to determine the need to recognise impairment.

PA and PD support amortisation because it allows for a balance between income and expenses, making it easier to match the return obtained with the amortisation of the amount overpaid and avoiding the perpetuation of goodwill. For PA, even in successful businesses, after 20 years goodwill no longer makes sense as an asset.

Among the auditors, three (A2, A3, A4) prefer amortisation followed by impairment tests, two (A1, A5) prefer the impairment-only model and one (A6) suggests that it should be a choice of accounting policy. Proponents of impairment-only consider this model to be conceptually more robust, adequately capturing the initial value and eventual loss of goodwill, and that goodwill can increase in value. They also criticise the arbitrary definition of the useful life in the amortisation model.

The auditors in favour of amortisation (A2, A4) believe that this model is more appropriate, as the useful life of goodwill can be defined based on an economic rationale captured during the PPA, or by the expected period of realisation of the synergies acquired. They suggest that amortisation should reflect the expectation of future profits, unlike impairment-only, where internally generated goodwill can protect acquired goodwill against impairment. A4 disagrees with setting a maximum period for amortisation but points out that it is unlikely to last more than 10 years.

A6, which defends the choice of accounting policy, suggests keeping the impairment-only model with more disclosures and considering amortisation as an alternative method. It considers impairment an event and amortisation a fact based on expectations and argues that goodwill should be removed from the balance sheet through impairment losses or amortisation.

The financial analysts interviewed did not express a specific preference as to the subsequent measurement model for goodwill, emphasising the importance of having access to the client's calculations and assumptions in order to carry out an accurate assessment of goodwill.

4.2 Influence of the Sector of Activity on the Subsequent Measurement of Goodwill

When asked about the influence of the sector of activity on the subsequent measurement of goodwill, the preparer PA mentioned that a different measurement model may make sense for specific cases, such as concessions with a defined useful life. PB pointed out that technological business models, which change rapidly, may need a different approach compared to more traditional and stable businesses. PD believes that comparability would be compromised if there were more than one measurement model, although he recognises that the characteristics of the activity sector should influence the definition of the useful life of goodwill. Thus, sectors that become obsolete quickly and need constant innovation should assign shorter useful lives to goodwill.

Auditor A4 pointed out that there are sectors of activity in which the speed with which they evolve and change can make it more difficult to carry out impairment tests. He compared sectors such as paper, which change little, with sectors such as telecommunications, which evolve rapidly. As A1 points out, these changes "*affect the ability to maintain the business with the original assumptions of profitability and synergies*".

Despite A3's preference for amortisation in traditional business models, he finds no theoretical justification for there being separate models by sector, not least because the large groups are multi-sectoral.

Interviewee A6 takes the opposite view, arguing that in certain more technological sectors, the existence of a single model for the subsequent measurement of goodwill seems misaligned with the number of existing business models, not least because "*there are activity sectors that are more exposed to technological disruption, market discontinuity and consumer and generational preferences*".

As for financial analysts, AA emphasised the importance of understanding the type of activity of the entity in order to measure goodwill. For AB, the financial analysis is carried out regardless the sector, always considering the different goodwill measurement models used between companies and competitors, to avoid bias in the analysis.

4.3 Influence of the Level of Business Digitalisation on the Subsequent Measurement of Goodwill

When asked about the influence of the business digitalisation level on the subsequent measurement of goodwill, the PA preparer pointed out that the speed and dynamics of change in businesses make long-term projections difficult, with five-year plans being replaced by three-year plans and rolling forecasts. PC emphasised that in more digital businesses with fewer physical assets, it can be more difficult to separate goodwill from other intangible assets.

With increasing digitalisation and the reduction in the useful life of business models, the preparers agree that goodwill tends to lose value more quickly, underlining PA that rapid change in business increases subjectivity and uncertainty in financial projections, and PD that the speed of change in digital businesses can shorten the useful life attributed to acquisitions in these sectors.

New customer habits and behaviours also influence how goodwill is consumed or integrated into the business. PB emphasised that in technological areas, products and services evolve over time, increasing the value and substance of the original goodwill with internally generated goodwill. Hence his preference for the amortisation model, as it assigns a cost to each financial year, like companies that grow organically and cannot recognise internally generated goodwill.

From the auditors' perspective, most digital businesses change rapidly, increasing the complexity of the subsequent measurement of goodwill. A1 and A5 considered that, in technology businesses, there are business models based on employees and others on organisational platforms and processes, with different expectations of identifiable assets. A4 emphasised that in sectors intensive in technological innovation, it is difficult to sustain the impairment test, since "*it is complicated to say that the goodwill you are testing today is the same 5 years later.*"

Auditors in favour of the amortisation model also consider that new customer habits influence how goodwill loses value. A2 emphasised that rapid change reduces the life cycle of goodwill, reinforcing the need for amortisation. A3 argues that non-amortisation presupposes non-existent perpetuity in businesses, which change completely in five years. A4 also emphasised that technological innovations, such as artificial intelligence, change business models, making it difficult to apply traditional impairment tests and to separate acquired and internally generated goodwill.

Financial analysts also admit the impact of digitalisation on financial analyses, highlighting the need for tangible guarantees in banking. They believe that banks need to project pessimistic scenarios and that the intangible assets of digital businesses are insufficient as guarantees because they don't create liquidity quickly. AB also emphasised that the rapid change in customer habits could lead to goodwill acquired years ago being replaced by new goodwill.

5. Final Considerations

The debate on the subsequent measurement of goodwill, which is clear from the analysis of the interviews, reveals significant criticism of both models (amortisation versus impairment tests). Common concerns include subjectivity, complexity and the impact on the comparability of financial statements.

As most of the preparers and auditors interviewed pointed out, goodwill is more related to the future than to the company's history and is a subjective judgement and difficult to predict. It is therefore essential to assess the quality of the business project, the management team, the market in which the company operates and macroeconomic factors because the future is being audited.

Some auditors consider that, conceptually, the impairment-only model is perfect, but in practice it is very difficult to apply due to the great inherent subjectivity in the projection of future cash flows resulting from management estimates and associated assumptions, internal reorganisations and reallocations of goodwill, as well as the fact that acquired goodwill is being protected against impairment due to internally generated goodwill.

Therefore, both measurement models have pros and cons for the interviewees. While the amortisation model has the advantages of simplicity of application and predictability, determining the useful life can be challenging and provide useful information insofar as it manages to capture the period of realisation of the synergies expected from the concentration. Advocates of the impairment model consider that it provides a more accurate reflection of a company's economic condition, despite its inherent subjectivity and potential for earnings management. These perceptions highlight the need for a balanced approach that addresses the shortcomings and virtues of both models in order to improve the reliability and comparability of financial reports.

The nature of this asset is closely linked to what the business is and what it is, or was, intended, to achieve with that acquisition. So, the influence of the activity sector and level of business digitalisation on the subsequent measurement of goodwill is also highlighted. Technology sectors and more digital businesses, with rapid changes and shorter useful lives of business models, present additional challenges for the measurement of goodwill. Growing digitalisation and new customer habits increase subjectivity and uncertainty in financial projections, suggesting the need for measurement models that reflect the dynamic reality of these sectors.

In short, the subsequent measurement of goodwill continues to be a debated topic, with different needs depending on the sector of activity and the level of business digitalisation. The search for a model that balances subjectivity and objectivity, and that offers transparency and reliability in financial information, remains a central challenge for the stakeholders involved.

The main limitation of this study is that the data was collected through interviews, which means that the results cannot be extrapolated. However, the results of this study could serve as a basis for future research, namely, to carry out a questionnaire aimed at a wider sample of stakeholders. Extending the research to include stakeholders from different countries could provide a global perspective and allow for international comparisons of goodwill measurement practices.

Acknowledgements

We would like to thank all the interviewees for generously sharing their knowledge, gained over several years of intense professional experience, without which this study would not have been possible.

This work was financially supported by the Research Unit on Governance, Competitiveness and Public Policies (UIDB/04058/2020) + (UIDP/04058/2020), funded by national funds through FCT - Foundation for Science and Technology.

References

Amiraslani, H., Latridis, G. E. and Pope, P. F. (2013) Accounting for asset impairment: a test for IFRS compliance across Europe. Cass Business School, London.

André, P., Filip, A. and Paugam, L. (2016) 'Examining the Patterns of Goodwill Impairments in Europe and the US', Accounting in Europe, Vol 13, No. 3, pp. 329–352.

André, P. Dionysiou, D., and Tsalavoutas, I. (2017) 'Mandated disclosures under IAS 36 Impairment of Assets and IAS 38 Intangible Assets: value relevance and impact on analysts' forecasts*', Applied Economics*, Vol 50, No. 7, pp. 707–725.

Andreicovici, I. Jeny, A. and Lui, D. (2019) 'Disclosure Transparency and Disagreement Among Economic Agents: The Case of Goodwill Impairment', *European Accounting Review*, Vol 29, No. 1, pp. 1–26.

Ashmarina, S., Mesquita, A. and Vochozka, M. (2020) 'Digital Transformation of the Economy: challenges, trends and new opportunities', Berlin: Springer International Publishing.

Ayres, D. R. Neal, T.L. Reid, L.C. and Shipman, J.E. (2019) 'Auditing Goodwill in the Post-Amortisation Era: Challenges for Auditors', *Contemporary Accounting Research*, Vol 36, No. 1, pp. 82-107.

Bepari, M. K. and Mollik, A. T. (2017) 'Regime change in the accounting for goodwill: Goodwill write-offs and the value relevance of older goodwill', *International Journal of Accounting and Information Management*, Vol 25, No. 1, pp. 43-69.

Bugeja, M. and Gallery, N. (2006) 'Is older goodwill value relevant?', *Accounting and Finance*, Vol 46, No. 4, pp. 519-535.

Bugeja, M. and Loyeung, A. (2015) 'What drives the allocation of the purchase price to goodwill?', *Journal of Contemporary Accounting and Economics*, Vol 11, No. 3, pp. 245-261.

Cascino, S., Clatworthy, M. A., Osma, B.G., Gassen, J., and Imam, S. (2021) 'The Usefulness of Financial Accounting Information: Evidence from the Field', *Accounting Review*, VOL 96, No. 6, pp. 73-102.

Chambers, D. and Finger, C. (2011) 'Goodwill Non-Impairments', *CPA Journal*, 141(February), pp. 38-42.

Dal Mas, F., Piccolo, D., Edvinsson, L., Skrap, M., D'Auria, S. (2020) 'Strategy Innovation, Intellectual Capital Management, and the Future of Healthcare: The Case of Kiron by Nucleode', *Knowledge, people, and digital transformation: Approaches for a sustainable future*, pp. 119-131.

D'Orey, M. and Carvalho, C. (2023) 'Stakeholder's Perception of Subsequent Goodwill Measurement: An Analysis of IASB Comment Letters.' In *ECKM 2023 24th European Conference on Knowledge Management* Vol 1. Academic Conferences and publishing limited.

Durocher, S. and Georgiou, O. (2022) 'Framing accounting for goodwill: Intractable controversies between users and standard setters', *Critical Perspectives on Accounting*, Vol 89, pp 1-26.

Ferramosca, S. and Allegrini, M. (2021) 'Impairment or amortisation of goodwill? An analysis of CFO perceptions of goodwill accounting', *European Management Journal*, Vol 39, No. 6, pp. 816-828.

Gray, D., Jorge, M. and Rodriguez, L. (2016) 'Goodwill Accounting Alternative: Private Versus Non-private Companies', *Journal of Social Science Studies*, Vol 3, No. 1, pp. 159-167.

Hamberg, M., Paananen, M. and Novak, J. (2010) 'The Adoption of IFRS 3: The Effects of Managerial Discretion and Stock Market Reactions', *European Accounting Review*, Vol 20, No. 2, pp. 263-288.

Hayn, C. and Hughes, P. J. (2006) 'Leading indicators of goodwill impairment', *Journal of Accounting, Auditing and Finance*, Vol 21, No. 3, pp. 223-265.

Hilton, A. S. and O'Brien, P. C. (2009) 'Inco Ltd.: Market value, fair value, and management discretion', *Journal of Accounting Research*, Vol 47, No. 1, pp. 179-211.

Huang, J. Henfridsson, O., Liu, M. J., and Newell, S. (2017) 'Growing on Steroids: Rapidly Scaling the User Base of Digital Ventures Through Digital Innovaton.', *MIS quarterly*, Vol 41, No. 1, pp. 301-314.

IASB (2020a) DP-2020/1 Discussion Paper - Business Combination: disclosures, goodwill and Impairment, IASB.

IASB (2020b) IFRS 3 - Business Combinations, IASB.

IASB (2024) Exposure Draft: Business Combinations-Disclosures, Goodwill and Impairment, IASB.

Lasi, H., Fettke, P., Kemper, H.G., Feld, T., and Hoffmann, M. (2014) 'Industry 4.0', *Business and Information Systems Engineering*, Vol 6, pp. 239-242.

Li, K. K. and Sloan, R. G. (2017) 'Has goodwill accounting gone bad?', *Review of Accounting Studies*, Vol 22, No. 2, pp. 964-1003.

Linsmeier, T., Wangerin, D. D. and Wheeler, E. (2020) 'The Underlying Economic Components of Acquired Goodwill', *SSRN 3663210.*

Mazzi, F., André, P., Dionysiou, D., and Tsalavoutas, I. (2017) 'Compliance with Goodwill Related Mandatory Disclosure Requirements and the Cost of Equity Capital', *Accounting and Business Research*. Vol 47, No. 3, pp. 268-312.

Noland, T. G., Cox, C., and Prescott, G. (2013) 'An Analysis of Goodwill in the Banking Industry', *International Research Journal of Applied Finance*, IV, pp. 997-1005.

Pechlivanidis, E., Ginoglou, D. and Barmpoutis, P. (2022) 'Debt crisis, age and value relevance of goodwill: evidence from Greece', *International Journal of Accounting and Information Management*, Vol 30, no. 2, pp. 189-210.

Plotnikov, V. S. and Plotnikova, O. V. (2019) 'Goodwill as an economic resource in the digital economy: recognition and measurement', *In Proceedings of the International Scientific Conference on Digital Economy*, pp. 485-488.

Presch, G., Dal Mas, F., Piccolo, D., Sinik, M., and Cobianchi, L. (2020) 'The World Health Innovation Summit (WHIS) platform for sustainable development: From the digital economy to knowledge in the healthcare sector', *Intellectual Capital in the Digital Economy*, (March), pp. 19-28.

Ramanna, K. and Watts, R. L. (2012) 'Evidence on the use of unverifiable estimates in required goodwill impairment', *Review of Accounting Studies*, Vol 17, no. 4, pp. 749-780.

Roychowdhury, S. and Martin, X. (2013) 'Understanding discretion in conservatism: An alternative viewpoint', *Journal of Accounting and Economics*, Vol 56, No. 2-3, pp. 134-146.

Ruslin, R., Mashuri, S., Rasak, M. S. A., Alhabsyi, F., and Syam, H. (2022) 'Semi-structured Interview: A Methodological Reflection on the Development of a Qualitative Research Instrument in Educational Studies', *Journal of Research & Method in Education*, Vol 12, No. 1, pp. 22-29.

Saastamoinen, J., Djatej, A., Pajunen, K., and Gorton, M. D (2020) 'Practitioner views of goodwill accounting under US GAAP', *Journal of Applied Accounting Research*, Vol 21, No. 4, pp. 783-798.

Schatt, A., Doukakis, L., Bessieux-Ollier, C., and Walliser, E. (2016) 'Do Goodwill Impairments by European Firms Provide Useful Information to Investors?', *Accounting in Europe*, Vol 13, No. 3, pp. 307-327.

Silvola, H., Mouritsen, J. and Huikku, J. (2024) 'The Usefulness of Goodwill Information to Financial Analysts: A Qualitative Approach', *Accounting and Finance*, Vol 73, No. 1, pp. 32-63.

Tiesheva, L. and Smyrnov, I. (2023) 'A Company's Digital Goodwill: The Concept and Valuation Possibilities', *Economic Affairs* (New Delhi), Vol 68, No. 2, pp. 1279-1290.

Ullberg, E., Edvinsson, L. and Lin, C.Y.Y. (2021) *Intangible Asset Gap in Global Competitiveness: Mapping and Responding to the New Economy*. Springer Nature.

Vaska, S., Massaro, M., Bagarotto, E. M., and Dal Mas, F (2021) 'The Digital Transformation of Business Model Innovation: A Structured Literature Review', *Frontiers in Psychology*, Vol 11(January), 539363.

Yang, J., Ying, L. and Xu, X. (2024) 'Digital transformation and accounting information comparability', *Finance Research Letters*, Vol 61(November 2023).104993.

Zhang, I. X. and Zhang, Y. (2017) 'Accounting discretion and purchase price allocation after acquisitions', *Journal of Accounting, Auditing and Finance*, Vol 32, No. 2, pp. 241-270.

Knowledge Graphs in Information Retrieval

Jakub Dutkiewicz and Czesław Jędrzejek
Poznań University of Technology, Poznań, Poland

jakub.dutkiewicz@put.poznan.pl
czeslaw.jedrzejek@put.poznan.pl

Abstract: This paper introduces an information retrieval model that leverages knowledge graphs, specifically tailored for Clinical Trials. In these scenarios, the document in question takes the form of a semi-structured clinical trial, containing details about enrolled patients, descriptions of experiments and procedures conducted during the trial, relevant diseases, and specific enrollment criteria. While the document retains a semi-structured format, the majority of the information is expressed in natural language. Queries in this context consist of specific patient characteristics, such as disease type, genetic information, and demographic data. The primary aim of this paper is to develop and utilize a knowledge graph capable of storing this information, including links to external resources like the Disease Ontology. We propose an Object-Relational model, which is then transformed into a knowledge graph. This graph is subsequently employed to identify semantic connections between concepts present in the clinical trials and those in the queries. These connections are then utilized to formulate a retrieval model for each aspect of the query. To achieve this, we design a relevance formula that incorporates weights to account for ontological relationships between concepts. We evaluate the effectiveness of our model by comparing the results with manual annotations.

Keywords: Knowledge Extraction, Knowledge Modeling, TREC Clinical Trials Track

1. Introduction

Information Retrieval(IR) deals with searching and evaluating information from document repositories. Given a set of documents and a list of queries, the task is to return a list of documents sorted by the relevance of each document to the given query. TREC-PM (Roberts, et. Al 2017, 2020) was (and is in a TREC-CT version) a biomedical track, which evaluates the systems performing the IR tasks on a specific set of documents (clinical trials) and queries called topics. The TREC PM in 2017-2018 in total and partially in 2019 was dedicated to oncology related topics. The set of clinical trials originates from clinicaltrials.gov. In this paper we use the snapshot which was used in the The relative narrowness of content facilitates a use of a knowledge based model. The organizers of the TREC-PM track provide a manual, along with a meticulously crafted set of annotations, and an outline to guide annotators. In this paper, our goal is to automate this process. Specifically, we aim to automatically identify relevant entities within both clinical trials and the topics. We propose that carefully chosen relevant links can serve as the foundation for an exceptionally accurate Clinical Trial retrieval system. This paper presents a detailed description of our Knowledge Graph model, along with the publication of the generated graph. Additionally, we provide a code repository containing key components of the implementation, including the object-relational model of the data, a set of functions for populating the database, and functions for generating the knowledge graph. We utilize the data stored within the database in order to find entity links to external Disease Ontology as well as to our hand-crafted set of data. This indirectly enhances the information retrieval quality. We also provide an ad-hoc retrieval model, which utilizes the entity links.

2. Related Work

The concept of employing knowledge graphs in Information Retrieval is succinctly outlined in a survey (Reinanda et al, 2020). Specifically, the notion of directly utilizing knowledge graphs for Document Retrieval is expounded upon in section 4.1. Our perspective resonates with the authors of the survey, who assert that effectively leveraging entity annotations and text in tandem to enhance ad-hoc document retrieval remains a challenge yet to be fully addressed. This challenge serves as a primary motivation for our research endeavors. Within the survey, the authors cite two papers that exemplify the utilization of knowledge graphs in this particular task. Both papers make use of the Knowledge Graphs for query expansion. Authors of the first paper mentioned in the survey (Dalton et el, 2014) introduce the idea of knowledge base links to the Information Retrieval model. We expand on the idea by employing only a specific subset of the knowledge base entities, which corresponds to the query domain. We also make use of dedicated external knowledge sources, such as the Disease Ontology (Schmirl et al, 2018). In our research queries are structured, hence specific parts of the query are linked to various external knowledge sources - mentions in a field dedicated for diseases are linked to the disease entities, mentions in a gene field are linked to the gene entities. Second paper mentioned in the survey (Xiong and Callan, 2015) exploits entity links in the process of query expansion. The terms in the query are linked to various

Freebase entities. Each linked entity is a basis for a query expansion. The expansion is done via a general Freebase description of an entity. This approach is different to ours as it doesn't exploit entity linking in the documents.

Information retrieval techniques are frequently employed in knowledge management (Rezgui, 2006). This is due to the connection between natural language and knowledge models—concepts are articulated using specific phrases that are part of both the knowledge model vocabularies and natural language. Ontology serves as a fundamental formal mechanism to link concepts from knowledge models to their natural language expressions. (Munir and Anjum, 2018) discuss effective methods for retrieving information from a formal ontology. However, this approach has limitations, as converting extensive natural language resources into a formal framework requires highly complex and detailed algorithms. A successful attempt at creating a Clinical Trials Knowledge Base (CTKB) for clinical trials resources was undertaken by (Chen, 2020). This work uses data provided by publicly available Aggregate Content of Clinical Trials (AACT) and focuses on the full description of each clinical trial. (Jayaram et al., 2015) propose an approach for querying the knowledge model. By analyzing their work, one can clearly deduce that information retrieval engineering should focus on key, elementary concepts, rather than graph nodes with extensive textual information. Consequently, we propose a cost-effective approach that incorporates the key low-level concepts into the model. In our work, the documents are interpreted as knowledge model entities. We make use of the natural language descriptions within Clinical Trials and link the documents to existing concepts in external ontologies. The knowledge graph in this work focuses on all aspects of the document retrieval process: documents (clinical trials), document entity links, queries (topics) and query entity links. (Otegi et al., 2015) propose an alternative approach, using concept relatedness for information retrieval. Unlike our method, they employ ad-hoc query expansion, linking documents to external resources each time a search is performed. We believe it is more effective to index all relevant concepts before the information retrieval process. In our opinion, a knowledge model-based approach allows for the creation of an environment where AI methods can be utilized in an explainable manner (Pascal et al., 2020).

3. Object-Relational Representation of a Clinical Trial

The dataset utilized for this research comprises a snapshot of clinical trials sourced from clinicaltrials.gov. We use the particular snapshots of the data, used by the human annotators. In this research, the trials were initially converted into an Object-Relational model using a dedicated Django application. This model comprises 21 object-oriented classes put into 25 relations. In addition to clinical trials, the model encompasses TREC PM topics, Entity Links to external ontologies, and hand-crafted resources such as lists of drugs and genes. These resources provide sufficient terminology to construct a T-Box ontology tailored specifically for this subset of clinical trials and queries.

Let's explore the primary sections of the model. The ***clinicaltrial*** relation is intended for storing data related to Clinical Trial documents. Clinical Trials may include various additional fields, such as lists of ***keywords***, ***conditions***, or ***outcomes*** they are associated with. The ***entity*** relation includes links to external ontologies, particularly the Disease Ontology. The ***gene*** and ***drug*** relations are designed to house hand-crafted data concerning drugs and genes relevant to TREC topics. Entities, drugs, and genes are linked to clinical trials through three connecting relations: ***entitylink***, ***druglink***, and ***genelink***. These relations establish associations between specific entities, drugs, or genes and the respective clinical trials in which they are referenced or utilized. Information regarding Information Retrieval queries is stored within the ***topic*** relation. Each instance of a ***rating*** relation pertains to a specific topic and a Clinical Trial. Details regarding matching genes and diseases (and indirectly drugs) are stored within the ***conditionannotation*** and ***geneannotation*** relations. These relations contain data on the associations between conditions, genes, and diseases referenced within the clinical trials and mentioned in a given topic.

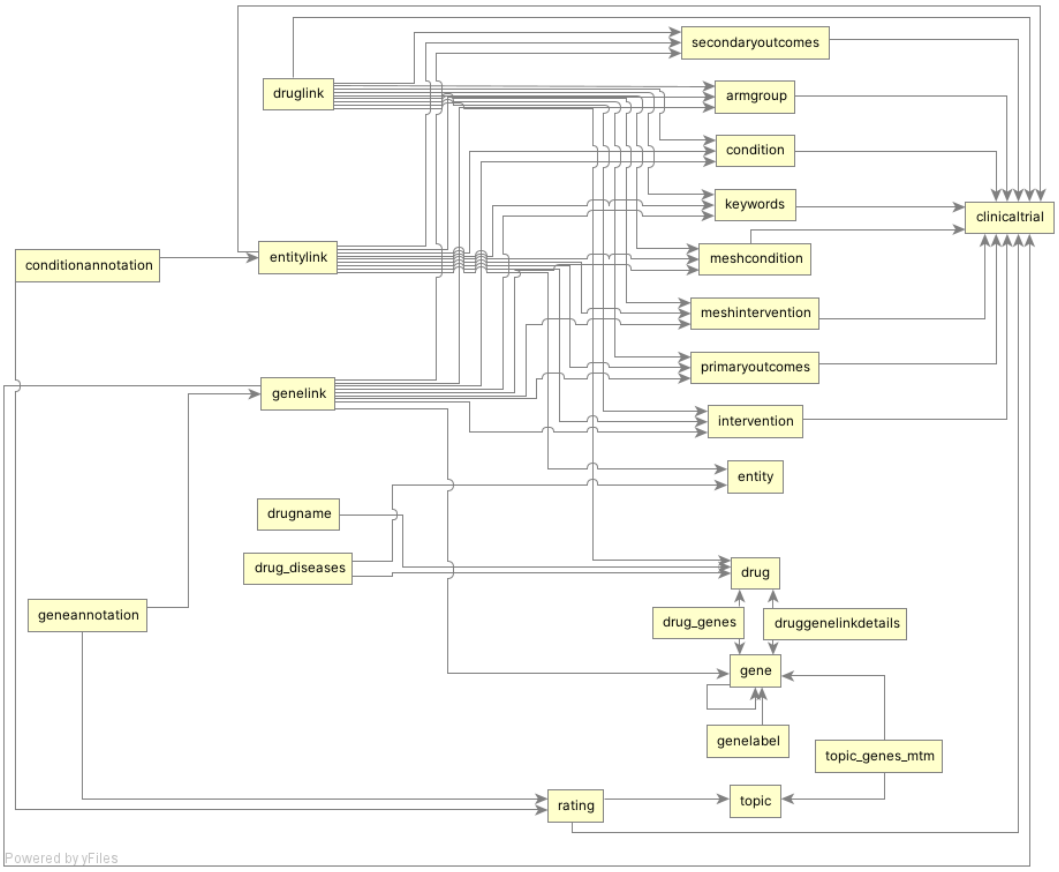


Figure 1: Relational model of the data.

4. Knowledge Model for a Clinical Trial

In this section, we examine different components of the Knowledge Model. We specifically address various **entities** and the *relationships* that exist between them. We propose a simple model for describing a clinical trial, where each document within the database is instantiated as an example of this class. Similarly, we outline a model for topic description. The connection between Clinical Trials and Topics is established through links to external resources or a manually curated vocabulary.

4.1 Clinical Trial Model

The focal points of the graph are the **Clinical Trial Documents**. Each document consists of a set of fields of a **Clinical Trial Document Part** type. As this is a knowledge graph, the vast majority of the data is stored as the individuals. Each individual consists of a set Data Properties, for which every **Clinical Trial** has exactly one value. The **Clinical Trial** model is depicted in Fig. 2 and Fig. 3. The first figure illustrates all of the Clinical Trial document properties. A model of **Clinical Trial Document Parts** in the second figure is depicted on the latter figure. Such parts are modeled as Object Properties, this is due to the fact the documents can be related to more than one such part. The second figure illustrates only two document part types, however in fact the graph incorporates Mesh Terms, descriptions of the Arm Groups, Keywords, Interventions and Outcomes in a similar manner. The data we used to create a graph consists of 18883 unique clinical trials.

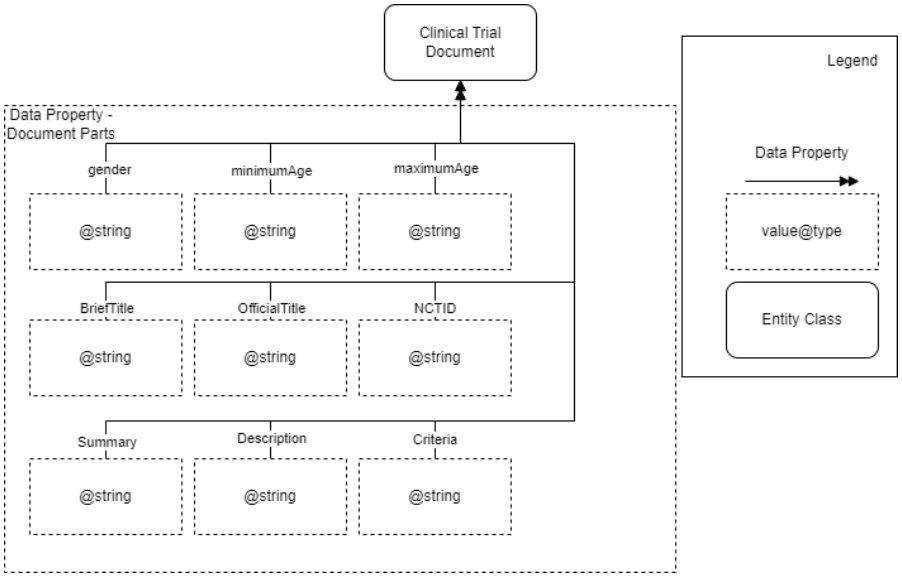


Figure 2: The clinical trial model with a list of document parts, which appear only once in the trial.

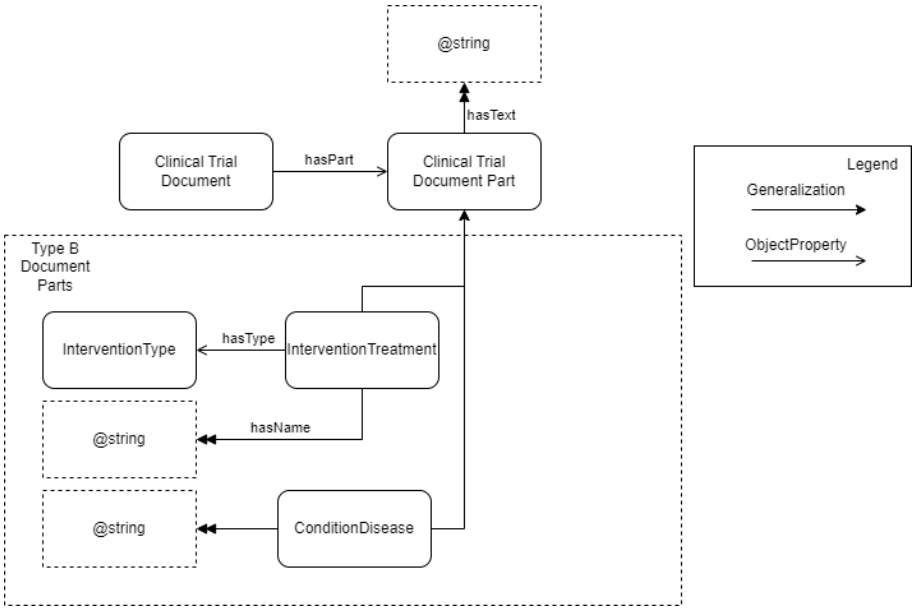


Figure 3: The clinical trial model with sample document parts, which can appear more than once in the trial.

4.2 External Terminology

This research encompasses three types of external terminology: a collection of phrases utilized to represent Disease, Drug, and Gene concepts. It's important to note that frequently, existing ontological resources prioritize proper topology and relational properties of the described classes, while overlooking the aspect of a rich and extensive vocabulary. This oversight is particularly crucial in Entity Linking, and indirectly affects Information Retrieval when utilizing such resources.

For disease-related vocabulary, we rely on Disease Ontology. This standardized ontology offers consistent, reusable, and sustainable descriptions of human diseases. Considered a core ontology, it features external links to many popular resources such as MeSH, ICD, NCI's thesaurus, SNOMED, and OMIM. We extensively utilize the *label* and *hasExactSynonym* annotation properties to model the vocabulary knowledge of concepts. Efforts are made to manually expand this knowledge to accommodate the language used in clinical trials for referring to disease concepts. The concepts described in the Disease Ontology are integrated into our model using the *entityLink* object property. This property has a domain of Clinical Trial Documents and Clinical Trial Document Parts, and a range of the flat Entity class, essentially serving as a reference to the Disease Ontology. While this relation may seem somewhat redundant as the link could directly refer to an external class, it proves convenient

in practical applications where we utilize only a portion of the external resource. The Entity class functions as a hyper reference, facilitating streamlined access to relevant disease-related concepts within our model depicted on Fig. 3.

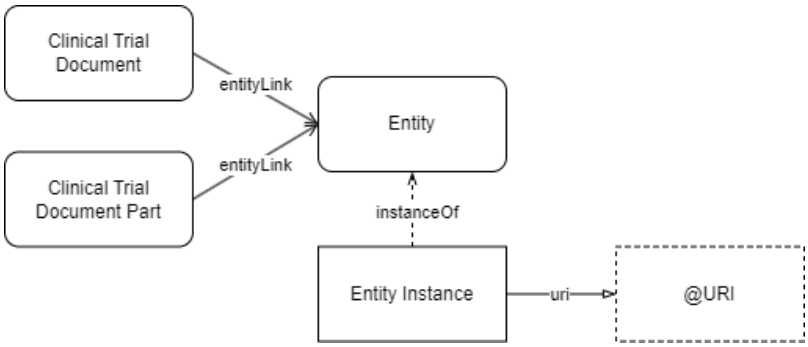


Figure 3: Entity Linking Knowledge Model

The vocabulary for **Gene** and **Drug** entities is hand-crafted. Both genes and drugs are stored in the ontological T-Box. The information stored in the Knowledge Model does not refer to specific instances of neither Drugs nor Genes. **Clinical Trials Documents** relate to the concepts via **GeneLinks** and **DrugLinks**. The model for hand-crafted vocabulary is presented on Fig. 4.

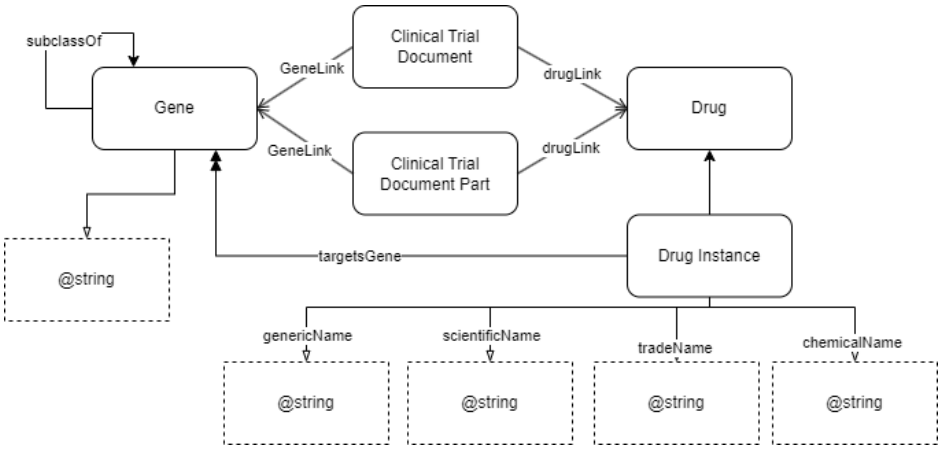


Figure 4: Gene and Drug Knowledge Model

4.3 Topic and Rating Model

In the knowledge graph, each TREC **Topic** is associated with a single disease, a list of genes, patients' demographics, and a single textual field for more information. Each **Topic** is linked via EntityLink with a **CrossReferenceEntity** and via a **GeneLink** with a set of Gene entities. The demographic description and the additional information are stored as a Data Properties. This structure facilitates efficient organization and retrieval of information related to TREC topics within the knowledge graph.

Rating encompasses information about the relevance between a given **Topic** and a **Clinical Trial Document**. There are two versions of the relevance assessments, the one delivered by TREC organizers and one calculated with use of this knowledge model. The fifth section of this work covers the details on obtaining the relevance score.

5. Using the Graph in Information Retrieval

In this section we describe the processes of using the Knowledge Graph for direct information retrieval. We provide description of annotation process, which we want to recreate.

5.1 TREC Annotation Guidelines

We implement our retrieval system according to the guidelines for annotators provided by the TREC organizers. There are several steps in the annotation process. The first step is ought to determine whether the clinical trial

is related to precision medicine. Here the organizers provide a list of steps, which after detailed evaluation seems vague. Document is related to Precision Medicine if: it is related to humans, involves any form of cancer, focuses on treatment or prognosis of cancer and contains any mention of a genes from the relevant topic. This seems not obvious as the PM property, in our eyes should not be decided in correlation with the formulated query. On top of that we find some annotations, which deem the documents as related to the Precision Medicine and annotate all of the genes as missing. We assume that this intermediate step should not be interpreted very directly, as it uses specific vocabulary – mention of a gene could not be interpreted as a relation to any given gene. In fact, we refrain from its complete evaluation. We intend to work on this step of the evaluation, as it is particularly important for the total evaluation. In this stead we focus on the analysis of clinical trial treatment type.

If a document passes the first phase – is annotated as relevant to precision medicine – it enters the second phase. In the second phase annotator is supposed to determine whether the document is relevant to a given query. It comes in three parts: determining appropriate category for a Disease part of a query (Exact, More General, More Specific and Not Disease), appropriate category for a Gene part of a query (Exact, Missing Variant, Different Variant, Missing Gene) and assessing the score for demographic criteria. We assume that the patient described in the query should be eligible for the trial, as it is expressed in eligibility criteria.

5.2 Treatment Evaluation

The first item in the TREC guidelines underscores the importance of documents in the field of precision medicine. This requirement prompts an analysis of the treatment type, which constitutes the focal point of the clinical trial.

Definition of “treatment” in TREC PM/clinical trials is the most difficult among the clinical trials’ concepts. In the wide sense “treatment” encompasses: diagnosis, treatment, and prevention. In general, Screening tests are not “treatment”, because they are primarily used for early detection of disease or risk factors whereas diagnostic tests are used to establish the presence or absence of disease. Medical “treatment” should be differentiated from clinical research.

Clinical research is characterized by (*Clinical Research Versus Medical Treatment*, access 2024):

1. Generally designed and intended to benefit future patients.
2. Involves periodic and systematic assessment of patient data.
3. Tests products and procedures of unproven benefit to the patient.

Medical “treatment” is characterized by:

1. Generally designed and intended to benefit future patients.
2. Address the needs of individual patients.
3. Intended to benefit the individual patient.
4. Requires real-time decisions.
5. Based on as-needed patient assessment.

This analysis encompasses the following fields within a clinical trial: **Intervention/Treatment** and **Study Type**. A single **Clinical Trial** document has one **Study Type**. This is represented with *hasStudyTypeAssignment* object property. **Clinical Trial** is capable of encompassing several **Intervention/Treatment** fields. There are four distinct **Study Types:** Interventional, Observational, Expanded Access and Observational (Patient Registry). The knowledge model for the study types is represented on Fig. 5. The knowledge model is implemented with the owlready2 library, which does not support class punning, which would be very useful in this case. We use a similar model, in which we create a single instance for each of the study type classes, which represents the respective class.

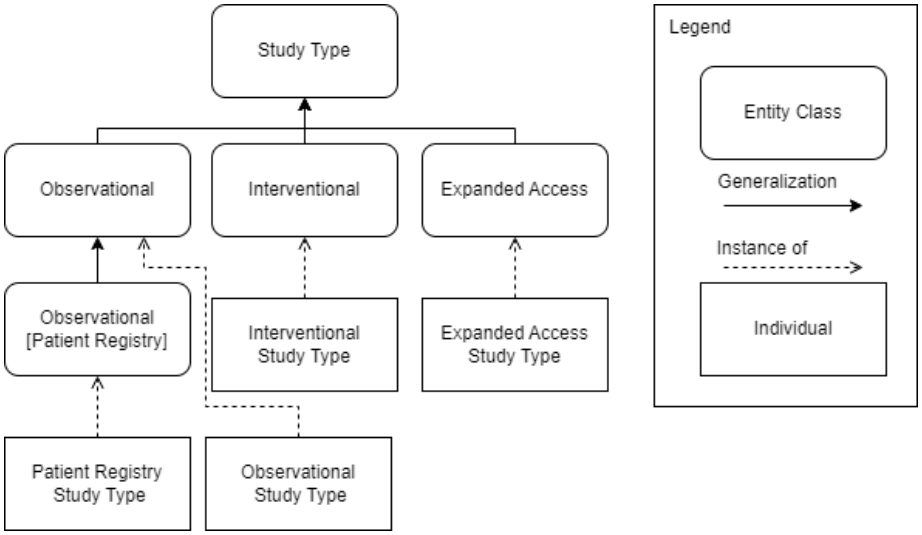


Figure 5: Study Type knowledge model

The **Intervention/Treatment** field comprises two sections: a type and a description. Here we analyze a set of types. There are a total of 8 distinct Intervention/Treatment types: Drug, Procedure, Other, Biological, Behavioral, Genetic, Radiation, Device.

The scoring depends on what weight we ascribe to each of the treatment types> If a Drug name appears in a document (alone or with other types) the score has value 1. For observational study type the score is 0.

For 2017-2019 years (2019 only cancer related topics) the total number of evaluated document is 41444 (15481 labeled by TREC as Human PM, and 25963 Not PM). We can directly compare TREC Human PM cases with our score.

When each of the 8 distinct Intervention/Treatment types: Drug, Procedure, Other, Biological, Behavioral, Genetic, Radiation, Device is equal 0 (corresponding to non-intervention types, mostly observational we get 1255 cases (1144 cases for only observational type). There are 2218 cases where a Drug is absent but there might be other non-zero types. Using our method we get 1615 non-treatment cases for TREC Human PM. This amounts to a 10.4% discrepancy with TREC in the treatment Human PM category. For the Not PM category the direct comparison with TREC is not possible (because a possible cause: disease, gene, treatment and demography are not separated). This will be the goal of future analysis.

5.3 Demography Evaluation

Demographic evaluation follows a straightforward process. Both TREC topics and clinical trials adhere to standardized demographic information. In TREC topics, demographic information is represented using a specific format: NN-TIMEUNIT-years-old gender. Here, NN denotes the numerical quantity of the age property, while TIMEUNIT indicates the unit of time used. To manage this format, we utilize a regular expression interpreter. If the TIMEUNIT is anything other than "year," we interpret the specified age as zero. The TREC topics cover only two genders: male and female.

Each Clinical Trial includes properties such as minimum age, maximum age, and gender, represented as text strings following a standardized format. If any of these properties are unspecified, we assume that every patient meets the relevant demographic criteria. The outcome of the evaluation is binary. If a particular topic describes a patient who does not fall within the specified criteria range outlined in the trial, the trial is considered irrelevant to that topic. Conversely, if the patient described in the topic fits within the specified criteria range, the demography criterion is deemed fulfilled. Table 1 presents the agreement between our system and human annotators on the Demography assessment.

Table 1: Annotation agreement between human TREC annotators and our automated system on the demography assesment.

Annotation\Demography score	0	1
Excludes	371	370
Not Discussed	21	651
Matches	67	8 319

5.4 Disease and Gene Evaluation

Another aspect of the relevance between a given query and a clinical trial is assessed by considering the number of relevant entity links. Each topic is associated with a single assigned entity from the Disease Ontology and can have up to three Gene links.

In the Clinical Trial, various entity links are present: disease links, gene links, and drug links. Each link is annotated with the part of the document it originates from. We posit that a higher number of links in a document, which either match the topic's disease link, match one of the topic's gene links, or are drug links for drugs targeting one of the genes within the topic, indicate greater relevance between the topic and the document. Conversely, we hypothesize that links within the document that do not match the topic links may lower the relevance score.

We also consider the source of the links within the document. Links originating in the title (or in the condition/disease field for diseases) of the clinical trial are deemed more important than those from other parts of the document. Additionally, we utilize the taxonomic properties of the ontology. Diseases found in the trial that are more specific than the one mentioned in the title are considered fully relevant. Conversely, diseases that are more general are treated as partially relevant and contribute to the total score with partial impact. If there are any disease links in the title of the document, the disease part of the relevance score is calculated as follows:

$$rel_{disease} = \frac{\#disease_{rel,title} + \#disease_{rel,condition} + 0.5\#disease_{part-rel,title} + 0.5\#disease_{part-rel,condition}}{\#disease_{rel,title} + \#disease_{rel,condition} + \#disease_{part-rel,title} + \#disease_{part-rel,condition} + \#disease_{non-rel,title} + \#disease_{non-rel,condition}}$$

If there are no diseases mentioned in the title, we rely on other parts of the document. In this scenario, we operate under the assumption that if the ratio between relevant and non-relevant diseases appearing in the same document is sufficiently high, the document is relevant. Therefore, the relevance score should be adjusted using a non-linear, sigmoid-shaped function:

$$rel_{disease} = \sigma(w_0 \cdot \frac{w_1 \cdot \#disease_{rel,other} + w_2 \cdot \#disease_{part-rel,other}}{1 + w_3 \cdot \#disease_{non-rel,other}} - b)$$

The parameters are selected manually after investigating the shape of the relevance function with synthetic data. Empirically assigned values are as follows: w0=3, w1=1, w2=0.5, w3=1, b=3. Moreover, the gene relevance score incorporates information on the number of relevant drugs mentioned in the document. However, it's important to note that genes are not searched in the condition field. The coefficient d represents the number of mentioned relevant drugs in the entire clinical trial:

$$rel_{gene} = \sqrt[d+1]{\frac{\#gene_{rel,title} + 0.5\#gene_{part-rel,title}}{\#gene_{rel,title} + \#gene_{part-rel,title} + \#gene_{non-rel,title}}}$$

Similarly, if there are no genes in the title, the gene score is given by:

$$rel_{gene} = \sqrt[d+1]{\sigma(w_0 \cdot \frac{w_1 \cdot \#gene_{rel,other} + w_2 \cdot \#gene_{part-rel,other}}{1 + w_3 \cdot \#gene_{non-rel,other}} - b)}$$

We use the same parameter values as for the disease score.To complete the relevance assessment between a document and a topic, we need to implement a total score, which should be calculated as the multiplication of the component relevances.

Table 2: Annotation agreement between human TREC annotators and our automated system on the disease assesment.

Annotation\Disease Score	0.25 > Score	0.25 <= Score < 0.5	0.5 <= Score < 0.75	Score >= 0.75
Not Disease	5 025	57	60	44
More General	2 271	250	273	156
More Specific	236	129	260	1 969
Exact	450	272	646	3 364

Table 3: Annotation agreement between human TREC annotators and our automated system on the gene assesment.

Annotation\Gene Score	0.25 > Score	0.25 <= Score < 0.5	0.5 <= Score < 0.75	Score >= 0.75
Missing Gene	5838	289	123	132
Different Variant	329	143	126	537
Missing Variant	1 336	341	400	710
Exact	1 882	734	834	1 949

6. Conclusions

In this work, we combine a knowledge graph-based approach with information retrieval for clinical trial documents. We make this knowledge graph publicly available, along with the object-relational model and graph creation code (https://github.com/dudenzz/ClinicalTrialsKGBasedIR). For convenience, we also publish a database filled with data. We compare our results with TREC annotations for individual concepts within the Human PM category. In contrast to (Otegi et al. 2015), who use concept relatedness and ad-hoc query expansion for information retrieval, we advocate for indexing relevant concepts prior to retrieval, believing this to be a more efficient approach. Additionally, our strategy supports the creation of an environment where AI methods can be employed in an explainable manner, a perspective also shared by Jayaram et al. (2015), who emphasize focusing on key, elementary concepts over graph nodes with extensive textual information. Our incorporates these key concepts into the model. In this work, we compare the outputs of our automated retrieval system, which is based on the knowledge graph, with hand-crafted annotations. We have shown that such a system can implement simple retrieval models. The proposed models appear to partially align with annotators' assessments; however, we refrain from a comparative analysis of retrieval quality at this point. Our major concern, which we leave to future work, is the formal and strict definition of a non-PM clinical trial. We aim to address this issue so we can ultimately compute and evaluate final relevance scores.

References

Chen, Z., Peng, B., Ioannidis, V.N. et al. (2022) *A knowledge graph of clinical trials (CTKG).* Sci Rep 12, 4724. https://doi.org/10.1038/s41598-022-08454-z

Dobbins, N.J., Mullen, T., Uzuner, Ö. et al. *The Leaf Clinical Trials Corpus: a new resource for query generation from clinical trial eligibility criteria.* (2022) Sci Data 9, 490.

Dalton J., Dietz L., and Allan J. (2014) *Entity query feature expansion using knowledge base links.* In Proceedings of the 37th international ACM SIGIR conference on Research & development in information retrieval (SIGIR '14). Association for Computing Machinery, New York, NY, USA, 365–374. https://doi.org/10.1145/2600428.2609628

Reinanda R.; Meij E.; Maarten de Rijke (2020) *Knowledge Graphs: An Information Retrieval Perspective* , Foundations and Trends® in Information Retrieval: Vol. 14: No. 4, pp 289-444. http://dx.doi.org/10.1561/1500000063

Pascal Hitzler, Krzysztof Janowicz, and Freddy Lecue. 2020. *On the role of knowledge graphs in explainable AI*. Semant. web 11, 1 (2020), 41–51. https://doi.org/10.3233/SW-190374

Rezgui, Yacine. (2006). *Ontology-Centered Knowledge Management Using Information Retrieval Techniques*. Journal of Computing in Civil Engineering. 20. 10.1061/(ASCE)0887-3801(2006)20:4(261).

Roberts K., Demner-Fushman D., Voorhees EM, Hersh WR, Bedrick S, Lazar AJ, Pant S. (2017) *Overview of the TREC 2017 Precision Medicine Track*. Text Retr Conf. 2017 Nov;26. PMID: 32776021; PMCID: PMC7410346.

Roberts, Kirk et al. (2020) *Overview of the TREC 2020 Precision Medicine Track.* The text REtrieval conference : TREC. Text REtrieval Conference vol. 1266 (2020).

Munir, Kamran & Anjum, M.. (2017). *The use of Ontologies for Effective Knowledge Modelling and Information Retrieval*. Applied Computing and Informatics. 14. 10.1016/j.aci.2017.07.003.

Otegi, Arantxa & Arregi, Xabier & Ansa, Olatz & Agirre, Eneko. (2014). Using knowledge-based relatedness for information retrieval. Inf. Syst. 44. 1-30.

Schriml, L. M., Mitraka, E., Munro, J., Tauber, B., Schor, M., Nickle, L., Greene, C. (2018). *Human Disease Ontology 2018 update: classification, content and workflow expansion*. Nucleic acids research, 47(D1), D955–D962. doi:10.1093/nar/gky1032; PMID:30407550; PDF.

Xiong C. and Callan J. (2015) *Query Expansion with Freebase.* In Proceedings of the 2015 International Conference on The Theory of Information Retrieval (ICTIR '15). Association for Computing Machinery, New York, NY, USA, 111–120. https://doi.org/10.1145/2808194.2809446

Website access: 12.04.2024 *Clinical Research Versus Medical Treatment* https://www.fda.gov/patients/clinical-trials-what-patients-need-know/clinical-research-versus-medical-treatment

Exploring Perceptions of Benefits and Challenges Associated with Cryptocurrencies: A Demographic Analysis among University Students in Poland

Monika Eisenbardt[1] and Tomasz Eisenbardt[2]
[1]University of Economics in Katowice, Poland
[2]University of Warsaw, Poland

monika.eisenbardt@ue.katowice.pl
teisenbardt@wz.uw.edu.pl

Abstract: This study investigates the differences in perceptions of benefits and challenges associated with cryptocurrencies among diverse demographic cohorts. We focus on gender, field of study, and prior experience as key demographic factors influencing perceptions. Data were collected from 679 university students in Poland using a survey questionnaire. The findings reveal disparities in perceptions based on gender, with males perceiving more benefits and females encountering more challenges. Additionally, regardless of academic background, students tend to perceive the benefits and challenges similarly. Moreover, prior experience with cryptocurrencies significantly influences perceptions, with experienced students perceiving more benefits and fewer challenges compared to their inexperienced counterparts. Our study contributes to the literature by highlighting the importance of considering personal characteristics in understanding perceptions of cryptocurrencies and provides insights for policymakers, regulators, and industry stakeholders to develop targeted strategies for addressing concerns, enhancing adoption, and mitigating risks associated with cryptocurrencies.

Keywords: Cryptocurrencies Perception, Students Opinion, Gender Differences, Field of Study-Related Differences, Prior Experience.

1. Introduction

Numerous studies have delved into cryptocurrencies, often emphasizing economic aspects such as national regulations, taxation, and monetary policies (Benigno et al., 2022; Marthinsen and Gordon, 2022; Raza et al., 2023). While some researchers concentrate on domestic approaches, their focus tends to be primarily economic (Alvarez et al., 2022; Cifuentes, 2019; Li et al., 2023). Many papers center solely on Bitcoin, given its widespread recognition (Alvarez et al., 2022; Köchling et al., 2020; Mzoughi et al., 2022; Nouir and Hamida, 2023). In contrast, our paper adopts an interdisciplinary perspective, treating cryptocurrencies as a multifaceted phenomenon beyond mere economics.

This paper seeks to address a significant research gap by examining how personal characteristics influence the perception of benefits and challenges associated with cryptocurrencies. While numerous studies have delved into various aspects of cryptocurrencies, including economic factors and regulatory frameworks, few have systematically investigated the role of personal characteristics in shaping individuals' opinions and perspectives on cryptocurrencies. Existing literature predominantly focuses on gender-related issues (Jora and Nandal, 2020; Nyhus et al., 2024; Sudzina, Dobes, and Pavlicek, 2023). In our paper, we concentrate on three complementary factors: gender, field of study, and prior experience. Thus, our study aims to provide a deeper understanding of how gender, academic background, and field experience influence individuals' perceptions in this rapidly evolving field of cryptocurrencies.

We purposefully selected our sample for this research by targeting young individuals, specifically university students. This demographic is notably engaged with emerging technologies and solutions in the market, exemplified by the growing interest in cryptocurrencies (Gogus and Saygın, 2019; Szymkowiak et al., 2021). Furthermore, our observations from teaching experiences indicate a rising number of students with cryptocurrency experience. They actively seek to expand their understanding of this topic through various sources, both technological and conventional, driven by two primary motivations: (1) viewing cryptocurrencies as a form of entertainment and leisure activity, and (2) exploring the potential for financial gain.

The structure of the paper is as follows: we begin by presenting the research questions and hypotheses, followed by an outline of the research methodology. Subsequently, we present and analyze the results, leading to a comprehensive discussion. Finally, the paper concludes with a summary of findings, discussion on limitations, and suggestions for future research directions.

2. Benefits and Challenges Facing Cryptocurrencies – the Literature Review

Cryptocurrencies represent a complex and interdisciplinary field, drawing on principles from economics, computer science, cryptography, and finance. Despite its relatively recent emergence, this domain is experiencing rapid growth and evolution, marked by ongoing technological advancements, regulatory developments, and shifts in market dynamics. Challenges such as the enigma surrounding BTC's creator, the absence of a central authority, volatility, intricacy, and legal entanglements contrast with the undeniable advantages, including the unrestricted, anonymous, and swift movement of capital. Notably, instances of cryptocurrencies being exploited for illicit activities, exemplified by the Silk Road case, have been conspicuous. Furthermore, concerns about the environmental repercussions of cryptocurrency operations have emerged due to the escalating energy demands of mining endeavors. The substantial downturn in the cryptocurrency market in 2022 serves as a stark reminder of the risks entailed in cryptocurrency investment (CoinMarketCap, 2024).

The genesis of cryptocurrencies is intricately linked with the emergence of Bitcoin (BTC) in the late 2008 and early 2009 period (Nakamoto, 2009). Facilitated by technologies such as the Distributed Ledger concept, Blockchain technology, cryptography, and peer-to-peer networks, cryptocurrency trading has burgeoned, providing digital alternatives to conventional currencies. The proliferation of cryptocurrencies has been exponential, with the cryptocurrency market assuming a prominence that cannot be disregarded (CoinMarketCap, 2024; Phillips and Graves, 2021).

The volume of literature on cryptocurrencies is extensive. Numerous authors discuss the benefits and disadvantages of cryptocurrencies. Decentralization is one of the prominent benefits highlighted in the literature. Chenguel (2021), Lee (2019), Narayanan et al. (2016), delve into the concept of decentralization, emphasizing its significance in the cryptocurrency realm. Another advantage frequently mentioned in the literature is the lower transaction fees associated with cryptocurrencies. Frankenfield (2023), Tambe and Jain (2023), and Hileman and Rauchs (2017) contribute to the discourse surrounding the economic benefits of cryptocurrencies. Security emerges as a crucial aspect of cryptocurrencies, attracting attention from scholars such as Thul (2021), Zimprich (2019), Lewis (2018), Narayanan et al. (2016), Burniske, and Tatar (2017), Bonneau et al. (2016), as well as Vigna and Casey (2015). These authors emphasize the robust security measures inherent in cryptocurrency systems. Privacy and anonymity are additional advantages frequently explored in the literature. Lewis (2018), Antonopoulos (2017), Burniske and Tatar (2017), Vigna and Casey (2015) shed light on the privacy features of cryptocurrencies, highlighting their importance in preserving user anonymity. Furthermore, the literature also emphasizes the speed of transactions facilitated by cryptocurrencies. Frankenfield (2023), Tambe and Jain (2023), and Hileman and Rauchs (2017) discuss the efficiency of cryptocurrency transactions, underscoring their rapid processing capabilities.

On the other hand one can list the challenges related to the cryptocurrency market. Volatility and risk management emerge as significant challenges in the literature. Almeida and Cruz Gonçalves (2022), Al Guindy (2021), Peng et al. (2018), Baur, Dirk, and Dimpfl (2018), Klein et al. (2018), and Katsiampa (2017) delve into the volatility of cryptocurrency markets and the associated risks, emphasizing the need for effective risk management strategies to mitigate financial losses and ensure market stability. The lack of regulation represents another pressing challenge discussed in the literature (Chenguel, 2021; Lee, 2019; Song, Chen, and Wang, 2023; Kim et al.,2022; Dordal, 2018; Hardy and Norgaard, 2016; Böhme et al., 2015). They explored the regulatory uncertainties surrounding cryptocurrencies, highlighting the absence of clear regulatory frameworks and the resulting legal and compliance challenges faced by market participants and investors. Security risks pose a significant challenge to the cryptocurrency, attracting attention from scholars such as Weichbroth et al. (2023), Yu et al. (2022), Zaghloul et al. (2020), and Zimprich (2019). These authors analyze various security threats, including hacking attacks, fraud, and vulnerabilities in cryptocurrency protocols, underscoring the importance of robust security measures to safeguard digital assets and protect investors. Environmental impact emerges as a constantly growing concern associated with cryptocurrency mining activities. De Vries (2018), Hileman and Rauchs (2017), Peck (2017), Stoll, Klaaßen, and Gallersdörfer (2019), Wendl, Doan, and Sassen (2023), and Vranken (2017) investigate the environmental implications of cryptocurrency mining, particularly the significant energy consumption and carbon footprint associated with proof-of-work consensus mechanisms. Limited acceptance represents a challenge to the mainstream adoption of cryptocurrencies, as discussed by Bajpai (2023), Eisenbardt and Eisenbardt (2023), and LLC (2021). These authors explore the factors contributing to the limited acceptance of cryptocurrencies in various sectors and highlight the barriers to their broader integration into traditional financial systems and everyday transactions.

In summary, the literature review reveals a comprehensive examination of the benefits and challenges facing cryptocurrencies. Figure 1 presents a conceptual model illustrating the benefits (B) and challenges (C) discussed by scholars in the field. This model serves as the foundation for our subsequent analyses. It integrates two demographic variables, specifically gender and field of study, along with students' prior experience.

Code	Benefits		Fields of analyses		Challenges	Code
B1	[Low transaction costs]				[No issuer]	C1
B2	[Fast transactions]				[Lack of control and independence]	C2
B3	[No issuer]				[Unstable exchange rate]	C3
B4	[Lack of control and independence]		*Gender*		[Interest from the black market]	C4
B5	[Resilience to crises]		*Field of study*		[Network security aspects]	C5
B6	[Mining]		*Prior experience*		[Increasing energy consumption]	C6
B7	[Limited supply]				[Not widely accepted]	C7
B8	[Decentralization]				[Instability]	C8
B9	[Transparency]				[Storage necessity]	C9
B10	[Immutability]				[Risk of loss]	C10
B11	[Easy storage]				[Legislative gap]	C11

Figure 1: The conceptual model of benefits (B) and challenges (C) of cryptocurrencies

3. Research Methodology

3.1 Research Purpose, Questions, and Hypotheses

The primary objective of this paper is to address principal research question: What are the differences in perceptions of benefits and challenges associated with cryptocurrencies among diverse demographic cohorts? The demographic factors examined encompass gender and field of study, alongside respondents' prior experience. To achieve this aim, the study addresses the following research questions:

RQ1: What is the perception of benefits and challenges associated with cryptocurrencies in students' opinion?

RQ2: What are the differences between males and females in their perception of cryptocurrencies' benefits and challenges?

RQ3: What are the differences among students based on their field of study in their perception of cryptocurrencies' benefits and challenges?

RQ4: What are the differences among students based on their prior experience in their perception of cryptocurrencies' benefits and challenges?

To explore above research questions, three hypotheses were formulated:

H1: There are statistically significant differences between males and females in their perception of cryptocurrencies' benefits and challenges.

H2: There are statistically significant differences among students based on their field of study in their perception of cryptocurrencies' benefits and challenges.

H3: There are statistically significant differences among students based on their prior experience in their perception of cryptocurrencies' benefits and challenges.

3.2 Research Procedure

The research undertaken in this paper is part of a broader study aimed at gathering students' opinions and experiences with cryptocurrencies. To address the primary research objective, tackle specific research questions, and test the formulated hypotheses, a quantitative research approach was employed, involving the administration of a questionnaire survey. The research process unfolded through the following phases:

(1) Survey Questionnaire Development: The questionnaire, prepared in Polish, aimed to collect students' opinions on cryptocurrencies, particularly focusing on evaluating the benefits and challenges associated with them. It was created using LimeSurvey software and consisted of five parts. The first part included questions about students' experiences with cryptocurrencies, while the second part explored the sources of information and knowledge about cryptocurrencies that students utilized. The third part was dedicated to students' opinions on the benefits and challenges of cryptocurrencies. The subsequent section aimed to gauge students' beliefs about the future of cryptocurrencies as a mainstream and widely accepted form of payment. Finally, demographic characteristics of the respondents were collected at the end of the questionnaire (Table 1). In this paper, our focus is on the third part of the questionnaire, where respondents were asked to evaluate the following issues: 1. Assess the benefits associated with cryptocurrencies. 2. Assess the challenges and risks associated with cryptocurrencies. A 5-point Likert scale was used for evaluation, with response options ranging from (1) definitely disagree to (5) definitely agree.

(2) Data Collection Process: A pilot survey was conducted in October 2021 to ensure the questionnaire's validity and methodological soundness. Data collection took place from November 2021 to February 2022, with a deliberate selection of university students as the target population. Specifically, the focus was on Generation Z, comprising 679 respondents, which accounted for 87.3% of the final sample (see Table 1). Gender, field of study, and prior students' experience were considered in order to capture students' perspectives on the benefits and challenges of cryptocurrencies across different academic disciplines.

Table 1: Demographics of the research sample

Variable	Categories	Number of respondents	Percentage
Age/ generation	Z: 1995-2009	679	100%
Gender	females	413	53.1%
	males	365	46.9%
Field of study	social sciences	445	65.5%
	exact sciences	190	28%
	humanities	19	2.8%
	natural and medical sciences	25	3.7%
Prior experience	yes	200	29.5%
	no	479	70.5%

(3). Data analysis. To address the research questions and test the research hypotheses, statistical analyses were conducted. Firstly, descriptive statistics such as mean, median (MDN), first quartile (Q1), mode, third quartile (Q3), standard deviation (SDV), skewness (SK), and coefficient of kurtosis (CK) were computed. Secondly, the Mann-Whitney U test was employed to either confirm or reject the hypotheses. These tests were chosen due to their non-parametric nature, which does not require assumptions about the distribution of the data (verified through the Shapiro-Wilk test with $\alpha = 0.05$). The statistical analyses were performed using Statistica package.

4. Results

4.1 Analysis of Benefits and Challenges in the Opinion of Generation Z

To answer the RQ1, the frequency procedures were employed and the results are presented in Table 2.

Table 2: Descriptive statistics for benefits and challenges of cryptocurrencies

Variable	Mean	MDN	Mode	Q1	Q3	SDV	SK	CK
B1	3.57	4	5	3	5	1.22	-0.51	-0.64
B2	3.98	4	5	3	5	1.13	-0.99	0.18
B3	3.24	3	3	3	4	1.15	-0.11	-0.60
B4	3.55	4	5	3	5	1.29	-0.47	-0.85
B5	3.39	3	5	3	5	1.30	-0.35	-0.93
B6	2.91	3	3	2	4	1.18	0.04	-0.71
B7	3.74	4	5	3	5	1.16	-0.69	-0.27

Variable	Mean	MDN	Mode	Q1	Q3	SDV	SK	CK
B8	3.47	3	3	3	4	1.08	-0.24	-0.49
B9	3.44	3	3	3	4	1.07	-0.15	-0.58
B10	3.17	3	3	2	4	1.25	-0.21	-0.86
B11	3.97	4	5	3	5	1.10	-0.93	0.17
C1	2.71	3	3	2	3	1.13	0.18	-0.51
C2	3.05	3	3	2	4	1.34	-0.05	-1.12
C3	3.72	4	5	3	5	1.20	-0.62	-0.53
C4	3.71	4	5	3	5	1.23	-0.65	-0.52
C5	3.63	4	3	3	5	1.16	-0.49	-0.54
C6	3.53	4	3	3	5	1.19	-0.40	-0.69
C7	3.50	3	3	3	5	1.20	-0.32	-0.81
C8	3.69	4	5	3	5	1.13	-0.52	-0.49
C9	2.76	3	3	2	3	1.16	0.08	-0.72
C10	3.71	4	5	3	5	1.20	-0.62	-0.56
C11	3.32	3	3	3	4	1.13	-0.19	-0.48

The results presented in Table 2 shows that, in the scope of the average value, the benefits students perceive as the most important are B2 [Fast transactions], B11 [Easy storage], and B7 [Limited supply] whereas B6 [Mining] they evaluate as the less important one. In case of challenges, the crucial are C3 [Unstable exchange rate], C4 [Interest from the black market], and C10 [Risk of loss], whereas C1 [No issuer] is the less important in their opinion. It is advisable to stress that the results presented in Table 1 embrace all students' opinions regardless of their characteristics. Thus it was decided to perform detailed analyses for respective groups of students. This approach could bring the wider perspective the problem analyzed.

4.2 Benefits and Challenges of Cryptocurrencies for Males and Females

To test hypothesis **H1** and answer **RQ2**, since the authors used convenient samples in the study, the Mann-Whitney U test was employed to determine whether the H1 is supported by empirical data. The test results presented in Table 3 show that there are significant differences (the *p*-value is lower than 0.05) between students opinion and their gender for benefits in case of B3, B4, B5, B7, and B8 and C1, C2, C4, C5, C9, C10, and C11 in case of challenges. Hence hypothesis H1 is supported in the study.

Table 3: The Mann-Whitney U test results as to for gender comparison

Benefits	Z	*p*-value	Challenges	Z	*p*-value
B1	-0.109	0.914	C1	-3.000	0.003
B2	-0.683	0.494	C2	-4.014	0.000
B3	2.310	0.021	C3	-0.059	0.953
B4	3.992	0.000	C4	-2.484	0.013
B5	-2.788	0.005	C5	-3.228	0.001
B6	-1.944	0.052	C6	0.688	0.491
B7	2.227	0.026	C7	-0.332	0.740
B8	6.376	0.000	C8	0.286	0.775
B9	1.526	0.127	C9	-3.315	0.001
B10	-1.718	0.086	C10	-3.757	0.000
B11	-0.272	0.786	C11	-2.748	0.006

Taking into account the test results presented in Table 3 it was decided to show the broader picture of the problem analyzed using frequency procedures. The results are presented in Figure 2. They embrace statistically significant variables only.

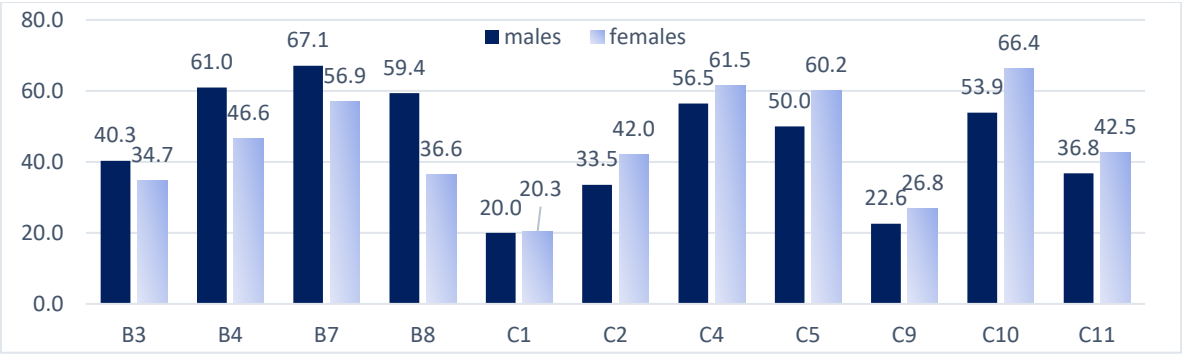


Figure 2: The benefits (B) and challenges (C) in males and females opinion [% values]

The results presented in Figure 2 show that males tend to perceive more benefits associated with cryptocurrencies compared to females. The most notable gender gap is observed in B8 [Decentralization], with males showing a 22.8% higher inclination towards the benefits. Conversely, females appear to encounter more challenges than males. Particularly C10 [Risk of loss] stands out, indicating that females perceive it as a greater risk compared to males.

4.3 Benefits and Challenges of Cryptocurrencies for Students – Fields of Studies Perspective

To test **H2** hypothesis and answer **RQ3**, the Mann-Whitney U test was employed for students representing two distinct fields, i.e. social sciences and exact sciences. We have limited the results to these two groups of students as they represent the majority of the sample. The results are presented in Table 4.

Table 4: The Mann-Whitney U test results as to fields of study

Benefits	Z	*p*-value	Challenges	Z	*p*-value
B1	1.729	0.084	C1	0.151	0.880
B2	1.590	0.112	C2	0.735	0.462
B3	1.625	0.104	C3	-0.434	0.665
B4	0.490	0.624	C4	0.848	0.396
B5	0.613	0.540	C5	1.345	0.179
B6	0.071	0.944	C6	-0.508	0.612
B7	-1.785	0.074	C7	2.060	0.039
B8	-0.878	0.380	C8	0.153	0.878
B9	-0.350	0.726	C9	0.889	0.374
B10	-1.914	0.056	C10	0.478	0.632
B11	-0.095	0.924	C11	0.918	0.358

The test results presented in Table 4 show that only for C7 [Not widely accepted] the *p*-value is lower than 0.05. It means that there were statistically significant differences in students opinions for this one variable exclusively. Thus, hypothesis H2 is rejected.

4.4 Benefits and Challenges of Cryptocurrencies – Students' Prior Experience Perspective

To assess hypothesis H3, the results of the Mann-Whitney U test are presented in Table 5, revealing significant differences (p-values below 0.05) between students with and without prior experience. Specifically, these differences are observed for 8 out of the total 11 benefits and 6 out of the total 11 challenges. Therefore, hypothesis H3 is supported by the findings of this study.

Table 5: The Mann-Whitney U test results

Benefits	Z	*p*-value	Challenges	Z	*p*-value
B1	2.56651	0.010273	C1	-4.12426	0.000037
B2	3.33058	0.000867	C2	-4.97030	0.000001
B3	5.03646	0.000000	C3	-0.16647	0.867790
B4	5.11063	0.000000	C4	-0.97912	0.327520
B5	-1.09409	0.273918	C5	-0.80210	0.422494
B6	-0.12156	0.903248	C6	1.97373	0.048413
B7	2.14409	0.032026	C7	0.22460	0.822294
B8	6.19076	0.000000	C8	0.14927	0.881343
B9	3.82234	0.000132	C9	-4.56488	0.000005
B10	-1.50378	0.132638	C10	-2.11392	0.034523
B11	3.81112	0.000138	C11	-3.26666	0.001088

Considering the test results displayed in Table 5, it was deemed appropriate to illustrate the disparities between opinions of respondents with and without experience using frequency procedures. The outcomes are depicted in Figure 3, highlighting solely statistically significant variables.

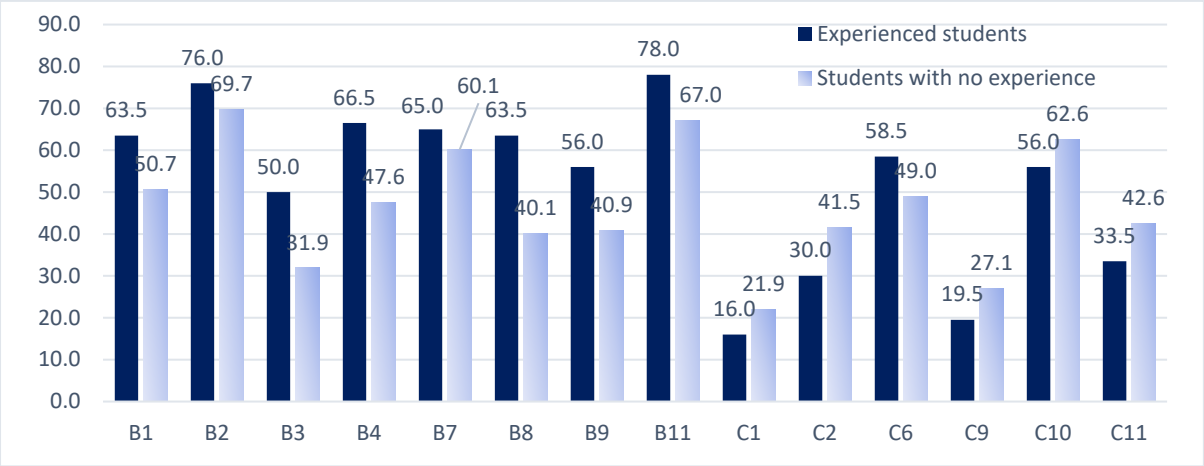


Figure 3: The benefits (B) and challenges (C), and students experience regarding cryptocurrencies [% values]

The findings illustrated in Figure 3 indicate that experienced students perceive more benefits compared to those with no experience. The most notable difference is observed in B8 [Decentralization], followed by B4 [Lack of control and independence] and B3 [No issuer]. Conversely, inexperienced students seem to face more challenges, with the most significant difference found in C2 [Lack of control and independence]. Of particular interest is the challenge highlighted by C6 [Increasing energy consumption], suggesting that experienced students view this as a greater concern and challenge compared to those lacking experience.

5. Discussion and Conclusions

Cryptocurrencies constitute a multidisciplinary, relatively nascent, and rapidly evolving domain. Cryptocurrencies have garnered significant attention in recent years, with their potential benefits and challenges subject to scrutiny across various demographics. This study aims to delve into students' perceptions of cryptocurrencies, examining how these perceptions differ based on gender, field of study, and their prior experience with cryptocurrencies. To achieve this objective, four research questions were addressed, along with corresponding hypotheses. The study addresses RQ1 by investigating students' opinions regarding the benefits and challenges associated with cryptocurrencies. As a result, [Fast transactions] and [Easy storage] turned out the most important for students whereas C3 [Unstable exchange rate] C4 [Interest from the black market, and C10 [Risk of loss] were the most important risks.

RQ2 delves into a comparison of the perceptions of benefits and challenges between males and females. Statistical analyses substantiate hypothesis H1, indicating differences between students' opinions and their genders. Our findings indicate that males tend to perceive more benefits associated with cryptocurrencies than females. This aligns with the findings of Jora and Nanda (2020), who identified gender disparities in attitudes toward cryptocurrencies, with male respondents exhibiting greater willingness to use cryptocurrencies than females. These results imply that gender influences individuals' perceptions of the benefits and challenges of cryptocurrencies.

RQ3 is investigated by analyzing differences among students based on their field of study. Although most variables did not exhibit statistically significant differences across fields of study, the identification of one significant difference for challenge C7 suggests the relevance of exploring field-specific perceptions. However, the overall support for hypothesis H2 is limited based on the findings of this study.

RQ4 examines the crucial aspect of individuals' experiences concerning benefits and challenges related to cryptocurrencies. The findings reveal variations in students' perceptions of benefits and challenges based on their prior experiences with cryptocurrencies. Experienced students tend to perceive more benefits and fewer challenges compared to their inexperienced colleagues, indicating that firsthand experience plays a significant role in shaping attitudes towards cryptocurrencies. These results are consistent with prior research (Eisenbardt and Eisenbardt, 2023a).

In summary, the study addresses research questions by analyzing students' perceptions of cryptocurrency benefits and challenges, comparing these views across genders and fields of study, and testing formulated hypotheses. The results offer valuable insights into the factors shaping individuals' perceptions of cryptocurrencies, underscoring the significance of considering gender-based and field-specific disparities in crafting strategies for cryptocurrency adoption and understanding its challenges. Furthermore, the study acknowledges the significance of experience-related factors, demonstrating that prior experience significantly influences individuals' perceptions of cryptocurrencies.

5.1 Research Contribution

This paper contributes to both practice and theory in the field of cryptocurrencies, focusing on gender and field of study differences, as well as prior experience with cryptocurrencies. The findings offer practical implications for policymakers, regulators, and industry stakeholders by highlighting nuanced perceptions of benefits and challenges among selected demographic groups. Understanding these perceptions can inform the development of targeted strategies to address concerns, enhance adoption, and mitigate risks associated with cryptocurrencies.

Policymakers can utilize insights from this study to tailor regulatory frameworks and policies surrounding cryptocurrencies. Recognizing the impact of experience on perceptions can aid in designing regulations that address specific concerns while leveraging perceived benefits. For instance, policies could focus on providing consumer protection measures for inexperienced users while fostering innovation and decentralization in the cryptocurrency space for more experienced users. Investors and industry stakeholders can benefit from understanding how experience influences perceptions of cryptocurrencies. Recognizing the biases introduced by varying levels of experience can guide investment strategies and decision-making processes, helping stakeholders navigate the complexities of the cryptocurrency market more effectively.

Insights into gender-based differences in perceptions can guide efforts to promote inclusivity and diversity in cryptocurrency-related initiatives and investments. The paper extends existing theoretical frameworks by empirically examining the influence of gender, field of study, and prior experience on perceptions of cryptocurrencies' benefits and challenges. By integrating findings from the literature review with empirical data, the study enriches our understanding of the factors shaping individuals' perceptions of cryptocurrencies.

The conceptual model presented in Figure 1 synthesizes the literature on benefits and challenges of cryptocurrencies, providing a comprehensive framework for future research and theoretical development. Overall, the paper bridges the gap between theory and practice in the field of cryptocurrencies, offering actionable insights for stakeholders while advancing theoretical understanding and knowledge in the domain..

5.2 Limitations and Implications

The study's findings are constrained by the sample size and demographic representation, suggesting the need for future research to employ larger and more diverse samples to enhance the validity and generalizability of

the results. Furthermore, longitudinal studies could offer valuable insights into the evolving dynamics of perceptions and behaviors surrounding cryptocurrencies and blockchain technology, taking into account the changing trends and advancements in the field over time. Additionally, qualitative research methods, such as interviews or focus groups, could provide a deeper understanding of the underlying factors that shape perceptions of benefits and challenges across various demographic groups and academic disciplines.

References

Al Guindy, M. (2021). Cryptocurrency price volatility and investor attention. International Review of Economics and Finance, 76, pp. 556 – 570. https://doi.org/10.1016/j.iref.2021.06.007

Alvarez, F.E., Argente, D., and Van Patten, D. (2022). Are Cryptocurrencies Currencies? Bitcoin as Legal Tender in El Salvador. National Bureau of Economic Research (NBER), 29968. DOI: 10.3386/w29968.

Antonopoulos, A.M. (2017). Mastering Bitcoin: Unlocking Digital Cryptocurrencies. O'Reilly Media, Inc.

Almeida, J. and Gonçalves, T.C. (2022). A Systematic Literature Review of Volatility and Risk Management on Cryptocurrency Investment: A Methodological Point of View. Risks 10(5), 107. https://doi.org/10.3390/risks10050107

Bajpai, P. (2023). Countries Where Bitcoin Is Legal and Illegal. Investopedia [Updated February 05, 2023]. Available at: https://www.investopedia.com/articles/forex/041515/countries-where-bitcoin-legal-illegal.asp, access: 2023-04-05.

Baur, D.G. and Dimpfl, T. (2018). Asymmetric volatility in cryptocurrencies. Economics Letters, 173, pp. 148–51, https://doi.org/10.1016/j.econlet.2018.10.008

Benigno, P., Schilling, L.M., and Uhlig, H. (2022). Cryptocurrencies, currency competition, and the impossible trinity. Journal of International Economics, 136(103601). https://doi.org/10.1016/j.jinteco.2022.103601

Böhme, R., Christin, N., Edelman B., andMoore T. (2015). Bitcoin: Economics, Technology, and Governance. Journal of Economic Perspectives, 29(2), pp. 213–238, http://dx.doi.org/10.1257/jep.29.2.213

Burniske, Ch. and Tatar, J. (2017). Cryptoassets: The Innovative Investor's Guide to Bitcoin and Beyond. McGraw-Hill.

Chenguel, M.B. (2023). Blockchain and Cryptocurrency: Development Without Regulation? In: Bahaaeddin Alareeni, Allam Hamdan (Eds.). Impact of Artificial Intelligence, and the Fourth Industrial Revolution on Business Success. Proceedings of The International Conference on Business and Technology (ICBT 2021), Springer. https://doi.org/10.1007/978-3-031-08093-7

Cifuentes, A.F. (2019). Bitcoin in Troubled Economies: The Potential of Cryptocurrencies in Argentina and Venezuela. Latin American Law Review (3), pp. 99-116. https://doi.org/10.29263/lar03.2019.05

CoinMarketCap. (2024). Available at: https://coinmarketcap.com

De Vries, A. (2018). Bitcoin's Growing Energy Problem. Joule, 2(5), pp. 801-805, https://doi.org/10.1016/j.joule.2018.04.016

Dordal, P.L. (2018). The Dark Web. In: H. Jahankhani (ed.), Cyber Criminology. Advanced Sciences and Technologies for Security Applications. Springer, Cham. https://doi.org/10.1007/978-3-319-97181-0_5

Eisenbardt, M. and Eisenbardt, T. (2023). Can Cryptocurrencies Be Feasibly Adopted as a National Currency? The Perspective of the Younger Generation. European Research Studies Journal, 26(2), pp. 467-485. DOI: 10.35808/ersj/3182.

Eisenbardt, M. and Eisenbardt, T. (2023a). The Impact of Knowledge and Experience on Opinion Formation - the Case of Cryptocurrencies. In F. Matos and Á. Rosa (eds.), Proceedings of the 24th European Conference on Knowledge Management ECKM 2023, Vol. 24 No. 1, pp. 344-353. https://doi.org/10.34190/eckm.24.1.1422

Frankenfield, J. (2023). Cryptocurrency Explained With Pros and Cons for Investment. Learn what you need to know before you invest in a virtual currency. Investopedia, [Updated February 04, 2023]. Available at: https://www.investopedia.com/terms/c/cryptocurrency.asp, access: 2023-04-05.

Gogus, A. and Saygın, Y. (2019). Privacy perception and information technology utilization of high school students. Heliyon, 5(5), e01614. https://doi.org/10.1016/J.HELIYON.2019.E01614

Hardy, R.A. and Norgaard, J.R. (2016). Reputation in the Internet black market: An empirical and theoretical analysis of the Deep Web. Journal of Institutional Economics, 12(3), pp. 515-539. doi:10.1017/S1744137415000454

Hileman, G. and Rauchs, M., (2017). 2017 Global Cryptocurrency Benchmarking Study [April 6, 2017]. SSRN. Available at: https://ssrn.com/abstract=2965436, http://dx.doi.org/10.2139/ssrn.2965436, Access: 2023-04-01.

Jora, M.N., and Nandal, D.N. (2020). Investors attitude towards cryptocurrency- based on gender. Turkish Journal of Computer and Mathematics Education, 11(2), pp. 622–630. https://doi.org/10.17762/turcomat.v11i2.9756

Katsiampa, P. (2017). Volatility estimation for Bitcoin: A comparison of GARCH models. Economics Letters, 158, pp. 3-6, https://doi.org/10.1016/j.econlet.2017.06.023

Klein, T., Thu, H.P., andWalther T. (2018). Bitcoin is not the New Gold - A comparison of volatility, correlation, and portfolio performance. International Review of Financial Analysis 59, pp. 105–116. https://doi.org/10.1016/j.irfa.2018.07.010

Köchling, G., Schmidtke, P., and Posch, P.N. (2020). Volatility forecasting accuracy for Bitcoin. Economics Letters, 191(108836). https://doi.org/10.1016/j.econlet.2019.108836

Lee, J.Y. (2019). A decentralized token economy: How blockchain and cryptocurrency can revolutionize business. Business Horizons, 62(6), pp. 773-784, https://doi.org/10.1016/j.bushor.2019.08.003

Lewis, A. (2018). The basics of bitcoins and blockchains : an introduction to cryptocurrencies and the technology that powers them. Mango Publishing, Coral Gables.

Li, Z., Mo, B., and Nie, H. (2023). Time and frequency dynamic connectedness between cryptocurrencies and financial assets in China. International Review of Economics & Finance, 86, pp. 46-57. https://doi.org/10.1016/j.iref.2023.01.015.

LLC. (2021). Regulation of Cryptocurrency Around the World: November 2021 Update. The Law Library of Congress, Global Legal Research Directorate. Available at: https://tile.loc.gov/storage-services/service/ll/llglrd/2021687419/2021687419.pdf, access: 2023-04-05

Marthinsen, J.E., and Gordon, S.E. (2022). Hyperinflation, Optimal Currency Scopes, and a Cryptocurrency Alternative to Dollarization. The Quarterly Review of Economics and Finance (85), pp. 161-173. https://doi.org/10.1016/j.qref.2020.12.007

Mzoughi, H., Benkraiem, R., and Guesmi, K. (2022). The bitcoin market reaction to the launch of central bank digital currencies. Research in International Business and Finance, 63(101800). https://doi.org/10.1016/j.ribaf.2022.101800.

Nakamoto, S. (2009). Bitcoin: A Peer-to-Peer Electronic Cash System. Available at: https://bitcoin.org/bitcoin.pdf, access: 2023-03-29.

Narayanan A., Bonneau J., Felten E., Miller A., and Goldfeder, S. (2016). Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction. Princeton University Press.

Nouir, J.B. and Hamida, H.B.H. (2023). How do economic policy uncertainty and geopolitical risk drive Bitcoin volatility?. Research in International Business and Finance, 64(C). https://doi.org/10.1016/j.ribaf.2022.101809

Nyhus, E.K., Frank, D., Król, M.K., & Otterbring, T. (2024). Crypto cravings: Gender differences in crypto investment intentions and the mediating roles of financial overconfidence and personality. Psychology and Marketing, 41(3), pp. 447–464. https://doi.org/10.1002/mar.21921

Peck, M.E. (2017). Why the biggest Bitcoin mines are in China. IEEE Spectrum. Available at: https://spectrum.ieee.org/computing/networks/why-the-biggest-bitcoin-mines-are-in-china, access: 2023-04-01.

Peng, Y., Albuquerque, P.H., Camboim de Sá, J.M., Padula ,A.J., and Montenegro, M.R. (2018). The best of two worlds: Forecasting high frequency volatility for cryptocurrencies and traditional currencies with Support Vector Regression. Expert Systems with Applications, 97, 177-192, https://doi.org/10.1016/j.eswa.2017.12.004

Phillips, D. and Graves, S. (2021). The 10 Public Companies With the Biggest Bitcoin Portfolios. Available at: https://decrypt.co/47061/public-companies-biggest-bitcoin-portfolios

Raza, S.A., Khan, K.A., Guesmi, K., and Benkraiem, R. (2023). Uncertainty in the financial regulation policy and the boom of cryptocurrencies. Finance Research Letters, 52(3),103515. https://doi.org/10.1016/j.frl.2022.103515

Song, Y., Chen, B., and Wang, X.-Y. (2019). Cryptocurrency technology revolution: are Bitcoin prices and terrorist attacks related? Financial Innovation, 9(1), Article 29, https://doi.org/10.1186/s40854-022-00445-3

Sudzina, F., Dobes, M., & Pavlicek, A. (2023). Towards the psychological profile of cryptocurrency early adopters: Overconfidence and self-control as predictors of cryptocurrency use. Current Psychology, 42(11), pp. 8713–8717. https://doi.org/10.1007/s12144-021-02225-1

Stoll, C., Klaaßen, L., and Gallersdörfer, U. (2019). The Carbon Footprint of Bitcoin. Joule, 3(7), pp. 1647-1661, https://doi.org/10.1016/j.joule.2019.05.012

Szymkowiak, A., Melović, B., Dabić, M., Jeganathan, K., and Kundi, G. S. (2021). Information technology and Gen Z: The role of teachers, the internet, and technology in the education of young people. Technology in Society, 65, 101565. https://doi.org/10.1016/J.TECHSOC.2021.101565

Tambe, T. and Jain, A. (2023). Advantages and Disadvantages of Cryptocurrency in 2023. Forbes Advisor, [Published: Mar 23, 2023]. Available at: https://www.forbes.com/advisor/in/investing/cryptocurrency/advantages-of-cryptocurrency, access: 2023-04-05.

Thul, J. (2021). Pros and cons of cryptocurrency. EFG. Available at: https://www.efginternational.com/insights/2021/pros-and-cons-of-cryptocurrency.html, access: 2023-04-05

Weichbroth, P., Wereszko, K., Anacka, H., and Kowal, J. (2023). Security of Cryptocurrencies: A View on the State-of-the-Art Research and Current Developments. Sensors, 23(6), 3155. https://doi.org/10.3390/s23063155

Wendl, M., Doan, M., H., and Sassen, R. (2023). The environmental impact of cryptocurrencies using proof of work and proof of stake consensus algorithms: A systematic review. Journal of Environmental Management, 326(A), 116530. https://doi.org/10.1016/j.jenvman.2022.116530

Vranken, H. (2017). Sustainability of bitcoin and blockchains. Current Opinion in Environmental Sustainability, 28, 1-9, https://doi.org/10.1016/j.cosust.2017.04.011

Vigna, P., Casey, M.J. (2015). The Age of Cryptocurrency: How Bitcoin and Digital Money Are Challenging the Global Economic Order. St. Martin's Publishing Group.

Yu, Ch., Yang, W., Xie, F., and He, J. (2022). Technology and Security Analysis of Cryptocurrency Based on Blockchain. Complexity, 5835457. https://doi.org/10.1155/2022/5835457

Zaghloul, E., Li, T., Mutka, M.W., and Ren J. (2020). Bitcoin and Blockchain: Security and Privacy. IEEE Internet of Things Journal, 7(10), pp. 10288-10313. Available at: https://www.egr.msu.edu/~renjian/pubs/Blockchain-IoT.pdf, access: 2023-04-05.

Zimprich, S. (2019) Data Protection and Blockchain, Dotmagazine. Available at: https://www.dotmagazine.online /issues/security-trust-in-digital-services/data-protection-and-blockchain, access: 2023-04-03.

Expiring Technologies Face to the Development of Generative AI: Programming Languages

Tomasz Eisenbardt
University of Warsaw, Warsaw, Poland

teisenbardt@wz.uw.edu.pl

Abstract: The rapid development of AI, and Generative AI in particular, offers incredible opportunities for all humanity. However, this development carries serious threats and dangers. The topic of job reduction and the obsolescence of some professions that were previously downright lucrative is often raised in the literature. Such a phenomenon of disappearance of certain professions or abandonment of old technologies has occurred many times, which was related to technological development or simply the development of civilization. Information and communication technologies are particularly susceptible to change. Virtually every IT issue has gone through an individual development path, resulting in a departure from the original solutions in favor of more modern, more flexible, more easily scalable, or simply more intuitive for humans. Meanwhile, there is a danger that the solutions proposed by GenAI may become dehumanized. The author delved into the topic of the potential phasing out of certain technologies due to the influence of GenAI, using the example of programming languages that have been used thus far. Their collection turns out to be quite extensive. Some of these languages fell into oblivion before the GenAI era, naturally replaced by other programming languages, or gradually became increasingly niche or redundant. The research question posed in this work is: Will GenAI lead to a departure from currently used programming languages, which were typically designed to be user-friendly (in the sense of being human-readable)? The aim of the work is to answer this question, as well as several smaller ones, such as: Are there any chances that programming languages will remain understandable to humans? The work employs literature analysis, critical analysis of selected technologies, and the case study method.

Keywords: Expiring Technologies, AI, Generative AI, Genai, Programming Languages

1. Introduction

The issue of fading technologies has long been part of natural civilizational development. It is strongly associated with the phasing out of specific solutions and tools, as well as the obsolescence of some professions. Some technologies have completely eradicated what was previously in use, reducing certain inventions to the level of technological curiosities, artifacts, or even sentimental mementos. Some technological advancements have led to what was once very popular being relegated to niche status.

A. Toffler in The Third Wave (Toffler, 1994) described in a model-like manner the historical development of our civilization. The allegory of three waves simplifies the fate of humanity, which transitioned from the agrarian era to the industrial era, and then to the digital era. The current digital era is still in a phase of intense development, the ultimate destination of which is essentially unknown. Regardless, each transition carried a significant cost of replacing the old with the new. This includes various artifacts, technologies, professions, and even ways of life. Much of this has been lost irretrievably because it was no longer needed.

Let's focus now on the present day. The tools and technologies we currently use typically have their predecessors or prototypes. We usually opt for the latest version of a device, technology, or tool. When we need to perform calculations, it's not a dilemma whether to choose an abacus or a personal computer. Only someone deeply sentimental might choose a typewriter for their professional work when they have word processing software available. A photographer is more likely to use a digital camera rather than an analog one. It would be quite eccentric to travel by horse when we have fast trains, cars, and airplanes. Mobile phones have replaced landlines, and email has replaced traditional letters. The list could go on endlessly.

However, the above examples were deliberately chosen to illustrate a fragment of technological evolution that we essentially have already experienced. The examples describe the world from several decades ago. What is happening in the 2020s has a different character. Currently, changes largely encompass the digital and informational sphere of human life.

Around the world, successive generations cannot imagine a normal existence in which they would be disconnected - to some extent - from rather sophisticated information services. Currently, having access to efficient broadband internet, the ability for instant global VoIP communication, specific computer applications allowing for quick resolution of highly complex problems, various commercial web services, and on-demand multimedia access hold immense significance. Examples like these can be multiplied for a long time.

Therefore, there are many solutions that are used in our daily lives, without which we cannot imagine a day, and which not long ago were merely futuristic ideas straight out of science fiction movies. The fact that such services and conveniences exist at all is a result of the application of digital machines and various programming languages.

2. Literature Background

2.1 The Wide Scope of Past and Actual Programming Languages

Programming languages have been with us for decades. It is indicated here as the progenitor the first programming language, developed in 1883 by Ada Lovelace (Kim, Toole, 1999). This year computer program, to compute Bernoulli numbers for a primitive mechanical computer, was created. The next achievement in this matter was the first computer programming language prepared by Konrad Zuse: Plankalkül - in early 1940s. Next, in 1949, assembly language emerged and - around the same time - Shortcode appeared (Brief…, 2024; The history…, 2023; Computer History…, 2018).

Since then, the pool of languages has steadily expanded. Some of them have been in use for several decades. However, some have almost completely faded into obscurity, making way for others.

The history of programming languages is shown in a simplified way in Figure 1. In reality, there were many more programming languages (Most Used…, 2023). Another timeline of this kind was once published by O'Reilly Media (see References: History of Programming Languages, 2008) - it's available on the World Wide Web, and it hasn't been included here due to the size and complexity of the diagram. It's evident from the chart that many languages have faded into obscurity and are now considered extinct languages.

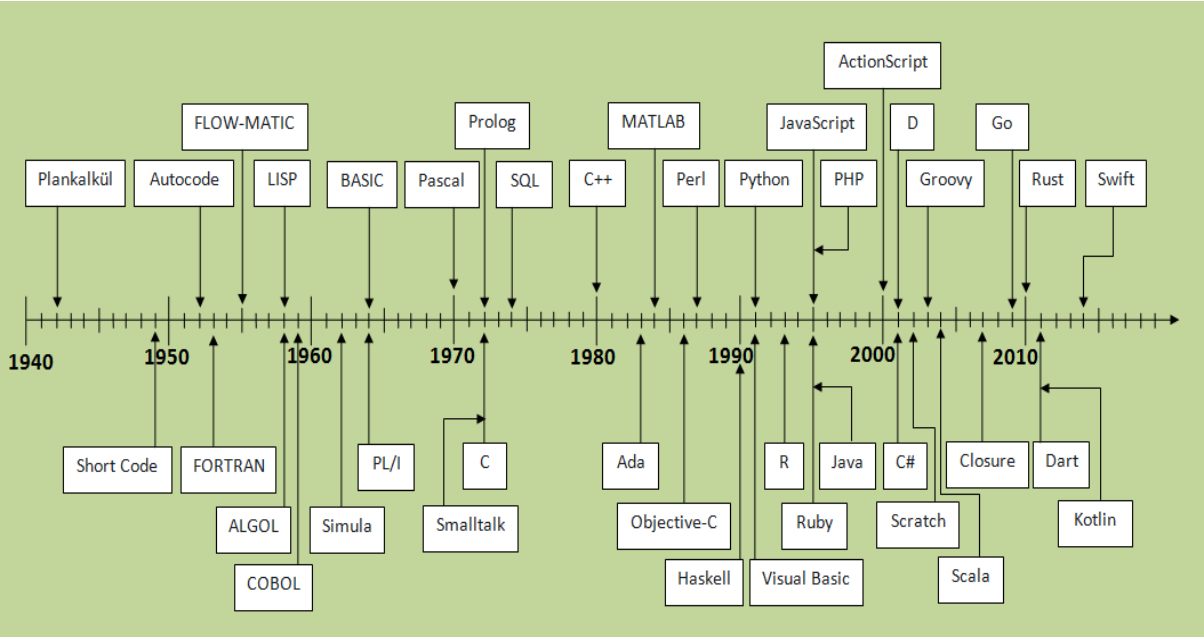


Figure 1: History of programming languages – simplified. Source: (History of Programming Languages, 2019)

So, we are still in the process of programming language evolution. Much has already happened in this regard. But are we perhaps on the verge of another turning point in programming language development? Because can an algorithm create algorithms on its own?

In recent times, various bold statements have been appearing in the media, such as: Jensen Huang (2024), CEO of Nvidia, stated that computer programming education will become unnecessary because natural language will be entirely sufficient for programming, and the emphasis should be placed on "*understanding domain expertise*." These assertions have sparked heated debate.

2.2 Generative AI - Basics

The next step in civilization appears to be the development of artificial intelligence, which began in the 1950s with the proposal of the Turing machine (Turing, 1950). Since then, a lot has happened (Eisenbardt, 2023). However, crucial from the perspective of this paper may be the year 2018. It was then, when the first version of ChatGPT[1] was released by OpenAI[2] (Introducing ChatGPT; History and Future…, 2023; Reynoso, 2021).

The ChatGPT itself can now confidently be called the "flagship" of GenAI - Generative Artificial Intelligence. There are currently many such tools, just as there are many definitions of Generative AI. They are quite similar in wording, so only one of them will be cited here:

> Generative AI is „*a class of machine learning technologies that can generate new content—such as text, images, music, or video—by analyzing patterns in existing data*" (Brynjolfsson, Li, Raymond, 2023).

Around the year 2022-23, there was a true explosion of interest in GenAI. This is evident from the attached chart (Chart 1). A similar peak was observed, and other researchers came to similar conclusions, such as García-Peñalvo, Vázquez-Ingelmo (2023).

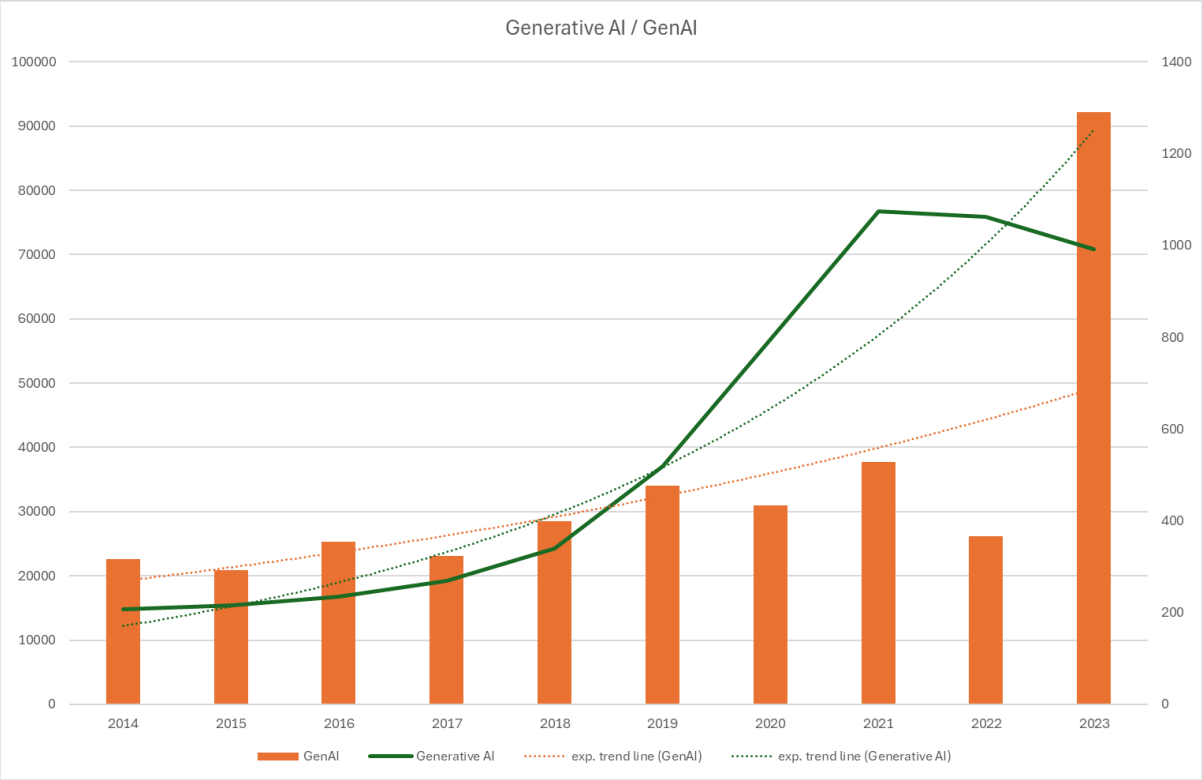


Figure 2: Number of publications according to Google Scholar regarding Generative AI and GenAI in the last 10 years. Source: own work based on Google Scholar[3], access: 2024-04-0

Currently (spring 2024), there are many solutions in the field of GenAI. The present discussion is limited to chatbots. There are many available chatbots (Haan & Main, 2024; Rebelo, 2023). In the study, only three of them were used, namely:

- ChatGPT[4] (Chat Generative Pre-trained Transformer) - produced by OpenAI,
- Copilot[5] - created by Microsoft Corp.,
- Gemini[6] - developed by Google (Alphabet Inc).

[1] ChatGPT, https://chat.openai.com
[2] OpenAI, https://openai.com
[3] Google Scholar, https://scholar.google.com
[4] OpenAI ChatGPT, https://chat.openai.com
[5] Microsoft Copilot, https://copilot.microsoft.com
[6] Google Gemini, https://gemini.google.com

These chatbots were subjected to trials aimed at assessing their usefulness in code generation in popular programming languages.

3. Research Methodology

3.1 Research Goal and Questions

The main goal of the study was to test three chatbots for code generation in several popular programming languages and to subject the chatbots to an attempt to create a new programming language. An additional objective was to verify the popularity of these three chatbots over time based on the number of publications about them.

The following research questions were formulated:

[Q1] Which chatbot currently enjoys the highest popularity in terms of publications about it?

[Q2] Do the chatbots handle generating typical code in selected languages?

[Q3] Can the chatbots optimize this code?

[Q4] Do the chatbots handle less obvious problems?

[Q5] Can the chatbots create alternative programming languages?

The answers to these questions are found sequentially in the Results section of this paper.

3.2 Research Procedure

In the first step, the interest in each tool over time was verified. Google Scholar listings for the three chatbots (ChatGPT, Copilot, and Gemini) were used. The period of the last 10 years was examined. This allowed us to gain knowledge about the level of interest from researchers and knowledge disseminators in these three tools and which one is currently the leader [Q1].

In the next step, these three chatbots were tested. It was checked whether they were able to generate simple code in several programming languages [Q2] and whether they could optimize it [Q3]. Subsequently, they were challenged with solutions to less typical problems [Q4]. Then it was verified whether the chatbots allowed for the generation of a completely new programming language [Q5] that could replace the previous languages.

4. Results

4.1 Popularity of Chatbots

The number of publications on the three analyzed chatbots was tracked. The analysis covered the last 10 years (2014-2024), as shown in Chart 2. Trend lines were added, and they were exponential in nature. The last year (2024) was not included in the charts because only one quarter of that year had passed. However, the results obtained until the end of March 2024 clearly indicate that the peak will be even higher (for each of the tools, the results obtained so far suggest a rapid surpassing of the record from the previous year).

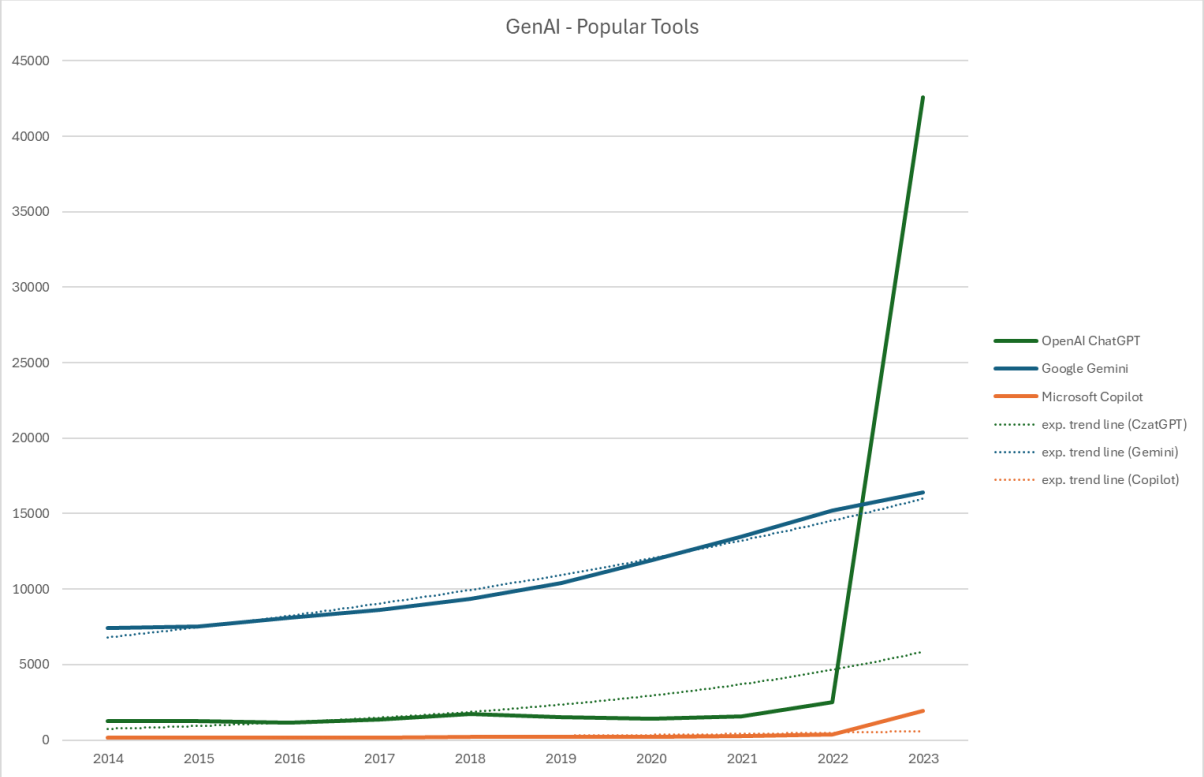


Figure 3: Number of publications according to Google Scholar regarding selected GenAI tools in the last 10 years. Source: own work based on Google Scholar, access: 2024-04-02

The chart quite clearly indicates that initially, the greatest interest and expectations were aroused by the Google Gemini tool. However, after 2022, the lead has been taken by the OpenAI product: ChatGPT.

4.2 The Test of Generating Simple Code

Each of the chatbots was asked to prepare a factorial algorithm. The code was to cover four programming languages: two relatively young and currently popular ones (Python, C#) and two with a very long, over 50-year history. This included the currently niche language C and the practically extinct Pascal. The results of this experiment are shown in Table 1. This test serves as an attempt to answer the research question [Q2].

Table 1: Results of the code generation test in multiple programming languages

Chatbot	Python	C#	C	Pascal
OpenAI ChatGPT	Yes (2 solutions: recursion and iteration)	Yes (2 solutions: recursion and iteration)	Yes (2 solutions: recursion and iteration)	Yes (2 solutions: recursion and iteration)
Google Gemini	Yes (2 solutions: recursion and iteration)	Yes (2 solutions: recursion and iteration)	Yes (2 solutions: recursion and iteration)	Yes (2 solutions: recursion and iteration)versions)
Microsoft Copilot	Yes (2 solutions: recursion and iteration)	Yes (even 4 versions)	Yes (2 solutions: recursion and iteration)	Yes (2 solutions: recursion and iteration)

Source: own study

Each of the chatbots coped excellently with such an elementary, popular, and thoroughly described computer science problem as the factorial algorithm. As seen in the table, Copilot stood out for its particularly meticulous treatment of the C# language, proposing 4 different solutions to the problem.

4.3 The Test of Optimizing Simple Code

Next, each of the chatbots was asked to optimize the recursive algorithm. The results of this operation are presented in Table 2. This is an answer to the research question. [Q3].

Table 2: Results of the code optimization test in multiple programming languages

Chatbot	Python	C#	C	Pascal
OpenAI ChatGPT	Yes (using memoization)	Yes (using memoization)	Yes (using memoization)	Yes (using memoization)
Google Gemini	Yes (using memoization)	Yes (using memoization)	Yes (using memoization)	Yes (using memoization)
Microsoft Copilot	None	None	None	None

Source: own study

The chatbots demonstrated the ability to delve deeper into the subject related to the described algorithm. They proposed optimization, but each time only through one method: memoization. Copilot, on the other hand, rather disappointed in this matter.

4.4 The Chatbots Test for Solving an Atypical Task

The next task was to draw a four-leaf clover on the screen using a programming language. The task is not particularly difficult, but it may be challenging to find ready-made solutions on the World Wide Web. Additionally, it requires including additional libraries beyond the standard ones. Results [Q4] are in Table 3.

Table 3: Results of the code generation test in multiple programming languages

Chatbot	Python	C#	C	Pascal
OpenAI ChatGPT	Task completed (Included turtle library)	Task completed (Included Windows Forms library)	Task completed (included Simple DirectMedia Layer)	Task completed (included Graph library)
Google Gemini	Task completed (Included turtle library)	Task completed (Included Windows Forms library and System.Drawing)	He included the header file <cairo.h> and completed the task	He couldn't solve the task in Pascal; he only proposed a solution in Delphi
Microsoft Copilot	At first, he misunderstood the context of the command and drew a clover on the screen. Only after being given a similar command for the C# language did he correct his previous response. The turtle library was used.	The solution was not complete; in fact, it was only the preparation of the form	Proposed a text-based solution	Proposed a text-based solution

Source: own study

The task was well executed by ChatGPT and Gemini. Copilot had some issues understanding the contextual nature of the command, and its solutions were slightly inferior.

4.5 Test of Artificially Generated Programming Languages

In the online sphere, there have been few mentions of attempts to generate new programming languages using GenAI tools. What this current study proposes is another such attempt. The chatbots were given a rather challenging task: "*Prepare a new programming language that uses double characters instead of commands and only hexadecimal values*". The results of this challenge are presented in Table 4.

Table 4: Results of code generation testing in multiple programming languages

Chatbot	Proposed new programming language	Results (sample)
OpenAI ChatGPT	HexLang	VA1A5 ; Assign value 5 to variable A VA2B8 ; Assign value 8 to variable B AA ; Add variables A and B VA3 ; Assign result to variable C FF ; End of program
Google Gemini	HexaScript	A1 // Assign value 0x01 to variable A B2 C3 // Add values at B and C, store result in variable 2 D5 0F // Compare value in D with 0x0F, jump to instruction at 5 if equal EF // Perform some operation (specific meaning depends on instruction code) 01 // End of program (could be a different code)
Microsoft Copilot	HexaGlyph	O ## 0x42 # Set memory address 0 to 0x42 O ## # Print the value at the current memory address

Source: own study

And here's a Python-based interpreter for this language:

python Copy code

```
class HexLangInterpreter:
    def __init__(self):
        self.variables = {}

    def interpret(self, code):
        lines = code.split("\n")
        for line in lines:
            if line:
                command, value = line[:2], line[2:]
                if command == 'VA':
                    var = value[0]
                    val = int(value[1:], 16)
                    self.variables[var] = val
                elif command == 'AA':
                    var1, var2, var3 = value[0], value[1], value[2]
                    self.variables[var3] = self.variables[var1] + self.variables[var2
                elif command == 'FF':
                    break
        print("Variables:", self.variables)

# Example usage
interpreter = HexLangInterpreter()
code = """
VA1A5       ; Assign value 5 to variable A
VA2B8       ; Assign value 8 to variable B
AA          ; Add variables A and B
VA3         ; Assign result to variable C
FF          ; End of program
"""
interpreter.interpret(code)
```

Figure 4: A fragment of the library for handling the conversion of the new programming language HexLang to Python. Source: ChatGPT, access: 2024-04-03.

As can be observed, each of the chatbots demonstrated a certain level of creativity in creating the foundations of a new programming language. Each of them named the new language and proposed its initial assumptions.

ChatGPT seems to be the best in this regard, as it immediately constructed a library in Python[7] (Figure 2) that would be responsible for translating and interpreting the code of the HexLang language.

5. Conclusions

The conducted analyses allow for answering the research questions. Thus, sequentially:

[Q1] Initially, Gemini enjoyed the greatest interest from researchers and knowledge disseminators in the field of GenAI. However, since 2022, ChatGPT has been the leader in this regard.

[Q2] All three examined chatbots perform well in generating typical code in several programming languages. These languages include Python, C#, C, and Pascal. Their language models are well-developed, and their knowledge bases allow for accurate formulation of responses.

[Q3] The chatbots are capable of optimizing code to the extent allowed by their model and knowledge base. Clearly, Copilot was weaker in this regard.

[Q4] It turns out that the chatbots handle less obvious, "non-textbook" problems quite well. They adeptly suggested libraries that extend the languages, and the methods and functions of these libraries were used rather skillfully. However, contextual understanding of commands by Copilot was an issue here.

[Q5] The chatbots are capable of laying the groundwork for creating alternative programming languages. However, to what extent they deviate from the languages that have been created so far and how creative and unique this approach is, is a highly debatable matter. Preliminary results suggest a certain level of imitation by artificial intelligence in this field.

Analyzing the above results, it is important to consider the significant capabilities of current GenAI technology. It is truly an emerging technology. It already has incredible capabilities, and the spectrum of its potential applications continues to grow. This study, along with many others, points to certain shortcomings in the creativity of solutions suggested by artificial intelligence, as well as certain problems with contextual understanding.

However, on the other hand, GenAI poses a significant threat to many professions, including those related to the IT industry. There is a reason why the potential of machine-generated code was tested here. It's a significant threat that coding might one day escape our control, and code written in languages created in such an artificial way would be completely incomprehensible and impossible to verify by humans. It is already worth ensuring that the code remains “humanized”.

The main conclusion, however, is that GenAI-supported chatbots are already an incredible support for programmers' work today. Their language models support not only natural language transcription but can also be equally successful in transcribing code in multiple programming languages. This applies to both currently used languages and those that are becoming obsolete or have long been forgotten.

5.1 Research Contribution

The study focuses on programming languages, considering extinct languages, in the context of using GenAI tools to write code in these languages. The proposed approach is original and authored. It was decided to test 3 GenAI chatbots: ChatGPT, Google Gemini, and Microsoft Copilot. Due to the high relevance of the compared solutions and the high interest in the topic by many researchers, it may serve as inspiration and encouragement for further research in this area.

5.2 Limitations and Implications

It should be noted that the examined solutions are still being developed. The study diagnoses the current state as of the present time (spring 2024). The conducted study was based on verifying the capabilities of the

[7] Python, https://www.python.org

examined tools by formulating one-time queries. Although a comprehensive study in this area would be more reliable, it should still be expected that the results achieved would vary greatly over time.

References

Brief Programming Languages History (2024). Computer Science Degree Hub. https://www.computersciencedegreehub.com/brief-history-of-programming-languages/. Access: 2024-03-30

Brynjolfsson E., Li D., Raymond L. R. (2023). Generative AI at Work. DOI: https://doi.org/10.3386/w31161

Computer History: A Timeline of Computer Programming Languages (2018). HP Tech Takes /... Exploring today's technology for tomorrow's possibilities, October 15, 2018, https://www.hp.com/us-en/shop/tech-takes/computer-history-programming-languages#:~:text=1883%3A%20The%20first%20programming%20language,just%20numerical%20values%20of%20things. Access: 2024-03-30

Eisenbardt T. (2023). Intelligent Virtual Assistants and New Perspectives of Knowledge Acquisition, IN: Vol. 24 No. 1 (2023): Proceedings of the 24th European Conference on Knowledge Management DOI: https://doi.org/10.34190/eckm.24.1.1421

García-Peñalvo F.J., Vázquez-Ingelmo A. (2023). What Do We Mean by GenAI? A Systematic Mapping of The Evolution, Trends, and Techniques Involved in Generative AI, DOI: https://doi.org/10.9781/ijimai.2023.07.006

Haan K., Main K. (2024). 7 Best Chatbots (April 2024). Forbes Advisor, https://www.forbes.com/advisor/business/software/best-chatbots/, Access: 2024-04-02

History and Future Impact of Chat GPT (2023). Pop!Automation. https://www.popautomation.com/post/history-and-impact-of-chat-gpt. Access: 2023-04-06

History of Programming Languages (2008). O'Reilly, https://www.cs.toronto.edu/~gpenn/csc324/PLhistory.pdf. Access: 2024-03-30

History of Programming Languages (2019). Java Concept Of The Day , July 21, 2019, https://javaconceptoftheday.com/history-of-programming-languages/. Access: 2024-03-30

Huang J. (2024). https://twitter.com/Carnage4Life/status/1761483377365152234. Access: 2024-04-04

Introducing ChatGPT. OpenAI. https://openai.com/blog/chatgpt. Access: 2023-04-06

Kim E. E., Toole B. A. (1999). Ada and the First Computer, Scientific American, Inc., May 1999, https://www.cs.virginia.edu/~robins/Ada_and_the_First_Computer.pdf, access: 2024-03-30

Most Used Programming Languages (1965-2023), (2023). https://www.youtube.com/watch?v=kECnb_aKoyk. Access: 2024-03-30

Rebelo M. (2023). The best AI chatbots in 2024. Zapier. https://zapier.com/blog/best-ai-chatbot/, Access: 2024-04-02

Reynoso R. (2021). A Complete History of Artificial Intelligence. https://www.g2.com/articles/history-of-artificial-intelligence. Access: 2023-04-06

The History of Programming Languages. (2023). Saylor.org Academy. https://learn.saylor.org/mod/page/view.php?id=67404&forceview=1. Access: 2024-03-30

Toffler A. (1994). The Third Wave. Random House

Turing A. (1950) Computing Machinery and Intelligence. Mind. vol. LIX. no. 236. October 1950. pp. 433-460

Links

OpenAI ChatGPT, https://chat.openai.com
Google Gemini, https://gemini.google.com
Google Scholar, https://scholar.google.com
Microsoft Copilot, https://copilot.microsoft.com
OpenAI, https://openai.com
Python, https://www.python.org

A Sentiment Analysis Framework for Estimating Relational Capital

G. Scott Erickson[1] and Helen N. Rothberg[2]
[1]Ithaca College, Ithaca, USA
[2]Marist College, Poughkeepsie, USA

gerickson@ithaca.edu
helen.rothberg@marist.edu

Abstract: This paper continues research to create a metric for relational capital, a progressively important type of knowledge asset. Knowledge concerning customers and how to engage with them is increasing at an exponential rate in some organizations due to customer relationship management (CRM) and related software gathering customer data. As such, understanding relational capital as a critical piece of an organization's intellectual capital (IC) is ever more important. But measuring the level of relational capital in a firm is difficult. Several consultancies publish brand equity assessments every year (a closely related concept) but these usually only include the biggest and most valuable brands. Popular metrics for studying IC either don't break out the relational capital and other individual components (Tobin's q) or don't include relational along with the others reported (VAIC). In previous work, we've explored using sentiment analysis as a measure of brand value/relational capital, studying the results of a number of firms in several specific applications (consumer brands, tech brands, media brands, etc.). Those results have been interesting but were also only exploratory. At last year's ECKM conference in Lisbon, we received a suggestion that it was time to take some of these metrics and put them together into a brand equity/relational capital predictor. This paper takes that first step, looking at some sentiment analysis results over time and evaluating their relationship with known brand equity estimates. Activity level for brand mentions, variance in activity level, sentiment (positive, negative, neutral), influencer levels, and other potential inputs can be fed into some scenarios for predicting relational capital. The scenarios could include both different variables and different weights, experimenting to determine if an algorithm providing the best fit to the data exists. Once this type of research establishing some benchmarks, additional comprehensive quantitative tests can be conducted in future research, validating and adapting the predictor to different industries and different circumstances. Consequently, we should be able to develop a much better understanding of the role of relational capital and its contribution to firm success as well as ways to help organizations manage it.

Keywords: Intellectual Capital, Relational Capital, Brand Equity, Smartphones, Sentiment Analysis

1. Background/Literature Review

Measuring knowledge assets or intellectual capital is an unsettled issue in our field even after decades of attention. While individual firm estimates and even periodic intellectual capital reports have been produced, with greater or lesser acceptance in terms of methodology, the final step of identifying a generally accepted knowledge metric to establish impact on organizational performance remains elusive. Conceptually and intuitively, the entire discipline believes that superior management of knowledge resources can lead to better financial and other results. But we still lack the means to prove it. And that includes in the area of relational capital.

1.1 Relational Capital

Knowledge management theory suggests that identifying and sharing knowledge resources can lead to competitive advantage (Grant, 1999; Teece, 1998). As tangible assets are ubiquitous and widely available, the potential of intangible assets unique to the firm may be the most available differentiator for many organizations (Nonaka & Takeuchi, 1995). This offshoot of the resource-based view of the firm (Barney, 1991; Wernerfelt, 1984) is the impetus for much of the interest in knowledge management (KM) and related disciplines.

One key related discipline is intellectual capital (IC). If one is to manage knowledge assets more effectively, it helps to be able to identify and measure them. IC grew out of several fields but one was accounting, an attempt to better account for intangible assets such as knowledge. Different approaches, some well-known such as the Balanced Scorecard (Kaplan & Norton, 1992) and the Skandia Navigator (Edvinsson & Malone, 1997), established a basis for later research. That research then generally centered on a framework including human capital, structural capital, and relational capital (Bontis, 1999; Edvinsson & Malone, 1997).

Human capital is most closely associated with KM and was often the core connection between the fields as individual knowledge about job performance is key to both concepts. Structural capital is more about knowledge embedded in the organization, captured in processes and procedures. Essentially, one objective of KM is to turn human capital into structural capital, so it is a key concept in connecting KM and IC. Relational capital,

knowledge about interactions with those outside the organization itself (Roos & Roos, 1997), has typically been more of an afterthought. Termed customer capital in some early IC frameworks, it was expanded to include all external publics. Customers, however, do remain the core constituency about which a firm desires knowledge (Gupta & Bhasin, 2014), and with the advent of customer relationship management systems, loyalty programs, customer logins and other advances related to customers and now available big data, the capabilities and value of relational capital have grown considerably in recent years. The volume of information and knowledge has exploded, so the potential value of the asset has similar increased, including relative to other aspects of intellectual capital.

Even with its burgeoning value, relational capital's lack of attention plays out in some of the traditional IC metrics. In firm-specific measures such as the Balanced Scorecard and Skandia Navigator mentioned earlier, indirect measures such as marketing expenditures have some value. But to evaluate a wider number of firms, a relational capital component can be difficult to isolate. Tobin's q (Tobin & Brainard, 1979), for example can be applied in estimating total IC but not the individual parts. Pulic's (2000) relatively popular VAIC method does break out individual components with a direct measure of human capital but then lumps everything else into a structural capital remainder that presumably includes an unidentified relational capital value.

So what is the contemporary view of customer relationships and how we might better measure those to guide knowledge management in organizations? One avenue is to borrow from other disciplines, including the concept of brand equity prominent in the marketing literature. The basic theory of both fields is that ongoing interactions between buyer and seller build relational capital as the seller increasingly learns what satisfies that individual buyer (Sussan, 2012; Stahle & Stahle, 2012). Brands have value because customers trust them, based on previous encounters and experiences, word-of-mouth from other users, and a general sense that the brand knows what to do to make them happy. That comes from learning turned into knowledge, and as the firm/brand can leverage that knowledge across customer service providers, it increases not only brand equity but relational capital (Chang & Tseng, 2005; de Castro, et al., 2004). And, again, in today's world with a wealth of data on customer likes, dislikes, interactions, digital media chatter, and other inputs, that aspect of knowledge management takes on increased importance.

1.2 Brand Equity

Branding is central to modern marketing. In an age of trillion-dollar companies, much of which can come from brand equity, a strong brand is seen as a unique and differentiating business asset. Sometimes misunderstood, brands are not necessarily successful because of the name chosen or from a clever catchphrase but more because, over time, repeated successful interactions with users builds trust. Customers develop expectations about the brand promise and as that is delivered and expectations continuously met or exceeded, the value of the brand increases. High brand values reflect firms with extensive knowledge, gained over time, about customer expectations and how to meet them effectively. As such, brand equity is directly related to relational capital or customer knowledge.

Branding is also an old concept, but in today's world, opportunities for brand building have increased in line with customer data, information and knowledge. Digital interactions with customers have mushroomed, not only online and through social media but also through on-the-ground loyalty programs and online/on-the-ground combinations. These interactions are based on what the literature calls information and communication technologies (ICTs), extended networks with individually identified participants (Lechman, 2017). Browsing behavior, website behavior, transactions, social media, mobile apps, and all sorts of other data-gathering opportunities present themselves and can be attached to known, identifiable customers. This customer data-gathering is one of the key trends driving big data and analytics, illustrating the common definition of big data as the "three V's: volume, velocity, variety (Rothberg & Erickson, 2017). Massive stores of real-time data of all sorts (structured and unstructured) provide opportunities for brand-building and for enhancing relational capital, turning data/information into knowledge/intelligence (Rothberg & Erickson, 2017; Sigala & Chaikiti, 2014; Levy, 2009).

Contemporary branding theory started with Aaker (1991), recognizing the value of a signaling mechanism of a better product worth a premium price. The later idea of brand equity encompassed brand value as a function of awareness, associations, and loyalty (Aaker, 1996). As noted, the value is created over time via successful interactions between brand and customer (Keller, 1993). As interactions differ, the perceived value will be different for different users, but a summation of the extra value across all customers provides the sense of total brand equity (Seggie, et al., 2006; Aliwadi, et al., 2003).

The brand equity estimate is somewhat fuzzy as we generally don't actually have these perceived brand values gathered anywhere nor is there anything resembling brand equity in financial reports or related documents. In some ways, that is where intellectual capital makes a connection as differences between firm value and tangible assets is generally thought to include brand equity somewhere, but not in a manner that can be readily accessed. Were we can obtain brand equity estimates is from consultancies preparing "top brands" lists (Interbrand, 20024), though those are often limited to only the biggest brands and so might be of less use for other firms.

What the growth in ICTs brings to the table are not only the exponential increase in brand-customer interactions but also a better understanding of the impact of those interactions. Data by itself doesn't lead to more brand equity/relational capital, but it can lead to deeper insights into how to further delight the customer, actions that do result in an increase. Existing, longstanding knowledge theory supports this line of thought.

Ackoff (1989) is among those credited with developing the DIKW hierarchy. Raw data (D) can be organization as information (I) from which relationships can be discerned (knowledge, K) capable of then providing deeper insights and understanding (wisdom, W). Substitute intelligence for wisdom, and we have the key contemporary concepts of big data and analytics as they related to our core concept of knowledge. DIKW incorporates all intangible assets of the firm and provides a guide for how they relate to each other and the progression from raw data to actionable intelligence. But the important conclusion is that all parts of the hierarchy can have value, even if not immediately. Knowledge is not the only valuable intangible asset.

Following this line of thought, Snowden's Cynefin framework updates DIKW and removes the hierarchy aspect, seeing data/information not only as inputs for other intellectual capital but as valuable assets in and of themselves (Kurtz & Snowden, 2006). Knowledge is also viewed more broadly, with tacit and explicit knowledge broken out separately and also seen as uniquely present and of value in specific circumstances. As is intelligence, forming a DIKW-like structure running through data/information, explicit knowledge, tacit knowledge, and intelligence (Rothberg & Erickson, 2017). And so decision makers have a range of tools and, with a range of circumstances (complex, chaotic, etc.), the successful strategy will fit the most useful intangible assets to the situation.

This perspective is extremely important in puzzling out the meaning and value of relational capital. As noted, ICTs provide considerable big data to companies with strong customer relationship capabilities. Sometimes that is only data/information, and just having a database concerning customers can be a huge competitive asset—identifying which customers to pay more attention to, tracking behavior and communications, and other data-centric activities can yield strategic advantages. But some organizations also have the ability to learn from the databases, customer preferences, customer reactions to marketing activities, and other such knowledge. Sometimes more tacit (leveraged through personal contact or individual learning), sometimes more explicit (more database-driven, leveraged across IT platforms). And, of course, some firms are able to create predictive, actionable intelligence, with intangible assets being used to find insights about the future help decision-making. The recent explosion of interest in artificial intelligence only adds potential value to this last level of DIKW.

Understanding all of this, contemporary intangible assets related to customers are not only varied and valuable but may contain natural metrics that can be used to assess specific areas of value such as relational capital. The most recent research on brand equity recognizes these possibilities, including incorporating social media metrics as a key input into brand value assessments (Fagundes, et al. 2023) from the academic side. From an applied perspective, the potential for applying social media data in estimating brand value is also gaining favor (McDowell, et. al 2023), especially given the wealth of data and the array of means to analyze them. Including, again, artificial intelligence.

For an individual company, standard metrics such as website visits and behavior, social media interactions, loyalty programs, and similar contacts are routinely tracked and can give a good sense of that firm's specific trends in relational capital. More importantly from a broader perspective, these data can be tracked to assess and compare relational capital across firms. That includes quantitative measures as well as qualitative. User chatter on social media and elsewhere can be brutally honest as well as complementary (Rovai, 2002), but can also provide deeper, more illuminating feedback. And, again, these inputs can reveal true feelings about a brand (Rizun & Kucharska, 2018), and platforms are available to allow gathering of the data and comparisons across companies. As a result, we have new ways to judge relational capital as a concept linked to but separate from brand equity.

2. Methodology

After several studies over the past few years to look at patterns in companies' digital media and how they might relate to relational capital or brand equity, we wanted to take the next step and start lexploring at statistical relationships that might allow identification of the key variables driving relational capital. If those can be determined, then relational capital can be predicted by new metrics, allowing more effective management of this particular aspect of knowledge. Consequently, this is preliminary, exploratory research with the core research objective of uncovering the basic relationships between available digital media metrics and relational capital.

In past studies, topics have included tech brands (Erickson, 2023), media brands (Erickson & Rothberg, 2023), ingredient brands (Erickson, Schmidt & Rothberg, 2020), and major consumer goods brands (Erickson & Rothberg, 2017). Preliminary findings from these small sample exploratory studies were that the more valuable brands tended to have a lot more digital media activity (volume), more neutral and more stable (lower standard deviation) sentiment, higher-rated influencers, and few obvious patterns in terms of platforms or other available variables.

The studies employed Salesforce's Social Studio software (now discontinued though other options are available), allowing "social listening" over designated time periods. Social Studio tracks activity concerning keywords (in this case brands) across the entire web, including social media platforms (X, Facebook), YouTube, blogs, forums, news aggregators and commenters such as Reddit, reviews, and other postings. Results provide data on volume of brand mentions, sentiment (positive/negative), top influencers, country, language, and activity by each digital platform. If one desires the actual posts behind the data, for qualitative research and descriptions (including word clouds), that is also available. Note again, results are from the entire internet, not just owned social media accounts.

For this exercise, we pulled the data from the tech brands study (Erickson, 2023) which included two different time periods of results. The brands included were from the smartphone industry, including high-value brands Apple iPhone and Samsung Galaxy as well as relatively high-value Chinese brand Xiaomi, and lesser-known brands Vivo and Oppo. In addition to the Social Studio data, brand equity estimates were available from Interbrand's (2024, 2023) Best Global Brands report for the Apple, Samsung, and Xiaomi names. The brand equity for Vivo and Oppo would be considerably lower, and we plugged in a number for each midway between Xiaomi's value and zero.

Preliminary variable correlation analytics were run using SAS Viya visual analytics software, allowing rapid comparison of the explanatory value of all statistics and easy variable manipulation of identified candidates for additional testing. Note the results are *very preliminary* as the sample is quite small. But the initial insights can then be applied in wider and more statistically significant manner in future studies.

3. Results and Discussion

Initially, we performed a correlation analysis on each of the available variables in the model. These included:

- Brand equity (dependent variable)
- Volume of digital media activity
- Volume range
- Sentiment (positive)
- Sentiment range
- Influencer index (1-100, higher is more influential)
- Twitter volume
- Twitter range
- YouTube volume
- YouTube range
- Forum volume
- Forum range

While the full correlation matrix was obtained and reviewed, we'll only report on the correlation of each variable to the brand equity value the exercise is meant to estimate. These results are included in Table 1.

As indicated, strong positive correlations are seen with the Volume, Twitter, and, to a lesser degree Influencer variables. The Volume and Influencer results are in line with expectations coming into this analysis. The Twitter

result was more surprising. But the initial conclusion is that digital media volume, influential influencers, and Twitter (now X) attention are related to strong relational capital. Strong negative correlations are seen with Sentiment, Twitter range, YouTube range, YouTube volume, and, to a lesser extent, Forum range. This also agrees with previous research indicating high equity brands tend to have less extreme feelings (sentiment) but more steady, neutral reactions. The digital media results were less expected but may also indicate more stability (all three ranges) and less YouTube volume (for no obvious reason).

Table 1: Correlation Results

Variable	Correlation with Brand Equity	Regression	Neural Network
		R^2 = .8908 **ASE** = 2296.3	**ASE** = 0.098
Intercept		-830.62 (.062)	
Volume of digital media activity	0.607	.003 (.206)	
Volume range	0.309	.011 (.198)	
Sentiment (positive)	-0.639	973.5 (.111)	
Sentiment range	-0.138	1205.8 (.152)	
Influencer index (1-100, higher is more influential)	0.398	-1.23 (.018)	
Twitter volume	0.694	330.6 (.118)	
Twitter range	-0.713	-674.8 (.432)	
YouTube volume	-0.498		
YouTube range	-0.516		
Forum volume	-0.239		
Forum range	-0.414		

The table also includes results from a linear regression including the all the variables except the less correlated digital media platforms (YouTube, Forums). Regression adds the ability to see the impact of each variable on the predicted value of brand equity, its statistical significance, and how the explanatory variables work together rather than in isolation.

Before analyzing the regression results, it's important to stress once again that the sample is very small, so any statements about the outcomes in general or statistical significance in particular need to be made with some care. There is not enough data to make confident predictions or to discern fine distinctions. The point of this more exploratory work is to identify potentially interesting variables for future work with bigger, intentional data sets.

Initially, note the results are presented with the coefficient for each item first, with the p value in parentheses. Which also raises a caution about the coefficient as it may be misleading in terms of magnitude and size with relation to the dependent variable—in a complex regression of this sort, with potential between-variable correlations among the many variables, the coefficients would not have the interpretive meaning of a slope in a more simple equation. As a predictive model is refined, we may be able to overcome this aspect in time. But for now, the size and magnitude of the coefficients can't be trusted (collinearity), even if we do include them.

The intercept term is both large and has the second lowest p-value (second highest significance), something that would likely be a concern in a different setting. One typically doesn't want a lot of the equation's explanatory power in the constant. But, again, in a small sample exercise, one can take the result as just part of making the equation work and leave the more rigorous interpretations for future study.

Of the variables, the one with the largest p-value significance is Influencers, at a 98% confidence level. Influencers does have a negative sign for the coefficient but that doesn't match up with what the correlation matrix tells us and makes little intuitive sense. The relative importance of the variable, however, is clear. The next highest p-value significances were Sentiment (positive) and Twitter Volume, at the 89% and 88% levels, respectively. The coefficients both make little intuitive sense, predicting single unit changes in these variables corresponding to hundreds of billions of dollars in valuation, but the Twitter variable at least agrees with the correlation result in sign. That case is similar to what we see with a fourth variable, Sentiment Range, with p-value matching an 85% confidence level but a wacky coefficient value.

The overall quality of the regression is quite good, with an R^2 of .8908, explaining 89% of the variation in brand equity. Average Squared Error (ASE) is also reported, a quality metric of prediction error whose importance will become clear shortly. So, in summary, the regression shows good fit with these variables, even with such a small sample. Moreover, we can identify some key variables that might merit further study, specifically Influencers, Sentiment, Twitter Volume, and Sentiment Range.

A different way to take a preliminary statistical look at the data is to apply an AI approach with a Neural Network. The SAS Viya software performs this analysis easily, grouping the initial variables into new predictors based on iterations to identify the best way to include and weight the inputs for maximum predictive capability. While the underlying relationships are complex and difficult to fully describe, the interactions of the variables uncovered by the analysis can be used to substantially amplify the predictive power. A neural network does provide a straightforward overall quality score and a sense of which variables are most important to the predictive power of the analysis. A visual of what this result looks like within the software is included in Figure 1.

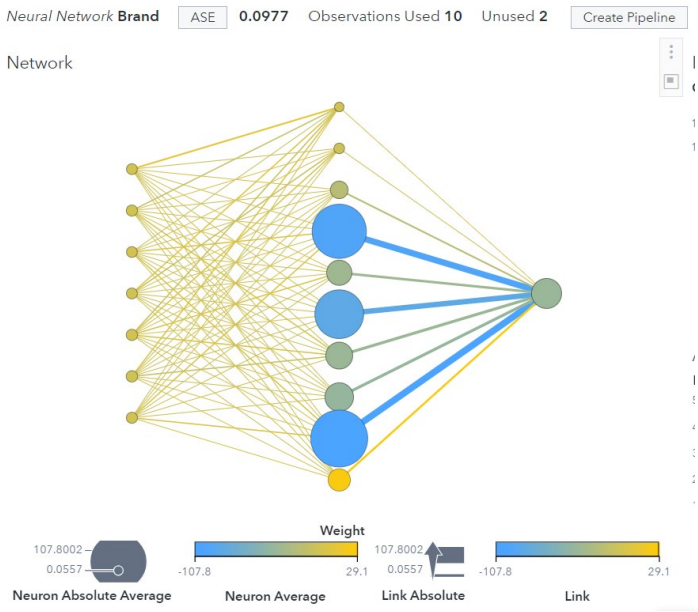


Figure 1: Neural Network Structure

As indicated in the figure, the individual original variables all feed into the newly constructed variables. These latter variables have different levels of correlation with the dependent variable, with the three coded blue showing a strong relationship. Again, we don't know how the original variables specifically fit into these most important constructed variables, but the system has uncovered the manner in which to arrange them and their interconnections in a manner such that the constructed variables have a high degree of predictive power. The quality metric of the overall equation is quite high, an average squared error (ASE) of only 0.0977. Note that figure in relation to the regression ASE of 2296.3, a much lower error rate is obtained with the Neural Network approach.

Further, although we don't have detailed specifics about the relationships between the original variables and the constructed variables, we do have some metrics on relative importance available if we use SAS Viya's Model Comparison feature (Figure 2). While we had already drawn some conclusions from the regression output itself about variable impact, the model comparison shows Influence and Sentiment Range as the most important inputs with all aspects of the process included. These were two of the top four in the discussion above, but the model comparison draws on additional details to isolate the most important contributors. These variables are further validated and even more emphasized in the Neural Network model (note the darker shade of blue). Whatever their relationship with the key constructed variables, these two are the most impactful original variables in a model with high predictability.

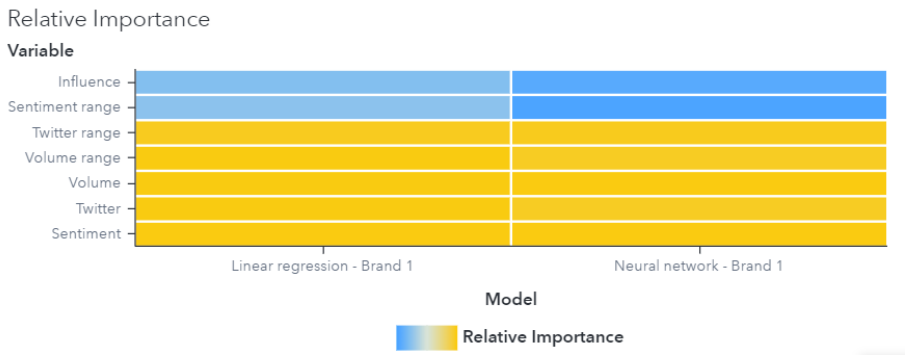


Figure 2: Model Comparison

What we're left with is a much better idea of what the key variables available from sentiment analysis might be, confirmed by a more quantitative approach. Influence, what other widely followed individuals/sites might interact with the brand, and Sentiment Range, how much brand sentiment varies (probably less variation, the higher the brand equity), appear to be the variables on which to focus more research. With more data, bigger sample studies, and other approaches, we can use these initial results to uncover a reliable relational capital metric.

4. Conclusions

This paper reports on initial work to quantify and structure variables that might reliably predict relational capital in organizations. An increasingly important part of firms' intellectual capital holdings, relational capital remains an understudied area in the field.

Using available data on brand equity, a closely related concept to relational capital, we used additional data gathered through the Social Studio sentiment analysis program. Although a very small sample and not statistically reliable in any way, the data are useful to provide initial confidence in concept validity and direction for future research. Previous studies, using data but more qualitative in analysis, had identified some key variables associated with high brand equity/relational capital. These included volume of digital media activity, brand sentiment and sentiment variability, influencers, and, potentially, activity on individual digital platforms.

This analysis used SAS Viya, both regression and neural network modeling, to plug these variables into a more advanced, quantitative analytical framework. The regression results were interesting and surprisingly powerful (high R^2) though the amount of collinearity in the high number of variables limited the ability to make assumptions on individual impact beyond significance. The neural network provided surprisingly impressive results, with a very high level of predictive power. The details of the constructed variables the neural network AI provided are opaque, but their reliability is quite high, with an error rate magnitudes lower than the already high R^2 regression results.

What the indicates is that there is a strong statistical relationship present, apparent even in a model with low statistical reliability. The neural network provides initial guidance to ferreting out this relationship and confirms there is something powerful to be uncovered. A significant, reliable predictive model is apparently available to be found.

References

Aaker, D. A. (1996). *Building strong brands*. The Free Press.
Aaker, D. A. (1991). *Managing brand equity.* New York.
Ackoff, R. (1989). From data to wisdom. *Journal of Applied Systems Analysis, 16*, 3–9.
Aliwadi, K.L., Lehmann, D.R. & Neslin, S.A. (October 2003). "Revenue premium as an outcome measure of brand equity". *Journal of Marketing*. *67*(4), 1–17.
Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, *17*(1), 99-120.
Bontis, N. (1999). Managing organizational knowledge by diagnosing intellectual capital: Framing and advancing the state of the field. *International Journal of Technology Management, 18*(5-8), 433-462.
Chang, A. & Tseng, C-N. (2005). Building customer capital through relationship marketing activities: The case of Taiwanese multilevel marketing companies. *Journal of Intellectual Capital, 6*(2), 253-266.

de Castro, G.M., Saez, P.L. & Lopez, J.E.N. (2004). The role of corporate reputation in developing relational capital. *Journal of Intellectual Capital*, *5*(4), 575-585.

Edvinsson, L. & Malone, M. (1997). *Intellectual capital*, Harper Business.

Erickson, G.S. (2023). Assessing technology brands with digital media. In Kucharska, W. & Lechman, E., eds., *Technology Brands in the Digital Economy*, Routledge: London.

Erickson, G.S. & Rothberg, H.N. (2023). Relational capital & media brands. In *Proceedings of the 24th European Conference on Knowledge Management*, Lisbon, Portugal, 369-376.

Erickson, G.S., Schmidt, J. & Rothberg, H.N. (2020). Relational capital: Knowledge assets and branding. *Proceedings of the 21st European Conference on Knowledge Management*, Coventry, UK, 263-269.

Erickson, G.S. & Rothberg, H.N. (2017). Digital media and relational capital. *Proceedings of the 18th European Conference on Knowledge Management*, Barcelona, Spain, 303-309.

Fagundes, L., Munaier, C. & Crescitelli, E. (2023). The influence of social media and brand equity on business-to-business marketing. *Revista de Gestão*, 30(3), 299-313.

Grant, R.M. (1996). Toward a knowledge-based theory of the firm *Strategic Management Journal*, *17*(Winter), 109-122.

Gupta, M. & Bhasin, J. (2014). The relationship between intellectual capital and brand equity. *Management and Labour Studies, 39*(3), 329-339.

Interbrand (2024, 2023). https://interbrand.com/best-brands/, accessed March 1, 2024.

Kaplan, R.S. & Norton, P.D. (1992). The balanced scorecard—Measures that drive performance. *Harvard Business Review, 70*(1), 71-79.

Keller, K.L. (1993). Conceptualizing, measuring, and managing customer-based brand equity. *Journal of Marketing*, *57*(1), 1-22.

Kurtz, C.F. & Snowden, D.J. (2003). The new dynamics of strategy: Sensemaking in a complex-complicated world. *IBM Systems Journal*, *42*(3), 462-483.

Lechman, E. (2017). *The diffusion of information and communication technologies*. Routledge.

Levy, M. (2009). Web 2.0 implications on knowledge management. *Journal of Knowledge Management*, *13*(1), 120-134.

McDowell, A., Jonas, B., Braun, A., Roussaky, M., Covoto, T. & Dilmaghani, S. (2023). *Measuring brand equity with public and social media data*. Strategy& (PwC), https://www.strategyand.pwc.com/lu/en/insights/brand-equity-with-public-and-social-media-data.html, accessed 1/30/2024.

Nonaka, I. & Takeuchi, H. (1995). *The knowledge-creating company: How Japanese companies create the dynamics of innovation.* Oxford University Press.

Pulic, A. (2000). VAIC—An accounting tool for IC management. *International Journal of Technology Management*, *20*(5-7), 702-714.

Rizun, N. & Kucharska, W. (2018). Text mining algorithms for extracting brand knowledge: The fashion industry case. *Proceedings of the 31st International Business Information Management Association Conference.*

Roos, J. & Roos, G. (1997). Measuring your company's intellectual performance. Long Range Planning, *30*(3), 45-62.

Rothberg, H.N. & Erickson, G.S. (2017). Big data systems: Knowledge transfer or intelligence insights. *Journal of Knowledge Management*, *21*(1), 92-112.

Rovai, A. P. (2002). Sense of community, perceived cognitive learning, and persistence in asynchronous learning networks. *The Internet and Higher Education*, *5*(4), 319–332.

Seggie, S.H., Kim, D., & Cavusgil, S.T. (2006). Do supply chain IT alignment and supply chain interfirm system integration impact upon brand equity and firm performance? *Journal of Business Research*, *59*(8), 887–895.

Sigala, M. & Chalkiti, K. (2014). Investigating the exploitation of web 2.0 for knowledge management in the Greek tourism industry: A utilisation-importance analysis. *Computers in Human Behavior*, *30*, 800-812.

Stahle, S. & Stahle, P. (2013). Towards measures of national intellectual capital: an analysis of the CHS model. *Journal of Intellectual Capital*, *13*(2), 164-177.

Sussan, F. (2012). Consumer interaction as intellectual capital. *Journal of Intellectual Capital*, *13*(1), 81-105.

Teece, D.J. (1998). Capturing value from knowledge assets: The new economy, markets for know-how, and intangible assets. *California Management Review*, *40*(3), 55-79.

Tobin, J. & Brainard, W.C. (1977). Asset markets and the cost of capital. In Fellner, W., Balassa, B.A. & Nelson, R.R., Eds., *Economic progress, private values and public policy, Essays in honor of William Fellner*, North-Holland Publishing Company, 235-262.

Wernerfelt, B. (1984). The resource-based view of the firm. *Strategic Management Journal*, *5*(2), 171-180.

Trust is a Factor Determining the Sharing of Knowledge Among Employees of Modern Organizations

Joanna Gajda
Częstochowa University of Technology, Częstochowa, Poland

joanna777gajda@vp.pl

Abstract: In the conditions of a knowledge-based economy, the basic and necessary factor responsible for the transfer of this resource is organizational trust. Organizational trust triggers employees' willingness to cooperate to share knowledge. Without trust in the work environment, skepticism and reluctance to participate in the exchange of knowledge prevail among employees, which makes it difficult to use it in everyday activities. **Aim.** The aim of the article is to examine the relationship between trust and knowledge sharing due to the importance of these factors in building organizational effectiveness. **Method.** Quantitative research was carried out in Poland using the CAWI method. In order to carry out the research, an original survey questionnaire was prepared and distributed to respondents via the Internet. The research group consisted of 358 people. **Results:** The research results revealed differences between the socio-demographic characteristics of research participants and the factors of trust in the management staff and members of the employee team that favor knowledge sharing. **Conclusions:** The research results expand knowledge of the conditions that should be met in an organization so that its members can gain confidence in sharing knowledge. Knowledge obtained from the analysis of own research results may be useful for the organization. It allows you to increase your superiors' awareness of the need to make efforts and take actions to build trust among employees.

Keywords*:* Trust, Sharing Knowledge, Managers, Employee Team

1. Introduction

In a knowledge-based economy, knowledge resources are of great importance for the efficient functioning of an organization. Skillful management increases the transparency of all activities. Processing and transferring knowledge prevents it from shrinking, and what's more, it increases knowledge (Bulińska-Stangrecka,2018). The efficiency of information flow depends on the attitudes adopted by employees. In an atmosphere of mutual support, cooperation and openness to the exchange of knowledge, bonds and trust between team members are developed. The article is of a theoretical and empirical nature. The first part explains the essence of organizational trust and characterizes the concept of knowledge sharing. Next, the research methodology is described and its results are presented. The aim of the study is to analyze the relationship between the factors of trust in the superior and team members and the socio-demographic characteristics of the study participants. The presented research results provide knowledge about the conditions that the organization must meet towards employees in order to make them trust in sharing knowledge.

2. Literature Review

2.1 The Essence of Organizational Trust

Effective solution of problems that a team of employees has to face requires access to information and its rapid flow. In order to expect a positive result in this respect, trust between the members of the organization is necessary. Some of its employees sometimes find it hard to believe that they can trust someone. In order to convince ourselves and others that trust enables people to achieve common goals, it is necessary to build it within the organization.

When considering the concept of organizational trust, it can be related to the general assessment of the organization in terms of caring for its internal stakeholders, being honest and open towards them, creating the opportunity to identify with it. Trust in the organization is associated with the belief that the organization conducts its activities effectively in order to increase the level of satisfaction of its employees with their duties (Rudziewicz, 2017).Trust is built based on the quality of work and the authority of the manager. By paying more attention to building trust, it inspires employees to take action, increasing their level of commitment to everyday duties. This approach to subordinates allows them to believe in their abilities, personal potential, as well as talents and passion for the profession. Trust contributes to increasing employee loyalty, efficiency and shaping a positive attitude towards the company if their superiors actively participate in building a climate of trust, focusing on expanding their managerial competences, creating relationships based on truth and values, and communicating good will towards ordinary employees (Rudziewicz, 2016).Trust is compared to an important

relationship between an employee and his or her superior, in which both parties undertake to fulfill the obligations imposed on them by the employer. Organizational trust concerns the mutual fulfillment of their obligations by the parties involved in the interaction (Kapuścik, 2015).It can be present in a horizontal and vertical arrangement. Horizontal trust occurs among people cooperating in the workplace when they work at the same organizational level. Vertical trust occurs when there are relationships between employees and their superiors, top management and their superiors, or members of the entire organization (Bugdol, 2010).Good management of an organization should come down to fulfilling the integration function between all its members. Good management is about maximizing the company's value, communicating and fulfilling promises to employees, and enabling them to identify with the workplace. Trust is achieved by building good relationships between team members and between the manager and employees (Józefowicz, 2015).The bond makes employees feel greater trust in other members of the organization and engage in the process of mutual implementation in joint work, contributing to building internal motivation to achieve greater work efficiency. Companies' activities aimed at bringing employees closer to achieving this goal should contribute to strengthening organizational trust, which, according to the authors of the Organizational Trust Index, means "the ubiquitous belief that the organization in its communication and behavior is competent, open and honest, committed, reliable and deserving of identification with its goals, norms and values" (Shockley-Zalabak et al, 2010). Based on previous research in the field of management sciences, it is indicated that the level of organizational trust depends, among others, on the mutual interactions that take place between organization members, the effectiveness of communication, employee competences and their motives (Bulińska-Stangrecka).Certainly, management behavior, regardless of management level, has a major impact on the development of organizational trust. Undoubtedly, what is important is the tendency to express empathy towards others, to genuinely show respect for each other, and to ensure compliance with the principle of fair treatment of employees in various situations that occur in the workplace (Józefowicz, 2015).

2.2 Sharing Knowledge - Characteristics of the Concept

Modern organizations achieve success on the market in a dynamically changing reality thanks to knowledge about the market, potential and commitment of employees for the efficiency of their operations. These factors are directly or indirectly related to knowledge. Perceiving knowledge as a determinant of the efficient functioning of the organization results from the experience and skills of employees and constitutes a serious challenge for the organization on the way to growth. C. Sołek emphasizes, following Bagshaw, that if knowledge is not translated into action, it will not be used correctly and continuously, and therefore it will not bring benefits to the organization. In order for it to be considered a company resource, a special role is played by those members of the organization who take part in its creation and transfer (Sołek, 2012).If there is a belief in the existence of individual or team knowledge and it is possible to recognize who has it, it is said that the organization has conditions for sharing knowledge. Sharing knowledge in an organization is, according to J. O. Paliszkiewicz, a process consisting in making information available to employees who need and seek it, or the flow of knowledge between co-workers or teams of employees within the company (Paliszkiewicz, 2007). Therefore, sharing knowledge is two-sided and interactive, during which people who decide to participate exchange it with each other. As S. Spałek and his colleagues note after M. Ipe, "the person transmitting knowledge does so consciously and voluntarily, at the same time relinquishing ownership of the knowledge in favor of sharing it with the recipient and with the intention that it will be understood, assimilated and used appropriately by him" (Spałek et al, 2018). Therefore, sharing knowledge leads to the acquisition of new knowledge or the effective application of existing knowledge (Flaszewska, 2019). According to G. von Krogh, by sharing knowledge one can notice a change in the level of knowledge and behavior of people who disseminate it and who can use it (Rudawska, 2013).

3. Methodology

The aim of the study was to verify the relationship between organizational trust factors and knowledge sharing in Polish organizations . It was checked what factors of trust in the superior and team members influence decisions about the willingness to share knowledge for the organization in which they are employed. Relationships were determined between the answers provided by respondents and their characteristics in terms of gender, age, seniority and size of the organization. Respondents from all over Poland took part in the study. The research was conducted in the first quarter of 2023 using online technology, anonymously. The CAWI method used a survey questionnaire sent to respondents via the Internet to answer the questions. Ultimately, the research group consisted of 358 people. The characteristics of the study sample are presented in Table 1.

Table 1: Characteristics of the research group

Features of the study group		N	%
Gender of employees	females	188	52,5
	males	170	47,5
	SUM	358	100
Seniority	Up to 1 year	6	1,67
	2-5 years	33	9,21
	6-15 years	115	32,12
	16-25 years	91	25,41
	26 and more	113	31,56
	SUM	358	100

Source: own study

χ2 independence tests were performed for the given research sample. The level of statistical significance was assumed to be $p<0.05$. The calculations were performed with the statistical program STATISTICA 13.3 by Statsof. Based on the study, it was assessed which factors of trust in the superior and members of the employee team translate into the willingness to participate in the exchange of knowledge with members of the organization. Additionally, the aim of the study was to determine whether the nature of the answer to the question depends on the socio-demographic characteristics of the surveyed group.

For the purposes of this study, the following research hypotheses were formulated and verified:

1. Socio-demographic factors of respondents differentiate their answers to the question: what attitudes and behaviors do superiors demonstrate to strengthen employees' trust in sharing knowledge?
2. Factors in the dimension of the characteristics of the employee team determine the involvement of employees in the exchange of knowledge and are closely related to the socio-demographic characteristics of the respondents participating in these studies.

4. Results

Building employee involvement in sharing knowledge is one of the challenges for direct superiors of modern organizations, because the effectiveness of activities in this area largely depends on them. One of the foundations of a supervisor's success is gaining the trust of employees.

In order to verify H1, the correlations were examined between the respondents' answers in the context of specifying the factors of trust in the superior, which are intended to inspire them to share knowledge, and the respondents' socio-demographic factors. It is essential that managers have the willingness and appropriate competences to provide employees with opportunities to be active in the exchange of knowledge. What conditions managers in Polish organizations create to gain employees' trust and encourage them to share knowledge are shown by these research results, which are included in the tables below. This hypothesis was largely confirmed.

Table 2: Relationships between trust factors in the superior that influence knowledge sharing and the gender of the respondents

Supervisor's behavior that inspires trust among employees to share knowledge	Sex %		The value of the statistic	
	Women	Men	Chi2(χ2)	p
Encourages maintaining good relationships between team members	50,96	49,04	0,935	0,333
Builds a sense of shared responsibility for achieving goals	50,58	49,42	13,174	0,000
Individual approach to the employee, interest in his opinion	50,16	49,84	6,926	0,008
Inspires employees to act and achieve goals in line with his expectations	54,85	45,15	1,537	0,214

Supervisor's behavior that inspires trust among employees to share knowledge	Sex %		The value of the statistic	
	Women	Men	Chi2(χ2)	p
Reliably and sympathetically assesses employees' efforts and work results	46,79	53,21	16,910	0,000
Helps employees develop and professional career	51,43	48,57	7,399	0,006
Initiates contacts with team members after work	49,28	50,72	0,359	0,548

Source: own study

The results of testing the relationship between the supervisor's attitudes and behaviors listed in the table above and the respondents' gender indicate in four cases a positive, statistically significant relationship between the variables ($p<0.05$). This means that the observed distribution of observations within variables 2,3,5,6 depends on the variable gender. The Chi2 test result showed differences between women and men in relation to these variables. Women are more likely to notice the above-mentioned competencies of the superior, which constitute the foundation of trust in sharing knowledge based on which the organization can function efficiently in a competitive environment. The position expressed by women regarding the tendencies shown by superiors to build a sense of co-responsibility for achieving goals proves the desire to build trust in it by positively motivating employees to work, encouraging them to actively participate in the exchange of knowledge and experiences, and presenting different points of view. Such involvement of employees in common successes becomes profitable for the organization, as it brings positive results, especially in the form of integration of team members, looking for ways to reach each other, and building awareness of conscientious fulfillment of one's duties. The summary of superiors' behavior also shows that an individual approach to an employee and interest in his opinion are very important for women; reliable, sympathetic assessment of employees' efforts and results. It can be concluded that superiors use such methods of approaching women to build trust in them and encourage them to take initiatives to exchange knowledge. Men believe significantly more often than women that providing employees with access to development and support in their professional career can have a positive impact and constitute an incentive to participate in the knowledge sharing process.

Table 3: Relationships between trust factors in the supervisor that influence knowledge sharing and the respondents' work experience

Supervisor's behavior that inspires trust among employees to share knowledge	Seniority					The value of the statistic	
	up to 1 year	2-5 years	6-15 years	16-25 years	26 and more	Chi2(χ2)	p
Encourages maintaining good relationships between team members	2,30	7,28	32,57	27,59	30,27	8,507	0,074
Builds a sense of shared responsibility for achieving goals	1,74	9,59	33,43	24,71	30,52	11,030	0,026
Individual approach to the employee, interest in his opinion	1,87	10,28	29,28	27,10	31,46	15,764	0,003
Inspires employees to act and achieve goals in line with his expectations	1,27	1,27	40,51	23,63	33,33	65,728	0,000
Reliably and sympathetically assesses employees' efforts and work results	2,14	11,79	37,86	21,07	27,14	41,534	0,000
Helps employees develop and professional career	1,71	8,57	31,43	26,00	32,29	14,251	0,006
Initiates contacts with team members after work	0,00	31,88	47,83	5,80	14,49	76,471	0,000

Source: own study

The above results indicate that there is a significant statistical relationship between seniority and virtually all factors of trust in the superior that facilitate knowledge sharing. The only exception is factor 1, which does not differentiate the respondents' statements. It can be noticed that work experience in the range of 6 - 15 years differentiates the respondents most strongly in terms of trust in their superior in the context of sharing

knowledge if he or she displays behaviors characteristic of variables 2, 4, 6, 7. It should be assumed that superiors, out of concern for the activity of employees with longer work experience, expect them to share responsibility for achieving goals. This may result from the need to build awareness among employees that they are a key part of the organization, the success of which depends on their willingness to work and their involvement in acquiring the knowledge necessary to perform their duties at the workplace. When a superior inspires employees to take actions related to sharing knowledge and therefore achieving goals in line with his expectations, he can make them willing to be open to taking up challenges and overcoming the difficulties resulting from them. In the case of long-term employees who have proven their professionalism and enjoy a strong position in the workplace, the superior uses other motivators to encourage the sharing of knowledge, such as: initiating contacts with team members after work and offering help and support in career development.

Employees with 26 years of experience and more have great trust in their superiors and are willing to share knowledge if their superiors demonstrate behavior towards them consisting of: an individual approach to the employee, interest in his or her opinion, and when he or she helps in professional development. It follows from the above that employees have the right to trust their superior because he is aware of their competences and can count on better use of their potential.

Comparing the differences in the statements of employees with short work experience - a maximum of 5 years, it should be noted that with its increase confidence in sharing knowledge increases if the superior helps build it.

In order to verify H2, the relationships between the analyzed variables in the research area regarding trust factors in co-workers and the socio-demographic characteristics of the respondents were examined. Trust in the employee team has a positive impact on the work efficiency of its members and the quality of cooperation between them in terms of engaging in knowledge exchange. What conditions must be met in a team so that its members are willing to share the necessary knowledge that the company needs to increase its chances of achieving business goals? The answers to this question are provided by the results obtained from this research, which are presented in the tables below. The results presented therein show that in most cases there is a statistically significant correlation between the analyzed variables and inform that this research hypothesis is true.

Table 4: Relationships between the factors of trust in members of the employee team, conducive to knowledge sharing, and the gender of the respondents

Actions of team members that build trust in sharing knowledge	Sex %		The value of the statistic	
	Women	Men	Chi2(χ2)	p
Willingness to help each other	52,86	47,14	0,060	0,805
The team creates favorable conditions for fulfilling one's ambitions	49,06	50,94	5,014	0,025
Mutual appreciation of experience and knowledge	62,45	37,55	25,136	0,000
Openness to understanding the needs and problems of team members	62,95	37,05	26,119	0,000
Openness to new solutions and ideas	52,92	47,08	0,103	0,747
Openness to expressing one's own opinions and views	57,87	42,13	10,073	0,001

Source: own study

Based on the obtained research results, it was observed that women are significantly more likely than men to gain confidence in sharing knowledge if the team is characterized by the following features: mutual appreciation of experience and knowledge; openness to understanding the needs and problems of team members; openness to new solutions and ideas. Men are more inclined to exchange knowledge if the conditions in the team are conducive to fulfilling their own ambitions.

Table 5: Relationships between the factors of trust in members of the employee team, conducive to sharing knowledge, and the work experience of the respondents

Actions of team members that build trust in sharing knowledge	Seniority					The value of the statistic	
	Up to 1 year	2-5 years	6-15 years	16-25 years	26 and more	Chi2(χ2)	P
Willingness to help each other	2,14	10,00	31,79	23,21	32,86	5,707	0,222
The team creates favorable conditions for fulfilling one's ambitions	0,00	10,49	25,84	32,21	31,46	51,395	0,000
Mutual appreciation of experience and knowledge	0,00	3,06	37,12	26,20	33,62	42,765	0,000
Openness to understanding the needs and problems of team members	2,68	5,80	29,02	36,61	25,89	48,522	0,000
Openness to new solutions and ideas	1,37	10,65	29,55	24,05	34,36	12,513	0,013
Openness to expressing one's own opinions and views	2,36	9,06	34,65	27,17	26,77	11,625	0,020

Source: own study

In terms of the work experience variable, statistically significant positive correlations ($p<0.05$) were revealed in relation to all trust factors towards the employee team, except point 1. Employees with 16-25 years of experience engage in knowledge exchange significantly more often than other respondents if the conditions in the team are conducive to fulfilling their own ambitions. People with 6-15 years of work experience are more willing to share knowledge when their experiences and knowledge are appreciated and they are open to expressing their own opinions and views.

Employees with long work experience (26 years and more) are significantly more likely to express readiness to share their knowledge with others if the team is open to new solutions and ideas.

5. Discussion

The research hypotheses set out in the article were confirmed and allowed to expand knowledge about the described issue. Based on the obtained research results, it can be concluded that there is a relationship between the analyzed factors of trust in the superior and members of the employee team in the context of knowledge sharing, and the socio-demographic characteristics of the respondents participating in the study. The research results clearly indicate differences between genders in the level of trust in the superior resulting from his positive attitude and behaviors that encourage sharing knowledge. Women's trust in the exchange of knowledge within the organization is greater than that of men and is the result of the attributes possessed by the superior. One example to support the above statement is the concept of Pamela Shockley-Zalabak, Kathleen Ellis and Gaynelle Winograd (2000), which shows that management staff is more effective when they demonstrate skills, demonstrate openness, honesty, concern for employees and approach the performance of their duties reliably.

It can be concluded from this that women are more willing to share ideas, knowledge and experience when they are led by a leader who creates an atmosphere of trust by being open to subordinates. When a highly inspiring supervisor guides them on their way to achieving their professional goals and behaves freely, it triggers the desire to cooperate and maintain better relationships with each other, so that they want to work more productively.

Moreover, research indicates that men have significantly greater trust in their superiors when they reliably and sympathetically assess employees' efforts and work results. The results obtained from the research are consistent with the research of other authors regarding the impact of employee trust on knowledge sharing. In the context of key factors in relation to the discussed issue, it is possible to point out the current results of analyzes confirming the relationship between management support and employee participation in knowledge exchange. A. Cabrera, W.C. Collins, J.F. Salgado (2006) draw attention to the importance of the role that management is to play in building employee involvement in active participation in this process. Moreover, they emphasize that they should influence employees' positive perception of the importance of activities aimed at mutual transfer of knowledge that the organization needs.

Hsiu-Fen Lin and Gwo-Guang Lee (2004) emphasize that support from management is a necessary condition for shaping an organizational culture conducive to the effectiveness of these activities.

Based on the obtained research results, it can be concluded that the seniority of the respondents clearly differentiate their trust in the management regarding the behavior encouraging their subordinates to share knowledge. Employees with 6-15 years of work experience and 26 years or more of experience have significantly greater trust in their superiors. They are not newly employed, which means that, compared to other groups of employees, they may be more mature and aware of the competencies that a superior should have to make them trust in carrying out activities requiring cooperation in the workplace.

The results of previous research emphasize the role of trust as a factor supporting the improvement of the quality of the relationship between the superior and the subordinate, which is reflected in the mechanism of social exchange. The principle of reciprocity is at the basis of social exchange, and the employee, guided by it, should, in gratitude for the support shown to him, including the actions of his superior, creating conditions for the fulfillment of professional duties, repay him by actively participating in the exchange of knowledge for its application in real situations (Wnuk, 2020). To meet the organization's requirements and demonstrate loyalty to it, employees have specific expectations of management. They require positive attitudes and behaviors towards them, helping to create trust that determines the effective sharing of knowledge within the organization.

Based on the results obtained, it should also be noted that there are positive relationships between the analyzed socio-demographic factors and trust in members of the employee team. Women declare a higher level of trust in the team and, therefore, a greater participation in the exchange of knowledge, if colleagues appreciate their experiences and knowledge, there is openness in the team to understand the needs and problems of team members and the ability to express their own views. Men have a higher level of trust in the work team if the conditions in it are conducive to fulfilling their own ambitions. When assessing individual aspects of trust in the team, employees with experience are significantly more likely to engage in knowledge exchange: 6-15 years of work (mutual appreciation of experience and knowledge; openness to expressing one's own opinions and views), 16-25 years of work (the team creates favorable conditions for fulfilling one's ambitions; openness to understanding the needs and problems of team members), 26 and more years of work (openness to new solutions and ideas). These results are consistent with other studies cited in the literature review (Biesok, 2013), which show that women have a higher level of trust in their colleagues, which makes them willing to share knowledge with them. A similar position is expressed by people with greater work experience. They point to several reasons for active participation in knowledge exchange, resulting from trust in colleagues: they enjoy the recognition of their colleagues, they have the opportunity to implement their ideas in the team, their involvement is appreciated. A low level of trust occurs among young people with short work experience. They are reluctant to share knowledge due to low job satisfaction, poorer cooperation and lack of recognition in the team.

6. Conclusions

The aim of the research was to determine the impact of socio-demographic factors on employees' tendency to trust management staff and co-workers, which determines the willingness to engage in active participation in the exchange of knowledge necessary in everyday work. The research results revealed differences between the characteristics of research participants and the factors of trust in other members of the organization. In order for employees who are research participants to trust them, certain conditions must be met that create an atmosphere conducive to strengthening the relationship between them. It follows that people will be willing to share their knowledge when their expectations are met by other members of the social interaction. The formation of organizational trust is influenced by the attitudes and behaviors displayed towards others, which result from having specific competences. Trust also appears when the person from whom it is expected is characterized by kindness, openness, reliability, and concern for others.

Taking into account the limitations resulting from the conducted research, it was found that the majority of study participants assessed a high level of trust in their superiors and the employee team thanks to the attitudes and behaviors they demonstrated (factors that build trust in sharing knowledge) proving their involvement in the process of including other employees in activities related to the knowledge sharing process. The author faces the challenge of conducting research on the impact of respondents' characteristics on trust in knowledge exchange in organizations due to their size, on a representative sample using a more extensive measurement tool.

References

Cabrera A., Collins, W.C., Salgado, J.F., (2006) Determinants of individual engagement in knowledge sharing, „International Journal of Human Resource Management" 17/2, pp. 245–264.

Bulińska-Stangrecka, H. (2018) Wpływ zaufania organizacyjnego na dzielenie się wiedzą w organizacjach IT, Zeszyty Naukowe Uniwersytetu Ekonomicznego w Katowicach, nr 359, p. 104.

Bugdol, M. (2010) Wymiary i problemy zarządzania organizacją opartą na zaufaniu, Wydawnictwo Uniwersytetu Jagiellońskiego, Kraków, p. 20.

Flaszewska, S. (2019) Ocena procesu dzielenia się wiedzą z perspektywy praktyków, „Przegląd Organizacji", nr 4 (951), p. 46.

Kapuścik, E. (2015) Dylematy nadużycia zaufania intraorganizacyjnego w organizacjach publicznych, „Zeszyty Naukowe WSH Zarządzanie", nr 2, pp. 140 – 141.

Lin,H.F., Lee, G.G. (2004) Perceptions of senior managers toward knowledge-sharing behaviour, „Management Decision" 42/1, pp.108–125.

Józefowicz, B. (2015) Budowanie zaufania organizacyjnego w przedsiębiorstwie, Studia i prace Wydziału Nauk Ekonomicznych i Zarządzania, nr 39, T.2, p. 197.

Józefowicz, B. (2015) Wewnątrzorganizacyjne uwarunkowania zaufania w przedsiębiorstwie w świetle badań nad pozytywnym potencjałem organizacji, p. 119, (in:) Januszkiewicz, K., Czajkowska, M., Kołodziejczak, M., Zalewska-Turzyńska M. (ed.), Zachowania organizacyjne. Relacje społeczne w przestrzeni zmian, Wydawnictwo Uniwersytetu Łódzkiego, Łódź.

Paliszkiewicz, J. O. (2007) Dzielenie się wiedzą oraz zaufanie w małych i średnich przedsiębiorstwach, Zeszyty Naukowe SGGW - Ekonomika i Organizacja Gospodarki Żywnościowej, vol., nr 62, p. 143.

Rudawska, A. (2013) Dzielenie się wiedzą w organizacjach – istota, bariery i efekty, „Organizacja i Kierowanie", nr 4, pp. 90-105.

Rudziewicz, A. (2016) Zaufanie wewnętrzne i zewnętrzne w przedsiębiorstwie, Zeszyty Naukowe Uniwersytetu Ekonomicznego w Katowicach, nr 255, p. 263.

Rudziewicz, A. (2017) Zaufanie w przedsiębiorstwie – znaczenie i pomiar, „Journal of Management and Finance", Vol. 15, No. 2/1/, p. 292.

Shockley-Zalabak, P., Ellis, K., Winograd,G. (2000) Organizational trust: What it means, why it matters, „Organizational Development Journal" 18(4).

Shockley-Zalabak, P.S., Morreale, S., Hackman, M. (2010) Building the High-Trust Organization: Strategies for Supporting Five Key Dimensions of Trust, Jossey-Bass, San Francisco, p. 12.

Sołek, C. (2012) Dzielenie się wiedzą i ochrona wiedzy w przedsiębiorstwie, Zeszyty Naukowe Politechniki Rzeszowskiej, z. 19, nr 285, p. 88.

Spałek, S., Major, P., Kowalewska, M. (2018) Wpływ wybranych czynników na dzielenie się wiedzą w projektach, Management Forum, vol. 6, no. 2, pp.28-33.

Wnuk, M. (2020) Skala Zaufania do Przełożonego jako narzędzie do mierzenia zaufania do menedżerów, Humaniora. Czasopismo Internetowe Nr 3 (31), p. 99.

A Case Study on how Space Agencies are Capitalizing on Space Projects: Lessons Learned Through Capture Events

Isabelle Gibek[1], Andrew Herd[2], Daniel Galarreta[1], Estelle Cavan[1] and Fabien Castanet[1]
[1]CNES, Toulouse, France
[2]European Space Agency, Noordwijk, The Netherlands

Isabelle.Gibek@cnes.fr
Andrew.Herd@esa.int
Daniel.Galarreta@cnes.fr
Estelle.Cavan@cnes.fr
Fabien.Castanet@cnes.fr

Abstract: The issue of effectively learning from experience through Lessons Learned (LL) is a long-standing one. Its deployment in the space sector, although more recent, is a well-established issue in the space business. Both the European Space Agency (ESA) and the French Space Agency (CNES) include Lessons Learned capitalization in their processes regarding development of orbital systems. One of the goal of these activities is to improve the risk assessment managed by the project teams, by providing them with lessons learned coming from previous projects. Management procedures, technical standards and handbooks used by the projects can also be improved as a result of the lessons capitalization. There are several steps in the capitalization process. Lessons Learned proposals need to be collected, then analyzed by experts, shared and agreed before being turned into understandable and usable lessons. Finally, these lessons need to be made available to the potential users. The first step in the capitalization is to collect the lessons, which is time consuming. People working in space projects do not usually produce lessons on their own. In order to help them, both agencies have organized Lessons Learned capture events, gathering people working on a project, and inviting them to elaborate collectively the Lessons Learned from their project experience. Attendees can come not only from the agencies, but also from their partners (for example other agencies, industrial companies). The paper deals with how ESA and CNES apply their LL processes. It especially describes the case study of capture events (preparation, typical description of an event, outcomes). The emphasis is put on the methods used both to have participants committed to the approach and to produce useful lessons. Events typical examples are given. Finally, the paper compares ESA and CNES approaches and insists on the benefits capture events can bring to Organizations.

Keywords: Space Sector, Lessons Learned, Knowledge Sharing, Cooperation, Event

1. Introduction

The issue of lessons capitalization - effectively learning from experience through Lessons Learned - is a long-standing one. Both the European Space Agency (ESA) and the French Space Agency (CNES) include Lessons Learned capitalization in their processes regarding development of orbital systems

The first step in the capitalization is to collect the lessons coming from the projects. There are several ways to do that. For example, we can analyze reports written by the projects teams, reports written by investigation committees on anomalies, anomaly sheets. But this is not enough. That is why a more collaborative approach such as capture events to collect the lessons has been put in place both at ESA and CNES.

After a brief description of the Lessons Learned processes in both agencies, the paper will focus on a case study of how ESA and CNES organize these capture events. The aim is to show what kind of methods can be applied to collect lessons, and what their respective advantages and drawbacks are.

2. Lessons Learned Processes

2.1 At ESA

The Lessons Learned (LL) process is an ESA level (corporate) implementation of the principles set out in the ESA Lessons Learned Policy.

The objectives of the Lessons Learned are to:

- Continually improve the quality and value of all the Agency's activities through improving standards, processes, tools and training;
- Identify changes needed as a result of experience in the execution of the Agency's activities, through deployment of appropriate processes and associated tools;
- Create an environment within which continuous improvement occurs.

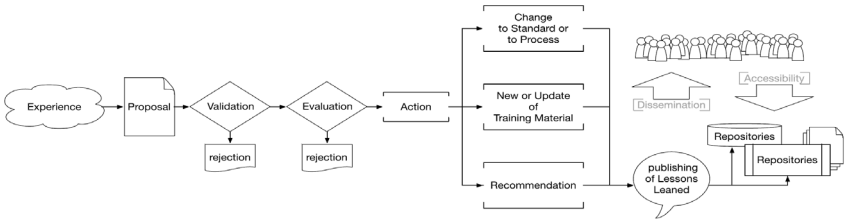


Figure 1 : Overview of ESA Lessons Learned process

The Lessons Learned process allows captured experiences, both positive and negative, to be transformed into knowledge shared for current and future use, as part of everyday practice throughout the Agency. The ESA Lessons Learned process is based on the following principles:

1. The Agency ensures effective communications and knowledge sharing throughout the organisation, including across organisational boundaries;
2. The Agency ensures that staff has access to relevant organisational experience and information;
3. No one in the Agency is excluded from proposing valuable lessons to be learned;
4. The Lessons Learned process is based on all experiences, positive and negative ones;
5. All Lessons Learned proposals are systematically screened (i.e., validated by the activity / project manager, evaluated by the ESA or Directorate level Board);
6. The Lessons Learned process is supported by appropriate tools (ESA Lessons Learned Portal**), training and resources;
7. Respective Directorate processes are aligned and comply to this Agency Lessons Learned process;
8. Actions are to be taken, following positive evaluation of a proposal, to implement proposed changes and thereby learn the lessons (i.e., Learning actions assigned to process owners to assess experience and adoption in the relevant process, its related documentation and training);
9. Originators of Lessons Learned receive feedback on their proposals;
10. The Agency ensures that approved Lessons Learned are appropriately disseminated within the organisation and that Lesson Learned records are retained and archived (ESA Lessons Learned Portal**);
11. The Agency actively promotes and supports the Lessons Learned process;
12. Confidentiality is respected where necessary, although the focus is on organisational learning.

As a lesson is not learned through its identification only, the Lessons Learned process is to be understood to involve the identification and learning of lessons as two discrete but interfacing processes:

- identification of potential lessons and their validation; and subsequently
- organisational learning of the lessons through implemented action.

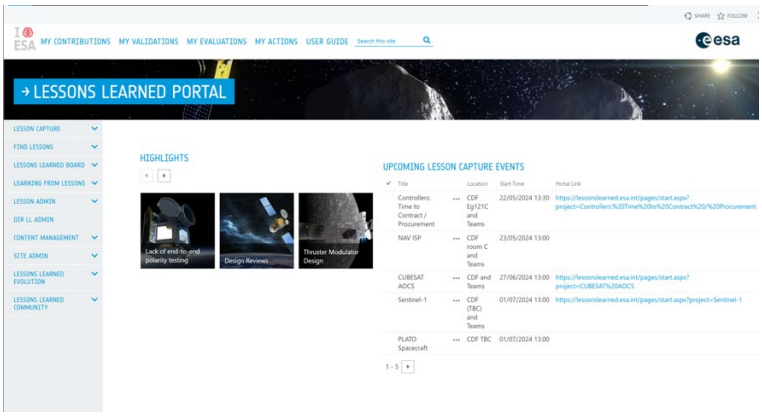


Figure 2 : Homepage of the ESA Lessons Learned portal **

Lesson identification is a process that identifies topics where experience and/or expertise need to be transferred within the Agency. Lesson identification is relevant for every aspect of the Agency's activities, but the nature of experience gained and the manner in which they are assessed, validated and disseminated may vary considerably according to organisational area and/ or domain. Proposed and dispositioned lessons are captured in an ESA central repository, the ESA Lessons Learned Portal**, which contains the history of validations, evaluations and the learning action closure of all proposed lessons, specifically:

- the context in which and a description of the experience gained;
- a proposed learning /improvement derived from the experience,
- if rejected, the justification for rejection, and if approved, the action needed for systematic learning

2.2 At CNES

The organization of the CNES Orbital Systems Lessons Learned (LL) is described in the CNES Management System, certified by ISO 9001 and ISO 14001.

The first issue of this process was written in 1996. Prior to that date, the various CNES departments operated independently regarding LL. Then, as a lesson learned, the need for centralization became obvious.

LL deals with the following topics:

- The technical outcomes of an orbital system project (for example engineering and quality),
- The operational issues at system or subsystem levels,
- The project management.

The organization is based on a LL Bureau, in charge of the technical coordination and of the LL tool management. The Bureau supports the secretariat and animation of the Comity of Return of Experience (COREX), which is a board of 20 senior experts, deciding the validation and publication of Lessons Learned. Members of the board come from the different CNES directorates, and the board covers the different kinds of orbital systems projects, and all associated technical skills. They are the LL points of contact for their respective directorates.

LL proposals are collected from different sources:

- The COREX members,
- The projects managers and their teams: the inputs coming from projects can be Anomalies, Non Conformances, quality alerts, technical Working Group and Review reports, but also End of Projects evaluations, which include LL proposals.
- Each CNES employee, who can propose LL directly through our database (Figure 3).

From these proposals, the Bureau and the COREX prepare LL sheets, completed by generic RIDs (Review Item Discrepancy), to be used by the other projects teams and reviewers, to help them better managing the risks. The goal of the LL process is also to capitalize by improving the CNES Normative System. The LL can generate change request proposals to update both the CNES Internal Standards and the applicable ECSS (European Cooperation for Space Standardization) standards.

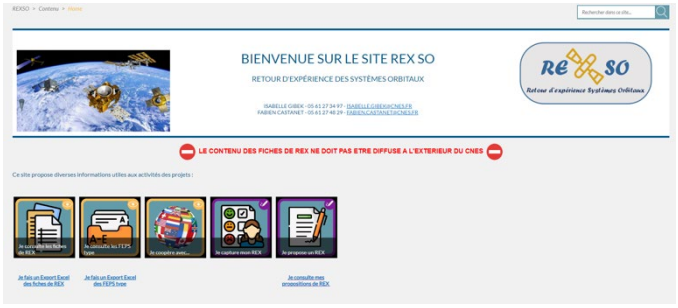


Figure 3 : Homepage of the CNES LL database, called REXSO

The LL are published in a cooperative tool: the REXSO database. Each LL sheet contains lessons and recommendations, and is pointed towards one or several generic RIDs. These generic RIDs suggest adequate questions, built from the LL sheets recommendations, to help reviewers as reminders during the project reviews. They are written both in French and English, and they depend on the project phases.

We have decided to keep a total of less than one hundred (100) active LL sheets inside the database, so that the analysis remains feasible for the projects team members, in compliance with their workload. LL sheets are regularly evaluated and archived in a backup folder, for example each time a related topic is included either in the standards or in our internal training material. The database is also used to preserve these archived LL sheets.

The projects teams only use the active LL sheets. The Bureau holds a LL kick-off meeting with the Project team at the very beginning of a project. The project team, with the help of the Product Assurance people, analyses

the potential applicability from the list of active LL sheets and selects the valuable ones. To manage the verification of conformity with these project useful selected sheets, experts are identified and tasked to take into account the associated LL. Then the conformity status is presented during the main reviews all along the project development.

CNES existing LL process has remained at internal level in the collection of lessons since many years. This is changing with a common plan to also capture and share lessons with ESA LL process, from projects developed in cooperation with integrated teams (Herd et al, 2022).

3. Capture Event

3.1 In General

There are in general, three capture techniques that could be employed by any organization to capture learning from experience. The techniques each have their strengths and weaknesses, and require different levels of investment to prepare for carry out and complete the experience capture process.

3.1.1 Interview Technique (Teams)

Team member interviews (carried out at the individual level) are a resource-intensive approach to lesson capture, but one which overcomes reluctance for team members to "speak up" during collective or group meetings, and ensures all voices are heard. This approach is a combination of an After Activity review questioning and the "Learning History" approach used at the Massachusetts Institute of Technology (MIT). The technique affords both Individual and (project) team based involvement with validation by the authorized individual. The outcome of this technique is the publication of individual lessons to be learnt and may include lesson prioritization. This technique's capture event typically has a duration spanning weeks to months and may be performed at any point within or at the end of a project.

Involvement - Individual or (project) team based collection

Validation - Individual validation

Outcome - Publication as individual lessons to be learnt

Lesson prioritization - on Team-based highest ranked learning taken from:

project objectives and outcomes, and

ranking of the key learning points (impact to the project) and,

their transferability to other projects

When to capture - no predetermined time

Capture event duration - weeks to months

Applicable time-span of lesson capture - At any point within or at the end of a project

3.1.2 After Activity Review

This technique is a short and focused meeting conducted by project teams, lasting for around 30 min. It is intended for immediate and in-the-moment learning. The After Activity Review allows for the capture of useful operational knowledge that can be discretely implemented for immediate repetition, allowing for improving performance by:

- Initiating course corrections during activities based on what is being learnt
- Addressing and optimizing a team's way of working
- Building collective operational knowledge resources

Involvement - (project) team-based lesson collection

Validation - immediate / in the moment

Outcome - immediate learning within the team

Lesson prioritization - no selection - all lessons where there was a deviation in outcome from expectation

When to capture - Immediately after each "activity" - single time-slot based on event or pre-specified time duration

Capture event duration - 30 minutes

Applicable time-span of lesson capture - Focus on a daily or limited period of time (discrete action, and proposed immediate repetition of that discrete action) - may also be since last After Activity Review

3.1.3 Retrospective View

The Retrospect is one of the most effective processes with a duration ranging from ½ to several days, for capturing Lessons from a project team, at key milestones/deliverables, or at project end. A Retrospect can bring out the key knowledge and experience developed by a project team, and capture it for future reuse and for the benefit of future projects. By facilitating a dialogue within the whole team, knowledge can be identified that comes from the whole team experience - knowledge that any one individual may be unaware of, but which the team as a whole knows. Good facilitation ensures high quality lessons which can be understood by people outside the project team.

Involvement - Team-based collection of lessons at the end of a project

Validation - by team during dialogue

Outcome - learning is captured in the form of a lesson by facilitator

Lesson selection - on Team-based highest ranked learning taken from:

project objectives and outcomes, and

ranking of the key learning points (impact to the project) and,

their transferability to other projects

When to capture - at the end of the project

Capture event duration - 4hrs to 4 days

Applicable time-span of lesson capture - entire project - however known limitations with memory of individuals based on the following

i) the limited recall

ii) preference on recently (better remembered events) than those of by-gone years

3.2 At ESA

At the corporate level, ESA has adopted an adaptation of the retrospective approach – improving it to fit within project lifecycle and the dynamics of the space sector in the definition, design manufacture and test and finally commissioning operations and de-commissioning of a space mission.

3.2.1 Event-Based Lesson Capture (and Validation)

The event-based focuses on collaborative team lesson collection and validation, facilitated in 3 modes – physical meeting, on-line videoconference (called e-capture) or a mixture of the two (called hybrid capture). Initially (from 2019) carried out as only a physical meeting, using the Concurrent Design Facility (at the largest ESA site, both in terms of workforce and footprint – ESTEC, The Netherlands), ESA created an immersive and safe environment to share experience from projects (both positive and negative). This meeting enabled the experience and associated proposed learning to be captured effectively on the basis of team discussion and agreement by the activity / project management. Discussion was supported through the use of ESA Lessons Learned Portal (based on Sharepoint) using a dedicated project-specific webpage, which could be shared by the portal administrator to all those in the meeting. During COVID (2020 / 2021) the capture events were adapted to on-line only, and the format reduced to 1/2day.

13:00	Introduction I) Overview of Project / Activity (Activity / Project Manager) II) Lesson Capture Process (ESA LL Secretariat)
13:30	Lesson Capture Collection of Lessons
14:30	Break
14:45	Validation Group discussion on each lesson Validation of lessons by Activity/Project Manager
17:15	Event Feedback and e-questionnaire
17:30	Meeting Ending

Figure 4 : Typical agenda of an ESA (corporate) Lesson Capture Event

It was found still effective using this technique with the added benefit of efficiency regarding reduced time of the event and removing the need to travel. As such it was found that participation of experts in the e-event increased significantly over the COVID period. Now out of COVID constraints, the ½ day format remains, with the event being both physical and on-line – creating the so-called “hybrid” event.

Figure 5 : ESA Project (AEOLUS) capture event using the Concurrent Design Facility (CDF) in 2019

It is typically a space mission project focused technique which is initiated at discrete significant milestones in the project (at least 3 times, relating to key project phases). It involves project and technical teams who have been directly, indirectly or partially and temporarily involved in the project, and includes validation authority (typically the activity or project manager) and can also involve evaluation entities. The validation of captured lessons happens by the project manager during the event through sharing of the captured lesson and dialogue that is initiated with the team present in discussing their content. Once lessons are validated, they are immediately visible to all ESA colleagues, as well as being forwarded to the Lessons Learned board for evaluation. This technique is applied equally to projects as it is to technical and non-technical topics.

Focus over a period of time (typically years)

Involvement - project and technical teams

Validation - by project manager during event dialogue

Outcome - proposed and validated lessons (ready for LL Board evaluation)

Lesson selection - none - all considered equal (if validated - pending evaluation)

When to capture - at discrete significant milestone in the project

Capture event duration -1/2 to 1 day

Applicable time-span of lesson capture - from previous lesson capture event (i.e. part of a project)

3.3 At CNES

Two years ago, CNES decided to improve the collection process of LL from projects, because there were less and less written end of project reports. Moreover, projects can last several years, and these reports, often available

only at the end of a project, did not present the LL learned from people that have moved away during the project time frame.

We studied ISO 16192, which outlines LL principles and guidelines that are applicable in all space project activities. It is a good basis which can help to define an in-house process. But each step of the LL process is not precisely defined, especially, the collection of relevant information.

NASA White Paper (2004-2006) describes a Pause and Learn (PaL) session, which is a structured discussion that focuses on recent project developments, challenges, and critical milestones. Consequently, the PaL process is a critical project management tool for learning during the project life cycle. PaL sessions enable project team members to collectively reflect on their experiences and articulate their LL and insights.

That is why we proposed accordingly to put in place capture events and the organization of a moderation process consistent with the objectives of efficiently capturing feedback.

3.3.1 Some observations from a knowledge engineering viewpoint

A particular feature of the proposed approach, as will be detailed shortly, is that it involves two colleges in the selection process: a first college made up of project members, and a second college made up of COREX members.

From a cognitive point of view, this corresponds to two significantly different objectives.

The first panel is tasked with identifying - unanticipated - circumstances that have prevented the production of knowledge that would have been necessary at a given time, or those that have, on the contrary, enabled the production of knowledge that has proved to be particularly useful in solving a problem. This collective awareness of unfavorable and favorable circumstances corresponds to the production of one or more pieces of knowledge. As we shall see, this stage is followed by a selection process based on their representativeness in relation to the project.

The second group will select this knowledge as *data* that is sufficiently new to be included in the REXSO database and to complement existing processes, standards and norms for orbital systems, on condition that it constitutes a corpus that can be processed by humans.

3.3.1 Event Preparation

A capture event consists of a dedicated meeting, attended by the project manager, the project team and as far as possible the main project stakeholders. The project manager is the technical facilitator. He or she is accompanied by the LL Bureau and organizational facilitators. Facilitators manage the brainstorming process during the session, highlight the key messages and control time. The project manager is asked to prepare before the collocation meeting the list of participants among the project team members, which number is on purpose restricted to about 15 people to ease the discussions, even if the project team is often much bigger. Most of the events have yet been organized with CNES people only, but it is encouraged to invite, when appropriate, people from participating research laboratories and from industry.

The meeting date must be fixed long time in advance, so that people can get available. The meeting takes place in person only. It is held in a big open room called “Crealab”, where we can move from one zone to another one according to the different steps of the meeting. A timeline tracing the main stages of the project is displayed, with the aim of encouraging participants to think back to the history of the project. It is mandatory and of high value to get LL proposals not only from the most recent project events.

Prior to the event, a questionnaire is established in order to:

- Inform the participants of the process and give them the opportunity to go back over the project before the capture session,
- Make a preliminary collection of event records likely to be the material for a LL proposal.

This questionnaire is in the form of an Excel file to be sent to participants. It contains LL proposal forms to be completed, as much as possible, by the participants. Participants are asked to send it back several days before the event.

Questionnaires to be completed during the session are also prepared.

3.3.2 Event Sequence

Table 1 shows a typical agenda. Flexibility should be maintained in the event program so that it can be adjusted according to the number of proposals. The duration is a compromise between:

- Not too short to obtain usable results,
- Not too long and dissuasive for participants' availability.

At the beginning of the meeting, we take time for participants to get and share together. It is important to create a good productive atmosphere.

There are three workshops steps during the event:

- The first workshop step, entitled "Vide-greniers", is divided into two phases: an initial presentation of their proposals by each contributor, followed by a second phase during which participants who had not completed the questionnaires beforehand, but who have nonetheless feedback proposals, can express their views.
- A second workshop step is called "The Stations". Participants are divided into sub groups and asked to think about events that could be the subject of feedback based on evocation of three "emotions" (joy, disappointment, pride). A discussion is then led on a priori anecdotal situations occurred during the project, in order to bring into light events likely to be material for new LL proposals.
- A third "sharing" workshop step is held to review and complete the proposals to be submitted to the COREX for decision to include them or not in the LL database.

During this last workshop step, people receive flags for voting. Only proposals considered as lessons sufficiently representative of the project and agreed by the majority of participants are completed. Some proposals can also be gathered according to their similarities and their complementarity.

Enough time must be kept at the end of the event, because clear and elaborated proposals are needed, so that the COREX can analyze them properly.

Table 1 : Typical agenda of a capture event

Phase	Duration
Welcoming participants	30 minutes
General presentation	15 minutes
« Vide-greniers » workshop	2h00
Break	15 minutes
« Les Stations » workshop	45 minutes
Lunch	1h15
« Sharing » workshop	45 minutes
Drafting of the final version of selected LL proposals	1h30
Conclusion	15 minutes

3.3.3 Event Outcomes

Table 2 shows the number of LL proposals obtained at the end of a capture event, and the number of corresponding LL sheets validated by the COREX.

We can see that the number of LL proposals at the end of the collecting event is of the order of a few dozens. After analysis and selection by the COREX, the number of new LL sheets is limited to a few of them. That is to say that only one tenth of the proposals are considered as new lessons to be added to the Orbital Systems LL database.

This drastic selection can be explained in different ways:

- The proposal can be used to update or complete an existing LL sheet, without creating a new one.
- The proposal is not retained as LL sheet, but will be used to update internal trainings, especially the trainings dedicated to people working on projects.
- The recommendations written in the proposal are not mature, and it is necessary to put in place a Working Group on the subject to produce the relevant recommendations. This can later lead to a new LL sheet.
- The proposal is covered by existing processes, standards and norms.
- The proposal corresponds to normal work, the lessons are well-known (It may have been difficult for the project to apply them, for various reasons (human resources, budget, planning, etc.)).
- The proposal needs to be shared with ESA, when it comes from a project in cooperation between ESA and CNES. This can later lead to a new LL sheet.
- The proposal is limited to a specific technical skill, it is not published at system level, but is managed at experts'level.
- The proposal is not generic enough, too specific to a project and its background, and cannot be easily reused.

Table 2 : Number of lessons

LL Capture event	Total number of proposals	Number of proposals after project team vote and gathering	Number of new validated LL sheets	Number of participants in the event	Analyzed project duration (years)
Project A	33	33	3	12	8
Project B	51	31	6	21	3
Project C	62	45	4	18	12

4. Comparison Between ESA and CNES Approaches as Concerns Capture Events

Table 3 shows some differences between the ESA and CNES approaches for capture events.

Table 3: Comparison between ESA and CNES LL events

Category	ESA	CNES	Advantages / Drawbacks
Is capture mandatory as part of normal project process?	Stated as policy, and locally in Directorates implementation varies between best practice and mandatory	Proposed	Mandatory : LL not missing Proposed : People want to come
Language of capture	English	French	English : multi-national organization French : clearer in native language, both for preparation and use of the LL
Is event physical meeting or held on-line (remotely)?	In-person, remote or hybrid techniques	In person only	Remote : easier for participants In person : better discussion and team event
How many lessons are generated (per event)?	No limit placed on lesson capture numbers (averaging around 30 lessons per event, with approx. 10 events per year)	No limit	Most often, people have a lot of things to say

Category	ESA	CNES	Advantages / Drawbacks
How many lessons are held in the database overall?	1600 hundred lessons currently – increasing at around 300 per year	100 active lessons maximum Continuous “cleaning” required	The way projects use the LL contained in the respective databases must be different (see below)
Means to learn from the lessons (portal only, dedicated lessons summaries or lessons embedded in processes document and training)	About 70% lessons are incorporated in our processes and related documents. The remaining 30% is uniquely accessed in the Portal. Function specific views allow for users to easily retrieve their learning.	LL sheets inside the database New versions of processes and standards Internal trainings	Same principles
Is the Agency applying new techniques or technology to ease access to lessons / learning ?	AI techniques are being applied and will be released this year (2024) – knowledge graph and ChatBot techniques assist the user in the ease and quality of both lesson capture and retrieval	AI techniques not required up to now On-line help for the principal operating modes of the database (Confluence pages)	Techniques depend on the amount of data

Thanks to capture events, new lessons are available on a regular basis. The last three lines of the table show the consequences for the overall functioning of the LL process.

5. Conclusion

Both ESA and CNES agencies have organized Lessons Learned capture events, gathering people working on a project, and inviting them to elaborate collectively the Lessons Learned from their project experience. These events are effective, as a great amount of LL material is produced. Projects teams really enjoy the opportunity, when the process is completed, even if some of them are reluctant at the beginning.

These events require a dedicated organization. The organization principles are the same in both agencies, and common capture events could be envisaged. It must be noted that ESA already invite partners to this kind of events.

The lessons coming from capture events are either incorporated in processes and standards, or used to prepare dedicated LL sheets, available in a database. Up to now, ESA and CNES have a different approach as regards the number of applicable lessons in their respective databases. But this does not prevent from organizing common capture events. The common lessons coming from these events can be processed by each agency, according to its own methods.

Acknowledgements

CNES would like to thank the company COUP DE PUCE EXPANSION for its involvement in the capture events.

References

Herd A., Sieminska A., Gibek I., Castanet F., Galarreta D. (2022) Establishing a protocol for the x-change of experience and learning between space entities – sharing what we do together and what we have in common –an esa / cnes case study, IAC-22,D1,5,x69458.

ISO 16192, Space systems — Experience gained in space projects (lessons learned) — Principles and guidelines

NASA (May 20, 2004, Revised May 10, 2005, Revised June 8, 2006) White Paper : Introducing the Pause and Learn (PaL) Process : Adapting the Army After Action Review Process to the NASA Project World at the Goddard Space Flight Center.

Our Knowledge Safeguards our Jobs and We're not Sharing! Knowledge Withholding Experiences of Emirati Private Sector Employees

Valerie Priscilla Goby
Zayed University, Dubai, United Arab Emirates

Valeriegoby@gmail.com

Abstract: Since the beginning of its rapid development following the oil boom of the 1960s, the United Arab Emirates has relied heavily on imported labour, largely from low GDP countries. This has resulted in a massive workforce imbalance with currently only about 4% of citizens in the private sector and 60% in the public sector. To address this, the government has implemented workforce localisation policies which provide better conditions, including greater job security, to citizens than to expatriates. Many expatriates perceive the presence of Emirati workers in their organisation as a direct threat to their own employment security. Research has demonstrated that this leads to Emiratis experiencing discriminatory behaviour. This qualitative study gathered data through narrative interviews with 16 Emirati private sector employees conducted to probe their experience of knowledge sharing within their organisations. The dominant themes that emerged from analysis of this data were 1) outgroup identity marking of Emirati employees; 2) purposeful knowledge withholding on the part of expatriate colleagues. Exclusion from knowledge sharing practices were accounted for by participants as due to the perception of employees from low GDP countries that Emiratis enjoy exceptional privilege because of their citizenship of a high GDP country. The implication of these findings is that exclusion from knowledge sharing exerts substantial restriction on the successful integration of citizens within the country's heavily expatriate dominated labour force. This study's contribution is its demonstration of citizenship and job security status as moderators of knowledge sharing practices in multicultural workforces.

Keywords: Emiratisation**,** Job Security, Knowledge Sharing, Multinational Workforces, Nationality Clusters, United Arab Emirates

1. Introduction

This study was conducted in the United Arab Emirates (UAE), an affluent, politically stable country in the Arabian Gulf, which hosts a massive expatriate population. Given much anecdotal evidence on information withholding from Emirati employees by their expatriate colleagues and limited academic research (Al-Ali, 2008; Al-Waqfi and Forstenlechner, 2010, 2012; Goby et al., 2015; Goby et al., 2017), it aimed to provide further empirical evidence on this issue. It explores the complex and challenging relationships between the small number of institutionally privileged local workers and the massive majority of expatriate employees who are substantially unprotected from profit-based corporate decisions regarding salary, work conditions, and job security. This chasm between the entitlements of local versus expatriate employees results in exclusionary tactics on the part of expatriates which frequently manifests in a refusal to assist their Emirati colleagues' integration into the organisation. A key tactic in this is denying their access to common information-sharing practices.

This study provides a theoretical contribution by its demonstration of citizenship and job security status as moderators of knowledge sharing practices in multicultural workforces and its analysis of the cultural variables dominant in the UAE which impact attitudes to organisational knowledge sharing. Its practical contribution lies in its identification of specific barriers to workforce localisation which can provide a guide to policymakers concerned with Emiratisation and the development of managerial strategies to reduce the gap between what local employees expect versus what they find in the country's private sector workforce.

The paper begins with an overview of the UAE labour force followed by a discussion of relevant literature. It then describes the methodology used, data collection, analysis, and results. It concludes with a discussion of the findings and limitations of the study.

2. UAE Labour Market and Workforce Localisation

The population of the UAE is currently around 10 million, but only 12% is local, and 88%, expatriate (Infographics, 2024). This demographic composition stems from the country's need for skilled labour which emerged during the oil boom of the 1960s when the population was only 90,000 and predominantly unskilled (Lahmeyer, 2001). To develop infrastructures funded by oil revenues, the UAE recruited vast numbers of expatriate workers across all skills levels who were attracted by the higher salaries on offer (Rees et al., 2007). UAE legislation facilitates the influx of foreign workers, making it an attractive destination for multinational corporations seeking to

participate in post-oil boom economic diversification. The country has emerged as a significant economic hub, ranking 12th of the 141 countries survey in the 2019 *Global Competitiveness Report* for quality of infrastructure, 15th for institutions, and second for ICT adoption. For diversity of workforce, it ranks second after Singapore, fifth for ease of hiring foreign labour, and 116th for workers' rights (Schwab, 2019).

The workforce in the UAE reflects the population imbalance, with the private sector comprising only 4% Emiratis (PWC, 2024). The primary reason for this phenomenon stems from organisations' continued preference for expatriate employees. These individuals typically have modest salary expectations shaped by significantly lower salary scales in their home countries (Goby, 2015). Moreover, their employment can be more easily terminated (Kerr and England, 2009).

To facilitate Emiratis' entry into the private sector and to promote the socioeconomic benefits of a stable, indigenous workforce (Sarker and Rahman, 2020), the government has implemented Emiratisation policies since the 1990s, aiming to increase Emirati representation in the private sector through training, incentives, and quotas (Elbanna, 2022; Zeffane and Kemp, 2020). Under these regulations, Emirati employees enjoy considerably more work-related rights and job security than expatriates. This contributes to greater inequality between the two groups, and expatriate workers often feel threatened by Emiratisation and losing their jobs means being legally required to leave the country, all of which contributes to work dissatisfaction (Ali et al, 2020). Additionally, the private sector's "hire and fire at will" culture further undermines expatriates' job security (Al-Waqfi and Forstenlechner, 2012, p. 621). Despite rapidly rising educational levels among citizens, a broad range of training schemes, incentives, and other initiatives, the Emiratisation policies have had limited success (Al Jawali et al., 2021).

3. Literature Review

Recent research has explored knowledge management and cultural context (Liu et al., 2022), the connection between knowledge management technologies and national culture (Liu et al., 2023), and the relationship between organisational learning and performance as facilitated by knowledge sharing within specific economic and cultural contexts (Liu et al., 2024). The importance of national culture in relation to knowledge management and transfer necessitates an account of cultural traits of the UAE context most especially those variables that have a strong impact on how communication is conducted. To demonstrate how Emirati culture shapes communication and perception, we can refer to Hofstede's influential framework for cultural analysis. According to Hofstede (2011), the UAE exhibits high power distance (90/100), indicating strongly hierarchical tendencies. It also demonstrates high uncertainty avoidance (80/100), suggesting a preference for risk aversion and rule-based approaches to minimise uncertainty. As a result of these cultural propensities, Emiratis will typically seek validation from their superiors to ensure clarity in work-related expectations. The culture also exhibits a prominently collectivist orientation, scoring a low 25/100 on the dimension of individualism, indicating Emiratis' disposition to prioritise group needs. Central to this collectivist ethos is the significance placed on face, defined as "the positive social value a person effectively claims for himself by the line others assume he has taken during a particular contact" (Goffman, 1955, p. 213). Although face is recognised as a universal construct (Zane and Yeh, 2002), its prominence is more marked in collectivist societies (Chan et al., 2009). Given these cultural tendencies, Emiratis are more comfortable with a group-oriented approach to activities and are likely to strive to avoid conflicts and to identify collective needs before acting individually. The specific gap in the literature which this study addresses is the impact of national citizenship status on organisational knowledge sharing.

4. Study

Narrative research represents a person-centric approach to data gathering and analysis. It attempts to unravel the stories people tell about their own lives and how they make sense of these, and this allows the researcher to gather insight from these subjective interpretations. This investigation employs narrative methodology adopting an interpretivist approach and seeking to identify commonalities from the stories participants relate about their working worlds and their nuanced understanding of these experiences.

4.1 Narrative Methodology

Narrative data inevitably involves a certain collaborative process between the narrator and the researcher, a fact which makes the role of reflexivity central in the investigation (Ozturk and Berber, 2022). The researcher minimised her impact (Gioia et al., 2013) by adopting an interview approach akin to a conversation. This tactic aimed to nurture a relationship built on trust (Dundon and Ryan, 2010) and to reduce any perceived distance

between the researcher and the participant (Essers, 2009). A conscious effort was made to avoid steering the conversation beyond introducing the issue of support or challenges encountered in the workplace. This approach aimed to create an environment in which participants felt comfortable enough to freely discuss experiences that held significance for them. Such an unstructured approach, through which participants had the freedom to share their personal narratives as they saw fit, justified considering these employees to be experts or "knowledgeable agents," remaining faithful to their interpretation of reality, and prioritising it in the analysis of the interview data (Gioia et al., 2013, p. 17).

4.2 Data Collection

Purposive sampling, a non-probability sampling technique, was used to identify participants. Snowball sampling, an approach which leverages on the interconnectedness of individuals, facilitated the recruitment of participants with sufficient experience to provide rich and valuable information. The researcher contacted Emiratis encountered in professional settings, requested their participation, and solicited their referrals to other Emiratis in the private sector. Emails were sent to these referred people inviting them to take part in the study. Interviews were conducted with a total of 16 Emiratis, nine men and seven women, aged between 22 and 45, all graduates, and three holding postgraduate degrees. The interviews took place in person at a venue of the participant's choice. They were conducted in English and all participants had a high level of facility in English which was one of the selection criteria. Interviews lasted between one hour and an hour and a half, and an audio recording of each was made with the permission of the participant. These recordings were then transcribed.

4.3 Analysis

Thematic coding was used to analyse the interview transcripts. An Emirati research assistant was engaged for this stage of the study, and both she and the researcher independently conducted fine-grained readings of the transcripts. This collaboration allowed the comparison of the themes identified by each and the discussion, validation, or dismissal of each theme (Gibbert and Ruigrok, 2010; Silverman, 2005). This approach addressed the issue of reflexivity in research and helped mitigate the potential influence of a single researcher's preconceptions regarding the analysis of the data (Ozturk and Berber, 2022, p. 220).

5. Findings

Given the rich data that emerged from these interviews, it was a challenge to make sense of this abundant material and identify significant patterns that could serve to construct a framework which would condense the data to specific issues that could guide both policy implications and the furtherance of this research stream (Patton, 1990). This dual aim was considered to be best met by a process of axial coding in which second order theoretical categories were inferred from the open codes and then amalgamated into aggregate theoretical dimensions (Strauss and Corbin, 1990). A process of constant comparison of statements led to the emergence of two overarching themes that can be stated as:

- Outgroup identity marking of Emirati employees
- Purposeful knowledge withholding on the part of expatriate colleagues

5.1 Outgroup Identity Marking of Emirati Employees

This dimension encapsulates a variety of perspectives all indicative of a sentiment of not being accepted as an integral part of the larger organisational body. The most frequent types of expressions relating to this perception include:

- Being assigned very basic duties, such as photocopying, despite holding high qualifications and job title.
- An abundance of strongly negative stereotypes of Emiratis. Participants reported a range of hostile comments that they frequently hear, such as "What the hell are they doing here?" "Why don't they hang out in the coffee shop!" "They don't need the money; their government takes care of them."
- Sense of personal incompetence even though their qualifications are adequate.
- Sense of needing to work harder than expatriate colleagues to diminish the stereotype that Emiratis are lazy.
- Far greater occurrence of Emiratis being rejected and marginalised than being welcomed by immediate colleagues.

- Hostility was generally of an implicit nature although some expatriate employees were highly vocal in their criticism of Emiratis.
- Perception of acute jealousy on the part of many expatriate colleagues often expressed with the notion that Emiratis enjoy so many financial benefits that they do not need to work at all and have no right to be in the workplace.
- Perception that Emiratis enjoy an excessive degree of privilege because of their citizenship of a high GDP country.

Hostile stereotypes of Emiratis' work ethic, such as those that emerge in these findings, have been found to adversely impact their organisational socialisation and retention (Karam et al., 2023). Much of the negative stereotyping of Emirati employees was accounted for by one participant with the explanation that in the 1970s it was quite common for an Emirati to be appointed as a manager and then do no actual work. This is an example of legacy thinking from a period in which the country was very new, and its citizens were largely professionally unprepared and unaware of the requirements of their organisational role. Since those times, however, there has been an exponential advance in Emiratis' qualifications and professional readiness. The government provides free education for all citizens up to undergraduate level and has fully sponsored large numbers of citizens for undergraduate and postgraduate studies at well-ranked universities overseas. Moreover, many Emiratisation policies provide specific professional training. However, the stereotype remains a comfortable one for expatriates seeking to assert their own greater value to the organisation.

5.2 Purposeful Knowledge Withholding on the Part of Expatriate Colleagues

Most participants reported a chronic lack of access to vital information which makes it difficult or impossible to secure task-essential information and leads to a drop in their morale. Expressions of this perception include:

- Sense of feeling lost while observing expatriate colleagues appear to know exactly what they are to do. This isolation was expressed by one participant as "I'm not in the box."
- Existence of nationality clusters in which individuals engage in high degrees of exclusive knowledge sharing among people from their own country and which function easily through the use of their native language even in the presence of members of other language groups.
- Overt expressions by expatriate colleagues that, given Emiratis' high degree of job security, they did not need to be further privileged by inclusion in organisational knowledge sharing networks. "Let him find out by himself" is an example of a type of comment frequently overheard.
- Much experience of asking for advice on how to perform a new task and, rather than receiving an explanation, having an expatriate colleague complete the task. This insistence on doing rather than teaching was interpreted as a means to prevent Emirati recruits from learning on the job and developing their own skills.
- Difficulties experienced in ensuring the correct execution of their duties due to receiving inadequate information or guidance.
- Expatriate managers as well as employees withhold important information.
- Three participants mentioned that restrictions on knowledge sharing with Emirati employees also operate in the public sector.

6. Discussion

This investigation into a central component of the integration of citizens into the private sector, namely, their access to organisational information sharing networks, provides data which can help shape focussed policy to enhance the success of the workforce localisation initiatives. Its findings suggest a case of knowledge sharing being weaponised as a means to exclude the full integration of a particular population group, namely, citizens, by other groups, namely, non-citizens, as part of an attempt to safeguard job security. It highlights the role of national citizenship and cultural affinities within knowledge sharing domains. Through its exploration of the sociocultural issues involved in working relations between Emirati minority and expatriate majority employees, it reveals embedded, context-specific dynamics that need to be addressed in policy and training.

Due to their deeply ingrained collectivist values, Emiratis tend to gravitate to collaborative endeavours rather than individual efforts when approaching tasks and working towards organisational goals (Goby and Nickerson, 2011). This cultural propensity inclines Emirati employees to strive for integration within groups rather than enacting personal autonomy. The impact of this in relation to information sharing is that Emirati employees prefer to seek required information from individuals with whom they feel personally connected. The

prioritisation of group solidarity and the affordance of mutual assistance are robust behavioural norms within traditional UAE culture (Salzman, 2008). This deliberate fostering of good personal relationships is also demonstrated in Emiratis' behaviour to foreigners (Goby and Nickerson, 2015). Given this historically embedded behaviour, the absence of mutual support identified in this study can be particularly damaging for Emirati employees who view any reluctance on the part of colleagues to provide help as constituting workplace incivility, a practice which has been demonstrated to curtail professional development (Chen et al., 2012).

7. Managerial Implications

This study's findings imply a wilfully imposed sense of isolation which undoubtedly affects Emiratis' integration into their organisations and their retention outlook. This calls for managers to consider the development of specific accommodations for Emiratis to assist their integration into the organisation. There are many sociocultural issues impacting the satisfaction and retention intention of Emiratis in the private sector (Rutledge, 2023). While there are organisational socialisation policies and practices in relation to Emiratis in the private sector (Waxin et al., 2020), the exclusion that this study's participants report demonstrates the need to refine these. The specific area of information withholding experiences of Emirati employees might become a strategic action field in which the minutia of the experience of each Emirati employee is elicited and tracked and specific individual responses developed. The need for special accommodations for minority groups in the workforce is well documented and their absence can lead to rapid attrition (Greer and Wyant, 2024). In the UAE context, managers could consider accommodations such as assigning a mentor to each new Emirati recruit mandating the mentor to gather a full account of the employee's experience with specific employees in terms of knowledge sharing and withholding. This would identify precise problems and provide data for specific solutions to knowledge withholding and strategies for full access to the knowledge sharing networks necessary for Emirati integration and satisfaction in the workplace. Typically, the dynamics involved in affirmative action plans involve giving advantage to a minority group that has been historically disadvantaged. But in the case of the UAE, the minority is actually a powerful one whose disadvantage derives from its numerical inferiority. This accounts for the complexity of the Emiratisation aspirations and the obstacles Emirati employees experience in adjusting their individual selves to a complex and sometimes hostile work environment.

8. Limitations

This study did not seek to establish broadscale, generalisable findings that could apply in diverse geopolitical settings. Nonetheless, it has direct relevance for other Arabian Gulf countries which rely on a vast majority of expatriate labour and are also seeking to achieve adequate localisation of their workforces.

The fact that the study dealt with a sensitive socio-political issue could have impacted on the interview data (Alvesson, 2010, p. 37). The sensitive nature of the topic under investigation meant that the data collection had to be approached with caution. Negotiating access to participants with a clear understanding of the purpose of the research and the absolute anonymity of information shared meant that the sample was restricted to respondents who demonstrated willingness to discuss their experiences and opinions openly. This methodological decision resulted in a significant limitation of the size of the data pool, but it was considered essential to prioritise the likely authenticity of participant input over quantity.

References

Al-Ali, J. (2008) "Emiratisation: drawing UAE nationals into their surging economy", The International Journal of Sociology and Social Policy, Vol. 28, No. 9, pp 365-379.

Ali, I., Ali, M., Grigore, G., Molesworth, M. and Jin, Z. (2020) "The moderating role of corporate reputation and employee-company identification on the work-related outcomes of job insecurity resulting from workforce localization policies", Journal of Business Research, Vol. 117, pp 825-838.

Al Jawali, H., Darwish, T. K., Scullion, H. and Haak-Saheem, W. (2021) "Talent management in the public sector: empirical evidence from the emerging economy of Dubai", The International Journal of Human Resource Management, pp 1-29.

Alvesson, M. (2010) Interpreting interviews, Sage.

Al-Waqfi, M. and Forstenlechner, I. (2010) "Stereotyping of citizens in an expatriate-dominated labour market: implications for workforce localisation policy", Employee Relations, Vol. 32, No. 4, pp 364-381.

Al-Waqfi, M. and Forstenlechner, I. (2012) "Of private sector fear and prejudice: the case of young citizens in an oil-rich Arabian Gulf economy", Personnel Review, Vol. 41, No. 5, pp 609-629.

Chan, H., Wan, L.C. and Sin, L.Y. (2009) "The contrasting effects of culture on consumer tolerance: interpersonal face and impersonal fate", Journal of Consumer Research, Vol. 36 No. 2, pp. 292-304.

Chen, Y., Ferris, D.L., Kwan, H.K., Yan, M., Zhou, M. and Hong, Y. (2012) "Self-love's lost labor? A self-enhancement model of workplace incivility", Academy of Management Journal, Vol. 56 No. 4, pp. 1199-1219, https://journals.aom.org/doi/abs/10.5465/amj.2010.0906.

Elbanna, S. (2022) "Policy and practical implications for workforce nationalization in the Gulf Cooperation Council (GCC) countries", Personnel Review, Vol. 51, No. 4, pp 1248-1261.

Gibbert, M. and Ruigrok, W. (2010) "The 'what' and 'how' of case study rigor: Three strategies based on published work", Organizational Research Methods, Vol. 13, No. 4, pp 710-737.

Gioia, D. A., Corley, K. G. and Hamilton, A. L. (2013) "Seeking qualitative rigor in inductive research: Notes on the Gioia methodology", Organizational Research Methods, Vol. 16, No. 1, pp 15-31.

Goby, V.P. (2015) "Financialization and outsourcing in a different guise: the ethical chaos of workforce localization in the United Arab Emirates", Journal of Business Ethics, Vol. 131, No. 2, pp 415-421, http://link.springer.com/article/10.1007/s10551-014-2285-6/fulltext.html.

Goby, V. P., Ali, H. M. A., Lanjawi, M. A. A. and Al Haddad, K. I. M. A. (2017) "Workforce localization, information sharing, and the imperative of culture: a preliminary exploration of expatriate-Emirati information sharing in Dubai's private sector", International Journal of Organizational Analysis, Vol. 25, No. 1, pp 103-122.

Goby, V.P. and Nickerson, C. (2011) "Exploring organizational communication through website analysis: a problem-based learning community exercise", Tojned, Vol. 1 No. 1, pp. 40-43.

Goby, V.P. and Nickerson, C. (2015) "Multicultural and multilingual: workplace communication in Dubai", in Holden, N., Michailova, S. and Tietze, S. (Eds), Routledge Companion to Cross-Cultural Management, Routledge, pp. 103-111.

Goby, V.P., Nickerson, C. and David, E. (2015) "Interpersonal communication and diversity climate: promoting workforce localization in the UAE", Journal of Organizational Analysis, Vol. 23, No. 3, pp 364-377.

Goffman, E. (1955) "On face-work: an analysis of ritual elements of social interaction", Psychiatry: Journal for the Study of Interpersonal Processes, Vol. 18 No. 3, pp. 213-231.

Greer, R. J. and Wyant, M. H. (2024) "It just really made me feel like I'm supposed to be here: Organizational socialization among expatriate workers in Japan", Communication Studies, pp 1-20.

Hofstede, G. (2011) "Dimensionalizing cultures: the Hofstede model in context", Online Readings in Psychology and Culture, Vol. 2 No. 1, https://scholarworks.gvsu.edu/orpc/vol2/iss1/8/

Infographics (2024) United Arab Emirates population statistics 2024, https://www.globalmediainsight.com/blog/uae-population-statistics/.

Karam, A., Ashill, N., Jayashree, P. and Lindsay, V. (2023) "Localization in the United Arab Emirates: A study of stereotypes, organizational socialization, employability and work outcomes", Personnel Review, Vol. 52, No. 5, pp 1362-1386, https://doi.org/10.1108/PR-07-2021-0548.

Kerr, S. and England, A. (2009) UAE to safeguard jobs of nationals, Financial Times, 18 February 2009, www.ft.com/intl/cms/s/0/7dfbc81e-fe0d-11dd-932e-000077b07658.html#axzz3Q5TNvB66.

Lahmeyer, J. (2001) The United Arab Emirates – historical demographical data of the urban centers, www.populstat.info/Asia/unarabet.htm.

Liu, G., Tsui, E. and Kianto, A. (2022) "How knowledge management differs across national cultures: A systematic literature review", in J. Chen and I. Nonaka (Eds.), The Routledge Companion to Knowledge Management (pp. 211-235). Taylor and Francis.

Liu, G., Kianto, A. and Tsui, E. (2023) "Knowledge management technologies and organizational performance: A meta-analytic study", Industrial Management and Data Systems, Vol.123, No.2, pp. 386-408.

Liu, G., Tsui, E. and Kianto, A. (2024) "A meta-analytic study on the organisational learning–performance relationships via country cultural and economic contexts", Knowledge Management Research and Practice, Vol. 22, No.1, pp. 17-31.

Ozturk, M. B. and Berber, A. (2020) "Racialised professionals' experiences of selective incivility in organisations: A multi-level analysis of subtle racism", Human Relations, Vol. 75, No. 2, pp 213-239.

Patton, M. Q. (1990) Qualitative evaluation and research methods, Sage.

PWC (2024) "The retention riddle: How to keep Emirati talent in the private sector", https://www.pwc.com/m1/en/publications/emiratisation-survey-2023-the-retention-riddle.html.

Rees, C., Mamman, A. and Bin-Braik, A. (2007) "Emiratization as a strategic HRM change initiative: Case study evidence from a UAE petroleum company", International Journal of Human Resource Management, Vol. 18, No. 1, pp 33-53.

Rutledge, E. J. (2023) "The tour guide role in the United Arab Emirates: Emiratisation, satisfaction and retention", Tourism and Hospitality Research, Vol. 23, No. 4, pp 610-623, https://doi.org/10.1177/14673584221122488.

Salzman, P.C. (2008) Culture and conflict in the Middle East, Humanity Books, Amherst, NY.

Sarker, A.E. and Rahman, M.H. (2020) "Social engineering and Emiratization in the United Arab Emirates", Public Administration and Policy: An Asia-Pacific Journal, Vol. 23, No. 2, pp. 173-186, https://doi.org/10.1108/PAP-02-2020-0009.

Schwab, K. (2019) The global competitiveness report 2019, World Economic Forum. https://www.weforum.org/publications/global-competitiveness-report-2019/

Silverman, D. (2005) Doing qualitative research, London: Sage.

Waxin, MF., Savita K. and Fang Z. (2020) "Workforce localization in the Arab Gulf countries: How do organizations socialize the members of a powerful minority?", Sustainability, Vol. 12, No. 14, pp 5847. https://doi.org/10.3390/su12145847.

Zane, N. and Yeh, M. (2002) “The use of culturally-based variables in assessment: studies on loss of face”, in Kurasaki, K., Okazaki, S. and Sue, S. (Eds), Asian American Mental Health: Assessment Theories and Methods, Kluwer Academic, Dordrecht, Netherlands, pp. 123-140.

Zeffane, R. and Linzi K. (2020) "Emiratization: Benefits and challenges of strategic and radical change in the United Arab Emirates", In Case studies in work, employment and human resource management, pp. 245-253. Edward Elgar Publishing.

Global Integration of Artificial Intelligence in Higher Education Sector: A Bibliometric Analysis

Olga Gordienko and Konstantin Bagrationi
Graduate School of Business, HSE University, Frankfurt am Main, Germany

oagordienko@hse.ru
kbagrationi@hse.ru

Abstract: In modern perspective, the phenomenon of artificial intelligence (AI) has witnessed considerable advancements, extending its influence across various sectors, with higher education emerging as one of the most significant areas of impact. Researchers who have found the revolutionary potential and essential contributions of AI in boosting educational practices and approaches have extensively emphasized this trend. (George & Wooden, 2023; George & Paul, 2020). The higher education domain is progressively acknowledging AI as a key factor for competitive edge (Hannan & Liu, 2021). This paper aims to examine the existing research on AI implications in the higher education segment. Grounded on the theory of technology diffusion (Rogers, 2003), our research systematically examines the scientific field, identifying emerging research topics. Using SCOPUS as a database for peer-reviewed article selection (publication period 2011–2024) and bibliometric analysis, we provide an insight into the varied geographic spread of research within the realm of AI in education. Our findings shed light on the evolution of models for the adoption of AI technologies in higher education, revealing six main areas of research in the field: (1) teaching and involving students in the educational process using generative AI, (2) using chatbots to improve the educational process, (3) improving the literacy of teachers and students in the field of AI, (4) AI and blockchain in educational practices (5) development of regulations for the use of AI and (6) improving operational processes at universities. This article explains current influences on research prospects in the context of higher education. By offering an understanding of the challenges and opportunities presented by AI, this paper encourages educators to investigate possible uses of AI in the context of higher education.

Keywords: Artificial Intelligence, Resistance to Change; Digital Technologies; Digitalization; Leadership; Leadership in Higher Education.

1. Introduction

The emergence of the ChatGPT served as a catalyst for a global technological breakthrough in almost all sectors of the economy and lead to the exponential increase in the interest of scientific community in implementing AI, especially in higher education sector (George & Wooden, 2023; Kroshilin, 2022). The latest phase in the digital transformation of higher education is AI. Although when introduced, its full extent and impact have not yet been comprehended (Solís et al., 2023). Representing an important watershed of pedagogical methodologies for higher education, AI has been grafted into the body of higher education. A cutting-edge technology moving ahead speedily, AI capability can be used in learning processes all sorts of exciting ways (Zaman, 2023). From the increasing output of academic words published during 2019-2023 it can be clearly observed that higher education is now obsessed with AI.

As field of AI in higher education matures, understanding its evolving landscape becomes vital. Researchers in this dynamic discipline continually seek fresh insights to enrich the knowledge base and unveil new research directions that stimulate debates on pivotal topics (Crompton & Song, 2021). Systematic reviews of the existing research in AI implementation within higher educational contexts are needed to recognize key contributions and to construct well-founded arguments about the field's progression (Zawacki-Richter et al., 2019). Literature reviews play a critical role in mapping the intellectual terrain for further scholarly exploration (Anand et al., 2021a), offering valuable insights into prominent authors, institutions, countries, and the predominant themes and works shaping this field (Anand et al., 2021a). However, a review employing bibliometric analysis to unravel the intellectual foundations and emerging trends in this area of AI diffusion in higher education has not yet been extensively undertaken, indicating a gap in scholarly inquiry (Zawacki-Richter et al., 2019).

Previous studies tended to be narrowed to specific aspects of AI and did not present a complete picture of the development of the field. For example, the work of Takahashi and colleagues (2024) in a bibliometric review of the diffusion of innovations demonstrates this shortcoming by not specifically focusing on AI in work. Simultaneously, several studies emphasize the need for a detailed analysis of the role of AI in higher education (Zaman, 2023).

While there have been attempts to review the diffusion of AI technologies in educational settings, these efforts often need scope and clarity. For example, some scholars have focused on specific aspects of AI in education, such as its impact on learning outcomes or its integration in curriculum design, without offering a broad overview

of the field's evolution (Zawacki-Richter et al., 2019). This study aims to overcome these limitations by employing systematic bibliometric methods to explore and systematize the existing literature on AI technology diffusion in higher education.

2. Background and Research Questions

Bibliometric techniques, combined with science mapping software, offer a robust approach to categorize, conceptualize, and reveal trends in literature, surpassing the capabilities of traditional review methods such as narrative or structured reviews (Anand et al., 2021a; Anand et al., 2021b,). This study adopts relational techniques (Benckendorff and Zehrer, 2013), to analyse qualitative, quantitative, and structural growth in this research field (Anand et al., 2021a). These techniques also help identify theoretical foundations (Zupic and Cater, 2015) and emerging trends (Walsh and Renaud, 2017).

Thus, the current study seeks to fill this gap by systematizing and analysing existing publications on AI in higher education through bibliometric data analysis (Anand et al., 2021a; Walsh & Renaud, 2017). This research applies both evaluative and relational bibliometric methods to analyse the global landscape of AI in higher education, identify influential authors, most cited papers, and identify emerging research trends.

Within this objective, the following research question was identified:

RQ: What are the emerging research topics and trends in the diffusion of AI technologies in higher education?

3. Methodology

Our study of AI in higher education relies on a systematic literature review conducted according to the five-step methodology proposed by (Anand et al., 2021a; Tranfield et al., 2003). To ensure the reliability of the results, this methodology was aligned with the Preferred reporting items for systematic reviews and meta-analyses (PRISMA) program to ensure academic transparency and reliability (Moher et al., 2009). Scopus was chosen as the database, with a focus on current and relevant publications in the field of AI and education, excluding irrelevant papers and other types of papers to maintain a rigorous methodological discipline. The collected data was analyzed and presented visually using VOSviewer.

Step 1. Firstly, our research process encompassed several steps, such as constructing SCOPUS search strings, and choosing the appropriate databases, among other tasks, all in line with the established guideline of Anand et al., 2021a.

3.1 Database Selection for the Search

To conduct this comprehensive literature review, the Scopus database was utilized for article selection and bibliometric analysis. This database provides access to a vast repository of research articles, making it a suitable resource for a review of AI in higher education.

3.2 Identification of Relevant Keywords and Subject Areas, Followed by the Construction of Precise Search Strings

Consequently, we executed a search in title and abstract to retrieve publications from this database for more in-depth analysis (Table 1). A term search in topic and abstract employing various combinations was conducted on the Scopus database to retrieve publications. We established specific inclusion criteria for selecting these publications, focusing on the subject codes related to business and economics. The data was collected in January 2024, and considering the regular updates to the Scopus database, it's expected that the figures might vary in future searches. We limited our inclusion to journal articles, deliberately excluding editorials, conference papers, and book chapters. This decision was based on the methodological rigor these articles hold in the scientific community, following guidelines by Anand et al, 2021a and Thyer, 2008. Later, the data was processed via MS Excel to remove duplicates and form a sample. This resulted in a total sample of 2652 articles related to AI in higher education.

Step 2: Secondly, to analyze the trends in the literature based on the 2652 publications we obtained, we employed bibliometric methods. These methods are commonly used in conjunction with science mapping tools and techniques to visualize the structure of a discipline (Anand et al., 2021a; Walsh and Renaud, 2017; Zupic & Cater, 2015) and to analyze clusters (Anand et al., 2021a; Walsh and Renaud, 2017). In our paper, we utilized Van Eck and Waltman's (2010) VOS Viewer software for mapping bibliography and citation trends, which are

represented through clusters, tables, and maps, as shown by Anand et al (2021a) and Walsh and Renaud (2017). Over the last decade (2013-2024), VOS Viewer has been increasingly adopted and applied in various literature reviews published in top-ranked journals, as evidenced by Kirby (2023).

Step 3: Relational techniques, as described by Anand et al. (2021a) and Benckendorff and Zehrer (2013), provide a more nuanced understanding of the connections and relationships within the field. These techniques involve analyzing the links between different academic works, authors, and themes, enabling a deeper exploration of the intellectual structure and network dynamics characterizing AI technology diffusion in higher education. The bibliographic coupling was performed, and 6 clusters were identified.

Step 4: Following Anand et al. (2021a) guideline, we embarked on a qualitative descriptive coding of the abstracts of these publications. Based on the content of abstracts, 102 out of 2652 publications were selected. The content of 102 abstracts from selected articles was analyzed in accordance with the parameters of Anand et al., (2021a). As emphasized by Salager-Meyer (1990, p. 367), abstracts are crucial for consolidating research ideas and fully grasping the arguments of the original articles. This process involved two researchers independently examining the abstracts and compiling notes, followed by a verification process for consistency by one other author.

Step 5: Fifth, synthesis was performed. In the line with the methodology of our study on AI technology diffusion in higher education, we conducted systematic reviews with a focus on synthesis, following the framework established by Anand et al. (2021a). The synthesis approach is a systematic method for amalgamating, integrating, and synthesizing diverse literature, offering a cohesive narrative and summary of the field (Schick-Makaroff et al., 2016). This approach is particularly useful in handling the multifaceted nature of AI technology diffusion in higher education.

4. Findings

RQ. What are the emerging research topics and trends in the diffusion of AI technologies in higher education?

Based on the bibliographic coupling in the research, six primary clusters were identified (Figure 1)

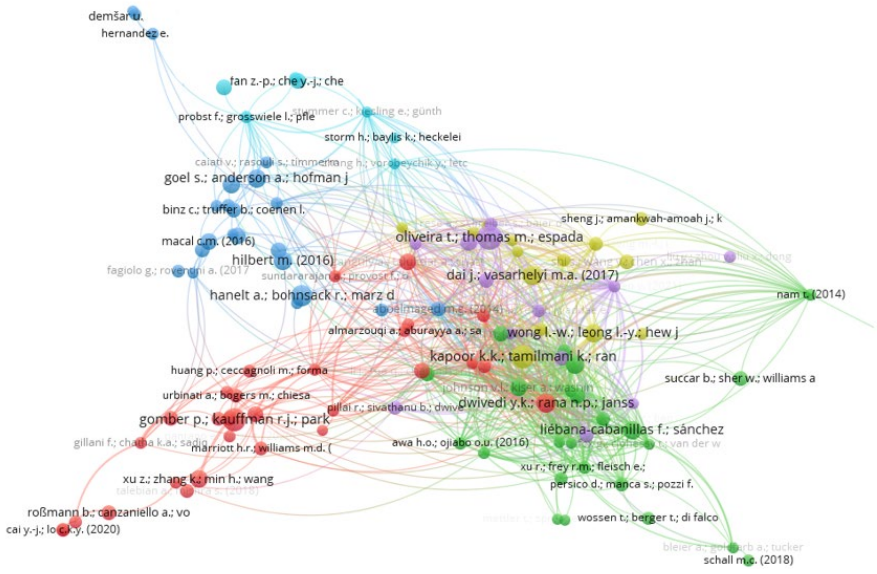


Figure 1: Bibliographic coupling (made in VOSviewer)

The first cluster (red) "*teaching and involving students in the educational process using generative AI*" (n=26) uncovers the application of generative AI in educational environments, not merely to improve student involvement in education, but also to promote individualized learning experiences and enable research tools. This cluster contains a seminal work by Dwivedi et al., 2019 "Re-examining the unified theory of acceptance and use of technology (UTAUT): Towards a revised theoretical model. Information systems frontiers" which serves as a conceptual framework for many studies observing AI implementations in educational context. Another seminal work Gomber et al., 2018 "On the fintech revolution: Interpreting the forces of innovation, disruption, and transformation in financial services" serves in articles as a framework to interpret AI innovation

implementation within educational context. The second cluster (green) *"using chatbots to improve the educational process"* (n=24) describes how the development of chatbots proceeds to improve the educational processes. The cluster is characterized by the representative capacity of chatbots, as a key tool for achieving guided learning. The third cluster (blue) "*improving the literacy of teachers and students in the field of AI*" (n=23) is focused on the expansion of AI literacy among educators and students. From this perspective, this cluster stresses the urgency of familiarizing teachers and learners with the principles of efficient utilization of AI devices in their educational environments. Fourth cluster (yellow) "*AI and blockchain in educational practices*" (n=12) analyzes the merger of AI and blockchain technology in universities. It specifically focuses on the use of AI for analysis of educational data, which is securely stored on blockchain platforms. Fifth cluster (purple) "*development of regulations for the use of AI*" (n=11) highlights the development of guidelines for an ethical and efficient approach to AI in education. The studies in this cluster focus on the call for a regulatory structure and deployment necessitate an ethical and comprehensive, regulatory framework, policy and responsible AI guideline's structure. Sixth cluster (light blue) "*improving operational processes at universities*" (n=6) is centered around optimizing operational processes in universities through developing guidelines for the use of AI .

5. Discussion

A deeper look into the first cluster demonstrates that AI is adept at improving student participation in interactive problem-solving exercises and the shift of AI from aiding teacher instruction to that of active learner management (Chan & Lee, 2023; Dehouche & Dehouche, 2023). AI provides a personalized educational solution that adjusts learning methods to cater to the needs of individual students, thereby fostering a more personalized learning environment (Cox et al., 2021; Chrisinger; 2019; Kumar, 2019). This cluster also focus on AI capabilities to ease research in educational processes (Kitamura, 2023; van Dis et al., 2023). Despite the advantages presented in the first cluster there still are controversial thoughts within AI research discourse. Resent research states that although AI can help higher education to significantly evolve, the models are biased and need development (Ouyang et al., 2022; Roshanaei, 2024). All in all, the findings reveal much promise and difficulty in implementing generative AI into educational practice which aligns with the findings of Farrokhnia et al. (2023).

In the second cluster, studies by Hwang & Chang (2023) and Lin's et al (2022) state that chatbots are effective in guiding students through data-driven and practice-based learning to develop discipline, learning perseverance and activate participation. Some articles within the cluster highlight that AI chatbots are enhancing students' collaborative learning and information exchange thus effectively supporting the assessment of peers and interactive learning (Bauer E. et al. 2023, Cachero et al., 2023; Darvishi et al., 2022, Chang et al., 2022). Other articles within the cluster focus on AI chatbots as assistants in scheduling and managing time or preparing for exams (Arruda et al., 2019, Fuchs, 2023; Frommert et al., 2018). Even though some scholars state that chatbots with, for example, FAQs and short answers can provide many improvements for teaching students and providing content to teachers (Cunningham-Nelson et al., 2019; Ismail & Ade-Ibijola, 2018) some sholars actively oppose the use of chatbots due to their inaccuracy and inability to be creative in response (Kooli, 2023; Toader et al., 2019).

Third cluster discusses the literacy of teachers and students in the field of AI. Some articles like Mizumoto & Eguchi (2023) and Crompton & Burke (2023) feature examples of how AI helps automate the process of checking students' papers, making it less biased and, at the same time, less time-consuming. Apart from simplifying certain personnel-related activities, this tool helps teachers concentrate more on applied aspects of their work than on organizational. Furthermore, the cluster discusses the application of AI as an enabler of synchronous studying in the form of group assignments or problem-solving tasks (Han et al., 2023). Although the positive aspects presented in the cluster, some studies in the existing research field raise concerns about teacher's trust in AI systems and the impact they can have on educational communities, suggesting that future work should explore not only the possibilities of using AI, but also the perception and understanding of these methods by students (e.g. Pishtari et al., 2023).

The fourth cluster uncovers the possible co-use of blockchain and AI. Blockchain is used to securely store educational records and student achievements, and AI can analyze this data to personalize curricula and teaching methods (Aliane & Salim, 2023). Such technologies have demonstrated effectiveness in managing student data and preventing fraudulent decryptions in higher education. However, there are several difficulties in implementing these technologies, including due to data privacy issues and a shortage of technical staff. (Aliane & Salim, 2023).

The fifth cluster indicates a strong need within educational systems to guide policy development and ensure responsible AI usage. Some studies such as Nguyen et al., 2023 and Dieterle et al., 2024 indicate the need for a normative framework that will regulate the deployment and use of AI in addition to preventing its misuse, but also innovation. There is also a concern about the vision of ethics the two parties between the educators and learners should have when it comes to operating and using AI. For example, Flores-Vivar & García-Peñalvo, 2024 focused on promoting a culture that maintains ethics in the use of AI. This signifies a call for a collaborative approach to responsible implementation and use of AI in education.

The last cluster states that AI can be used to help management in universities. For example, AI can be used to generate standardized templates for administrative communications, which can mitigate the bottlenecks created by the lack of standardized forms of communication between administrators (Parycek et al., 2023). However, there is a resistance towards AI among employees within universities which can have a different background for each case (Muñoz & Chimbo, 2023).

6. Conclusions

In this bibliometric analysis of the global integration of artificial intelligence (AI) in higher education, we provided a set of emerging research topics and trends in the diffusion of AI technologies in higher education. By synthesizing 102 papers, six clusters were found to be the main landscapes in this area: generative AI in education, chatbots for teaching and learning, AI literacy, AI and blockchain, ethical usage of AI and AI for administrative processes optimalization.

The research illustrates AI's potential to improve teaching and learning practices. The impact this might have includes encouraging student involvement, facilitating personalized instruction and automating administrative processes. In the education field, generative AI could offer the answer. While these are hugely complex systems which might exhibit bias or other vulnerability, it remains feasible when individuals concern themselves with their own educational direction (Chan & Lee, 2023; Dehouche & Dehouche, 2023; Cox et al., 2019). Chatbots are another promising app; they can improve student interaction with teachers and provide guided learning modes (Hwang & Chang, 2021). But their effectiveness depends very much on exact use, and this underscores the need for careful applications (Arruda et al., 2019). The research also indicates that educators require a greater understanding of AI (Mizumoto & Eguchi, 2023). With integration of AI and block-chain technology, educational data can be stably stored and then analyzed. However, adoption is obstructed by privacy anxieties as well as technical blockages (Aliane & Salim, 2023). The ethical problems arising from use of AI in education is a crucial issue. There is a general demand for comprehensive regulatory frameworks and codes of practice to be created, with consensus on balance innovation with responsible use (Nguyen et al., 2023; Flores-Vivar & García-Peñalvo, 2024). Finally, for universities and other higher education institutions AI presents potential, although this is contested because of potential technological bias or mistrust of automation (Muñoz & Chimbo, 2023).

References

Aliane, N., & Salim, A. S. (2023). Revolutionising Higher Education: Case Studies on Education4. 0 Integration and Blockchain-Enhanced Education Management. Eurasian Journal of Educational Research, 105(105), 217-235.

Anand, A., Brøns Kringelum, L., Øland Madsen, C., & Selivanovskikh, L. (2021a). Interorganizational learning: a bibliometric review and research agenda. The Learning Organization, 28(2), 111-136.

Anand, A., Muskat, B., Creed, A., Zutshi, A., & Csepregi, A. (2021b). Knowledge sharing, knowledge transfer and SMEs: evolution, antecedents, outcomes and directions. Personnel review, 50(9), 1873-1893.

Arruda, D., Marinho, M., Souza, E., & Wanderley, F. (2019). A chatbot for goal-oriented requirements modeling. In Computational Science and Its Applications–ICCSA 2019: 19th International Conference, Saint Petersburg, Russia, July 1–4, 2019, Proceedings, Part IV 19 (pp. 506-519). Springer International Publishing.

Bauer, E., Greisel, M., Kuznetsov, I., Berndt, M., Kollar, I., Dresel, M., ... & Fischer, F. (2023). Using natural language processing to support peer-feedback in the age of artificial intelligence: a cross-disciplinary framework and a research agenda. British Journal of Educational Technology, 54(5), 1222-1245.

Bauer, K., von Zahn, M., & Hinz, O. (2023). Expl (AI) ned: The impact of explainable artificial intelligence on users' information processing. Information systems research, 34(4), 1582-1602.

Benckendorff, P., & Zehrer, A. (2013). A network analysis of tourism research. Annals of Tourism Research, 43, 121-149.

Cachero, C., Rico-Juan, J. R., & Macià, H. (2023). Influence of personality and modality on peer assessment evaluation perceptions using machine learning techniques. Expert Systems with Applications, 213, 119150.

Chan, C. K. Y., & Lee, K. K. (2023). The AI generation gap: Are Gen Z students more interested in adopting generative AI such as ChatGPT in teaching and learning than their Gen X and millennial generation teachers?. Smart Learning Environments, 10(1), 60.

Chang, C. Y., Hwang, G. J., & Gau, M. L. (2022). Promoting students' learning achievement and self-efficacy: A mobile chatbot approach for nursing training. British Journal of Educational Technology, 53(1), 171-188.
Chrisinger, D. (2019). The solution lies in education: Artificial intelligence & the skills gap. On the horizon, 27(1), 1-4.
Cox, A. M. (2021). Exploring the impact of Artificial Intelligence and robots on higher education through literature-based design fictions. International Journal of Educational Technology in Higher Education, 18(1), 3.
Crompton, H., & Burke, D. (2023). Artificial intelligence in higher education: the state of the field. International Journal of Educational Technology in Higher Education, 20(1), 22.
Crompton, H., & Song, D. (2021). The potential of artificial intelligence in higher education. Revista virtual Universidad catolica del Norte, 62.
Cunningham-Nelson, S., Baktashmotlagh, M., & Boles, W. (2019). Visualizing student opinionthroughtext analysis. IEEE Transactions on Education, 62(4), 305–311
Darvishi, A., Khosravi, H., Sadiq, S., & Gašević, D. (2022). Incorporating AI and learning analytics to build trustworthy peer assessment systems. British Journal of Educational Technology, 53(4), 844-875.
Dehouche, N., & Dehouche, K. (2023). What's in a text-to-image prompt? The potential of stable diffusion in visual arts education. Heliyon, 9(6).
Dieterle, E., Dede, C., & Walker, M. (2024). The cyclical ethical effects of using artificial intelligence in education. AI & society, 39(2), 633-643.
Dwivedi, Y. K., Rana, N. P., Jeyaraj, A., Clement, M., & Williams, M. D. (2019). Re-examining the unified theory of acceptance and use of technology (UTAUT): Towards a revised theoretical model. Information systems frontiers, 21, 719-734.
Dwivedi, Y. K., Kshetri, N., Hughes, L., Slade, E. L., Jeyaraj, A., Kar, A. K., ... & Wright, R. (2023). "So what if ChatGPT wrote it?" Multidisciplinary perspectives on opportunities, challenges and implications of generative conversational AI for research, practice and policy. International Journal of Information Management, 71, 102642.
Farrokhnia, M., Banihashem, S. K., Noroozi, O., & Wals, A. (2023). A SWOT analysis of ChatGPT: Implications for educational practice and research. Innovations in Education and Teaching International, 1-15.
Flores-Vivar, J. M., & García-Peñalvo, F. J. (2023). Reflections on the ethics, potential, and challenges of artificial intelligence in the framework of quality education (SDG4). Comunicar, 31(74), 37-47.
Frommert, C., Häfner, A., Friedrich, J., & Zinke, C. (2018). Using chatbots to assist communication in collaborative networks. In Collaborative Networks of Cognitive Systems: 19th IFIP WG 5.5 Working Conference on Virtual Enterprises, PRO-VE 2018, Cardiff, UK, September 17-19, 2018, Proceedings 19 (pp. 257-265). Springer International Publishing.
Fuchs, K. (2023, May). Exploring the opportunities and challenges of NLP models in higher education: is Chat GPT a blessing or a curse?. In Frontiers in Education (Vol. 8, p. 1166682). Frontiers.
Galvagno, M. (2017). Bibliometric literature review: An opportunity for marketing scholars. Mercati & Competitività, (2017/4).
George, B., & Paul, J. (2020). Digital transformation in business and society. New York, NY, USA: Springer International Publishing
George, B., & Wooden, O. (2023). Managing the strategic transformation of higher education through artificial intelligence. Administrative Sciences, 13(9), 196.
Gil, D., Hobson, S., Mojsilović, A., Puri, R., & Smith, J. R. (2020). AI for management: An overview. The future of management in an AI world: Redefining purpose and strategy in the fourth industrial revolution, 3-19.
Gomber, P., Kauffman, R. J., Parker, C., & Weber, B. W. (2018). On the fintech revolution: Interpreting the forces of innovation, disruption, and transformation in financial services. Journal of management information systems, 35(1), 220-265.
Han, J. W., Park, J., & Lee, H. (2022). Analysis of the effect of an artificial intelligence chatbot educational program on non-face-to-face classes: a quasi-experimental study. BMC Medical Education, 22(1), 830.
Hannan, E., & Liu, S., (2021). AI: New source of competitiveness in higher education. Competitiveness Review: An International Business Journal 33: 265–79.
Hwang, G. J., & Chang, C. Y. (2023). A review of opportunities and challenges of chatbots in education. Interactive Learning Environments, 31(7), 4099-4112.
Ismail, M., & Ade-Ibijola, A. (2019). Lecturer's apprentice: A chatbot for assisting novice programmers. In 2019 international multidisciplinary information technology and engineering conference (IMITEC) (pp. 1–8).
Kirby, A. (2023). Exploratory Bibliometrics: Using VOSviewer as a Preliminary Research Tool. Publications, 11(1), 10
Kitamura, F. C. (2023). ChatGPT is shaping the future of medical writing but still requires human judgment. Radiology, 307(2), e230171.
Kooli, C. (2023). Chatbots in education and research: A critical examination of ethical implications and solutions. Sustainability, 15(7), 5614.
Kroshilin, S. (2022). Digital transformation of Russian universities during the pandemic. Science Culture Society, 28, 93-110.
Kumar, N. S. (2019). Implementation of artificial intelligence in imparting education and evaluating student performance. Journal of Artificial Intelligence, 1(01), 1-9.
Lin, X. F., Chen, L., Chan, K. K., Peng, S., Chen, X., Xie, S., ... & Hu, Q. (2022). Teachers' perceptions of teaching sustainable artificial intelligence: A design frame perspective. Sustainability, 14(13), 7811.
Mizumoto, A., & Eguchi, M. (2023). Exploring the potential of using an AI language model for automated essay scoring. Research Methods in Applied Linguistics, 2(2), 100050.

Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., & PRISMA Group*. (2009). Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. Annals of internal medicine, 151(4), 264-269.

Muñoz, G. F. R., & Chimbo, K. M. O. (2023). Application of artificial intelligence techniques in the administrative management of higher education institutions: an analysis of their effectiveness in process optimization and strategic decision making. Revista Científica Interdisciplinaria Investigación Y Saberes, 13(2), 66-83.

Nguyen, A., Ngo, H. N., Hong, Y., Dang, B., & Nguyen, B. P. T. (2023). Ethical principles for artificial intelligence in education. Education and Information Technologies, 28(4), 4221-4241.

Ouyang, F., Zheng, L., & Jiao, P. (2022). Artificial intelligence in online higher education: A systematic review of empirical research from 2011 to 2020. Education and Information Technologies, 27(6), 7893-7925.

Parycek, P., Schmid, V., & Novak, A. S. (2023). Artificial intelligence (AI) and automation in administrative procedures: potentials, limitations, and framework conditions. Journal of the Knowledge Economy, 1-26.

Pishtari, G., Sarmiento-Márquez, E. M., Rodríguez-Triana, M. J., Wagner, M., & Ley, T. (2023, August). Evaluating the Impact and Usability of an AI-Driven Feedback System for Learning Design. In European Conference on Technology Enhanced Learning (pp. 324-338). Cham: Springer Nature Switzerland.

Rogers, E.M. (2003) Diffusion of Innovations. Free Press, New York.

Roshanaei, M. (2024). Towards best practices for mitigating artificial intelligence implicit bias in shaping diversity, inclusion and equity in higher education. Education and Information Technologies, 1-26.

Salager-Meyer, F. (1990). Discoursal flaws in medical English abstracts: A genre analysis per research-and text-type. Text-Interdisciplinary journal for the study of discourse, 10(4), 365-384.

Schick-Makaroff, K., MacDonald, M., Plummer, M., Burgess, J., & Neander, W. (2016). What synthesis methodology should I use? A review and analysis of approaches to research synthesis. AIMS public health, 3(1), 172.

Solís, M. W. M. V., Ríos, C. A. G., Hermida, C. E. C., Alencastre, J. L. A., & Tovalin-Ahumada, J. H. (2023). The impact of artificial intelligence on higher education: a sociological perspective. Journal of Namibian Studies: History Politics Culture, 33, 3284-3290.

Takahashi, C. K., de Figueiredo, J. C. B., & Scornavacca, E. (2024). Investigating the diffusion of innovation: A comprehensive study of successive diffusion processes through analysis of search trends, patent records, and academic publications. Technological Forecasting and Social Change, 198, 122991.

Toader, D. C., Boca, G., Toader, R., Măcelaru, M., Toader, C., Ighian, D., & Rădulescu, A. T. (2019). The effect of social presence and chatbot errors on trust. Sustainability, 12(1), 256.

Tranfield, D., Denyer, D., & Smart, P. (2003). Towards a methodology for developing evidence-informed management knowledge by means of systematic review. British journal of management, 14(3), 207-222.

Van Dis, E. A., Bollen, J., Zuidema, W., Van Rooij, R., & Bockting, C. L. (2023). ChatGPT: five priorities for research. Nature, 614(7947), 224-226.

Van Eck, N., & Waltman, L. (2010). Software survey: VOSviewer, a computer program for bibliometric mapping. scientometrics, 84(2), 523-538.

Walsh, I., & Renaud, A. (2017). Reviewing the literature in the IS field: Two bibliometric techniques to guide readings and help the interpretation of the literature. Systèmes d'information et Management, 22(3), 75-115.

Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education–where are the educators?. International Journal of Educational Technology in Higher Education, 16(1), 1-27.

Zaman, B. U. (2023). Transforming Education Through AI, Benefits, Risks, and Ethical Considerations. Authorea Preprints

Zupic, I., & Čater, T. (2015). Bibliometric methods in management and organization. Organizational research methods, 18(3), 429-472.

International Assignments Management in a Knowledge-intensive Organisation: A Case Study

Adriana Gradim[1], José Vale[2] and Vera Vale[1]
[1]Department of Economics, Management, Industrial Engineering and Tourism & GOVCOPP - Research Unit on Governance, Competitiveness and Public Policies, University of Aveiro, Aveiro, Portugal
[2]CEOS.PP – Centre for Organisational and Social Studies of Polytechnic of Porto, Porto Accounting and Business School, Polytechnic Institute of Porto, Porto, Portugal

adrianacoutinho@ua.pt
josevale@iscap.ipp.pt
v.c.vale@ua.pt

Abstract: Knowledge represents a crucial part of the development of intellectual capital (IC). Therefore, the way knowledge is managed can impact IC creation and/or loss in an organisation. However, the need to manage knowledge resides in the strategic perspective of knowledge to sustain competitive advantage in a knowledge economy, especially in the context of international assignments. This work has the goal of understanding how personnel mobility affects the knowledge and intellectual capital management of a knowledge-intensive organisation. This study therefore applies a qualitative methodology to analyse how knowledge and intellectual capital are managed in the context of international assignments from a Portuguese knowledge-intensive organisation. Exploratory interviews and direct observation were used to achieve the goal of this study. This work identifies three main knowledge management processes that are involved in the context of international assignments, namely knowledge transfer, knowledge sharing and knowledge hiding. The goal is to increase knowledge transfer and sharing behaviours while reducing knowledge hiding ones. This study goes further and identifies that power, motivation and culture can influence the way these processes occur in an organisation Considering the work here presented, the results cannot be generalised to other organisations and industries due to the nature of the applied methodology, but it can serve as a benchmark for other organisations in the same industry. If other researchers find this topic interesting, it would be pertinent to conduct research in other organisations and industries to achieve a broader understanding and compare results.

Keywords: Knowledge Management, Intellectual Capital, International Assignments, Knowledge-Intensive Organisation

1. Introduction

The importance of managing knowledge from international assignees is crucial in knowledge-intensive business organisations (KIBOs) where knowledge is the most important strategic resource and employees are the main source of that knowledge (Steyn and Kahn, 2008; Nakash and Bouhnik, 2023). Therefore, managing knowledge in these settings becomes a primary focus in developing IC. KIBOs are defined in this study as organisations whose primary activities are dependent on knowledge management (KM) and that can produce exceptionally good outputs using a workforce of an intellectual nature that usually detains a high level of education or training (Millar, Lockett and Mahon, 2016; Nakash and Bouhnik, 2023).

Pharmaceutical companies are an example of KIBOs (Amaya *et al.*, 2022). This industry employs more than 750,000 people with 16% of them working in research and development (Ramy, Af Ragab and Arisha, 2022). In Portugal, the pharmaceutical industry, although important, is not as developed as in other European countries. This is due to a lack of resources and knowledge to move further and remain competitive. However, the pharmaceutical industry in Portugal has a place to grow and improve and can be a fundamental mechanism for the country's economic growth (European Federation of Pharmaceutical Industries and Associations, 2022).

Over the years, the research field regarding KIBOs has been frequently connected to KM and IC. However, there is a gap in the literature regarding the connection of these themes with international assignment management. As mentioned by Millar et al., (2017, p.273), more research is needed to understand how KIBOs, who rely on their people as their most valuable asset, manage the knowledge from their international workforce. Two KM processes are most researched in IAs literature, namely knowledge sharing and knowledge transfer. These two processes are seen as positive processes to foster KM in an organisation. On the contrary, knowledge hiding has emerged in the literature as a process that can negatively impact the previous two processes and compromise the management of knowledge in the organisation (He *et al.*, 2021; Phookan and Sharma, 2021; Issac *et al.*, 2022). Therefore, there is a need to understand which factors can lead to employees engaging in KM activities to develop IC.

Several factors can be identified as antecedents of KM. Knowledge sharing, transfer and hiding are all influenced by personal (e.g., motivation, empowerment, absorptive capacity, power, reputation), organisational (e.g., organisational culture, organisational hierarchy, work design, management support) and cultural factors (e.g., language of a country, culture of the country) (Lee and Al-Hawamdeh, 2002; He *et al.*, 2021; Xiao, 2023). Therefore, it is crucial to consider the relationship between the knowledge holder and the knowledge recipient. To increase knowledge sharing and transfer activities while reducing knowledge hiding ones, knowledge holders need to be motivated to share their knowledge while not fearing losing power in an organisational culture that promotes and rewards knowledge-sharing and transfer activities. On the other hand, the knowledge recipient needs to be motivated to receive and apply the knowledge from the holder by understanding that the received information is crucial for its job while being promoted to engaging in a knowledge sharing culture (Ado, Wanjiru and Su, 2021; Phookan and Sharma, 2021; Yeboah, 2023). From all the factors it seems that there is a stronger focus on motivation, power, and culture.

This work aims to understand how personnel mobility affects the knowledge and IC management of a knowledge-intensive organisation. The following research question then guides this study:

How and why to manage knowledge and intellectual capital in the context of personnel mobility?

2. Methodology

For this work, qualitative methodology was applied which allows maximum access to the human experience since its premise is "that there is no single absolute reality with an external ontic status" (Nakash & Bouhnik, 2023, p.705). The use of a single case study has gained importance in the literature over the years since it allows the generation of new theoretical concepts while giving examples from practitioners (Yin, 2009, 2018; Amaya *et al.*, 2022). In terms of data collection, three methods were used namely semi-structured interviews, direct observation and document analysis.

A first round of exploratory interviews was conducted at BIAL headquarters in Trofa, Porto between April and May 2023. The interviews were conducted both online (via Microsoft Teams) and in person. Also, some interviews were carried out in Portuguese while others were in English. These interviews aimed to understand how the company manages mobility (those who went abroad and those who came to work in Portugal) and if a knowledge management system exists. All participants (n=11) were interviewed and consent for the interviews was signed. For the interviews, different guides were produced with research questions related to the management of knowledge and intellectual capital in their position. The interviews were audio-recorded using the researcher's phone and laptop and notes were also taken. Interviews last on average forty minutes. The interviews were then transcribed by the researcher both in Portuguese and English according to the language used in the interview. The Portuguese transcriptions were then translated into English to achieve a coherent analysis of the results.

On May 9th, the first observation included an informal meeting with three human resource management team elements to understand how international assignees are managed. This meeting was also important to analyse the existence of systems to manage the human resources of the organisation and the knowledge produced, namely a talent and succession app and a career framework. Another element of observation occurred on May 25th when the researcher met an element of this team to analyse how SharePoint is used in the organisation to share and access information by the employees.

3. The Case Context

BIAL is a Portuguese pharmaceutic company that was founded in 1924 by Álvaro Portela. BIAL is an innovative pharmaceutical company dedicated to the research, development and marketing of medicines. BIAL's mission is to find, develop and provide therapeutic solutions in the field of health guided by the strategic lines of quality, research, and development (R&D) and internationalisation.

In Europe, BIAL has a production and R&D unit in Portugal and affiliates in Spain, Germany, the United Kingdom, Italy, and Switzerland. In the US, in 2020, BIAL established BIAL Biotech Investments Inc. (BIAL Biotech). In French West Africa, it has operated since 1999. Through partnerships with local promotion agents, BIAL Francophone Africa operates in 18 countries in the region. BIAL Angola is one of the leading pharmaceutical companies in the country and has a wide range of products (over 40 medicinal products). In Mozambique, BIAL owns Medimport. Established in 1996, the company is engaged in the import and distribution of pharmaceutical specialities, representing several pharmaceutical companies, with which it has licencing agreements for Mozambique. BIAL

also establishes partnerships/licensing agreements with leading pharmaceutical companies to be able to access other markets. This is the case in some European countries, the USA, Japan, China and South Korea. This broad network of partnerships has enabled BIAL to share innovative products in the neurosciences field in various countries.

Therefore, considering the previous description of the organisation and what is mentioned in the literature regarding KIBOs and pharmaceutical companies, BIAL is identified as a KIBO in this study. Moreover, the existence of subsidiaries in different locations suggests that the organisation has cross-border mobility as part of its business operation, making it a fit for the study of international assignments. Because BIAL can be considered a KIBO and to a certain extent a multinational company with IAs, it fits the goal of this research to be used as a case study. This study is then important for theoretical as well as practical reasons since the pharmaceutical industry in Portugal can be a fundamental mechanism for the country's economic growth, namely BIAL (BIAL, 2024).

4. Results and Discussion

4.1 Interviews

In terms of interviews, three groups of employees were included, namely auto-expatriates, expatriates and HR employees since these are the ones involved in cross-border mobility in the organisation. This study finds it pertinent to include different types of international assignees and different hierarchical levels to achieve a more detailed understanding of the analysed theme.

4.1.1 Expatriates

For this study, from the few available expatriates, two agreed to participate. These are two long-term expatriates since they have been in foreign countries for more than 20 years. Both occupy senior director positions which gives them the knowledge to speak about the subject from a managerial perspective. In terms of the expatriation process, both were career progression opportunities.

In terms of the interaction between the headquarters and the subsidiaries, INT1 believes that headquarters must be responsible for the main guidelines and corporate rules while monitoring the processes and practices in the various subsidiaries. For that to happen, there must be a permanent exchange of knowledge through meetings. In BIAL's case, there are local as well as global meetings. For example, INT2 comes to the country periodically to make a personal update on the activities and develop further strategic plans.

Regarding the reduced number of expatriates in the organisation, INT1 believes that this happens because Portugal does not have all the resources it wants, and BIAL still does not have the dimension to externalise. From the literature, it is possible to conclude that the reduced number of expatriations can then be associated with the difficulty of creating subsidiaries in Europe in the pharmaceutical market since it is very regulated (European Commission, 2020; European Federation of Pharmaceutical Industries and Associations, 2022) Therefore, BIAL ends up hiring local labour instead of using expatriates since it depends on the candidate profile and business needs that leads to the hiring of locals. Still, companies must keep in mind and prepare staff to externalise (Alexandre and Martins, 2023). This preparation must be a bidirectional process of culture management and INT2 believes that the expatriation process can be improved by giving greater support.

In terms of KM in the organisation, INT1 believes that the "(…) *sharing of information must come naturally*" to employees to work for the common good which must be the maximum sharing of information with the different layers. However, considering the information given by the interviewees, there is no guarantee that this information sharing will happen at all the subsidiaries since it depends on the country manager. At the same time, INT1 and INT2 believe there is no guarantee that people are willing to freely share the information they possess because information means value and power. BIAL can then educate its people to believe that information sharing is an added value and not a threat to reducing knowledge-hiding behaviour. This can be done by developing career models for future perspectives, so it reduces the fear of people losing their positions. Still, both expatriates believe that BIAL has improved its knowledge-sharing culture through the hierarchical change that took place. However, improvements are still needed. INT1 agrees that the creation and implementation of a proper KM mechanism in the organisation is crucial. This can be done by ensuring that people the organisation recruits the right people (those open to a knowledge-sharing culture), keeps them motivated (through the

development of career plans) and is ready to collaborate (hold accountable the people who want to own the information).

4.1.2 Self-Initiated Expatriates (Sies)

To start, to be considered a SIE, people need to move to a different country from that of origin and this decision must be a personally motivated choice. All involved confirmed that the decision to move to Portugal was an entirely personal decision motivated by the search for a new career opportunity and to live in a different country. Moreover, all of them are part of the R&D division since this is the division in the organisation that must look out for international talent to fulfil its needs. The search for international talent in the R&D department is motivated by the need of the organisation to have the best experts to guarantee its success in the pharmaceutical industry.

In terms of the recruitment process, all SIEs received a relocation package and sufficient support from the organisation. This package includes the travel expenses for the interviews and relocation to Portugal. Also, it includes two-month accommodations with a storage place to keep personal belongings as well as participation in Portuguese classes to develop their knowledge of the language. Finally, informal support is given regarding the obtention of identity cards and social security as well as fiscal numbers. In this aspect, the interviewees all agree that the organisation could provide additional emotional and informal support to family members as confirmed in the literature (Black and Stephens, 1989). Lastly, regarding the integration of new elements, participants feel that the time for the introduction could be reduced or more focused on the division they will be working in. The implementation of this relocation package must be seen as a good practice for companies with mobility since it allows a smoother relocation for the employee while promoting integration both in the organisation as well as the country's cultures.

Considering the contact of the interviewees with subsidiaries this is reduced as mentioned by INT6: "(…) *working in R&D division we don't have any contact with them because they are working in the marketing. So, they are not part of our direct network*." Participants feel that as they integrate the most important division of the organisation, additional knowledge could be shared. This leads to a sense of disconnection from the members of this division to the rest of the organisation. Some participants feel that more connection with subsidiaries could increase their motivation and reduce this sense of loss.

Regarding KM processes, the R&D division has been implementing some changes to facilitate the integration of new elements and improve the workflow and knowledge sharing. The participants feel that the hierarchical change in the organisation facilitates information sharing while fostering a knowledge-sharing culture in the organisation and has brought some fundamental improvements to KM. However, some barriers to knowledge sharing still exist and are perceived by the interviewees. As mentioned by INT5: "*I think that now there is perhaps more transparency, above all (…) but all this openness only comes from the top. I think that in Portuguese culture, the lower levels, still don't open doors to each other*". The participants recognise that information sharing is highly dependent on individual motivation and individual perception of the use of knowledge. At the same time, they still feel that some people hold knowledge as a way of maintaining power and their positions in the organisation. Also, the participants feel that these changes have improved communication within the teams but not among the teams. This implies that Team A does not know what Team B is doing which can reduce the chances of collaboration among team members. Lastly, due to the nature of the knowledge in the R&D division, it can be difficult to implement a proper KM mechanism that considers all the regulations of this division due to the confidential nature of knowledge. However, BIAL is trying to stay up to date with a new electronic system, derived from the hierarchical modification, to help manage knowledge. Although significant and positive changes are being made regarding the creation of a knowledge-sharing culture, the organisation still lacks control mechanisms that ensure that people are motivated and actively engaged in information-sharing activities without the fear of losing their position or power.

4.1.3 Human Resource Employees

The interviews included three human resource employees. In terms of the mobility processes, there is a general approach adopted by the team to recruit whether employees are going to a foreign country to work at a subsidiary (expatriation) or coming from a foreign country to work at the headquarters (self-initiated expatriation). To note that the company is much more flexible when it comes to timings for starting a role as a foreigner, because of the moving from one country to another and the various administrative processes that also must be completed. Also, the HR team needs more time to prepare.

In terms of expatriation, these are punctual processes in the organisation that are used to serve certain purposes normally associated with the creation or renovation of a subsidiary. Also, due to the seniority of the HR employees involved in this study, the participants did not have the experience of managing an entire expatriation process. In terms of other mobility processes, they exist for specific business needs and are transversal to the organisation. In total these people move for about a week of work outside.

Considering KM, there is no formal process or tools in the organisation. What exists is a culture of sharing in terms of work. This culture of sharing starts with the onboarding process (when someone new enters the organisation) which allows contact with different areas of the company to quickly get to know or identify key people for specific matters. Normally it ends up being the manager who transfers the knowledge of what happens in a team, the work that is supposed to be done, and the project to work on. And then the transfer of knowledge is very much out of necessity. Since a knowledge mechanism is lacking in the organisation, the three participants find it useful for future management and it can make the work easier.

4.2 Direct Observation and Document Analysis

The direct observation for this study was conducted to understand how BIAL uses online systems to manage knowledge from the employees and share it in the organisation which leads to document analysis. Namely, training plans and the talent and succession app were observed in detail since they are the ones with the most information.

In terms of general management, BIAL uses Sharepoint to have all the documents each department and employee needs to access and use. Furthermore, it uses DocX as a platform for recording standards and procedures.

In terms of training, for each employee, there is a record of training carried out since joining the company. The HR team, together with the heads of each department, also create annual training plans where each department has a plan. A training plan is then drawn up containing the following information: name of the person or team to receive training (team when there are many people in the division and name of the person when there are few), the training that will be received, the date of the training and its total cost. After going through HR, this plan must be approved by the administration board. HR always seeks to monitor whether training is being completed to guarantee that the total number of training hours is achieved. Additionally, to facilitate the work of HR regarding training management, an application is being implemented that helps to plan the budget and see if the training was carried out.

In terms of the talent and succession mapping app, the organisation has a biannual analysis conducted in March and October. This is based on the 9-box grid which is a well-known talent management tool in which employees are divided into nine groups, based on their performance (in this case, (under, effective, outstanding) and potential (in this case, (low, medium, high). In terms of functioning, when entering the application, the manager can see the talent and succession tabs as well as a box next to it with the names of the people to be evaluated. Only people who have been with the company for more than 6 months (and excluding temporary employees) are mapped and the mapping is common to all hierarchical levels, with the only person not mapped in the company being the chairman.

In the succession tab, only the management levels are mapped, and a list of names is presented to map immediate, short-term, and long-term successors. However, this term is not mandatory to identify for these three periods. Afterwards, people are identified by the HR team and a career development plan is prepared so that the successor can be ready when necessary. To emphasise that the organisation has plans to extend this mapping to different levels to improve succession management.

The introduction of these new human resource management tools allows the employees to feel heard and valuable within the organisation giving them the possibility to progress in their career in different ways. At the same time, it allows employee mobility in the organisation (cross-border as well as internal) because it opens the possibility of being selected and promoted to different positions in the organisation.

4.3 Conclusions

Regarding the management of knowledge in cross-border mobility, this study aimed to confirm if all processes of KM are crucial for this context. Considering the context of this research and aligned with previous authors, this work confirms that while talking with people involved in IAs, the main processes that need to be managed are knowledge sharing, knowledge transfer and knowledge hiding (e.g., Ado et al., 2021; Chang, 2012; Huang et

al., 2013). Second, this exploratory part of the work made it possible to understand that three main concepts can act as antecedents of KM in this context, namely motivation, culture, and power as mentioned in the literature (Tams and Arthur, 2015; Santos and Gonçalves, 2018; Linder, 2019; van Bakel and Salzbrenner, 2019; Issac *et al.*, 2022).

Considering, the creation of IC in the mobility context, IC is seen as the result of KM activities in cross-border mobility processes. In terms of structural capital, it is positive to notice that BIAL has been up to date by creating and promoting the use of digital tools for internal management and use by its employees. Regarding, relational capital this is positively developed by the development and promotion of culture sharing in the organisation motivates people to relate with one another in the pursuit of a common goal. Considering human capital, at BIAL this is a crucial IC dimension due to the nature of its core work. Therefore, the organisation has developed several tools that allow to keep employees motivated and equipped with the right skills to develop their work. Lastly, regarding social capital, it seems that the network of resources for international assignments can be further expanded both for SIEs as well as expatriates. SIEs working at the headquarters could engage more with colleagues working at subsidiaries to increase their knowledge of the work abroad and the results obtained that can influence their performance. On the other hand, expatriates need to feel more connected with the headquarters to reduce the fear of not belonging. Social capital is then crucial to be developed for knowledge workers who engage in international assignments (see Millar, 2016, p. 851).

From the development of this work and answering the research question "How and why to manage knowledge and intellectual capital in the context of personnel mobility?" it is possible to conclude that a robust mechanism to manage knowledge in the context of cross-border mobility is lacking. The development of such a tool is seen as an improvement and helpful resource for both the collaborators as well as human resource managers because it could help to reduce the complexity of some tasks (such as initial training to perform a job) as well as to integrate knowledge in a transversal way to the organisation. The overall feeling is that the organisation has been given important steps to see KM from a more strategic perspective to create IC.

Considering the work here presented, the results cannot be generalised to other organisations and industries due to the nature of the applied methodology, but it can serve as a benchmark for other organisations in the same industry. It would be pertinent to conduct research in other organisations and industries to achieve a broader understanding and compare results.

Acknowledgements

This work is financed by Portuguese national funds through FCT – the Portuguese Foundation for Science and Technology, under the project UIDB/05422/2020 and through a PhD Scholarship 2022.09437.BD that was awarded to the author. This work was financially supported by the Research Unit on Governance, Competitiveness and Public Policies (UIDB/04058/2020) + (UIDP/04058/2020), funded by national funds through FCT - the Portuguese Foundation for Science and Technology. This work is financed by Portuguese national funds through FCT - the Portuguese Foundation for Science and Technology, under the project UIDB/05422/2020.

References

Ado, A., Wanjiru, R. and Su, Z. (2021) 'Chinese expatriates working with African partners: power struggles and knowledge hiding', *Journal of Global Mobility*, 9(4), pp. 519–542. Available at: https://doi.org/10.1108/JGM-12-2020-0080.

Alexandre, B. and Martins, D. (2023) 'Knowledge Management and HRM Innovation Through Expatriates', in *24th European Conference on Knowledge Management*, pp. 42–49.

Amaya, N. *et al.* (2022) 'Role of internal resources on the competitive advantage building in a knowledge-intensive organisation in an emerging market', *VINE Journal of Information and Knowledge Management Systems* [Preprint]. Available at: https://doi.org/10.1108/VJIKMS-01-2022-0029.

van Bakel, M. and Salzbrenner, S. (2019) 'Going abroad to play: Motivations, challenges, and support of sports expatriates', *Thunderbird International Business Review*, 61(3), pp. 505–517. Available at: https://doi.org/10.1002/tie.22020.

BIAL (2024) *BIAL*.

Black, J.S. and Stephens, G.K. (1989) 'The influence of the spouse on American expatriate adjustment and intent to stay in Pacific rim oversear assignments', *Journal of Management*, 15(4), pp. 529–544.

Chang, Y.-Y. (2012) 'Expatriate Knowledge Transfer, Subsidiary Absorptive Capacity, and Subsidiary Performance', *Academy of Management Journal*, 55(4), pp. 927–948. Available at: https://doi.org/http://dx.doi.org/10.5465/amj.2010.0985.

European Commission (2020) *Pharmaceutical Strategy for Europe*. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020DC0761 (Accessed: 19 October 2023).

European Federation of Pharmaceutical Industries and Associations (2022) *The Pharmaceutical Industry in Figures*. Available at: https://www.efpia.eu/media/637143/the-pharmaceutical-industry-in-figures-2022.pdf (Accessed: 19 October 2023).

He, P. *et al.* (2021) 'Knowledge Hiding: Current Research Status and Future Research Directions', *Frontiers in Psychology*. Frontiers Media S.A. Available at: https://doi.org/10.3389/fpsyg.2021.748237.

Huang, M.C., Chiu, Y.P. and Lu, T.C. (2013) 'Knowledge governance mechanisms and repatriate's knowledge sharing: The mediating roles of motivation and opportunity', *Journal of Knowledge Management*, 17(5), pp. 677–694. Available at: https://doi.org/10.1108/JKM-01-2013-0048.

Issac, A.C. *et al.* (2022) 'The effects of expert power and referent power on knowledge sharing and knowledge hiding', *Journal of Knowledge Management* [Preprint]. Available at: https://doi.org/10.1108/JKM-10-2021-0750.

Lee, C.K. and Al-Hawamdeh, S. (2002) 'Factors impacting knowledge sharing', *Journal of Information and Knowledge Management*, 1(1), pp. 49–56. Available at: https://doi.org/10.1142/S0219649202000169.

Linder, C. (2019) 'Expatriates' motivations for going abroad: The role of organisational embeddedness for career satisfaction and job effort', *Employee Relations: The International Journal*, 41(3), pp. 552–570.

Millar, C.C.J.M., Chen, S. and Waller, L. (2017) 'Leadership, knowledge and people in knowledge-intensive organisations: implications for HRM theory and practice', *International Journal of Human Resource Management*, 28(2), pp. 261–275. Available at: https://doi.org/10.1080/09585192.2016.1244919.

Millar, C.C.J.M., Lockett, M. and Mahon, J.F. (2016) 'Guest editorial: Knowledge intensive organisations: on the frontiers of knowledge management', *Journal of Knowledge Management*, 20(5), pp. 845–857. Available at: https://doi.org/10.1108/JKM-07-2016-0296.

Nakash, M. and Bouhnik, D. (2023) 'Challenges of justification of investment in organizational knowledge management', *Knowledge Management Research and Practice*, 21(4), pp. 703–713. Available at: https://doi.org/10.1080/14778238.2021.1999184.

Phookan, H. and Sharma, R.R. (2021) 'Subsidiary power, cultural intelligence and interpersonal knowledge transfer between subsidiaries within the multinational enterprise', *Journal of International Management*, 27(4). Available at: https://doi.org/10.1016/j.intman.2021.100859.

Ramy, A., Af Ragab, M. and Arisha, A. (2022) 'Knowledge management in the pharmaceutical industry between academic research and industry regulations', *Knowledge Management Research and Practice*, 20(2), pp. 202–218. Available at: https://doi.org/10.1080/14778238.2020.1767517.

Santos, J. V. and Gonçalves, G. (2018) 'Organizational Culture, Internal Marketing, and Perceived Organizational Support in Portuguese Higher Education Institutions', *Journal of Work and Organizational Psychology*, 34(1), pp. 38–45. Available at: https://doi.org/10.5093/jwop2018a5.

Steyn, C. and Kahn, M. (2008) 'Towards the development of a knowledge management practices survey for application in knowledge intensive organisations', *South Africa Journal of Business Management*, 39(1), pp. 45–53.

Tams, S. and Arthur, M.B. (2015) 'Studying careers across cultures: Distinguishing international, cross-cultural, and globalization perspectives', *Career Development International*, 12(1), pp. 86–98. Available at: https://doi.org/http://dx.doi.org/10.1108/MRR-09-2015-0216.

Xiao, M. (2023) 'Antecedents and consequences of perpetrator-centric knowledge hiding within organizations: a cross-cultural meta-analytic review and implications for human resource management', *International Journal of Human Resource Management* [Preprint]. Available at: https://doi.org/10.1080/09585192.2023.2278525.

Yeboah, A. (2023) 'Knowledge sharing in organization: A systematic review', *Cogent Business and Management*. Cogent OA. Available at: https://doi.org/10.1080/23311975.2023.2195027.

Yin, R.K. (2009) *Case Study Research Design and Methods*. 4th editio. Sage Publications. Available at: http://cemusstudent.se/wp-content/uploads/2012/02/YIN_K_ROBERT-1.pdf%5CnISBN 978-1-412296099-1.

Yin, R.K. (2018) *Case Study Research: Design and Methods*. 6th Editio. Beverly Hills, CA.: Sage Publications.

Navigating Challenges: A New Conceptual Model for Human Capital Management in Healthcare

Evita Grigorovica[1,2], Andreta Slavinska[1,2], and Prof. Guntis Bahs[3]
[1] Medical Education Technology Centre, Rīga Stradiņš University, Riga, Latvia
[2] Faculty of Social Sciences, Rīga Stradiņš University, Riga, Latvia
[3] Faculty of Medicine, Rīga Stradiņš University, Riga, Latvia

Evita.Grigorovica@rsu.lv
Andreta.Slavinska@rsu.lv
Guntis.Bahs@rsu.lv

Abstract: In the 21st century, the healthcare sector faces formidable challenges, including the rapid proliferation of medical technology innovations, the extension of life expectancy, and the concurrent trend of ageing within society. Moreover, healthcare grapples with an acute shortage of workforce, accompanied by significant skills gaps and mismatches. The consequences of skills shortages, gaps, and mismatches are profound, potentially impeding the treatment process and compromising healthcare outcomes, thereby jeopardizing both the quality of healthcare and the safety of patients and healthcare professionals alike. These signals underscore the imperative for transformative adjustments within the healthcare sector. Amidst this dynamic landscape, healthcare institutions must cultivate systems and approaches capable of rapid adaptation to evolving circumstances while facilitating future planning and data-driven decision-making. Of paramount importance is the establishment of systems that ensure effective knowledge management for healthcare professionals, identify knowledge and skills gaps, and highlight improvement opportunities. In light of these exigencies, the authors have crafted a conceptual model of human capital management based on skills monitoring and tailored to the healthcare sector. This model encapsulates a human-centric management ethos, seamlessly integrated with a data-driven business strategy within a patient-centric healthcare paradigm. The practical implementation of the Human Capital Management Model would empower healthcare institutions to make informed, data-driven decisions to reach the strategic goals of the institution: ensuring efficient human resource provision with appropriate skill-mix, improving health quality, increasing patient and healthcare professional safety, and the sustainable use of financial resources.

Keywords: Human Capital, Skills Monitoring, Knowledge Management, Healthcare Institution, Healthcare Workforce

1. Introduction

Healthcare service coverage, workforce provisions, healthcare quality, and patient and healthcare professional safety are key criteria for the quality of healthcare systems. With rapid advancements in medical technology, increased life expectancy, and simultaneous trends in population ageing, the necessary changes in the healthcare sector are becoming increasingly evident. Anticipating future challenges, as early as 2007, the European Commission (EC) developed the European Union (EU) health strategy White Paper Together for Health: A Strategic Approach for the EU 2008-2013, where one of the objectives was outlined as the development of dynamic healthcare systems and new technologies (European Commission, 2007). Subsequently, in the European Commission's 2008 Green Paper (COM(2008) 725 final) on the EU workforce for health, ~~it~~ was indicated that continuous professional development, relevance of professional skills, enhancement of the safety of both patients and healthcare professionals, and also mechanisms to implement healthcare workforce monitoring are very crucial to support workforce capacity, education, and needs planning (EC, 2008). In 2016, the World Health Organization (WHO) identified as priority tasks until 2030 - ensuring data availability on human resources in healthcare to monitor and ensure accountability for the implementation of national, regional, and global strategies, as well as investments in healthcare workforce education, skills provision, and alignment with labour market and societal health needs (World Health Organization 2016). To promote investments in the education, skills and employment of the healthcare workforce, a multisectoral partnership, coordination, and funding are necessary; therefore, the WHO has established the "Working for Health platform" and implementation mechanisms to support countries in investment strategy development, monitoring, and management for the planning and financing of healthcare workers, education and employment, as well as protection and performance (World Health Organization, 2022).

The initiatives mentioned above serve to move toward a future perspective – 1) United Nations (UN) Sustainable Development Goals by 2030, to ensure a healthy life and promote well-being for all at all ages (Goal No.3), where among the tasks outlined is the provision of universal health coverage, protection against financial risks, and increasing healthcare financing and workforce (United Nations, 2015), and 2) also to reach the goal set by WHO - to create at least 40 million new jobs by 2030 and to address the projected shortage of healthcare workers,

ensuring that "right number of jobs for health workers with the right skills and in the right places to deliver universal health coverage" (World Health Organization, 2016).

International level guidelines emphasize the significant role of the healthcare workforce in the overall healthcare system. Furthermore, the effective development of human resource management in healthcare is a critical prerequisite to strengthening the healthcare system. Data-based analysis of healthcare workforce, healthcare economics, and societal health needs promotes evidence-based decision making at the institutional and national levels, as well as policy development in the sector, ensuring the needs-based development of the healthcare sector. However, to implement the EU strategy and achieve the objectives of the UN and WHO, it is essential to develop a systemic approach that involves all stakeholders shaping the healthcare system. Consequently, beyond state policies or national strategies, there is considerable importance in the investments made by healthcare institutions and their strategies at the institutional level. These strategies should promote workforce planning, skills management, and professional development of the workforce. Therefore, to address this issue, the authors have crafted a Conceptual Human Capital Management Model tailored to the healthcare sector.

2. Methodology

The aim of this theoretical paper is to propose a Conceptual Model of Human Capital Management based on skills monitoring and designed for the healthcare sector. Drawing on current trends in the healthcare sector as outlined in guidelines, standards, and regulatory documents, the authors identified the sector's needs to enhance the relevance of the skills of the healthcare workforce. A literature review was conducted to identify aspects of human capital management and intangible asset accounting, revealing a deficiency in qualitative human capital disclosure. Based on these research findings and considering the contextual factors of the healthcare sector, the authors developed a novel Conceptual Model of Human Capital Management to address the gap identified, which has emerged due to the current need for a skills-based approach in healthcare sector. Following the analysis, the authors have also delineated the foundational principles for the conceptual model and impact on strategic goal of healthcare institutions. This model is specifically designed for the healthcare sector to navigate contemporary workforce planning, healthcare quality, patient and healthcare professional safety, as well as financial sustainability challenges.

3. Theoretical Framework

3.1 Human Capital and Its Management

Knowledge management is the management process of creating, sharing, and using organizational information and knowledge (Girard and Girard, 2015). In healthcare knowledge management can encompass various strategies, practices, and technologies aimed to facilitate knowledge creation and dissemination to support evidence-based practice, to improve patient care, and drive organizational effectiveness and innovations in healthcare delivery. Knowledge management can be implemented through various pathways, and one of the approaches involves the learning and training of employees to disseminate knowledge, update clinical skills, and promote continuous professional development among healthcare professionals. According to human capital theory, when employees start their jobs, their knowledge and skills become part of the organization's human capital. Originally seen as just a mix of employees' knowledge and skills, the theory has evolved and now more various factors that characterize human capital are identified. These include intelligence, qualifications (Bontis *et al*., 1999), competencies (Bontis *et al*., 1999; Wang, Wang, and Liang, 2014), behaviour and personal energy (Davenport and Prusak, 1998), experience (Abdulaali, 2018; Wang, Wang, and Liang, 2014), mental capacity, thinking style, and ability to act (Lapina, 2010), social competence, professional competence, leadership skills, motivation, and expertise (Abdulaali, 2018), innovations, attitude, commitment, wisdom (Wang, Wang, and Liang, 2014).

The significance of human capital as an intangible asset of the organization has recently become increasingly pronounced. Studies have demonstrated a positive correlation between human capital development within organizations and performance at both the individual and the organizational levels. Moreover, this correlation can be examined from two perspectives: the influence of individual human resource knowledge and skills on organizational performance (Ployhart *et al*., 2014), and the impact of organizational performance on the individual level (Crocker and Eckardt, 2014). Considering the significant impact of human capital at the organizational level, it is imperative to manage this capital purposefully. Successful implementation of human capital management can attract and retain a high-quality workforce, creating a competitive advantage and

excellent company performance (Delery and Roumpi, 2017). Human capital is a unique internal resource and a key driver of organizational outcomes (Barney, 1991). Human capital has a significant positive impact on innovation (Sima *et al*., 2020), operational and financial performance, and company growth (Rauch and Rijsdijk, 2013). Researchers also point out that human capital must be integrated through corporate management, as management approach and style influence human capital growth (Khan *et al*., 2020). Therefore, human capital must be managed purposefully to overcome organizational and contextual challenges.

Similarly to other professions, the healthcare sector often faces a mismatch between the existing skills of employees and the skills required for their roles. This disparity highlights concerns about the potential underutilisation of human capital, where employees may have skills that exceed the requirements of their roles, or about the quality and safety of healthcare services, where employees may lack essential skills (Organisation for Economic Co-operation and Development, 2016). Hence, the authors have taken the initial step of developing a Conceptual Model for Human Capital Management in healthcare institutions. This model is predicated on the notion that an institution's human capital is constituted by the knowledge and skills of its workforce, and that effective human capital management is context-specific, considering the unique dynamics of the healthcare sector.

3.2 Human Capital Data Metrics and Disclosure

As the concept of human capital continues to evolve and the paradigm shifts, the issue of human capital disclosure grows in significance. With a company's intangible assets now estimated to represent an average of 52% of its market value (Klemash, Neill, and Smith, 2019), the measurements and the value of human capital become extremely relevant to the company's management, stakeholders, shareholders, and investors. The Standard and Poor's 500 index (S&P 500) summarizes the performance of approximately 500 high-value companies in the United States, reflecting the performance of the US stock market and the entire US economy. And, as the study shows, since 2009, the market value of non-material assets in S&P 500 companies has increased by 255%, while the volume of material assets during the same period has increased by only 97% (PricewaterhouseCoopers, 2021). Despite the increasing importance of non-material assets, the accounting model has remained largely unchanged. Human capital is not treated as an asset that requires accounting and valuation compared to financial or physical assets, and its value is predominantly absent from the organization's balance sheet or other financial statements. Consequently, traditional reports typically provide minimal or no information on human capital value, skills, management effectiveness, and productivity in relation to revenue and profit. However, there is a growing recognition in the literature of the significance of measuring and analysing human capital data to enhance strategic decision-making. To enhance employee performance, metrics are required to gauge the value of human capital (such as accumulated knowledge, skills, experience, etc.), and the garnered knowledge should be leveraged to efficiently administer the organization. Human capital measurement presents challenges, and assessing its value can be subjective. Without a unified understanding and widely accepted methodology or consistent approach, there is no avenue to incorporate the value of human capital into the annual balance sheet. Nevertheless, this does not hinder organizations from addressing this issue in a separate report on organizational human capital or integrating it into annual financial or other types of reports to showcase company value and transparency.

Currently, initial efforts are underway to find ways to reflect the intangible value of the company. For example, in 2018, the international audit and tax consulting firm 'Deloitte' introduced the 'Human Capital Balance Sheet,' a document designed to transparently consolidate human resources from cost, expense, and risk perspectives (Deloitte, 2018). Furthermore, trends that underscore the need for accounting and reporting of human capital are evident in various documents and initiatives at the international level. In 2018, the International Organization for Standardization (ISO) issued a new standard - 'ISO 30414:2018 Human resource management - Guidelines for internal and external human capital reporting' (International Organization for Standardization, 2018). In 2020, the International Financial Reporting Standards (IFRS) Foundation established the International Sustainability Standards Board (ISSB) and the Sustainability Accounting Standards Board (SASB) to address non-financial reporting issues, including human capital reporting (Sustainability Accounting Standards Board, 2021). The World Economic Forum (WEF) in its report "Human Capital as an Asset: An Accounting Framework to Reset the Value of Talent in the New World of Work" indicates that a robust framework for measuring and accounting human capital provides a more precise approach to workforce management and that differentiated accounting practices and isolated metrics need to be replaced with a more integrated, holistic approach (World Economic Forum, 2020). Adopting the principles of a paradigm shift, human capital accounting can help organizations to focus on long-term strategies, invest in human resources, and to create value by embracing the thinking of

people, work, and skills. Organizations should identify themselves as socially responsible participants in the broader ecosystem and thus create a three-way win-win-win situation, where beneficiaries are the organization, employees, and the wider society (WEF, 2020). In the report developed in collaboration with Deloitte, Ernst & Young, KPMG, and PricewaterhouseCoopers - "Toward Common Metrics and Consistent Reporting of Sustainable Value Creation" (2020), WEF proposes human capital accounting metrics: “1) Average hours of training per person that the organization’s employees have undertaken during the reporting period, by gender and employee category (total number of trainings provided to employees divided by the number of employees); 2) The average training and development expenditure per full time employee (total cost of training provided to employees divided by the number of employees)” (World Economic Forum, 2020). At the same time, WEF points out that these indicators may not reflect the overall impact of learning on measurable performance improvements.

These initiatives are highly valuable and desirable; however, the authors believe that within this novel framework, deeper transformative adjustments are imperative based on two considerations. Firstly, human capital accounting remains fragmentary and is not widely developed or implemented in practice, unlike financial accounting, which is a common standard in organizations. Secondly, existing solutions focus primarily on the collection of quantitative data, such as the number of training sessions attended or the time spent in training, but do not provide a deeper insight into the qualitative and substantive aspects of human capital. The authors suggest that human capital metrics should be based on qualitative skills management, ensuring human capital disclosure, and transparently reflecting the value of an organization's human capital. All stakeholders should have access to transparent information, specifically regarding the knowledge and skills possessed by the employees who constitute the organization's human capital. This should include detailed insights into the specific knowledge and skills acquired or refreshed by employees, and also the proficiency levels achieved, and recency or regularity of these acquisitions. This transparency not only allows better assessment and utilisation of human resources, but also fosters trust and engagement among stakeholders, including investors, clients, employees, and regulatory bodies. By providing a comprehensive view of the capabilities of the workforce, organizations can more effectively align their human capital with strategic objectives, drive performance improvements, and support informed decision-making processes.

3.3 Context of the Healthcare Sector

For particular organisations, such as healthcare institutions, especially those that are state-funded, the primary objectives are not focused on revenue generation, improving competitiveness, or expanding market share. Therefore, the approach to human capital management should be evaluated within the context of the healthcare sector, including the functions mandated by the state, providing a minimum level of medical assistance and ensuring the quality of healthcare, as well as the safety of patients and healthcare professionals. Over recent years, since the European Commission introduced the "New Skills Agenda for Europe," which promotes balancing skills acquisition, developing skills systems, and enhancing lifelong learning, there is still a notable lack of evidence regarding the practical implementation of a human capital management approach in healthcare sector institutions (Grigorovica *et al*., 2022). The quality of healthcare and the safety of patients and healthcare professionals are the key factors distinguishing enterprises and institutions in the healthcare sector from other sectors. Therefore, human capital management in this sector is context-dependent, and healthcare aspects are paramount in the development of the Human Capital Management Model.

According to the WHO, patient safety is the reduction of risk of unnecessary harm associated with healthcare to an acceptable minimum. The acceptable minimum refers to the collective judgment of current knowledge, available resources, and context in which care was delivered, and evaluated against the risk of non-treatment or alternative treatment (World Health Organization, 2009). Patient safety is a framework of organized activities that creates cultures, processes, procedures, behaviours, technologies, and environments in healthcare that consistently and sustainably reduce risks, reduce the occurrence of avoidable harm, make error less likely, and reduce its impact when it does occur (World Health Organization, 2021). Consequently, the failure of healthcare institutions to ensure safe care incurs additional expenses, paradoxically reducing funding for healthcare provision. The WHO also notes that investments in promoting patient safety can lead to financial savings, as evidenced by estimates showing that costs associated with medical errors amount to approximately $42 billion annually, excluding lost wages, productivity, or healthcare expenses, collectively comprising nearly 1% of global health expenditures (World Health Organization, 2019).

As indicated in the report 'Patient Safety 2030', reducing harm requires the development of an integrated, systemic approach that includes fostering a culture of safety, placing patients and healthcare personnel at the

centre of all intervention measures, and implementing evidence-based policy (Yu *et al*., 2016). Evidence-based policy aligns with human capital management, as the costs that healthcare institutions incur to reduce harm to patients would be more meaningfully invested in improving healthcare quality by primarily investing in institutional human capital, developing healthcare personnel skills, ensuring systematic human capital development and making data-driven decisions, thus also reducing risks to patient safety. Therefore, healthcare institutions must integrate human capital management with systems that signal skills gaps, skills mismatch, existing or protentional skills imbalance in the healthcare process, to reduce and prevent patient harm.

4. Conceptual Human Capital Management Model for Healthcare Institutions

In the dynamic contemporary work environment, the workforce is a dynamic asset that requires intentional human capital management. To improve the effectiveness of forecasting and planning human resources in healthcare and to address increasing workforce shortages and skills mismatches within existing staff, healthcare institutions must adopt a comprehensive human capital management strategy. The Human Capital Management Model proposed by the authors ensures not only the accounting numerical measures, but also incorporates qualitative, in-depth skills monitoring at the individual employee level. Skills monitoring as a central part of human capital management enables the acquisition of current employee skills levels, reflecting the extent and level of individual performance. It should be noted that within this model, the term 'skills' is used according to the European Commission's programme 'A New Skills Agenda for Europe' - skills refer 'broadly to what a person knows, understands, and can do' (European Commission, 2016).

Following the analysis, the authors have delineated the foundational principles for the Conceptual Model of Human Capital within healthcare:

- *Human capital management is grounded in skills monitoring.* A skills digital monitoring system should be established within the Human Capital Management Model, facilitating the accumulation and analysis of skills information. The skills digital monitoring system captures a wide range of skills data that are integrated into individual and institutional skills portfolios, enabling qualitative disclosure of the value of human capital. The authors assert that the improvement of healthcare quality and the safety of patients and healthcare professionals can only be achieved through rigorous validation of knowledge and skill acquisition. Monitoring skills effectively cannot solely rely on the collection of training programmes and course attendance certificates, as these do not guarantee the actual acquisition of knowledge and skills by the employee. Skills monitoring should be based on qualitative skills management, ensuring transparent human capital disclosure and revealing the specific knowledge and skills employees possess (including also the date of skill acquisition and refreshment).
- *Human capital management is based on an ecosystem of healthcare systems.* Human capital management must ensure seamless information integration between the skills digital monitoring system and other healthcare-specific data acquisition systems. These systems can vary between different institutions and can change over time, but systems such as patient satisfaction surveys, patient safety reporting systems, general quality surveys, and performance management systems, among others, can serve to identify existing or potential skills shortages or mismatches.
- *Human capital management is integrated at all levels of the institution*. At the strategic level, the management of a healthcare institution is responsible for defining the human capital management strategy, fostering a culture of learning, and incorporating an analytical approach and data-driven decision making. At the operational level, the human resources management unit performs the functions of collecting human capital data and performing data analytics, coordinates learning activities, and monitors all skills portfolios. Meanwhile, at the tactical level, the healthcare workforce, through active training and skills development, enriches the institution's human capital.

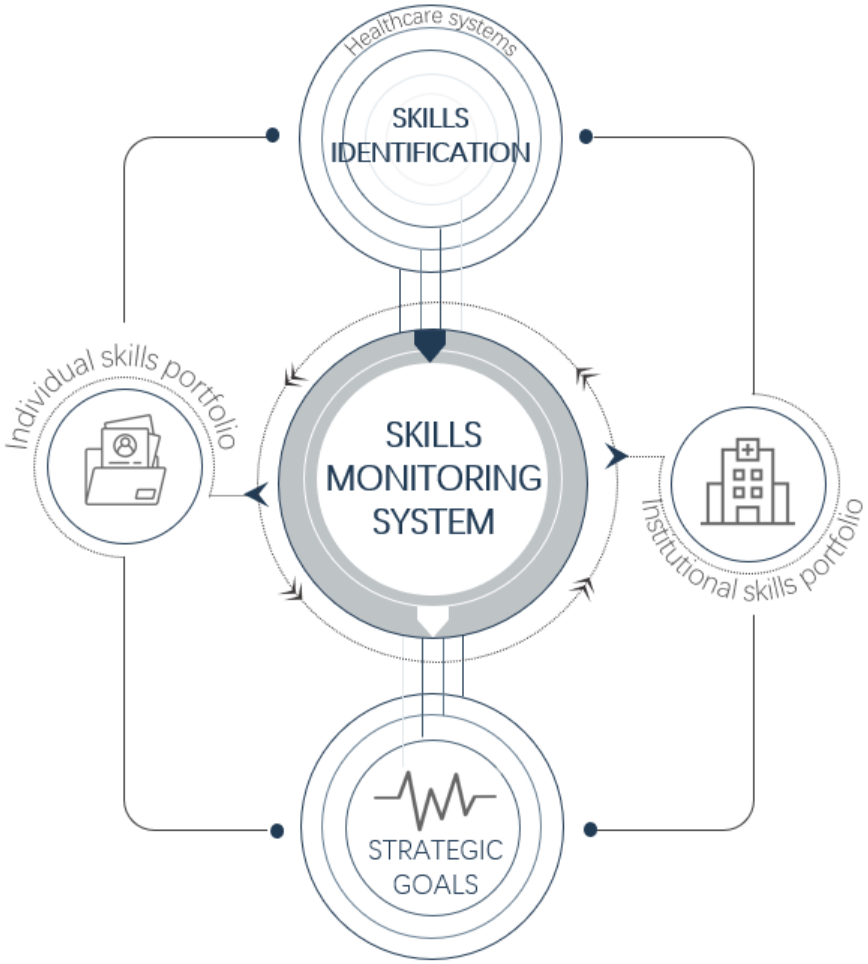


Figure 1: Conceptual Human Capital Management Model for Healthcare Institutions (by authors).

The model provided (Fig.1) is dynamic and flexible and can be customized to suit diverse settings and institutional needs. The implementation of the Human Capital Management Model can yield benefits across various operational levels of the institution, and through effectively executed human capital management, healthcare institutions have the opportunity to enhance the achievement of strategic goals:

- *Provision of Human Resources.* Skills monitoring supports the management of employees' skills, the implementation of professional development plans, the development of career paths, and the management of individual healthcare personnel's recertification plans. Managing these data enables more qualitative and precise forecasting and planning of human resources, performance evaluation, annual goal definition, and the preparation of precise, data-driven human capital reports for board, shareholders, stakeholders, and public administration from various perspectives.
- *Healthcare Quality & Safety*. With a suitable workforce with up-to-date skills, the risks of harm to patients are reduced and the results of healthcare processes are improved. If signals about existing or potential skills shortages or mismatches are linked with skills monitoring at an individual level, it is possible to ensure timely acquisition or refreshment of skills. This approach promotes quality enhancement, reduces the occurrence of avoidable harm, and allows for the prevention of potential future risks to patients or healthcare personnel.
- *Financial Sustainability*. By conducting human capital management equally as managing other types of capital and investing resources in employee knowledge and skills, institutional financial sustainability is promoted, as well as financial planning grounded in data-driven decisions. As incidents causing harm to patients decrease, the expenses of the healthcare institution related to harm reduction and compensation diminish. Concurrently, this demonstrates deliberate long-term action and fosters a positive institutional reputation.

5. Conclusions

Human capital is a crucial intangible asset for healthcare institutions, comprised of the knowledge and skills of their employees. In the healthcare sector, targeted and effective human capital management can improve the achievement of strategic objectives – ensuring efficient human resource provision, improving health quality, increasing the safety of patients and healthcare professionals, and the sustainable use of financial resources. The Human Capital Management Model provided by the authors deepens transformative adjustments in the field and drives to shift the mindset – from numeric measures to qualitative valuation, from systems to integrated ecosystem, and from costs to investments.

By implementing human capital management based on this novel Human Capital Management Model, healthcare institutions have the opportunity to navigate through contemporary challenges and to meet the health sector goals set by the World Health Organization and the United Nations – to ensure healthcare coverage with sufficient human resources and an appropriate skill-mix by 2030.

Future research should aim to (1) develop a detailed concept for a skills digital monitoring system designed to the healthcare institution (establishing skills levelling, categorization, and process integration), (2) develop a human capital management process from the perspective of innovation integration, and (3) expand the analysis of the impact of human capital management on the strategic objectives of healthcare institutions.

References

Abdulaali, A.R. (2018). The Impact of Intellectual Capital on Business Organization, *Academy of Accounting and Financial Studies Journal,* vol. 22, no. 6. Available at: https://www.proquest.com/docview/2177530589/fulltextPDF/68AFCE83597143D8PQ/1?accountid=32994&sourcetype=Scholarly%20Journals

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, 17(1). Available at: https://doi.org/10.1177/014920639101700 10

Bontis, N., Dragonetti, N. C., Jacobsen, K., and Roos, G. (1999). The knowledge toolbox: A review of tools available to measure and manage intangible resources. *European Management Journal*, 17(4), 391-402. DOI: https://doi.org/10.1016/S0263-2373(99)00019-5

Crocker, A. and Eckardt, R. (2013). Multilevel investigation of individual- and unit-level human capital complementarities. *Journal of Management*, 40(2), 509–30. DOI: https://doi.org/10.1177/0149206313511862

Davenport, T.H. and Prusak, L. (1998). Working knowledge: How organizations manage what they know. Harvard Business School Press.

Delery, J.E. and Roumpi, D. (2017). Strategic human resource management, human capital and competitive advantage: is the field going in circles? *Human Resource Management Journal* 27(1):1-21. DOI:10.1111/1748-8583.12137

Deloitte (2018). Making winning workforce decisions. Available at: https://www2.deloitte.com/us/en/pages/human-capital/articles/optimizing-the-human-capital-balance-sheet.html

European Commission (2007). White paper - Together for Health: A Strategic Approach for the EU 2008-2013. Brussels. {SEC(2007) 1374} {SEC(2007) 1375} {SEC(2007) 1376}. Available at: https://op.europa.eu/en/publication-detail/-/publication/34f74e87-1c26-428f-ade3-b0225e1b7061/language-en

European Commission (2008). Commission Green Paper (COM(2008) 725 final) on the EU workforce for health. Brussels. Available at: https://ec.europa.eu/health/ph_systems/docs/workforce_gp_en.pdf

European Commission (2016). A New Skills Agenda for Europe - Working together to strengthen human capital, employability and competitiveness. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52016DC0381

Girard, J. and Girard, J. (2015). Defining knowledge management: Toward an applied compendium. *Online Journal of Applied Knowledge Management*. **3** (1): 14. Available at: https://www.iiakm.org/ojakm/articles/2015/volume3_1/OJAKM_Volume3_1pp1-20.pdf

Grigorovica, E., Slavinska, A., Jansone-Ratinika, N., and Bahs, G. (2022). Aspects of human capital management of healthcare workforce in the context of lifelong learning: a rapid review. *SOCIETY INTEGRATION EDUCATION Proceedings of the International Scientific Conference*, 753-766. DOI: https://doi.org/10.17770/sie2022vol1.6865

Khan, M., Ismail, F., Hussain, A., and Alghazali, B. (2020). The interplay of leadership styles, innovative work behavior, organizational culture, and organizational citizenship behavior. *Sage Open* 10, DOI: https://doi.org/10.1177/2158244019898264

Klemash, S., Neill, B. M., and Smith, J. C. (2019). How and Why Human Capital Disclosures Are Evolving. EY Center for Board Matters, Harvard Law School Forum on Corporate Governance. Available at: https://corpgov.law.harvard.edu/2019/11/15/how-and-whyhuman-capital-disclosures-are-evolving

Lapina, I. (2010). Cilvēkkapitāla attīstība un izglītības sistēma Latvijā. Doctoral theses, Riga Technical University

Yu, A., Flott, K., Chainani, N., Fontana, G. and Darzi, A., 2016. Patient Safety 2030. London, UK: NIHR Imperial Patient Safety Translational Research Centre. Available at: https://www.imperial.ac.uk/media/imperial-college/institute-of-global-health-innovation/centre-for-health-policy/Patient-Safety-2030-Report-VFinal.pdf

Organisation for Economic Co-operation and Development (2016). Health Workforce Policies in OECD Countries. Right Jobs, Right Skills, Right Places. OECD Publishing, Paris. DOI: https://doi.org/10.1787/9789264239517-en

Organization for Standardization (2018). ISO 30414:2018 - Human resource management. Guidelines for internal and external human capital reporting. Available at: https://www.iso.org/standard/69338.html

Ployhart, R. E., Nyberg, A. J., Reilly, G., and Maltarich, M. A. (2014). Human capital is dead; long live human capital resources! *Journal of Management*, 40(2), 371–98. DOI: https://doi.org/10.1177/0149206313512152

Rauch, A. and Rijsdijk, S.A. (2013). The effects of general and specific human capital on the long-term growth and failure of newly founded companies. *Entrepreneurship Theory and Practice* 37(4). DOI: 10.1111/j.1540-6520.2011.00487.x

Sima, V., Gheorghe, I.G., Subić J., and Nancu D. (2020). Influences of the Industry 4.0 Revolution on the Human Capital Development and Consumer Behavior: A Systematic Review. *Sustainability 2020*, *12*(10), 4035;
DOI: https://doi.org/10.3390/su12104035

Sustainability Accounting Standards Board (2021). A Practical Guide to Sustainability Reporting Using GRI and SASB Standards. Available at:
https://sasb.ifrs.org/wp-content/uploads/2021/04/GRI-SASB-V4-040721.pdf

The World Economic Forum (2020). Human Capital as an Asset: An Accounting Framework to Reset the Value of Talent in the New World of Work In collaboration with Willis Towers Watson. Available at: https://www3.weforum.org/docs/WEF_NES_HR4.0_Accounting_2020.pdf

The World Economic Forum (2020). Toward Common Metrics and Consistent Reporting of Sustainable Value Creation. Available at: https://www3.weforum.org/docs/WEF_IBC_ESG_Metrics_Discussion_Paper.pdf

United Nations (2015). Transforming our world: the 2030 Agenda for Sustainable Development. Available at: https://sdgs.un.org/2030agenda

Wang, Z., Wang, N. and Liang, H. (2014). Knowledge sharing, intellectual capital and firm performance. *Management Decision*, Vol. 52 No. 2, pp. 230-258. DOI: 10.1108/MD-02-2013-0064.

World Health Organisation (2009). The conceptual framework for the international classification for patient safety. Available at: https://iris.who.int/bitstream/handle/10665/70882/WHO_IER_PSP_2010.2_eng.pdf?sequence=1

World Health Organization. (2016). Global strategy on human resources for health: Workforce 2030. Available at: https://iris.who.int/bitstream/handle/10665/250368/9789241511131-eng.pdf?sequence=1

World Health Organization (2016). Working for health and growth: Investing in the health workforce. Available at: https://iris.who.int/bitstream/handle/10665/250047/9789241511308-eng.pdf?sequence=1&isAllowed=y

World Health Organization (2019). *Ten Facts on Patient Safety [online]. Available at:* https://www.who.int/news-room/facts-in-pictures/detail/patient-safety

World Health Organization (2021). Global patient safety action plan 2021–2030: towards eliminating avoidable harm in health care. Geneva: World Health Organization. Available at: https://iris.who.int/bitstream/handle/10665/343477/9789240032705-eng.pdf?sequence=1

World Health Organization (2022). Working for Health 2022–2030 Action Plan adopted by Seventy-fifth World Health Assembly. Available at: https://www.who.int/news/item/02-06-2022-w4h_wha75

Seeing is Believing: 3D-Printed Boundary Objects for the Additive Manufacturing Twin Transition

Trond Halvorsen, Raymond Andreas Stokke and Gunnar M. Lamvik
SINTEF Digital, Trondheim, Norway

trond.halvorsen@sintef.no
raymond.stokke@sintef.no
gunnar.lamvik@sintef.no

Abstract: This article describes the use of 3D-printed demonstrators as boundary objects in intra-firm collaboration processes aimed at implementing additive manufacturing (AM). AM is a disruptive digital technology with large potential environmental benefits. Demonstrators are common early in the learning process to familiarize organisations with AM, and it's important to understand both their benefits and the limitations and risks involved. The results suggest that 3D-printed demonstrators can be effective in establishing a common minimum level of knowledge across diverse professions within the same organisation. Having physical objects available makes conversations about AM more engaging and legitimizes the idea of utilising AM as realistic. However, the fabrication of demonstrators can be a lengthy and costly process, and the result may not be a good representation of the final design. Negative experiences in such initial trials may turn managers away from AM prematurely. Many of the benefits of demonstrators can be obtained by producing low-cost miniatures and/or polymer parts that will mitigate the risks.

Keywords: 3D-printing, additive manufacturing, boundary object, twin transition.

1. Introduction

Additive Manufacturing (AM) has been proclaimed as a paradigm shift in the production landscape, offering a range of benefits that promise to redefine manufacturing processes (Mehrpouya et al, 2019). AM's ability to produce customized, complex components swiftly and with reduced material waste positions it as a pivotal technology in the ongoing industrial modernisation (Gibson, Rosen, and Stucker, 2014). Despite its potential, the assimilation of AM into the intricate structures of large organisations is fraught with challenges. For example, a lack of collective understanding and acceptance of AM's capabilities and benefits across diverse business units, often hinder its widespread adoption (Ford and Despeisse, 2016).

In addressing these challenges, the concept of boundary objects, particularly in the form of 3D-printed demonstrators, emerges as a useful tool for fostering cross-disciplinary collaboration and knowledge sharing (Swann et al, 2023). Boundary objects serve as physical interfaces that facilitate communication and understanding among different social worlds within an organisation, thereby aiding in the alignment of objectives and the harmonisation of efforts towards a common goal (Star and Griesemer, 1989). In the context of AM, 3D-printed demonstrators not only provide tangible examples of AM's potential, but may also act as catalysts for discussion, exploration, and learning across various departments (Bosch-Sijtsema and Postma, 2010).

This paper delves into the utilisation of 3D-printed demonstrators as boundary objects within large organisations to promote a twin transition, i.e. green and digital (Rehman et al, 2023), towards the acceptance and integration of AM. Drawing on a qualitative research design that incorporates action research and semi-structured interviews across multiple industries, this study aims to shed light on how 3D-printed demonstrators can bridge knowledge gaps and facilitate collaborative exploration and adoption of AM technologies. The empirical evidence gathered from managers, engineers, and operational staff across sectors such as shipping, oil and gas, and research offers a multifaceted perspective on the role of demonstrators in advancing organisational understanding of AM.

This paper contributes to the existing body of literature on cross-disciplinary learning in large organisations by showcasing multiple examples of designs and discussing the benefits and limitations of using 3D-printed demonstrators as boundary objects. By building on use cases and developing a strategic roadmap for exploring business opportunities with AM, organisations can navigate the complexities of integrating this disruptive technology into their operations.

2. The use of Demonstrators When Integrating AM in Manufacturing Processes

The integration of AM into established value chains represents potential for a significant shift towards more agile, and customized production methodologies. AM production processes, characterized by their ability to add material layer by layer to create objects, offers unprecedented flexibility in design and manufacturing,

challenging traditional manufacturing paradigms (Gibson, Rosen, and Stucker, 2014). This technology holds the potential to revolutionize industries by reducing lead times, minimizing material waste, and enabling the production of complex geometries that are otherwise impossible to achieve through conventional methods (Ford and Despeisse, 2016).

Despite these advantages, the adoption of AM technologies within large organisations is fraught with challenges. One of the primary obstacles is the disparate understanding and acceptance of AM across various departments and business functions. The novelty of the technology, combined with its perceived complexity, often leads to resistance or scepticism among stakeholders (Rogers, 2003). This challenge underscores the importance of effective intra-firm collaboration and knowledge sharing to foster a conducive environment for AM integration.

The concept of boundary objects, introduced by Star and Griesemer (1989), offers a valuable framework for facilitating such collaboration. Boundary objects are artifacts that serve as points of reference that different social worlds within an organisation can understand and use, despite holding divergent viewpoints or expertise. In the context of AM, 3D-printed demonstrators have emerged as potent boundary objects, enabling diverse stakeholders to visualize, discuss, and explore the potential applications of AM technologies (Carlile, 2002; Swann et al, 2023). In our study we posit demonstrators as a form of prototype or final product which offer a tangible solution to showcasing the potential of 3D-printed parts in large organisations.

Research on the use of prototypes and demonstrators in industrial design and innovation highlights their role in enhancing communication and collaboration among interdisciplinary teams. Prototypes enable stakeholders to tangibly interact with a concept, fostering a shared understanding and facilitating consensus-building (Thomke and Fujimoto, 2000). This interaction is particularly critical in the early stages of technology adoption, where abstract concepts need to be translated into concrete examples to gain organisational support (Bosch-Sijtsema and Postma, 2010).

3D-printed demonstrators have emerged as essential tools across various organisational functions, notably for sales and design purposes (Gao et al, 2015; Robinson, Lagnau and Boon, 2019; Schniederjans, 2017). In sales, these demonstrators serve as tangible representations of AM's capabilities, allowing sales personnel to distinctly showcase the potential of AM to clients and stakeholders. The physical presence of 3D-printed parts can significantly enhance customer engagement and comprehension, providing a concrete example of abstract AM benefits, thereby facilitating a more effective sales process.

Within the design phase, 3D-printed protypes enable a hands-on approach to product development, fostering a collaborative environment among designers, engineers, and other stakeholders (Swann et al, 2023). These items act as boundary objects that facilitate communication and understanding across disciplinary divides, allowing for rapid prototyping and iterative design processes. This not only accelerates the design phase but also ensures that the final product is more attuned to the practical requirements and constraints, embodying a collective vision shaped by diverse inputs.

However, the production of 3D-printed demonstrators is not without its challenges. The process can be time-consuming and costly, and the resulting artifacts may not always accurately represent the final product. This discrepancy can lead to misunderstandings or misplaced expectations regarding the capabilities and limitations of AM technologies (Thompson, 2012). Despite these challenges, the benefits of using 3D-printed demonstrators extend beyond mere knowledge dissemination. By providing a tangible representation of AM's capabilities, demonstrators can stimulate interest, inspire innovation, and legitimize the exploration of AM technologies within an organisation (Berman, 2012). They serve as a catalyst for engaging discussions, enabling stakeholders to envision the practical applications of AM in their respective domains (Horne and Nissen, 2006).

Organisations can build on the use of demonstrators to develop a strategic roadmap for exploring business opportunities with AM. This roadmap should encompass a thorough evaluation of potential applications, considering both the technical feasibility and the economic viability of AM. By systematically leveraging demonstrators to showcase AM's capabilities, organisations will be more likely to identify and prioritize high-value applications, aligning their AM initiatives with broader business objectives.

This underscores the important role that 3D-printed demonstrators have as boundary objects in facilitating the twin transition towards AM adoption in large organisations. By serving as tangible points of reference, demonstrators enable diverse stakeholders to collectively explore, understand, and embrace the potential of AM technologies. Despite the challenges associated with their production, the strategic use of demonstrators can significantly enhance intra-firm cross-disciplinary collaboration, knowledge sharing, and innovation, paving the

way for the successful integration of AM into organisational processes (Star and Griesemer, 1989; Carlile, 2002; Gibson, Rosen, and Stucker 2014; Robinson, Lagnau, and Boon 2019).

3. Methodology

This study adopts an explorative qualitative research design to document the utilization of 3D-printed demonstrators as boundary objects in intra-firm collaboration towards the industrialization of AM within large organisations. A case-based approach (Yin, 2014) was deemed most suitable for obtaining in-depth insights into the complex processes and interactions associated with the adoption of AM technologies.

The primary data collection methods employed in this study were action research (Greenwood & Levin, 2006) and semi-structured interviews, which enabled the gathering of empirical evidence from the field. Action research was chosen for its participatory and iterative nature (Kindon, Pain, and Kesby 2007), allowing researchers to engage directly with the phenomena under study and to implement and observe the impact of 3D-printed demonstrators in a real-time organisational setting. This was carried out by providing coworkers and research managers access to various demonstrators. Semi-structured interviews provide a flexible yet structured means of capturing the diverse perspectives of individuals involved in the AM integration process. These interviews were conducted with managers, engineers, and operational staff of large organisations, ensuring a comprehensive understanding of the experiences and perceptions surrounding the use of 3D-printed demonstrators in AM adoption. The demonstrators were photographed by the authors or interview subjects.

The selection of cases for this study was guided by the objective of covering industries where AM has the potential to significantly impact large-scale manufacturing processes, and where we see that organisations are working actively to foster intra-organisational learning. As such, large Norwegian firms from the oil and gas industry, the maritime industry, and our own research organisation were included in our study. This diverse selection of cases allowed for incorporating a wider range of industry-specific challenges, opportunities, and strategies related to the adoption of AM technologies. The collected data were subjected to narrative analysis, with the aim of identifying recurring patterns, themes, and insights related to the use of 3D-printed demonstrators as boundary objects in AM adoption. This analytical approach facilitated the extraction of meaningful information from the qualitative data, enabling the formulation of conclusions and recommendations grounded in empirical evidence.

The study was carried out between October 2023 and March 2024, in the context of a three-year innovation project aiming to promote the use of AM in the maritime industry. Table 1 describes the interview subjects.

Table 1: List of interview subjects

Organisation	Role of interview subject
AM service provider 1	AM engineer
AM service provider 2	Chief Commercial Officer
Ship management	Fleet manager
Oil and gas operator	Head of AM team
Maritime OEM	AM ambassador
Research organisation	Research manager and research director

4. Examples of 3D-Prints Used as Boundary Objects

The photos below illustrate a variety of items that are 3D-printed and obtained with the purpose of illustrating unique aspects of AM production processes. Figure 1 shows metal items suitable for daily use in an office setting. Example 1a is a titanium coffee mug designed, printed and used by an engineer on from a Norwegian AM service bureau, currently working for a large oil and gas operator. In addition to the intricate pattern, the cup conveys the light weight and heat conductivity of the material. Example 1b shows two bottle openers. The one on the left is an unpolished titanium piece that illustrate the surface finish of parts as they come from the printer. At the back end is a small remnant of the support structure that fixed the item to the build plate during the printing process. The one on the right is a multi-functional stainless-steel item that combines a bottle opener with a flute and a loop for a key ring (not printed). The flute is attached to the logo and rotates freely within the cylinder. Example 1c are two pens with 3D-printed bodies made in titanium. Both display a lattice structure on large areas of the surface, and an integrated logo. The pen on the left has a two-piece body that screws together with 3D-printed threads, while the pen on the right has a solid body with an ink cartridge inserted from the bottom.

Figure 1: Metal prints for daily use

Figure 2 shows three examples of polymer card holders. The Figure 2 shows three examples of polymer card holders. These are used to hold identification cards that are common at many workplaces, exhibitions and conferences. Example 2a is made by sintering nylon powder with a laser. It has a slot on top to insert a business card, which is held in place by a clip on a lanyard. Example 2b is made with polylactic acid (PLA) filament in a fused filament fabrication (FFF) process. It displays a small boat, known as the 3D benchy, at the top to showcase the level of detail that the process can achieve. It also has varying surface textures and overhangs that can hold a paper conference badge. Lastly, example 2c is an access card holder with movable gears. The model does not require any manual assembly as it's a build-in-place design. The front is customized with text displaying four company core values.

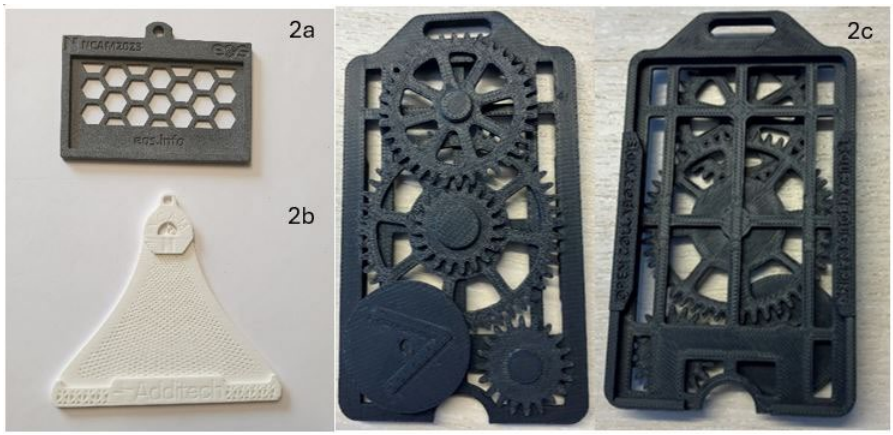


Figure 2: Polymer card holders

Figure 3 presents a few examples of items that are made for display and education, i.e. not actual use. Example 3a is a working Rubic's cube, with each small cube showing different patterns and textures. Some of them also include moving pieces, such as springs. The piece illustrates the design freedom of 3D-printing, but the polymer material is relatively fragile. Example 3b is a replacement for a PC keyboard support. It was made to illustrate the importance of part orientation during FFF-printing. The visible layer lines that are orthogonal to the length of the clips make them prone to breaking. Example 3c is a holder for tips of silicone tubes sold in hardware stores. It represents a product for which resin printing can compete economically with injection moulding for mass manufacturing. Examples 3d and 3e are made from the same digital design file. The difference is that the build process was stopped prematurely for example 3e to display the internal structures. These items are used together to illustrate the material savings that can be achieved with AM relative to subtractive manufacturing processes.

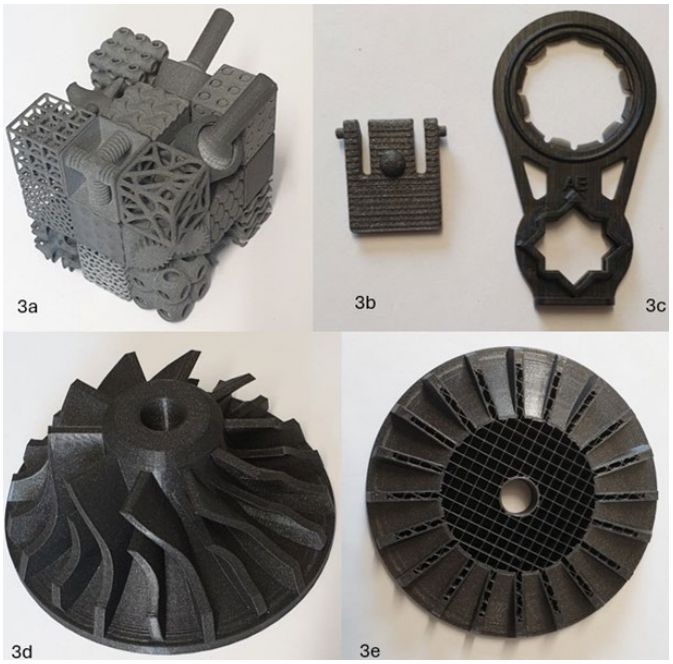


Figure 3: Illustrative polymer prints

Figure 4 shows two examples of 3D-printed products that have full production quality but are used by large organisations to create awareness about the capabilities of metal 3D-printing. Example 4a is a bike with a 3D-printed titanium frame, and an accompanying rollup with basic information about the item. The bike is painted with a company logo, and the rollup highlights some benefits. Example 4b is a pipe connector made with binder jet technology using 316L stainless steel. This item is part of a collection of 3D-printed spare parts for the maritime sector. A ball pen is included in the picture for size reference.

Figure 3: Display pieces of metal prints

5. Findings From Interviews

The interviews reflect the wide variety of settings in which the demonstrators are used, and his section summarises key findings across the subjects. Firstly, the need for and challenges of creating awareness about the value proposition of AM within large organisations was confirmed. Even though the technology is being described as sufficiently mature to produce both critical and non-critical components, the standards needed to certify the parts were not available until a few years ago. Therefore, the use of AM is not reflected in many policy documents such as maintenance plans, approved vendor lists, and project descriptions. Now there's a particular need to educate the teams responsible for renewing such documents, and those people are distributed across different departments and geographical locations.

Secondly, the organisations included in this study typically utilize more than one kind of demonstrators. Each individual item may highlight a few aspects of AM, but providing more examples is necessary to generate a better understanding of both the potential and limitations of AM production methods. Demonstrating a variety of materials and production processes is one goal. Another goal is to inspire enthusiasm and the attitude that the potential of AM is broader than one first realized. The oil and gas operator has identified “AM mindset” as a strategic concept that they refer to on this topic. “AM awareness” is another term that is used with similar connotations.

Thirdly, the knowledge level that is generated with these demonstrators is not deep, and it doesn’t have to be. Each organisation has some experts on AM, and the job of designing and producing the demonstrators, such as examples 1a and 4b, provided them with additional in-dept knowledge. But as a boundary object, the function of the demonstrator is to provide opportunities for discussing 3D-printng with non-experts and inspire questions.

Fourthly, the impact of the demonstrators can be enhanced if it’s tailored to a specific context. The bike in example 4a was acquired in relation to a bike race that the company sponsored and was used in promotional posts on social media. The card holders of examples 2a and 2b were made for AM conferences. If they were to be used in other settings, people seeing them may not realize that they are 3D-printed. The organisation that provided example 2c also make this access card holder in a separate colour for their AM experts team. This helps to build a sense of shared identity across geographical and organisational locations.

Fifthly, the tangible aspect of demonstrators is seen as important. In the interview with a ship services employee and a fleet manager, the fleet manager asked specifically for AM parts that could be shown to other officers within his company. Seeing and touching actual parts is thought to provide additional realism compared to seeing a picture of the item on a presentation slide, or just hearing about it. The research director noted that particularly holding the pens in example 1c was inspiring to him. This changed his perception of AM from being useful for making cheap plastic copies (e.g. prototypes) to seeing it as a viable alternative for making actual functional items of good quality.

The interviews also uncovered some important challenges of inter-organisational learning from demonstrators. The AM expert at the maritime equipment OEM explained that a different department than hers had experimented with making a part with a metal powder bed fusion (PBF) process and comparing it with conventional manufacturing in a low-cost country. Since PBF is a relatively expensive process and there was no redesign of the part to optimize it for AM, the head of department had concluded that AM was not a viable alternative for them. This sentiment then influenced other heads of department within the company, despite the AM expert’s opinion that another AM process would have been more cost efficient for that specific part. This story illustrates that demonstrators can also facilitate the spread of misperceptions and misunderstandings across inter-organisational boundaries.

The second challenge is that the information that is meant to be transferred between individuals is not contained, or not readily apparent, in the object itself. For example, some people may see the demonstrator without realizing that it is 3D-printed. A way to overcome this is by displaying it with signs with a short description of the item and production process. The demonstrators are also used in combination with digital presentations, such as power point slides and social media posts, that provide additional information. Thirdly, the most convincing demonstrators are typically the most expensive to produce. It makes little sense to make several identical copies of large metal parts for educational purposes. In contrast, the access card holder (example 2c) has the benefit of being very portable and visible. It is also relatively cheap and can be distributed to many employees within an organisation.

6. Discussion

The findings suggest that the use of 3D-printed demonstrators contributes significantly to the advancement of AM. By facilitating knowledge sharing, enhancing interdisciplinary collaboration, and providing tangible proof of AM's potential, these objects play a crucial role in convincing stakeholders of the value of AM, securing necessary resources, and fostering a culture of innovation. The interview subjects emphasize the role of these demonstrators in offering a hands-on learning experience, which is instrumental in building a foundational understanding of AM processes, materials, and capabilities across large organisations.

In the context of anchoring AM within organisational processes, 3D-printed demonstrators serve as concrete examples of the technology's potential impact on product development, supply chains and maintenance strategies. Physical models can significantly enhance the persuasive power of internal presentations, enabling

innovators and advocates of AM to communicate the potential applications and benefits of the technology more effectively. This can lead to a stronger buy-in from senior management, crucial for securing the necessary resources and attention for AM initiatives. Moreover, demonstrators can play a pivotal role in the acquisition of resources for AM projects. By showcasing the functional and economic benefits that can be achieved with AM, these models can stimulate interest and curiosity among different departments.

The utilisation of demonstrators as boundary objects represents a collaborative approach to adopting AM technologies. These demonstrators appear as important in bridging the some of the knowledge gaps between various departments, facilitating a shared understanding of AM's capabilities and potential applications (Halvorsen and Lamvik, 2022). This study's findings resonate with the concept introduced by Star and Griesemer (1989), highlighting the importance of boundary objects in fostering interdisciplinary collaboration. The tangible nature of 3D-printed demonstrators catalyses discussions around AM, making the technology's abstract concepts more accessible and engaging to diverse professional groups within the organisation. This also aligns with the observations made by Bosch-Sijtsema and Postma (2010), who emphasized the role of tangible prototypes in enhancing intra-firm communication and collaboration.

The challenges associated with the production of 3D-printed demonstrators, such as the time, cost, and potential inaccuracies in representing the final product, necessitate a careful consideration of their design and development. These challenges, if not managed effectively, could deter interest in AM and impede its integration within organisational processes. This is in line with Thompson's (2012) findings, which pointed out the importance of physical prototypes in mitigating risks associated with new product development. It underscores the need for a strategic approach to the development of these demonstrators, as suggested by Berman (2012), to ensure that they accurately convey the capabilities and limitations of AM technologies, thus preventing misconceptions and misplaced expectations.

7. Recommendations

Considering the findings from this study on the use of 3D-printed demonstrators in facilitating the adoption of AM within large organisations, several recommendations can be posited to enhance the effectiveness of AM integration processes:

- Organisations should consider starting small with plastic prototypes. This approach allows for the exploration of AM's capabilities without incurring significant costs or committing extensive resources.
- Organisations are encouraged to actively explore redesign opportunities and demonstrate the unique opportunities that AM presents. Demonstrators don’t need to have the same size, shape or material as original models.
- Demonstrators should be presented in connection to an information source, explaining the process and benefits of AM for each item.
- Knowledge sharing sessions, workshops, and regular discussions centred around the learnings from initial demonstrator efforts can catalyse a collective understanding of AM's potential and limitations. The physical demonstrators should be brought to these arenas.
- The establishment of a structured roadmap for AM integration, informed by the insights gained from prototyping, testing, and verification efforts, is recommended. This roadmap should outline clear milestones, objectives, and strategies for scaling AM capabilities within the organisation. It should also lay out a strategy for using demonstrators for intra-organisational knowledge sharing.

The strategic use of 3D-printed demonstrators, coupled with a focused approach to knowledge building, redesign exploration, and rigorous testing, can significantly enhance the adoption and integration of AM within large organisations. These recommendations provide a pragmatic framework for organisations to leverage AM's transformative potential, driving innovation and efficiency across their operations.

8. Conclusions, Limitations, and Future Research

Our study show that 3D-printed demonstrators serve as tangible intermediaries that not only bridge the knowledge gap across diverse professional domains but also facilitate an environment conducive to collaborative innovation and exploration. Our study highlights that, by embodying the capabilities and potential of AM, demonstrators can effectively stimulate discussions, facilitate learning, and drive the twin transition towards more sustainable and digitalized manufacturing processes. Despite the challenges associated with their

production, such as time and cost implications, the strategic deployment of these demonstrators has been shown to significantly enhance intra-firm communication, knowledge sharing, and ultimately, the integration of AM technologies into organisational processes.

This research is not without limitations. The case-based, qualitative nature of the study, focusing on selected industries within the Norwegian context, may restrict the generalisability of the findings to other sectors or geographical regions. Moreover, the production and utilisation of 3D-printed demonstrators are contingent upon the specific AM technologies, designs and materials employed, which may introduce variability in their effectiveness as boundary objects. For example, confidence in the use of AM processes for critical parts may be negatively influenced by only seeing AM used for demonstrations of non-critical parts (e.g. a pen). This makes the case for also making demonstrators of critical parts that are subjected to rigorous quality tests. Future research should aim to address these limitations by expanding the scope of investigation to include a broader array of industries and geographical contexts, thereby enhancing the generalisability of the findings. More research is also needed on optimizing the design and development process of these demonstrators to maximize their effectiveness while minimizing associated costs and challenges.

3D-printed demonstrators can also help in capturing the attention of key stakeholders outside the organisation. Bringing these tangible models to stakeholder meetings and industry conferences to demonstrate the organisation's commitment to innovation and technological advancement is a common practice that was outside the scope of this study. The benefits of this activity include positioning the organisation as a leader in AM adoption but also attracting customers, talent, partners, and investors who are interested in cutting-edge manufacturing technologies. Evaluating this behaviour in light of the literature on knowledge management would be valuable from both an industrial and academic standpoint.

Acknowledgements

The authors are grateful to three interview subjects for permissions to use photos of examples 1a, 2c and 4b. The remaining photos are by the authors. All photos can be reused with a reference to this article. We also appreciate the constructive feedback on the article given by anonymous reviewers. The funding for this study was provided by the Research Council of Norway, grant: 332374.

References

Berman, B. (2012) “3-D printing: The new industrial revolution”, *Business Horizons*, Vol 55, No. 2, pp 155–162.

Bosch-Sijtsema, P.M. and Postma, T.J.B.M. (2010) “Knowledge sharing in an R&D project: The case of the shipbuilding industry”, *Technovation*, Vol 30, No. 2, pp 100–109.

Carlile, P.R. (2002) “A pragmatic view of knowledge and boundaries: Boundary objects in new product development”, *Organisation Science*, Vol 13, No. 4, pp 442–455.

Ford, S. and Despeisse, M. (2016) “Additive manufacturing and sustainability: An exploratory study of the advantages and challenges”, *Journal of Cleaner Production*, Vol 137, pp 1573–1587.

Gao, W., Zhang, Y., Ramanujan, D., Ramani, K., Chen, Y., Williams, C.B. and Zavattieri, P.D. (2015) “The status, challenges, and future of additive manufacturing in engineering”, *Computer-aided Design*, Vol 69, pp 65–89.

Gibson, I., Rosen, D.W. and Stucker, B. (2014) *Additive manufacturing technologies: 3D printing, rapid prototyping, and direct digital manufacturing*, Springer, 2nd ed.

Greenwood, D. J., and Levin, M. (2006) *Introduction to Action Research: Social Research for Social Change*, Sage Publications.

Halvorsen, T. and Lamvik, G. M. (2021) “Additive manufacturing of spare parts in the maritime industry: Knowledge gaps for developing a Norwegian AM-based business ecosystem for maritime spare parts” *in Proceedings of the 22nd European Conference on Knowledge Management*. Coventry University, pp 484-491.

Horne, R. and Nissen, B. (2006) “Prototyping in digital clay: Craft and responsibility in new media product design”, *Design Studies*, Vol 27, No 3, pp 499–520.

Kindon, S., Pain, R., and Kesby, M. (2007) Participatory action research: Origins, approaches and methods. In *Participatory action research approaches and methods* (pp 35-44). Routledge.

Mehrpouya, M., Dehghanghadikolaei, A., Fotovvati, B., Vosooghnia, A., Emamian, S. S., and Gisario, A. (2019) “The potential of additive manufacturing in the smart factory industrial 4.0: A review”, *Applied Sciences*, Vol 9, No18, 3865.

Rehman, S. U., Giordino, D., Zhang, Q., and Alam, G. M. (2023) “Twin transitions & industry 4.0: Unpacking the relationship between digital and green factors to determine green competitive advantage”, *Technology in Society*, Vol 73, 102227.

Robinson, D.K., Lagnau, A. and Boon, W.P. (2019) “Innovation pathways in additive manufacturing: Methods for tracing emerging and branching paths from rapid prototyping to alternative applications”, *Technological Forecasting and Social Change*, Vol 146, pp 733–750.

Rogers, E.M. (2003) *Diffusion of innovations*, Free Press, 5th ed.

Schniederjans, D.G. (2017) “Adoption of 3D-printing technologies in manufacturing: A survey analysis”, *International Journal of Production Economics*, Vol 183, pp 287–298.

Star, S.L. and Griesemer, J.R. (1989) “Institutional ecology, 'translations' and boundary objects: Amateurs and professionals in Berkeley's Museum of Vertebrate Zoology, 1907-39”, *Social Studies of Science*, Vol 19, No. 3, pp 387–420.

Swann, L., McKinnon, H., Boase, N., Mirzaei, M., Wiedbrauk, S. and Wigman, S. (2023) “Beyond Boundaries: 3D Printing and Functional Materials as Boundary Objects to Mediate Interdisciplinary Collaboration”, In *Proceedings of the International Conference 2023 of the Design Research Society Special Interest Group on Experiential Knowledge (EKSIG): From Abstractness to Concreteness–experiential knowledge and the role of prototypes in design research*, Politecnico di Milano, pp 587–604.

Thomke, S. and Fujimoto, T. (2000) “The effect of 'front-loading' problem-solving on product development performance”, *Journal of Product Innovation Management*, Vol 17, No. 2, pp 128–142.

Thompson, M.K. (2012) “Design for additive manufacturing: Trends, opportunities, considerations, and constraints”, *CIRP Annals - Manufacturing Technology*, Vol 61, No. 2, pp 737–760.

Yin, R. K. (2014) *Case study research design and methods*, Sage, 5th ed.

From Concept to Market: Integrating Organizational Knowledge Creation to Bridge Technology and Business Gaps

Irina-Emily Hansen, Ola Jon Mork, Paul Steffen Kleppe and Lars Andre Langøyli Giske
Department of Ocean Operations and Civil Engineering, Norwegian University of Science and Technology, Aalesund, Norway

irina-emily.hansen@ntnu.no
ola.j.mork@ntnu.no
paul.s.kleppe@ntnu.no
lars.a.l.giske@ntnu.no

Abstract: This study explores the intersection of project development and organizational knowledge creation within the context of industry-academia collaboration, applying Nonaka and Takeuchi's organizational knowledge creation model as the theoretical framework. Conducted at the Manufacturing Laboratory (Manulab) at the Norwegian University of Science and Technology in Aalesund, the research investigates how integrating academic research into industrial applications can be optimized through effective knowledge management and the use of practical tools. The findings emphasize the critical role of knowledge workers, including researchers, engineers, sales managers, and decision-makers from the industry, in every project phase. A significant focus is placed on the Manulab-industry competence-building process, which progresses in parallel with the Technology Readiness Level and Business Readiness Level axes. This dual advancement strategy ensures that technological innovations meet both technical standards and market needs, enhancing their commercial viability. The study demonstrates that adopting a structured framework incorporating TRL and BRL helps overcome common challenges such as the creation of technically sound but commercially unviable technologies. Additionally, the integration of simulation platforms has facilitated the active involvement of diverse stakeholders throughout the development process, improving the practical application of Nonaka and Takeuchi's model. Specifically, the research tests two hypotheses: (1) that the use of TRL and BRL frameworks for tracking and verifying project progress is a practical tool for applying Nonaka and Takeuchi's model, and (2) that the use of simulation platforms in the product development process, by involving diverse stakeholders, significantly improves the alignment and synchronization of technology and business concept development. The research concludes that successful implementation of academic research in industrial settings requires a comprehensive understanding of organizational knowledge creation, strategic collaboration, and the use of practical tools like TRL and BRL. These findings advocate for a systematic approach to project development that emphasizes both theoretical knowledge and actionable insights for effective industry-academia collaboration.

Keywords: Organizational Knowledge Creation, Industry-Academia, Technology Readiness Level, Business Readiness Level, Collaboration, Innovation

1. Introduction

The interplay between academia and industry is a cornerstone for pushing the boundaries of technological innovation. Yet, the path from academic research to tangible industrial applications often encounters numerous hurdles. Recent research conducted at the Manufacturing Laboratory (Manulab) within the Norwegian University of Science and Technology in Aalesund highlights these challenges and illuminates the crucial role that knowledge workers play in every phase of organizational knowledge creation to ensure the success of projects (Hansen *et al.*, 2023). These knowledge workers include a diverse group of individuals, from researchers and students at Manulab to engineers at technology integration firms and various stakeholders within industrial companies such as operators, engineers, sales managers, and decision-makers.

Drawing upon the Manulab-industry competence-building process, which is inspired by Nonaka and Takeuchi's seminal model of organizational knowledge creation, this research explores the vital elements required to synchronize all participants into a unified, collaborative effort (Hansen, Mork and Welo, 2019; Nonaka and Takeuchi, 1995). A key element of this framework is the strategic use of virtual and physical prototypes, which provide a tangible medium for both industry and academic stakeholders to collaborate effectively.

The aim of this article is to evaluate the effectiveness of integrating Technology Readiness Level (TRL) and Business Readiness Level (BRL) frameworks, along with simulation platforms, in enhancing the practical application of Nonaka and Takeuchi's knowledge creation model in industry-academia collaborations. Specifically, this study tests two hypotheses: (1) that the use of TRL and BRL frameworks for tracking and verifying project progress is a practical tool for applying Nonaka and Takeuchi's model, and (2) that the use of simulation platforms in the product development process, by involving diverse stakeholders, significantly improves the alignment and synchronization of technology and business concept development.

This article delves into a comprehensive case study involving Manulab and the FishMech company to dissect the factors that contribute to successful research implementation. This partnership not only resulted in immediate project successes but also set the stage for a strategic, long-term competence-building initiative that continues to benefit both the university and the company. Moreover, the paper advocates for the implementation of TRL and BRL as critical tools to monitor and guide project development from its inception in the lab to its full-scale implementation in the industrial arena.

The forthcoming sections of this article explore the theoretical background, methodology, case study, and findings. Section 2 outlines the theoretical premises and hypotheses tested. Section 3 describes Manulab-industry competence-building process and details the TRL and BRL frameworks. Section 4 elaborates on the methodology, including the case study approach and workshops for data collection. Section 5 details the collaboration between Manulab and FishMech, highlighting key stages and outcomes. Section 6 presents findings from the case study and workshops, showing the impact of TRL, BRL, and simulation platforms. Section 7 discusses the verification of hypotheses and supporting evidence. Finally, Section 8 summarizes the findings, discusses practical implications, outlines limitations, and suggests future research directions.

2. Theoretical Background and Hypotheses

The need for an effective knowledge management (KM) approach in industry-academia collaboration projects is critical for facilitating technological advancement and innovation. Studies by Hermansand and Castiaux (2007) and Johnson and Johnston (2004) highlight the significance of knowledge conversion processes and enabling conditions, which are positively associated with technological achievements. This underscores the necessity of a structured KM approach to achieve successful outcomes.

In the context of Norwegian marine and maritime industries collaborating with academia through Manulab, the organizational KM model developed by Nonaka and Takeuchi has been adapted to suit the local context (Hansen, Mork and Welo, 2019). This model has proven valuable in fostering knowledge creation and innovation across several projects. However, there remains a pressing need to develop more practical tools for the effective implementation of this model.

Several other studies underscore this need for practical applications of the organizational knowledge creation model by Nonaka and Takeuchi. Researchers like Balde, Stoyanov, and Cabana advocate for tools that better address practical KM aspects. Balde (2018) and Stoyanov (2018) build on the SECI model, focusing on team trust, intrinsic motivation, and the conversion of tacit and explicit knowledge. Cabana (2021) emphasizes the role of wise leadership in balancing knowledge types and prioritizing long-term sustainability.

Additional studies explore KM dynamics in industry-academia collaborations. Marijan and Gotlieb (2021) proposes a participative knowledge creation model with active stakeholder involvement to meet both academic and industrial objectives. Gómez-Marín et al (2022) suggest a comprehensive KM model tailored for academics and business stakeholders, highlighting systematic management of knowledge flows. Hansen et al (2022) and Talab et al (2020) emphasize the critical role of universities in fostering innovation through agile principles and extensive knowledge collaboration.

While the Nonaka and Takeuchi model provides a solid foundation, there is a clear demand for the development of practical tools to enhance its application in organizational knowledge creation. Addressing team dynamics, leadership, and the balance between tacit and explicit knowledge is essential to drive innovation and achieve successful industry-academia collaborative outcomes.

Researchers working in Norway with Manulab observed that using simulation platforms in product development significantly increases the implementation of research results in real industrial settings. These platforms enable the involvement of operators, engineers, sales personnel, and decision-makers throughout the entire development process. This integration connects technology development with the evolution of business concepts. Consequently, the Manulab-industry competence-building process, derived from Nonaka and Takeuchi's organizational knowledge creation model, advances simultaneously along both the TRL and BRL axes. Building on these observations, the following hypotheses are proposed to explore the potential benefits of integrating TRL and BRL frameworks with simulation platforms:

Hypothesis 1: The use of Technology Readiness Level and Business Readiness Level frameworks for tracking and verifying project progress is a practical tool for applying Nonaka and Takeuchi's organizational knowledge creation model in industry-academia collaborations.

Hypothesis 2: The use of simulation platforms in the product development process, by involving diverse stakeholders (operators, engineers, sales personnel, and decision-makers), significantly improves the alignment and synchronization of technology and business concept development.

These hypotheses aim to evaluate the effectiveness of TRL and BRL frameworks, along with simulation platforms, in facilitating the practical application of knowledge management principles and improving collaboration outcomes between academia and industry.

3. Manulab-Industry Competence Building Process, TRL, and BRL

Drawing on the framework developed by Nonaka and Takeuchi, Manulab researchers have outlined a comprehensive six-stage process for competence development in Manulab- industry projects, as illustrated in Figure 1 (Nonaka and Takeuchi, 1995; Hansen *et al.*, 2023). This framework reflects the model of organizational knowledge creation by Nonaka and Takeuchi but also introduces specific stages tailored to Manulab.

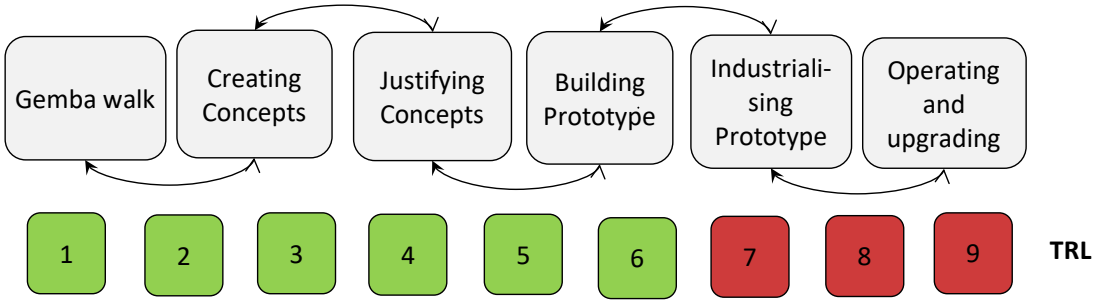


Figure 1: Manulab-industry competence building process in relation to TRL – when the research results are not implemented in industry

The process begins with a Gemba-walk, which promotes interaction between the corporate team and Manulab personnel (Womack, Jones and Roos, 2007). These Gemba-walks initiate cooperation through visits to manufacturing sites and Manulab, enhancing mutual understanding of methods, fostering connections, and identifying industrial challenges.

Following phases include "creating concepts" and "justifying concepts," as well as "building prototype." These phases are deeply connected and involve repeated adjustments between the conceptualization and prototyping stages.

The “industrialising prototype” stage signifies the deployment of the technological solution at the industrial facility. Typically managed by a system integrator, this stage requires detailed planning and may disrupt ongoing production. The system integrator is also charged with training staff and ensuring that the technology integrates smoothly into the current production environment.

The concluding stage, "operating and upgrading," involves industrial personnel and engineers who maintain and improve the system, while the system integrator focuses on maintenance and upgrades. Through collaborations between Manulab and industry, the Manulab-industry competence building process aims to close the gap between technological innovation and its practical implementation in industry. The technological innovation develops alongside the competence building process. As Figure 1 shows, the Technology Readiness Level rises together with the projects’ development. TRL is a metric used to assess the maturity of a specific technology, progressing from conceptualization to deployment. Here is a brief overview of the TRL stages according to Innovation Norway (2023):

1. *Basic principles observed*: Initial scientific research translates into applied research. Phenomena are recognized, and potential applications are understood.
2. *Technology concept formulated:* Practical applications are formulated based on observed principles. The concept is speculative, lacking proof or detailed analysis.
3. *Experimental proof of concept:* Research and design efforts, including analytical and lab studies, validate predictions of separate technology elements.
4. *Technology validated in lab:* Technology is refined and validated through controlled experimentation.
5. *Technology validated in relevant environment:* Technological components are tested in a simulated environment, reflecting operational conditions.

6. *Technology demonstrated in relevant environment***:** A representative model or prototype is tested in a relevant environment to assess performance.
7. *System prototype demonstration in operational environment:* A near-final prototype is tested in the intended environment under expected conditions.
8. *Technology proven to work in its final form and under expected conditions:* The technology is completed and qualified through tests and demonstrations.
9. *Actual technology proven through successful deployment in operational environment:* The technology is fully developed and proven to work in its final form and under expected conditions.

These levels are essential for assessing technology maturity, managing developmental risks, and guiding technology from conceptualization to commercial deployment. Integrating TRL with the Manulab-industry model is crucial. Prior research on various collaborative projects between industry and Manulab revealed that, although project outcomes were satisfactory for the industry, they were not implemented in industrial settings. Figure 1 highlights this issue with TRL 7-9 in red, indicating project shortcomings at these levels. Previous studies using the Manulab-industry competence-building process investigated why these final phases were unsuccessful (Hansen *et al.*, 2023). A significant problem is the minimal involvement of decision-makers, system integrators, and sales leaders in the early stages, which hampers the integration of Manulab innovations into production environments. Additionally, excluding the Manulab team from later industrial stages reduces their potential to enhance operational technology.

To address the need for commercialization of research results, Manulab researchers decided to assess their projects in parallel with the Business Readiness Level framework. BRL measures the readiness of a new technology or product for successful commercialization (Innovation Norway, 2023). Since Manulab's projects success are evaluated by the commercial deployment of technology solutions, the BRL metric was crucial in the workshops. The BRL framework assesses commercial maturity across nine levels:

1. *Basic Principle Observed:* The core idea or principle behind the business initiative is identified, recognizing the potential opportunity.
2. *Technology Concept Formulated:* The concept is structured into a basic business model, outlining potential markets and preliminary value propositions.
3. *Proof of Concept:* The business concept is experimentally tested for feasibility through small-scale experiments or pilot studies.
4. *Business Model Validated in Lab***:** The model undergoes rigorous testing in a controlled environment to validate its functionality and effectiveness.
5. *Fidelity of Business Model Validated:* The model is tested in a simulated environment to assess its performance under near-real conditions.
6. *Prototype Model Tested:* A working prototype is developed and tested in a relevant environment, encountering real-world variables.
7. *Business Model Demonstrated in Operational Environment:* The model is fully implemented on a limited scale, including all aspects of operations and market engagement.
8. *Actual System Completed and Qualified:* The model is finalized and integrated into the operational framework, ready to meet specified performance standards.
9. *Business Model Proven and Ready for Full Deployment:* The model has been successfully proven through full-scale operations and is ready for widespread deployment, fully viable and sustainable in the market.

4. Methodology: Case Study and Workshops

Recently, Manulab has seen an increasing number of projects that not only reach industrial realization but also spawn subsequent initiatives with the same partners, often extending to include additional companies. To understand the drivers behind these successful outcomes, several workshops were conducted. Workshops serve as an effective research tool for gathering accurate and insightful data on advanced strategies (Ørngreen and Levinsen, 2017). The workshops aimed to identify the key factors contributing to project success and to determine how best to leverage these insights across other projects.

Three researchers and two engineers working in Manulab, and one the researcher and the chief of the research and development team in the industrial company participated in these workshops.

Alongside these workshops, the research team reviewed various project documents, including applications, meeting summaries, and final reports. The focus of the total four workshops was to examine industry-

collaborative projects within the framework of Manulab-industry competence building process, as well as to promote the advancement of projects in terms of Technology Readiness Levels and Business Readiness Levels.

Four projects were selected as case studies for the workshops: one collaborated with a company that specializes in air filters, while the other three were associated with enterprises in the fish industry. The sizes of the companies involved vary significantly. The air filter company employs approximately 90 people. Two of the fish industry cases involved the same company, which has around 200 employees. The third case relates to a smaller fish company with about 40 employees. The case study focusing on this smaller company, which we will refer to as "FishMech" for the purposes of this article (this is not the company's real name), is detailed in the next section.

5. Case Study Fishmech-Manulab

FishMech, a company specializing in fish processing equipment, approached Manulab for expertise in camera vision and machine learning to enhance their market competitiveness. In addition to creating new devices, FishMech also upgrades and refurbishes existing equipment for resale.

The collaboration followed the structured phases of the Manulab-industry competence building process, starting with the Gemba work phase, which included multiple meetings at Manulab. During these sessions, researchers and engineers showcased their equipment, software, and case studies, emphasizing the importance of active participation from FishMech.

Attendees from FishMech included decision-makers, sales managers, engineers, and operators. Manulab also visited FishMech's facilities to understand their operations, equipment, production methods, market dynamics, and customer interactions.

After several discussions, Manulab and FishMech agreed to focus on integrating camera and machine learning technologies into a fish cutting machine, with an interested customer already identified. The technology integrator, familiar with both organizations, had previously collaborated with them, completing the initial Gemba work.

The project team included two engineers and three researchers from Manulab, one engineer, two operators, a sales manager, and a decision-maker from FishMech, and three engineers from the technology integrator. The project progressed through phases: "creating concepts," "justifying concepts," and "building a prototype," advancing from TRL 1 to 5. Figure 2 shows the project meeting where Manulab, FishMech, and the technology integrator discuss the virtual prototype.

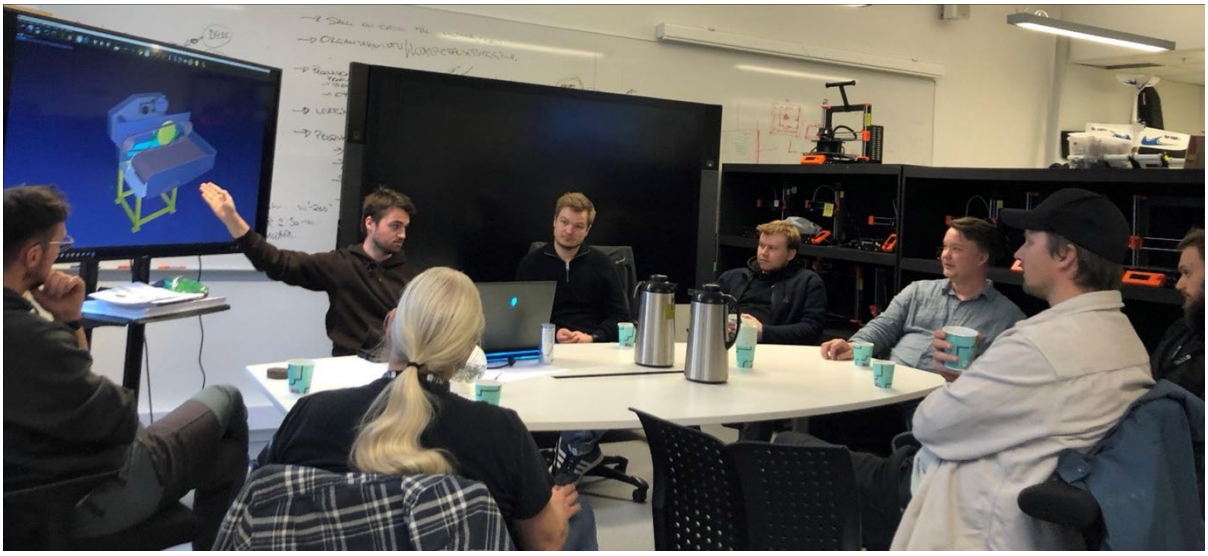


Figure 2: Project meeting FishMech, Manulab and technology integrator company

Several concepts were developed and justified by testing the virtual prototypes in simulation programs before the physical prototypes was first built in the Manulab facility as Figure 3 illustrates. This corresponds to the TRL 6.

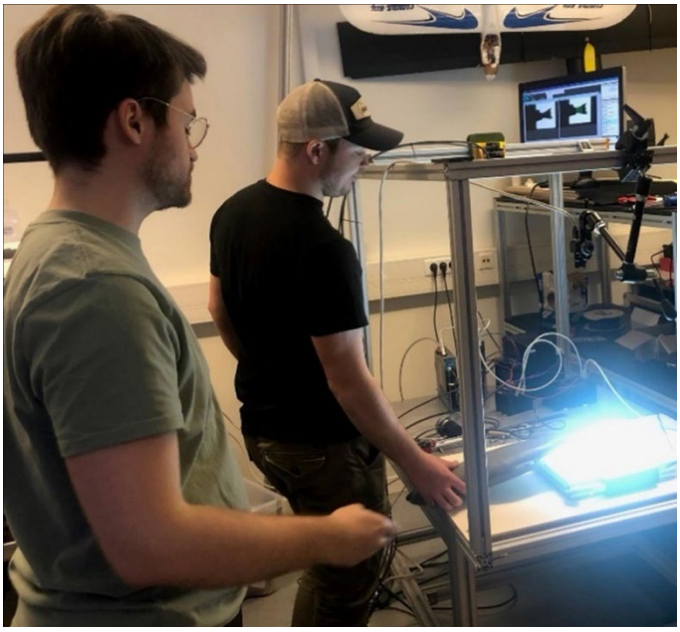


Figure 3: Building physical ptototype in Manulab

When this prototype was verified by the company and the technology integrator, it was transported in the manufacturing facilities of FishMech and integrated in the fish processing machine to test if the system was working as intended in the operational environment, which corresponds to the TRL 7. This is shown in Figure 4.

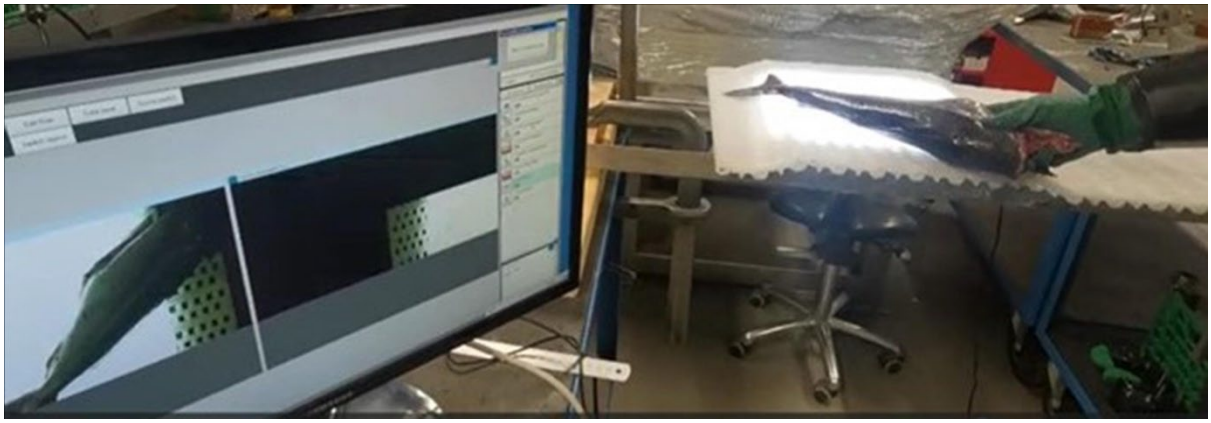


Figure 4: Test of the prototype in the FishMech facilities

Throughout the project, the partners actively collaborated in knowledge exchange and creation. A skilled operator from FishMech, with a professional diploma in automation, dedicated one day each week to develop a prototype in the university lab. Working closely with Manulab engineers, the operator gained significant insights into equipment design and simulation programs, while the Manulab team learned practical aspects of fish processing. This mutual exchange greatly influenced the design of fish processing equipment, especially in understanding the unique behaviors and anatomical features of fish.

The technology integrator company contributed their expertise in vision technology throughout the project. Numerous formal and informal meetings ensured consistent involvement and rich knowledge exchange among project members.

The developed solution has been successfully integrated into FishMech's machinery, demonstrating efficacy and reliability under operational conditions, achieving TRL 8. This milestone showcases the technology's readiness for broader application. FishMech has already attracted interest from customers, indicating market receptivity and a shift toward advanced methodologies in fish processing.

Manulab's expertise in advanced manufacturing and prototyping was instrumental in transitioning the concept into a viable product. Their optimization of machine learning algorithms and vision systems ensured the solution

met industry standards. The technology integrator played a crucial role in seamlessly incorporating new systems into existing processes, addressing deployment challenges and ensuring a smooth transition.

The enthusiastic customer response brings the project closer to commercial deployment, aligning with BRL 8. This level involves not only launching the product but also expanding and optimizing business operations. For FishMech, this means refining their go-to-market strategy, enhancing customer support, and potentially scaling production to meet demand. With the combined efforts of FishMech, Manulab, and the technology integrator, the project is set to revolutionize fish processing operations, improving efficiency and sustainability in the industry.

6. Findings

This section elaborates on the results derived from the workshops evaluating four distinct projects, focusing on their progression through key developmental metrics and stakeholder engagement. Figure 5 shows Manulab-industry competence building process alongside TRL and BRL development.

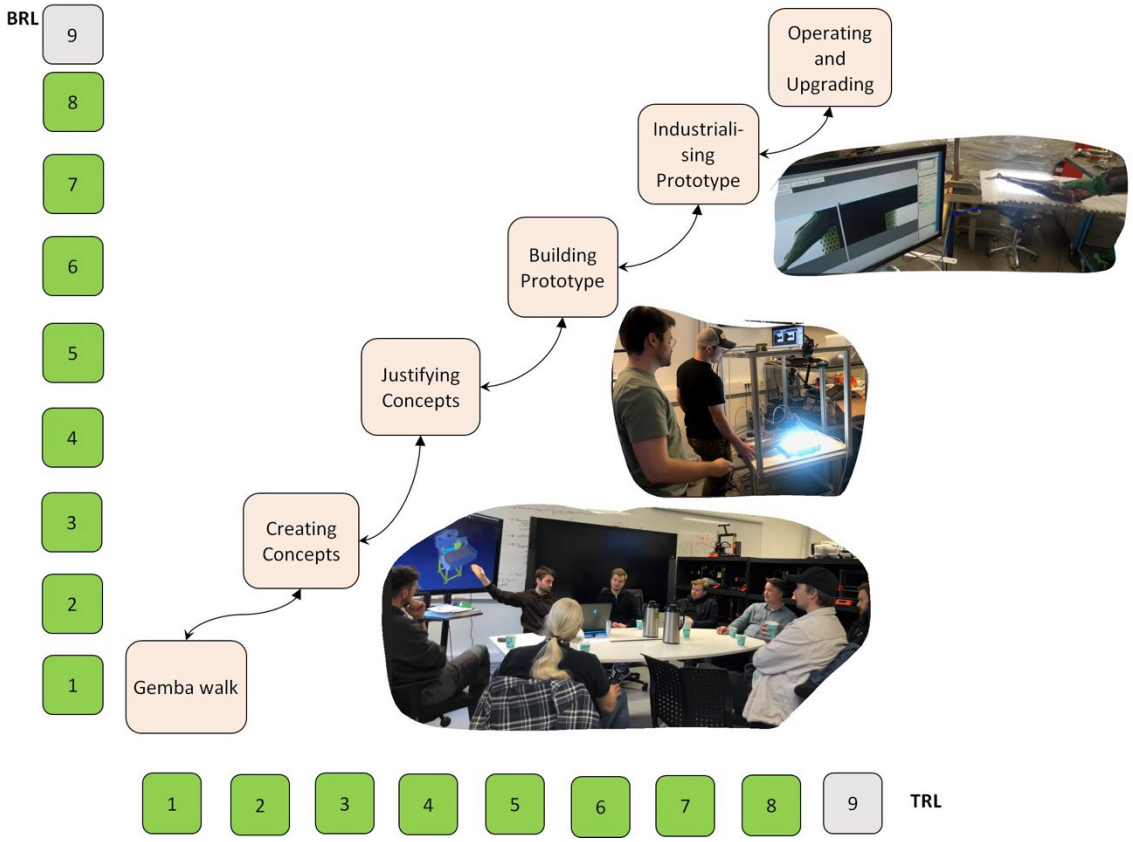


Figure 5: Manulab-industry competence building process alongside TRL and BRL

7. Utilization of TRL and BRL as Project Development and Competence Building Indicators

The projects, including the collaboration between Manulab and FishMech, successfully progressed through the Manulab-industry competence building process by simultaneously advancing along both TRL and BRL metrics, as depicted in Figure 5 . This concurrent advancement is crucial as it ensures that research outcomes are not only technically feasible but also economically viable and ready for real-life implementation. The findings suggest that the TRL and BRL metrics are effective tools for mapping the journey of a project from concept to execution, providing a clear framework for tracking progress in both technological development and market readiness. By understanding and utilizing these metrics, organizations can better navigate the complex landscape of collaborative project development, ensuring that each phase aligns with both technical specifications and business objectives.

7.1 Enhancing Project Effectiveness Through Inclusive Engagement of Stakeholders, and all Organisational Levels in the Industrial Company

The analysis underscored the significance of inclusive engagement, involving a diverse range of personnel- from ground-level operators and engineers to upper management and decision-makers within the industrial company. This comprehensive involvement ensures that strategic decisions, such as finalization of production strategies, small-scale operations, and marketing tactics for the technological solutions, are well-informed and broadly supported. Moreover, engaging technical staff like operators and engineers in the process facilitates a smoother transition of innovations from the laboratory to real-world applications. This strategy not only maximizes the effectiveness of the projects but also expands their impact by incorporating diverse perspectives and expertise, which is essential for addressing real-world challenges effectively.

7.2 Strategic Commitment to Knowledge and Business Development

For the partnership between a company and a university to be fruitful, both parties must recognize and commit to filling a specific knowledge gap that promises long-term competitive advantages. When such a need is identified, the company is more likely to dedicate necessary organizational and financial resources, fostering an environment conducive to effective collaboration. This strategic alignment between the partners' goals and the project's objectives ensures that both parties are equally invested in the project's success and can reap substantial benefits from their joint efforts. This commitment is crucial for the seamless translation of laboratory research into practical, industrial applications, enhancing the overall value and impact of the collaborative project.

7.3 Important Role of Simulation Platforms in the Competence Building Process

The use of simulation platforms is instrumental in bridging the gap between diverse stakeholder groups, such as engineers, financial analysts, and decision-makers. These platforms serve as critical tools for knowledge exchange and co-creation, allowing for iterative testing and refinement of project designs in a virtual environment. They enable stakeholders to provide direct feedback on both the technical and business aspects of a project, thus enhancing the design and functionality of the solutions. By demonstrating technological effectiveness and market viability, simulation platforms play a pivotal role in attracting investment and ensuring alignment with broader business strategies. This iterative, inclusive approach to simulation-based development and evaluation not only fine-tunes the project outcomes but also significantly contributes to the robustness and readiness of the technology for market introduction.

8. Discussion: Verification of Hypothesis

Hypothesis 1: The use of Technology Readiness Level and Business Readiness Level frameworks for tracking and verifying project progress is a practical tool for applying Nonaka and Takeuchi's organizational knowledge creation model in industry-academia collaborations.

The case studies from Manulab provide robust evidence supporting this hypothesis. Projects that incorporated TRL and BRL frameworks demonstrated a more systematic and structured approach to development. These frameworks facilitated a clear progression from conceptualization to commercialization, ensuring that technological innovations were both technically mature and market ready. For instance, the FishMech project showed that by systematically advancing through the TRL stages, the team could effectively validate technological components and integrate them into operational settings. Similarly, the use of BRL helped align the project's business objectives with market needs, ensuring commercial viability. This dual tracking of technological and business readiness enhanced the overall effectiveness and implementation of research outcomes in industrial settings, confirming the practical utility of TRL and BRL frameworks in applying Nonaka and Takeuchi's model.

Hypothesis 2: The use of simulation platforms in the product development process, by involving diverse stakeholders (operators, engineers, sales personnel, and decision-makers), significantly improves the alignment and synchronization of technology and business concept development.

The FishMech project highlighted the critical role of simulation platforms in fostering effective stakeholder collaboration. By providing a virtual environment for testing and feedback, these platforms allowed for continuous interaction among operators, engineers, sales personnel, and decision-makers. This inclusive approach ensured that diverse perspectives were integrated into the development process, leading to more

comprehensive and aligned technological and business strategies. The iterative nature of simulation platforms facilitated real-time adjustments and improvements, which enhanced both the technical robustness and market readiness of the final product. The active involvement of all stakeholders not only improved the project's outcomes but also strengthened the collaboration between academic and industrial partners, thereby validating the second hypothesis.

9. Conclusion

This study confirms that integrating TRL and BRL frameworks with simulation platforms effectively applies Nonaka and Takeuchi's knowledge creation model in industry-academia collaborations. The use of these practical tools enhances the systematic development of projects, ensuring that innovations are both technically sound and commercially viable. The case studies from Manulab demonstrate that such an approach leads to better alignment and synchronization of technological and business developments, fostering more successful project outcomes.

For organizations seeking to enhance their collaborative projects, adopting TRL and BRL frameworks and utilizing simulation platforms are critical steps. These tools not only help track project progress but also ensure that both technological and business objectives are met. Engaging diverse stakeholders throughout the development process is essential for achieving comprehensive and effective project outcomes. The structured approach demonstrated in this study provides a practical roadmap for organizations to follow, facilitating better alignment between research and real-world application.

While the study provides valuable insights, it is based on a limited number of case studies, which may not fully capture the diversity of industry-academia collaborations. Additionally, potential biases in project selection and participant involvement may influence the results. The specific context of Manulab and the Norwegian industrial environment may also limit the generalizability of the findings. Further research with a broader range of case studies and more diverse participant groups is needed to validate and expand upon these findings.

Future studies should explore the long-term impacts of integrating TRL and BRL frameworks on project success across various sectors. Additional research is needed to refine the role of simulation platforms at different stages of project development and across different industries. Understanding how these tools can be tailored to specific contexts will provide deeper insights into their effectiveness and broader applicability. Furthermore, investigating the role of power dynamics, tensions, and stakeholder differences in the use of these tools can offer a more nuanced understanding of their impact on collaboration outcomes.

References

Baldé, M., Ferreira, A. I. and Maynard, T. (2018) 'SECI driven creativity: the role of team trust and intrinsic motivation', *Journal of knowledge management,* 22(8), pp. 1688-1711.

Cabana, G. C. (2021) 'The Wise Company: How Companies Create Continuous Innovation, by Ikujiro Nonaka and Hirotaka Takeuchi. Oxford: Oxford University Press, 2019. 304 pp', *Business ethics quarterly,* 31(2), pp. 312-315.

Gómez-Marín, N., Cara-Jiménez, J., Bernardo-Sánchez, A., Álvarez-de-Prado, L. and Ortega-Fernández, F. (2022) 'Sustainable knowledge management in academia and research organizations in the innovation context', *The international journal of management education,* 20(1).

Hansen, I.-E., Mork, O. J., Kleppe, P. S. and Giske, L. A. L. (2023) 'Towards Industry 5.0: Developing Knowledge and Skills in a Research and Innovation Lab', *European conference on knowledge management,* 24(1), pp. 509-517.

Hansen, I.-E., Mork, O. J. and Welo, T. (2019) 'Managing Knowledge in Manufacturing Industry - University Innovation Projects', *IFIP Advances in Information and Communication Technology*: Springer International Publishing, pp. 603-610.

Hansen, I.-E., Mork, O. J., Welo, T. and Ringen, G. (2022) 'Bridging the 'Valley of Death': Can Agile principles be applied in industry-academia research and innovation projects?', *Journal of the Knowledge Economy,* 13(4), pp. 3172-3194.

Hermansand, J. and Castiaux, A. (2007) 'Knowledge Creation through University-Industry Collaborative Research Projects', *Electronic Journal of Knowledge Management,* 5(1), pp. pp43-54.

Innovation Norway (2023) *Business Readiness Level (BRL) og Technology Readiness Level (TRL)*. Available at: https://www.innovasjonnorge.no/artikkel/brl-og-trl.

Johnson, W. H. and Johnston, D. A. (2004) 'Organisational knowledge creating processes and the performance of university-industry collaborative R&D projects', *International Journal of Technology Management,* 27(1), pp. 93-114.

Marijan, D. and Gotlieb, A. (2021) 'Industry-Academia research collaboration in software engineering: The Certus model', *Information and software technology,* 132, pp. 106473.

Nonaka, I. and Takeuchi, H. (1995) *The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation.* Oxford University Press.

Stoyanov, S. (2018) *An analysis of Ikujiro Nonaka's A dynamic theory of organizational knowledge creation.* Macat Library.

Talab Haghighi, A., Scholten, V. and van Beers, C. (2020) 'The role of universities in inter-organizational knowledge collaborations', *Journal of the knowledge economy,* 11(2), pp. 458-478.

Womack, J. P., Jones, D. T. and Roos, D. (2007) *The machine that changed the world: The story of lean production--Toyota's secret weapon in the global car wars that is now revolutionizing world industry.* Simon and Schuster.

Ørngreen, R. and Levinsen, K. T. (2017) 'Workshops as a research methodology', *Electronic Journal of E-learning,* 15(1), pp. 70-81.

Impact of Chatbots on Satisfaction and Loyalty in Lima's Telecom Sector

Catherine Alexandra Herrera Fallaque
University of Lima, Lima, Peru

20190938@aloe.ulima.edu.pe

Abstract: The migration towards digital environments has transformed the expectations of consumers, who now not only look for quality products and services, but also convenience, personalization and efficiency in each interaction with the brand. This change presents significant challenges for companies, as they need to constantly adapt to meet their needs and thus maintain loyalty in a highly competitive market. The pressure to offer added value and maintain customer preference is intensified by the ease with which consumers switch to competitors. which drives companies to innovate and adapt AI such as chatbots, which could be the answer to this challenge. The objective of this research work is to know if the use of chatbots positively influences the satisfaction and perceived loyalty of consumers of telephone services, since in this case the speed, quality of the service and the customer's need for understanding. They are critical and represent a greater challenge to differentiate. The methodology used for this research maintains a quantitative, correlational, non-experimental approach. The type of sampling was non-probabilistic, and the strategy was snowball. The instrument used was a questionnaire with a sample of around 130 consumers in the city of Metropolitan Lima in Peru. The findings suggest that chatbots are not only innovative tools, but also strategic ones for telephone companies seeking to improve customer satisfaction and loyalty. The implementation of appropriate chatbots can transform the customer experience, providing a more agile, personalized and effective service, thus seeing a close relationship between the dimensions of the chatbot with the satisfaction and loyalty perceived in consumers. In a world where these variables are key to business survival, chatbots represent an opportunity to create exceptional experiences. Uncover how cutting-edge AI chatbots are revolutionising customer satisfaction and loyalty in the competitive telephone service industry, offering transformative, personalised, and efficient interactions.

Keywords: Chatbots, Customer Satisfaction, Loyalty, Telephone Services, Digital Innovation

1. Introduction

Today, we live in an era where consumers spend more time in digital environments, seeking services in an accessible and fast way, regardless of location, time or channel (Escobar, 2016). In Peru, delays in customer service and low information accuracy have negatively impacted sales and customer satisfaction (Gestión, 2018). Consumers value convenience, personalisation and efficiency in all their interactions with brands. Companies face the challenge of remaining robust and efficient in all their digital channels to attract and retain customers, seeking their preference and loyalty (Hasberg et. al., 2016). In response to digitalisation and business issues, several countries have incorporated chatbots as an effective solution to address customer queries and concerns through AI (Dhaoui, 2014).

The main purpose of the paper is to draw insight into the relation between the use of Chatbots and the perception of customer satisfaction and loyalty, with a focus on the telephone service sector that has been criticized for poor customer care. This is further echoed by the study by Anda Peru (2021), stating issues such as slow service, poor customer care, and bad processes. This study tries to comprehend the relationship that the use of chatbots, satisfaction (S), and loyalty (L) perceived in consumers of telephony services in Metropolitan Lima (LM) would have in 2024. The research studies three dimensions: dimensions such as chatbot interactions (I), personalization (P), problem resolution (RP) capabilities, which are related to influences on perceived S and L. The following will present the research objectives of analysing such relationships and its effect on perceived S and L. Overall Objective: To analyse the relationship between the use of chatbots, "S," and "L" in consumers of telephony services in "LM" in 2024. The specific objectives vary along the above-mentioned dimensions. The research aims at extending theoretical knowledge on customer satisfaction by using chatbots, aligning with Feine et al. (2019). It also aims to update the conceptual framework on chatbots and customer experience, identifying gaps and establishing a solid foundation for future research, as suggested by Xu et al. (2023). Furthermore, it seeks to provide information on tools to improve customer satisfaction in business strategies, following Dhaoui (2014). The research has practical relevance, as it will analyse the usefulness of chatbots in customer satisfaction among users of telephony services in Lima, influencing investment decisions and strategies of consolidated entities, like Sanny et al. (2020). According to Antonio et al. (2022), the results will provide guidance and practical knowledge for domestic and international consumers, helping them to understand the benefits of chatbots and their proper employability. The migration of customers to digital channels has increased interest in chatbots in the Peruvian economy because of their novel nature and the improvements they promise

in digital offerings (Medina, 2019). Chatbots stand out not only for their 24-hour availability, but also for their ability to collect valuable information from users (Guzmán, 2020). The importance of chatbots as an additional method of customer service in the Peruvian market is underlined, with high growth potential in digital developments aimed at improving customer satisfaction, according to INEI (2023).

Regarding the background, it can be mentioned that relevant findings with similar views were found among several authors, such as the studies by Surjandy & Cassandra (2023), Naqvi et al. (2023), Bhattacharya & Sinha (2022) agree on the idea of a positive relationship in the e-commerce context, highlighting factors and such as response time, reliability and chatbot usability as key factors of the customer's "S" and "L". Meanwhile, Naqvi et al. (2023), in their study entitled "Impact of service agents on customer satisfaction and loyalty: mediating role of Chatbots", with focus on the essence of fashion retail brands in Pakistan, find that chatbots can provide personalised treatment that improves the quality of communication and, consequently, the customer's "S" and "L". Bhattacharya & Sinha, looking at the banking sector, find that chatbots are crucial for improving customer interactions, aiding and recommendations that increase customer's perceived "S" and "L".

Naqvi et al. (2023) and Antonio et al. (2022) agree on the importance of the "P" in the customer-chatbot "I" to increase customer "S". Naqvi et al. emphasise that chatbots can offer personalised treatment by adapting to individual customer needs, leading to a higher "S" and "L". Antonio et al., in "Study Literature Review: Discovering the Effect of Chatbot Implementation in Ecommerce Customer Service System Towards Customer Satisfaction", further argue that the implementation of chatbots does not guarantee high levels of "S" if there is no adequate "P" in the conversation with the user.

Sanny et al. (2020), in "The analysis of customer satisfaction factors which influence chatbot acceptance in Indonesia", Zhang et al. (2023), Eren (2021) and Feine et al. (2019) provide a measured view of the elements that affect the customer's "S" with chatbots. Sanny et al. recognise factors such as usability, brand image development, personality and ease of use as crucial determinants of the customer's "S". Zhang et al. (2023), in "Emotional expression by artificial intelligence chatbots to improve customer satisfaction: Underlying mechanism and boundary conditions", highlight the importance of emotionality in the "I", while Eren (2021) highlights the relevance of received performance, perceived trust and company reputation. Feine et al. (2019) introduces sentiment analysis as a tool to improve customer "S", demonstrating its usefulness in understanding chatbot behaviour and being able to adjust it according to the user's needs.

Huang et al. (2023) and Xu et al. (2023) address the comparison between chatbots and human service in relation to customer "S". Huang et al., in "Can chatbot customer service match human service agents on customer satisfaction? An investigation in the role of trust", find that, while chatbots contribute to improving customer "S", there is room for improvement compared to human attention. On the other hand, Xu et al. (2023) explore the mixed effects of chatbot-human "I" on customer "S", concluding that chatbots with accurate responses are preferred over those with social orientation biases, highlighting the importance of accuracy in "I".

Chung et al. (2020), in "Chatbot e-service and customer satisfaction regarding luxury brands", and Xu et al. (2023) focus on the importance of accuracy in chatbot responses. Chung et al. find that the accuracy of the information provided by chatbots, along with the credibility of the information, significantly affects the customer's "S". Xu et al., on the other hand, highlight that chatbots with concise responses are more highly valued, evidencing that the accuracy of responses is a crucial component in influencing the customer's "S".

In the theoretical framework of this research, three key variables are presented: the independent variable, which are the service agents (chatbots), and the dependent variables, which are the customer's "S" and the customer's "L". Chatbots are defined as a type of AI that use Natural Language Processing (NLP) to understand and process human language, enabling conversations in text or voice format (Shawar and Atwell, 2007). ELIZA, the first chatbot, was developed in 1960 by Joseph Weizenbaum at MIT. Since then, significant advances have been made with systems such as WeChat (2009) and personal assistants such as SIRI and Alexa. In real life, chatbots are AI systems that interact with users through a chat interface, designed to simulate human conversations, help, answer questions or perform specific tasks. They are widely used in customer service, sales and technical support.

The qualities of a chatbot can be assessed in four dimensions: entertainment, trendiness, customization and problem-solving accuracy, credibility and communicative competence, i.e. the ability to converse effectively (Chung et al., 2020). Naqvi et al. (2023) proposed four dimensions of service agents: Interaction as a social quality, Personalisation for adapting to customer needs, Problem Resolution (RP) as an effective solution, and the last one which it was not taking into consideration is Entertainment. These dimensions are essential to verify

the ransmission and processing of language by chatbots. The design of chatbots uses NLP techniques and AI algorithms, such as machine learning and neural networks, to improve their interaction capabilities. Human-Computer Interaction (HCI) theory is also relevant, focusing on the design of interfaces that facilitate effective human-computer interaction (Dix et al., 2004). The dependent variable of customer "S" is defined as the emotional reaction to the quality of the product or service received (Silva et al., 2021). Mora Contreras (2011) extends this definition by considering a sequence of emotional states that culminate in a positive or negative response before and after the purchase. Chiou and Droge (2006) suggest that customer "S" occurs when products or services meet or exceed expectations. In practice, customer "S" reflects how well a product or service meets prior expectations. In light of the above, this research prefers the Chiou and Droge definition over that of Silva et al. (2021). However, it is pertinent to mention that the cognitive-affective customer "S" model, developed by Caro and Garcia (2007), considers that the behaviour behind the "S" is marked by rational judgements (cognitive) and emotional aspects (affectivity). The dimensions of this model include perceived information quality, perceived delay time and positive emotions during the interaction with the chatbot. There are two approaches to how emotions influence on "S": one view sees emotions as mediating the relationship between cognition and "S" (Bigné and Andreu, 2002), while the other sees them as independent sources of "S" (Oliver, 1993).

As for the dependent variable of customer "L", this refers to the degree to which a customer remains loyal to a company or brand and continues to purchase its products or services over time. Customer "L" is closely related to customer "S", as a satisfied customer is more likely to develop "L". According to Dick and Basu (1994), the customer "L" can be understood as a deep commitment to repurchase or continue using a product or service in the future, despite situational influences and marketing efforts that might cause a change in behaviour.

Customer "L" can be measured along several dimensions, such as repurchase intention, recommendation of the product or service to others, and resistance to switching to competitors. According to Oliver's (1999) "L" Model, "L" develops in four stages: cognitive, affective, conative and action. The cognitive stage is based on the consumer's beliefs about the quality of the product or service; the affective stage includes the consumer's feelings towards the brand; the conative stage refers to the customer's intention to continue purchasing; and the action stage involves the performance of loyal behaviours, such as repurchase and recommendation.

In practice, customer "L" can also be measured through metrics such as customer retention rate, purchase frequency, market share, willingness to recommend the brand (NPS) and price sensitivity. In addition, surveys and purchase behaviour analysis can be conducted to assess "L" (Zeithaml et al., 1996)

The general hypothesis of this research is: "The use of chatbots positively influences the perceived "S" and "L" of consumers of telephony services in Metropolitan Lima 2024". In line with was previously stated with the problem and objectives, there are six specific hypotheses in relation to the three dimensions brought about using chatbots.

The first hypothesis would be "the interaction of chatbots positively influences the "S" in consumers of telephony services in Metropolitan Lima in the year 2024". The second hypothesis would be "the interaction of chatbots positively influences the "L" in consumers of telephony services in Metropolitan Lima in the year 2024".

Both hypotheses are in line with Sanny et al. (2019), Antonio et al. (2022) and Naqvi et al. (2023).

The third hypothesis would be "the "P" of chatbots positively influences the "S" in consumers of telephony services in Metropolitan Lima in the year 2024". The fourth hypothesis would be "the "P" of chatbots positively influences the "L" in consumers of telephony services in Metropolitan Lima in the year 2024", both according to Chung et al. (2020), Eren (2021) and Naqvi et al. (2023); rejected by Xu et al. (2023).

The fifth hypothesis would be "The "PR" provided by the chatbot positively influences the "S" in consumers of telephony services in Metropolitan Lima in the year 2024". The sixth hypothesis would be "The "PR" provided by the chatbot positively influences the "L" in consumers of telephony services in Metropolitan Lima in the year 2024". Both according to Zhang et al. (2023) and, Moran and Agüero (2022), rejected by Huang et al. (2023).

2. Methods

The focus of this research was quantitative because it could contribute to the resolution of practical problems, knowing the reality through limited and measurable data. In relation to the scope, it is descriptive-correlational with a "non-experimental" cross-sectional design, where data can be placed in space-time. In this study, the focus was on consumers of telephone services in Metropolitan Lima in the year 2024.

In relation to the design of the model, we considered the population data of Metropolitan Lima up to January 2024, where we found that the capital had 10,292,408 inhabitants (Gestión, 2024). It was also further narrowed down to those people who used the internet via mobile phone in the capital, as it is understood that by using and having access to the internet, users could make queries to their mobile phone company's chatbots. To this end, it was found that 94.1% of the population of Metropolitan Lima that is older than 6 years of age complies with the above (INEI, 2023). Therefore, by performing a simple multiplication, we have a population of 9,345,507 inhabitants.

According to this population a sample of 130 observations is adequate for PLS-SEM as it ensures reliable and robust estimates (Hair et al., 2017). In relation to the type of sampling it will be non-probabilistic, as the present research will be bounded with certain parameters seen above, and finally regarding the sampling strategy, this will be Snowball. The data collection instrument was an improved, adapted, and refined version based on an instrument by Naqvi et al. (2023). The article has been tested and published in the English Language, so it was translated into Spanish (free translation) for practical research purposed. It is also important to mention that moderating variables are not being considered as part of the model.

On the data collection side for the present research, it was through dissemination via email and social networks. The results collected were tabulated in Excel for better data manipulation, coded and the PLS-SEM method was used. Finally, descriptive statistics were used, taking into consideration Cronbach's Alpha, estimated parameters and correlation coefficient to analyse the results.

3. Results and Discussion

The JAMOVI platform was used to calculate the previously collected data, which has been tabulated both in filter questions and in relation to the questions asked for each variable, in the case of the dependent variables, and to the independent variable in relation to its dimensions, both on a Likert scale. Thus, the structural equation model (SEM) is presented in Figure 1, where each circle represents each variable. Recall that, Personalisation is manifested by the letter "P", Problem Solving is "RP", Interaction is "I", Loyalty is "L" and Satisfaction is "S".

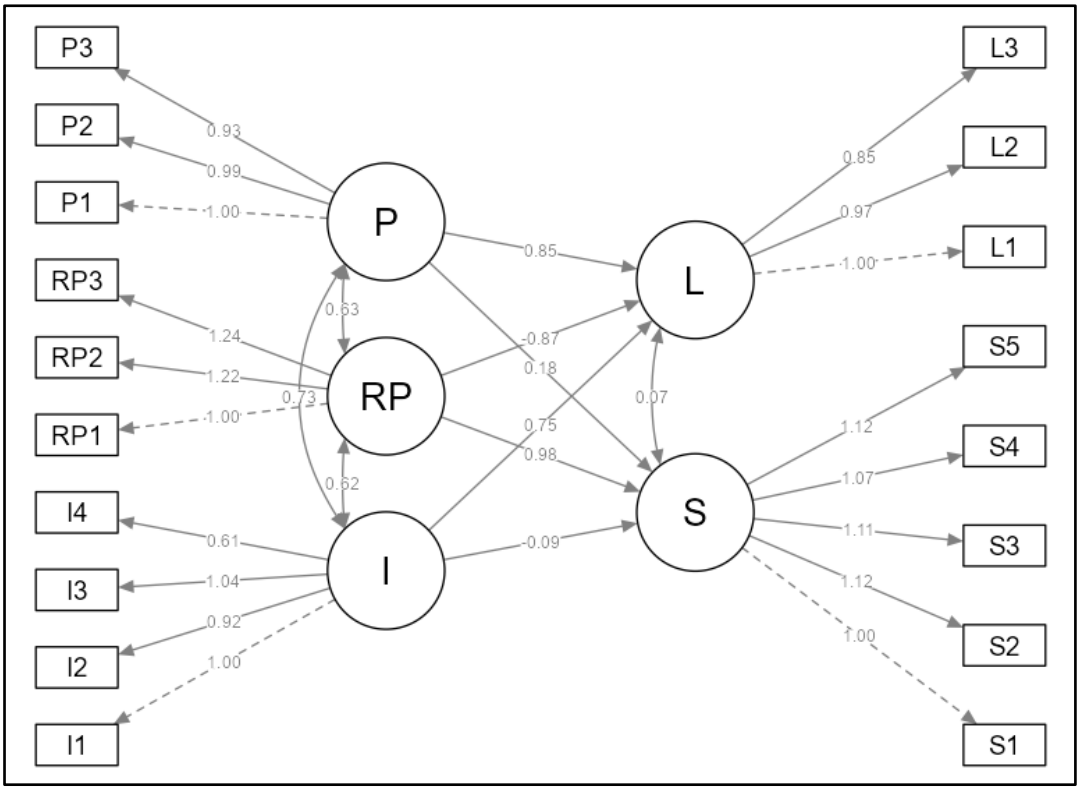


Figure 1:SEM Model

Dashed lines in the model generally represent hypotheses that are being tested and do not have strong empirical confirmation.

Table 1: Estimated model parameters.

				95% Confidence Intervals				
Dep	**Pred**	**Estimate**	**SE**	**Lower**	**Upper**	**β**	**z**	**p**
S	I	-0.0913	0.253	-0.5870	0.404	-0.0939	-0.361	0.718
S	RP	0.9773	0.408	0.1777	1.777	0.8525	2.396	0.017
S	P	0.1768	0.161	-0.1385	0.492	0.1854	1.099	0.272
L	I	0.7503	0.409	-0.0510	1.552	0.7806	1.835	0.066
L	RP	-0.8684	0.633	-2.1091	0.372	-0.7667	-1.372	0.170
L	P	0.8512	0.296	0.2720	1.430	0.9035	2.881	0.004

Table 2: Measurement model.

				95% Confidence Intervals				
Latent	**Observed**	**Estimate**	**SE**	**Lower**	**Upper**	**β**	**z**	**p**
I	I1	1.000	0.0000	1.000	1.000	0.879		
	I2	0.923	0.0370	0.850	0.995	0.811	24.92	< .001
	I3	1.040	0.0292	0.983	1.098	0.914	35.58	< .001
	I4	0.607	0.0765	0.457	0.757	0.533	7.94	< .001
RP	RP1	1.000	0.0000	1.000	1.000	0.746		
	RP2	1.217	0.0592	1.101	1.333	0.907	20.57	< .001
	RP3	1.242	0.0615	1.122	1.362	0.926	20.21	< .001
P	P1	1.000	0.0000	1.000	1.000	0.896		
	P2	0.989	0.0329	0.924	1.053	0.886	30.07	< .001
	P3	0.934	0.0357	0.864	1.004	0.837	26.14	< .001
S	S1	1.000	0.0000	1.000	1.000	0.855		
	S2	1.122	0.0333	1.057	1.188	0.959	33.66	< .001
	S3	1.108	0.0332	1.043	1.173	0.947	33.38	< .001
	S4	1.068	0.0340	1.001	1.135	0.913	31.39	< .001
	S5	1.124	0.0354	1.054	1.193	0.961	31.75	< .001
L	L1	1.000	0.0000	1.000	1.000	0.844		
	L2	0.966	0.0514	0.866	1.067	0.816	18.79	< .001
	L3	0.851	0.0626	0.728	0.973	0.718	13.59	< .001

Table 3: Model Fit Indices

			95% Confidence Intervals		
Type	**SRMR**	**RMSEA**	**Lower**	**Upper**	**RMSEA p**
Classical	0.055	0.053	0.027	0.074	0.394
Robust	0.052				
Scaled	0.052	0.100	0.083	0.117	< .001

Table 4: Model used vs reference model

	Model
Comparative Fit Index (CFI)	0.999
Tucker-Lewis Index (TLI)	0.999
Bentler-Bonett Non-normed Fit Index (NNFI)	0.999
Relative Noncentrality Index (RNI)	0.999

	Model
Bentler-Bonett Normed Fit Index (NFI)	0.996
Bollen's Relative Fit Index (RFI)	0.995
Bollen's Incremental Fit Index (IFI)	0.999
Parsimony Normed Fit Index (PNFI)	0.814

Regarding the RMSEA indicator, which, according to Xia and Yang (2019), "assesses how well the model, with the estimated parameters, fits the covariance matrix if it were available". In this case, the value came out to be 0.051 which indicates an acceptable model fit. Also, in relation to the CFI (Comparative Fit Index), which is an "(…) incremental fit index that compares the fit of a hypothetical model with that of a reference model" (Xia and Yang, 2019), a value of 0.999 it can be concluded that the model has a very strong fit and is adequate to explain the relationships between the variables being analysed.

The results of this research provide an interesting insight into the influence of chatbots on the "S" and "L" of consumers of telephony services in Metropolitan Lima in 2024.

The provided PLS-SEM model analyzes the relationships between several dimensions: Personalization (P), Problem Solving (RP), Interaction (I), Satisfaction (S), and Loyalty (L). The analysis of the results shows that the interaction has a non-significant negative relationship with customer satisfaction (coefficient: -0.0913, p-value: 0.718), which could be because the quality of the interaction is not consistently perceived as positive. by clients. On the other hand, the ability to solve problems has a positive and significant relationship with customer satisfaction (coefficient: 0.9773, p-value: 0.017), suggesting that effective problem-solving increases satisfaction. Personalization has a positive but non-significant relationship with customer satisfaction (coefficient: 0.1768, p-value: 0.272), indicating that customization alone is not a determining factor in satisfaction.

Regarding loyalty, interaction has a marginally significant positive relationship with customer loyalty (coefficient: 0.7503, p-value: 0.066), suggesting that good interaction can influence loyalty, but not conclusively. The ability to solve problems has a non-significant negative relationship with customer loyalty (coefficient: -0.8684, p-value: 0.170), which is counterintuitive and could indicate that problem solving does not always translate into loyalty. In contrast, personalization has a positive and significant relationship with customer loyalty (coefficient: 0.8512, p-value: 0.004), indicating that personalization is a key factor in fostering loyalty.

The results of the measurement model show that the construct indicators have high and significant loadings, except for the Interaction indicator I4, which has a lower loading (0.607), which could suggest problems with this item, this is an opportunity to improve future research. The Problem Solving and Personalization constructs have indicators with high and significant loadings, which indicates that they adequately measure the constructs. Customer Satisfaction, measured by indicators S1 to S5, and Customer Loyalty, measured by L1 to L3, also present very high and significant loadings, indicating that they are good measures of their respective constructs.

A negative coefficient on structural relationships, such as RP to L, may indicate an unexpected inverse relationship and may be due to problems with the operationalization of the constructs, cultural differences, or unmet customer expectations. Given that this research is original in a geographical context not extensively explored, this finding constitutes an opportunity to explore this phenomenon in detail rather than a weakness.

Values of 1 in the indicator loadings indicate that these are perfect reflections of their respective constructs, which can occur when the construct is measured by a single indicator or when the model has been standardized in this way.

For the results that we will call unexpected, the following alternative explanations are proposed. Interaction and Satisfaction: The negative relationship could indicate that the quantity of interaction is not as important as its quality. Excessive interactions could be perceived as annoying or invasive by customers. Problem Solving and Loyalty: Problem solving could be linked to previous serious problems that reduced initial loyalty, and even if they are resolved, the damage to loyalty could already be done.

4. Conclusions

In conclusion, personalization is a critical factor for customer loyalty, the ability to solve problems significantly increases customer satisfaction, although it does not have a significant impact on loyalty, and interaction has a marginal impact on loyalty and has not a significant impact on satisfaction, which suggests that the quality of the interaction must be improved. It is recommended to improve the quality of the interaction, encourage personalization and review the problem resolution strategy to understand why it does not translate into loyalty. It is necessary to note that analysis has highlighted both the expected and unexpected results of structural equation modeling using PLS-SEM for these study variables in a little explored geographic context. Alternative explanations for the unexpected results have been proposed and future lines of research have been suggested to address these issues. Based on the findings and the proposed alternative explanations, the following lines of future research are suggested: Quality vs. Quantity of Interactions, to investigate the influence of the quality and quantity of interactions on customer satisfaction, differentiating between types of interaction. Delve into the impact of Previous Problems, thus studying the impact of previous problems on loyalty and how problem resolution can restore, but not necessarily improve, loyalty. Although further research is crucial to better understand these dynamics and incorporate cultural or geographic variables in future research.

References

Anda Peru (2021) '¿CUÁL ES LA SITUACIÓN ACTUAL DEL CUSTOMER EXPERIENCE EN EL PERÚ?' Available at: https://revista.andaperu.pe/cual-es-la-situacion-actual-del-customer-experience-en-el-peru/#:~:text=En%20Activa%2C%20realizamos%20un%20estudio,supermercados%20y%20tiendas%20por%20departamento

Antonio et al. (2022) 'Discovering the Effect of Chatbot Implementation in E-commerce Customer Service System Towards Customer Satisfaction', Institute of Electrical and Electronics Engineers. Available at: https://doi.org/10.1109/isemantic55962.2022.9920434

Chen, Q., Lu, Y., Gong, Y. and Xiong, J. (2023) 'Can AI chatbots help retain customers? Impact of AI service quality on customer loyalty', Internet Research, 33(6), pp. 2205-2243. Available at: https://doi.org/10.1108/intr-09-2021-0686

Chiou, J. (2006) 'Service Quality, Trust, Specific Asset Investment, and Expertise: Direct and Indirect Effects in a Satisfaction-Loyalty Framework', Journal of the Academy of Marketing Science, 34(4), pp. 613-627. https://doi.org/10.1177/0092070306286934

Chung, M., Ko, E., Joung, H. and Kim, S. J. (2020) 'Chatbot e-service and customer satisfaction regarding luxury brands', Journal of Business Research, 117, pp. 587–595. Available at: https://doi.org/10.1016/j.jbusres.2018.10.004

Dhaoui, C. (2014) 'An empirical study of luxury brand marketing effectiveness and its impact on consumer engagement on Facebook', Journal of Global Fashion Marketing, 5(3), pp. 209–222. Available at: https://doi.org/10.1080/20932685.2014.907605

Dick, A. S. and Basu, K. (1994) 'Customer Loyalty: Toward an Integrated Conceptual Framework', Journal Of The Academy Of Marketing Science, 22(2), pp. 99-113. Available at: https://doi.org/10.1177/0092070394222001

Dix, A., Finlay, J., Abowd, G. D. and Beale, R. (2004) Human-Computer Interaction. 3rd edn. Pearson.

Eren, B. A. (2021) 'Determinants of customer satisfaction in chatbot use: evidence from a banking application in Turkey', International Journal of Bank Marketing, 39(2), pp. 294–311. Available at: https://doi.org/10.1108/ijbm-02-2020-0056

Escobar, A. (2016) 'The impact of the digital revolution in the development of market and communication strategies for the luxury sector (Fashion Luxury)', Central European Business Review, 5(2), pp. 17–36. Available at: https://doi.org/10.18267/j.cebr.149

Feine, J., Gnewuch, U., Morana, S. and Maedche, A. (2019) 'A taxonomy of social cues for conversational agents', International Journal of Human-Computer Studies, 132, pp. 138–161. Available at: https://doi.org/10.1016/j.ijhcs.2019.07.009

Feine, J., Morana, S. and Gnewuch, U. (2019) 'Measuring Service Encounter Satisfaction with Customer Service Chatbots using Sentiment Analysis', Karlsruhe Institute of Technology. Available at: https://aisel.aisnet.org/cgi/viewcontent.cgi?article=1248&context=wi2019

Gestión (2018) 'Un 67% de clientes se aleja de un servicio por mala atención', Gestión, 8 August. Available at: https://gestion.pe/economia/67-clientes-aleja-servicio-mala-atencion-240918-noticia/?ref=gesr

Gestión (2024) 'Lima: ¿Cuántos habitantes existen y en qué distritos se concentra la mayor población?', Gestión, 21 January. Available at: https://gestion.pe/peru/aniversario-de-lima-cuantos-habitantes-hay-en-la-capital-y-en-que-distritos-se-concentra-la-mayor-poblacion-sjl-smp-comas-vmt-noticia/#:~:text=Lima%2C%2021%2F01%2F2024,que%20equival%C3%ADa%20a%2010%2C292%2C408%20habitantes

Guzmán, C. (2020) 'Cuatro aplicaciones de la inteligencia artificial más usadas por las empresas peruanas'. Available at: https://pqs.pe/actualidad/tecnologia/cuatro-aplicaciones-de-la-inteligencia-artificial-mas-usadas-por-las-empresas-peruanas/

Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2017). *A primer on partial least squares structural equation modeling (PLS-SEM)* (2nd ed.). Sage Publications.

Hagberg, J., Sundstrom, M. and Egels-Zanden (2016) 'The digitalization of retailing: an exploratory framework'. Available at: https://www.econbiz.de/Record/the-digitalization-of-retailing-an-exploratory-framework-hagberg-johan/10011595543

Hernández-Sampieri (2018) Metodología de la investigación. Las rutas cuantitativa, cualitativa y mixta. McGraw Hill.

Huang, D., Markovitch, D. G. and Stough, R. A. (2023) 'Can chatbot customer service match human service agents on customer satisfaction? An investigation in the role of trust', Journal of Retailing and Consumer Services, 76, 103600. Available at: https://doi.org/10.1016/j.jretconser.2023.103600

INEI (2023) 'ESTADÍSTICAS'. Available at: https://www.inei.gob.pe/estadisticas-indice-tematico/

Jones, T. and Taylor, S. (2007) 'The conceptual domain of service loyalty: how many dimensions?', Journal of Services Marketing, 21(1), pp. 36-51. Available at: https://doi.org/10.1108/08876040710726284

Jenneboer, L., Herrando, C. and Constantinides, E. (2022) 'The Impact of chatbots on Customer Loyalty: A Systematic literature review', Journal of Theoretical and Applied Electronic Commerce Research, 17(1), pp. 212–229. Available at: https://doi.org/10.3390/jtaer17010011

Medina, E. (2019) '¿Cuál es la situación actual y potencial de la Inteligencia Artificial en el Perú?'. Available at: https://archivo.gestion.pe/panelg/situacion-actual-y-potencial-inteligenciaartificial-peru-2208564

Misischia, C. V., Poecze, F. and Strauß, C. (2022) 'Chatbots in customer service: Their relevance and impact on service quality', Procedia Computer Science, 201, pp. 421–428. Available at: https://doi.org/10.1016/j.procs.2022.03.055

MIT Sloan (2021) 'Machine learning explained', MIT Sloan, 21 April. Available at: https://mitsloan.mit.edu/ideas-made-to-matter/machine-learning-explained

Mora Contreras, C. (2011) 'La calidad del servicio y la "S" del consumidor'. Available at: https://www.redalyc.org/pdf/4717/471747525008.pdf

Naqvi, M. H. A., Zhang, H., Naqvi, M. H. and Li, K. (2023) 'Impact of service agents on customer satisfaction and loyalty: Mediating role of chatbots', Journal of Modelling in Management. Available at: https://doi.org/10.1108/jm2-01-2023-0004

Oliver, R. L. (1999) 'Whence consumer loyalty?', Journal Of Marketing, 63(4_suppl1), pp. 33-44. Available at: https://doi.org/10.1177/00222429990634s105

Porter, M. E. (2008) La Ventaja Competitiva de Michael Porter.

Sanny, L., Susastra, A., Roberts, C. C. and Yusramdaleni, R. (2020) 'The analysis of customer satisfaction factors which influence chatbot acceptance in Indonesia', Management Science Letters, pp. 1225–1232. Available at: https://doi.org/10.5267/j.msl.2019.11.036

Shawar, B. A. and Atwell, E. (2007) 'Chatbots: Are they Really Useful?', Journal for Language Technology and Computational Linguistics, 22(1), pp. 29–49. Available at: https://doi.org/10.21248/jlcl.22.2007.88

Silva-Treviño, J. G., Macías-Hernández, B. A., Tello-Leal, E. and Delgado-Rivas, J. G. (2021) 'La relación entre la calidad en el servicio, "S" del cliente y "L" del cliente: un estudio de caso de una empresa comercial en México', CienciaUAT, pp. 85–101. Available at: https://doi.org/10.29059/cienciauat.v15i2.1369

Surjandy, S. and Cassandra, C. (2023) 'The Effect of Using Chatbots at e-Commerce Services of Customer Satisfaction, Trust, and Loyalty', 2023 International Conference On Computer, Control, Informatics And Its Applications. Available at: https://doi.org/10.1109/ic3ina60834.2023.10285799

Xia, Y. and Yang, Y. (2019) 'RMSEA, CFI, and TLI in Structural Equation Modeling With Ordered Categorical Data: The Story They Tell Depends on the Estimation Methods', Behavior Research Methods, 51(1), pp. 409-428.

Xu, Y., Niu, N. and Zhao, Z. (2023) 'Dissecting the mixed effects of human-customer service chatbot interaction on customer satisfaction: An explanation from temporal and conversational cues', Journal of Retailing and Consumer Services, 74, 103417. Available at: https://doi.org/10.1016/j.jretconser.2023.103417

Xu, Y., Zhang, J. and Deng, G. (2022) 'Enhancing customer satisfaction with chatbots: The influence of communication styles and consumer attachment anxiety', Frontiers in Psychology, 13. Available at: https://doi.org/10.3389/fpsyg.2022.902782

Zeithaml, V. A., Berry, L. L. and Parasuraman, A. (1996) 'The Behavioral Consequences of Service Quality', Journal Of Marketing, 60(2), pp. 31-46. Available at: https://doi.org/10.1177/002224299606000203

Zhang, J. et al. (2023) 'Emotional expression by artificial intelligence chatbots to improve customer satisfaction: Underlying mechanism and boundary conditions', Tourism Management, 100, 104835. Available at: https://doi.org/10.1016/j.tourman.2023.104835

How to Create New Business Knowledge Through Multi-Disciplinary Discussion

Yayoi Hirose
Toyo University, Tokyo, Japan

yayoi.hirose@iniad.org

Abstract: Generating innovative high-tech business in the DX (digital transformation) era requires the formation of multi-disciplinary teams, which include engineers and business experts or large companies and technology ventures. However, each team member tends to focus on certain objectives: Engineers aim to develop highly advanced technology, believing it will be in high demand, whereas business experts want engineers to follow their marketing strategies. The knowledge that is deemed necessary for generating innovative products or services differs between these groups. Thus, generating new business knowledge requires that members of multi-disciplinary teams disrupt their conventional ways of thinking, understand each other, exchange knowledge, and ultimately generate new knowledge. Previous literature on knowledge creation mainly discusses the generation of new knowledge within or between organizations that have relatively the same goals and organizational values, such as how to build trusting relationships for knowledge creation and exchange. However, as modern society comprises various fields of experts and numerous values, the discussion of knowledge exchange and creation needs to include knowledge creation among experts who have previously focused on different goals and values. Furthermore, generating innovative business requires individuals to disrupt their conventional ways of thinking, but previous studies on knowledge creation rarely mention how to do so in order to create innovative knowledge. Thus, this study aims to explore the impediments to new knowledge creation and proposes a new model that overcomes these impediments through multi-disciplinary discussions.

Keywords: Knowledge and Digital Transformation, Multi-Disciplinary Discussion, creation of Innovative Knowledge

1. Introduction

Generating innovative business in the Digital Transformation (DX) era requires the formation of multi-disciplinary teams that include both engineers and business experts, as DX is a business transformation strategy that enhances and engages relationships with customers and other stakeholders using advanced digital technologies. It is crucial for companies to transform and deepen their relationships with their stakeholders – such as customers, suppliers, and employees – by leveraging advanced digital technologies, including artificial intelligence and robotics, for their competitive advantage (Wade et al., 2019). To conduct innovative digital business, it is necessary to transform employees' mindsets from a conventional approach, disrupting their conventional ways of thinking and creating new business (Rogers, 2016; Wade, 2019). Yet according to business surveys, over 70% of DX projects fail (Bonnet, 2022; Saldanha, 2019). One of the reasons for such failure is that large firms struggle with bureaucratic structures that sap initiative and they also have a tendency to maintain conventional ways of thinking. These factors make it challenging for firms to generate innovative business knowledge (Hamel & Zanini, 2018). Thus, managers and employees need to disrupt their conventional business knowledge and practices, gain more insight into external knowledge and ultimately create innovative business with other experts.

Christensen (1997) points out it that long-term successful companies find it difficult to disrupt their conventional business models because they tend to stick to their past successful experiences. This study points out three impediments for generating innovative business. In the first stage, managers and staff have difficulty disrupting their conventional business knowledge and ways of thinking because their conventional knowledge has been constructed through their experiences (Bolisani & Bratianu, 2018). The second impediment is difficulty understanding other experts' knowledge because they lack the ability to understand such knowledge (Cohen & Levinthal, 1990; Zara & George, 2002). After disrupting their conventional knowledge and practices, managers and staff need to exchange specialized knowledge, understand the each other's knowledge, and generate innovative business knowledge with other specialists. Past literature discusses the difficulty of understanding other specialized knowledge without any preparation. The third impediment is the difficulty of sharing innovative knowledge at the organizational level, because if only a limited number of people can grasp an innovative idea, such knowledge tends to be regarded as merely subjective knowledge (Brunsson, 1982).

For two decades, numerous practitioners and academics have stressed that knowledge regarding the managerial process and technology knowledge serve as major competitive assets for organizations (Nonaka, 1994; Grant, 2006; De Long & Fahey, 2000; Nonaka & Takeuchi, 1997; Suzulanski, 1996; Crossan, et al.,1999; Zahra & George, 2002; van Winkelen & Mckenzie, 2007). With increasing globalization, firms are being required to manage an

increasing number of relationships between organizations and even across borders, such as joint ventures and strategic alliances (Inkpen & Dinur., 1998; Larsson et al., 1998). Owing to the severe international competition brought about by globalization, firms are now required to effectively learn specific knowledge from external sources through various types of relationships that they previously lacked (McKenzie & van Winkelen, 2004).

Past literature discusses that modern society is comprised of specialized knowledge (Beck, 1992; Schon, 1983) and points out the limitations of rigorous professional knowledge when it comes to solving uncertain and unique practical problems (Schein, 1972; Schon, 1983). Schein (1972) points out the gap between convergent basic and applied science and divergent practice. He claims that dealing with professional practice requires taking a convergent knowledge base and tailoring it to the unique requirement of practice based on "divergent thinking skills". Thus, in order to generate innovative business knowledge, "divergent thinking" must be adopted, which includes both technological and business ways of thinking, based on practical business strategy. Innovative business requires the disruption of conventional values and practices, understanding the value of other participants' knowledge, and finally collectively generating new transformative knowledge (Christensen, 1997).

Previous studies on knowledge creation mainly address how tacit and explicit knowledge can be exchanged and extended from an individual to organizational level (Crossan et al., 1999). However, little research has investigated the detailed process of innovative knowledge creation in the DX era: how people disrupt their conventional ways of thinking and practices, understand other experts' knowledge, and create innovative knowledge with other experts at the organizational level. Moreover, a gap exits in previous research as to how members of different organizations understand innovative knowledge.

2. Difficulty in Disrupting Conventional Ways of Doing Business

Sveiby (2001) divides knowledge into two categories: "a justified true belief" and "capacity-to-act". Sveiby (2001) claims that a justified true belief acts as a filter when a person is trying to make sense of a new situation as such a belief can be used by the individual to create meaning. People often develop ways of justifying that their beliefs are true based on their norms and values, rather than questioning whether those beliefs hold true for changing circumstances. A capacity-to-act, however, is an individual competence that is reflected in action and developed through experience (Calhoun & Starbuck, 2005; Sveiby, 2001). People's capacity to act may be limited by the norms and values that they have absorbed and rely on. Thus, even if they learn something new from a cognitive perspective, meaning that they understand it, they may still find it difficult to put such knowledge into practice and therefore fail to change their behaviour. Thus, it can be difficult for individuals to doubt their conventional, justified true beliefs and accept the different beliefs upon which others within an organization rely. Berger and Luckmann (1967) argue that academic experts and practitioners can come into conflict because their understandings of reality differ in their work.

Schumpeter (1942) defines innovation as creative disruption; society is always looking for new processes. Innovation can be defined as generating new knowledge which has been rarely recognized by disrupting conventional, widely shared perceptions of beliefs. However, people have difficulty disrupting their conventional "justified true beliefs", as these have served as the correct knowledge for a long time. As Schumpeter (1934) claims, innovation needs to be diffused. Thus, innovative ideas need to be shared by group members. A perception of belief held by only one person may be regarded as subjective (Calhoun & Starbuck, 2003). Thus, it can be said that in high-tech innovative discussions, every participant may hold their own "subjective belief" and try to disrupt their own differing conventional belief. As Christensen (1997) points out, a company that has achieved success through their conventional business activities may have difficulty in disrupting their way of business. It is hard to disrupt their conventional values and practice because people accumulate knowledge by reflecting on their social experiences (Berger and Luckmann, 1967; Cohen & Levinthal, 1989).

2.1 Difficulty in Understanding Other Experts' Knowledge in Multi-Disciplinary Discussions

The importance of considering the tacit dimension of knowledge is highlighted in previous literature. Here, knowledge is categorized into two types: rationalism, and empiricism (Bolisani & Bratianu, 2018). Knowledge in rationalism is comprised of a reasoning process and does not include human perception (Bolisani & Bratianu, 2018; Russel, 1972). On the other hand, empiricism claims that knowledge is created through human sensory experience of the real world. According to Polanyi (1969), knowledge in empiricism, which includes tacit knowledge, should be distinguished from explicit knowledge. He explains that while explicit knowledge can be transferred through writing and verbal expression between people, tacit knowledge cannot, as this knowledge

is produced based on human experiences associated with their contexts. Nonaka (1994) claims that tacit knowledge is created by interaction between various individual experiences and rational external knowledge.

Thus, based on the past literature, participants in multidisciplinary discussions need to consider other participants' tacit dimensions of knowledge, which are generated by social integration within their organizations. Past discussions suggest that expert knowledge differs depending on careers and social rules. Berger and Luckmann (1967) point out the difficulty of accepting of knowledge of a different field of experts; individuals often avoid accepting knowledge which is inconvenient and only apply knowledge within their familiar community (Berger & Luckmann, 1967).

Cohen and Levinthal (1990) point out that people's understanding of external knowledge depends on their accumulated prior knowledge within an organizational context, which means how they accumulate organizational-related experience and cognitively understand external knowledge. Thus, in order to understand other experts' knowledge, one must avoid mere surface learning (Marton & Salig, 1984). Moreover, understanding external knowledge requires that individuals obtain the capacity to understand the knowledge (Cohen & Levinthal, 1990; Zara & George, 2002; Todorova & Durisin, 2007). Cohen and Levinthal (1989, 1990, 1994) use the phrase "absorptive capacity" to describe the capacity to understand. They claim this capacity is path-dependent because it is developed based on already-accumulated knowledge within an organizational context.

2.2 Difficulty in Exchanging Different Experts' Knowledge in Multi-Disciplinary Discussion

Past literature on knowledge creation mainly discusses new knowledge generation within or between organizations that have relatively the same goals and values, such as how to build trusting relationships for knowledge exchange and creation（Nonaka, 1994). Lane & Lubatican (1998) point out the importance of selecting companies which have the same salary system and organizational structure to successfully understand the knowledge generated from external companies. However, as modern society is made up of various fields of experts, the discussion of knowledge exchange and creation needs to consider various experts who have been focused on different goals and values.

At this stage, the pattern of interaction affects the partner's feeling of psychological attachment to their relationship (Kumar & Nti, 1998). For example, the difference in each individual way of understanding can be an impeding factor to exchanging different specialized knowledge. Regarding the flow of knowledge among humans, Walsham (2002) cited Polanni's (1967) paper and found that when A, who went on a trip, explained the details of his trip to B, who had never been to the area, Polanni (1967) explained sense-reading and sense--giving using an example in which the information is not necessarily transmitted to B. Thus, within a group, the ways in which new knowledge is understood differ from person to person, and it is important to be aware of the different interpretations each person may have.

Tacit knowledge is made up of people's values, beliefs, and assumptions, and because these cannot always be clearly expressed it can be difficult for people to obtain others' tacit knowledge (Baumard, 1999; Polanyi, 1967) Collective behaviour is generated when the collective tacitly accepts tacit knowledge as holding true for them and relies on it to guide collective behaviour (Calhoun & Starbuck, 2005). People tend to rely on their organizational, collectively accumulated knowledge rather than external knowledge, which is unfamiliar to them. Thus, if each individual way of understanding differs, knowledge cannot be widely shared because a belief held by only one person would be subjective and result in only that person's action (Brunsson, 1982). On the other hand, a widely shared perception or belief acquires the status of being objective (Brunsson, 1982). It can be difficult to collectively generate new knowledge by integrating various kinds of "subjective beliefs" by disrupting conventional objective knowledge.

Another impeding factor can be the differences in routine processes and local language among team members. For example, discrepancies in their business processes, including "speedy decision making," impede trust relationships among team members. This is particularly true when the work objectives or technical terms they can share differ (Lei et al., 1997).

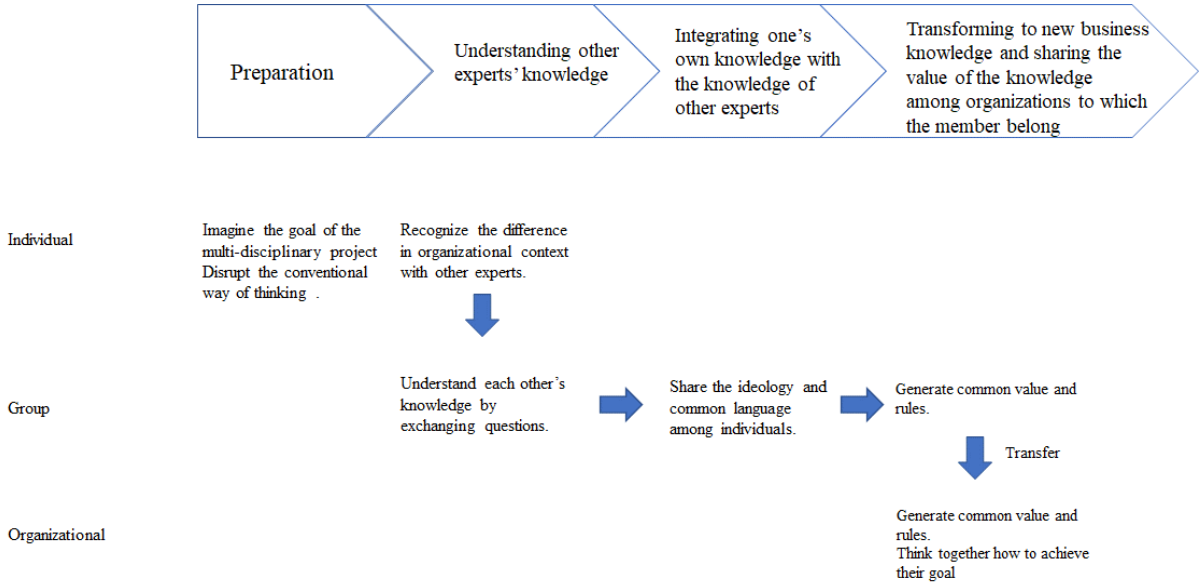
3. Creation of Innovative Knowledge in Multi-Disciplinary Discussion

This paper aims to propose a process for creating innovative knowledge in a multi-disciplinary discussion (Figure 1). Based on past discussions on knowledge creation, the model can be divided into three levels: the individual, group and organizational level. Previous literature on knowledge creation mainly discusses how individual levels

of knowledge can be extended to group and organizational collective knowledge by connecting it to existing organizational knowledge (Crossan et al., 1999; Nonaka & von Krogh, 2009). To generate knowledge at the organizational level it is important to obtain individual understanding at the initial phase (Nonaka, 1994; Taylor & Osland, 2003). In particular, multi-disciplinary knowledge creation should consider that individuals tend to follow conventional ideas that have been socially constructed in the initial stage because their social reality is constructed in individual everyday life (Berger & Luchman, 1967).

Based on these discussions, Figure 1 assumes that one specialized field of knowledge can be created by the individual experience which occurs in each organization. It suggests that the longer individuals belong to their organizations, the harder it is to disrupt their conventional mindsets. There are, however, few discussions regarding how individuals attempt to create innovative knowledge by disrupting their conventional organizational knowledge. Figure 1 considers the necessity of this disruption.

Figure 1: Process of Innovative Knowledge Creation in Multi-disciplinary Discussion



3.1 Preparation: Individual level

As Christensen (1997) claims, creating innovative knowledge requires that people disrupt past successful business knowledge. The model indicates the importance of having and envisioning a goal during the preparation phase of multi-disciplinary discussions in order to disrupt conventional way of thinking and understand the external knowledge. As Figure 1 shows, individuals need to envision their goal and understand why they need to disrupt their conventional way of thinking. Hirose (2023) points out the importance of having an image of the goal to disrupt one's conventional way of thinking and that companies which successfully launched new transformational projects succeeded in enabling the employees and managers to understand their business goal. Doing so allowed people to obtain the capacity to understand other knowledge. (Cohen & Levinthal, 1990; Zara & George, 2002; Todorova & Durisin, 2007). The past discussions emphasize that this capacity is path-dependent (Cohen & Levinthal, 1990; Zahra & George, 2002) because it is developed based on already-accumulated prior knowledge within an organization. In multi-disciplinary discussions, participants need to disrupt the path-dependency way of thinking and accept new value of external specialized knowledge. This capacity includes know-how regarding how to collaborate with other experts. After understanding their business goal vision, people will be able to understand the value of other specialized knowledge in multi-disciplinary discussions.

3.2 Understanding Other Experts' Knowledge: Individual and Group Level

As argued by Nonaka (1994) and Taylor and Osland (2003), understanding knowledge at the individual level at the initial stage is key to creating knowledge in an organization. However, most of the past literature that focuses on transferring technological or scientific knowledge lacks the perspective of managing knowledge generated in a different organizational context, which may disrupt the conventional organizational values of the knowledge receivers (Almeida, et al., 2005; Grant & Baden-Fuller, 1995; Hargadon and Sutton, 1997; Katz & Tushman, 1980; Makhija & Ganesh, 1997). These studies do not discuss the effect of organizational difference on the process of

knowledge transfer, such as how knowledge receivers reconsider and change their conventional norms, values, and assumptions to adapt to knowledge providers. As Walsham (2002), in quoting Polanyi (1967), explains, the process by which individuals transfer knowledge to one another is extremely difficult, particularly when the interest is to share knowledge among individuals who live in separate communities with different backgrounds, because they have conflicting assumptions based on their localised priorities and values.

To overcome this impediment, individuals need to transform their cognitive structure (Todorova & Durisin, 2007; Lei et al., 1997). In multi-disciplinary discussions, people need to understand the differences in the value evaluation of knowledge brought about by differences in organizational context and understand the value of other experts' knowledge. Doing so will enable to build a new cognitive structure that is incompatible with the conventional structure because their organization needs to counteract the tendency of conventional competence to undermine change. (Todorova & Durisin, 2007; Tushman & Anderson, 1986).

When individuals attempt to present their knowledge to other experts, they are not necessarily able to transfer their knowledge in the way they had expected (Crossan, et al., 1999; De Long et al., 2000). Past literature suggests that in the case of transferring technological or scientific knowledge, it is easier for the knowledge provider and receiver to share much of the same lexicon. In this case, knowledge can be transferred simply by assimilation. (Almeida, et al., 2005; Inkpen & Tsang 2005; Leonard & Swamp, 2004) However, in the case of knowledge exchange for generating innovative business, people need to interact and ask each other questions in order to understand each other's values and content (Brymer, et al., 2018). Thus, this is not simple assimilation because these individuals do not share the same lexicon.

3.3 Integrating With Experts of Other Fields: Group Level

In this phase, people need to exchange the value and contents with other experts and generate new knowledge by integrating their specialized knowledge at a group level. It is expected that as individuals create their own different cognitive maps depending on their environment, group discussion creates and refines common language, clarifies images, and creates shared meaning and understanding in order to distribute knowledge (Crossan et al., 1999).

When knowledge transfer is difficult, individuals try to clarify their communication through the use of metaphors (Crossan et al., 1999). Therefore, at group-level discussions, a shared understanding will be achieved by defining a common language called social activities. In order to promote understanding among other fields of experts, it is important to build a common language and image of various knowledge by interactions among individuals. At this stage, exchanging questions within the multidisciplinary group is the most important factor (Bentley Brymer, et al., 2018).. Participants' interactions and critical thinking through participatory processes and integration of different knowledge can lead to changes in participants' cognition or knowledge (Schneider et al., 2009).

Maltz and Kohli (2000) show that cross-functional teams, cross-functional training, and social activities improve internal communication and help to overcome internal conflict. De Long et al. (2000) point out the importance of the culture in encouraging social interaction to promote new knowledge sharing. They identify the cultural factors that promote social interaction as (1) organizational norms and practices that make possible frank exchanges between executives and members, (2) formal and informal interactions between individuals and groups, and (3) collaborations and learning from mistakes. Thus, group members should encourage social interaction to make clear what norms and practices need to be changed to reinforce more collaborative knowledge use before they directly try to convince individuals to share human knowledge (De Long et al., 2000).

3.4 Expanding Innovative Knowledge to the Organizational Level

In contrast with past discussions on knowledge creation, this model considers that each team member may belong to a unique organizational context, including large companies and high-tech ventures, business people, and engineers. Schein (2004) claims that if a group generates a common value, the group members will be able to transfer the new knowledge to other group of members. Larsson et al. (1998) point out that group members need to consider how to build their common achievement. Thus, in this phase, it is important to create a common business goal and values through multi-disciplinary discussion.

It is also important to understand the organizational differences among team members. Group members need to build trusting relationships by understanding differences in language use, practices, and ways of thinking among each member's organization (Lei et al., 1997; Van Winkelen, 2009). Some related articles stress the need to adjust both partners' "protocols" to enable alliance partners to learn from one another and share and create

knowledge (Lei et al., 1997; Van Winkelen et al., 2009). Doz (1996) stresses that a strategic alliance can be strengthened when a company recognizes and prepares for differences in organizational practices and rules with an alliance partnering company. Companies may need to set a rule that rewards innovative activities and encourages risk taking to create new knowledge (Kumar & Nti, 1998; Reid et al., 2001). This is because organizational values often prevent employees from sharing knowledge.

4. Conclusion

This study aimed to propose a new model for generating innovative knowledge through multi-disciplinary group discussions. Two main points set this study apart from past discussions on knowledge creation. The first is the importance of disrupting conventional ways of thinking and accepting the value of other experts' knowledge in order to understand it. While past literature on knowledge creation has emphasized the importance of sharing the same organizational values and practices, this study proposes how such innovative knowledge can be generated by disrupting conventional values and practices. Individuals tend to understand external knowledge based on their own past experiences. The study proposes that the model needs to consider how to disrupt these conventional ways of thinking to generate innovative knowledge. The second point is that this study provides a strategy for promoting understanding among various experts within a group. As a first step, group members need to recognize the differences in organizational context among team members, and provided they exchange questions based on this recognition, they will be more able to understand the specialized knowledge of other members. If group members share the ideology and common language, it will be easier for the team to generate innovative knowledge and extend that knowledge to other members of the organization. Finally, it is also crucial to generate common values and rules among team members.

References

Almeida, P., Phene, A., and Grant, R. (2005) "Innovation and Knowledge Management: Scanning, Sourcing, and Integration," Chapter 18

Baumard, P. 1999. Tacit knowledge in organizations, Sage, London.

Beck, U. （1992）Risk Society: Towards a New Modernity,SAGE Publications Ltd

Berger and Luckmann (1967) The Social Construction of Reality : A Treatise in the Sociology of Knowledge, Anchor .

Bonnet, D. (2022) 3 Stages of a Successful Digital Transformation, " Harvard Business Review. September.

Bolisani, E & Bratianu, C. (2018) Emergent Knowledge Strategies: Strategic Thinking in Knowledge Management, Springer.

Bentley Brymer, A. L., J. D. Wulfhorst, and M. W. Brunson. 2018. Analyzing stakeholders' workshop dialogue for evidence of sociallearning. Ecology and Society Vol. 23. No. 1:42

Brunsson, N. (1982) "The irrationality of action and action rationality: decisions, ideologies and organizational actions", Journal of Management Studies. Vol 19 No. (1), pp. 29-44.

Calhoun, M.A. and Starbuck, W. H. (2003) "Barriers to Creating Knowledge in Mark Easterby-Smith and Marjorie A. Lyles (eds.), Handbook of Organizational Learning and Knowledge. Blackwell, pp 471-490

Carlile, P. R. (2004) "Transferring, Translating, and Transforming: An Integrative Framework for Managing Knowledge Across Boundaries", Organization Science Vol.15 No. 5 pp555-568.

Christensen, C.M. (1997) Innovator's Dilemma: When New Technologies Cause Great Firms to Fail, Harvard Business Review Press.

Cohen, W.M. and Levinthal, D.A. (1989). "Innovation and Learning: two faces of R&D," The Economic Journal, Vol. 99 No. 397, pp 569-96.

Cohen, W.M. and Levinthal, D.A. (1990). "Absorptive capacity: a new perspective on learning and innovation." Administrative Science Quarterly, 35, 126-152.

Cohen, W.M. and Levinthal, D.A. (1994). "Fortune Favors the Prepared Firm," Management Science Vo. 40. No.2. pp. 227-251.

Crossan, M.M., Lane, H.W., and White R.E. (1999). "An organizational learning framework: from intuition to institution." Academy of Management of Review. Vol. 24, No.3, pp 522-537.

De Long, D. W., and Fahey, L. (2000). "Diagnosing cultural barriers to knowledge management." The Academy of Management Executive, Nov., 14, (4) 113-127.

Grant, R.M. (2006), "Toward a Knowledge-Based Theory of the Firm," Strategic Management Journal (17), Winter Special Issue, 109-122.

Grant, RM and Baden-Fuller, C. (1995). "A Knowledge-Based Theory of Inter-Firm Collaboration, "Academy of Management Proceedings 1995, No. 1. Pp. 17-21

Hamel, G. and Zanini, M. (2018) The End of Bureaucracy: How a Chinese appliance maker is reinventing management for the digital age, Harvard Business Review. November- December.

Hargadon and Sutton (1997) Technology Brokering and Innovation In A Product Development Firm. Administrative Science Quarterly, 42 (4), 716-749.

Heifetz, R. A., Linsky, M., and Grashow, A. (2009). The Practice of Adaptive Leadership: Tools and Tactics for Changing Your Organization and the World, Harvard Business Review Press.
Hirose, Y. (2023). "Threshold Concept for Promoting Business Transformation, Proceedings of the 24th European Conference on Knowledge Management, Vol. 24 No. 1.
Hughes, M. (2016) "Leading changes: Why transformation explanations fail," Leadership, Vol. 12, No. 4, pp 449-469.
Inkpen, A.C. and Dinur, A. (1998). "Knowledge management processes and international Joint ventures." Organization Science, Vol.9, No.4, p454-468.
Kaplan, S. (2008). "Framing Contests: Strategy Making Under Uncertainty, "Organization Science, Vol. 19. No. 5, pp 729-752.
Katz, R. and Tushman, M.L. (1980) "External Communication and Project Performance: An Investigation Into The Role Of Gatekeepers," Management Science 26(11), November 1980
Khoja, F., *Maranville*, S., 2010. How Do Firms Nurture Absorptive Capacity? Journal of Managerial Issues, Vol. 22, No. 2, Summer.
Kumar, R. and Nti, K.O. (1998) "Differential learning and interactions in alliance dynamics: a process and outcome discrepancy model." Organizational Science, 9, 356-367.
Lane, P.J. and Lubatikin, M. (1998) "Relative absorptive capacity and interorganizational learning." Strategic Management Journal, 19, 461-477.
Larsson, R., Bengtsson, L., Henriksson, K. and Sparks, J. (1998). "The interorganizational learning dilemma: Collective knowledge development in strategic alliances." Organizational Science, 9, 285-305.
Lei, D., Slocum, J.W., and Pitts, R.A. (1997) "Building Cooperative Advantage: Managing Strategic Alliances to Promote Organizational Learning," Journal of World Business, 32 (3), 203-223.
Leonard, D. A. and Swap, W. C. (2004). Deep Smarts, Harvard Business Review, No. 82., No. 9, pp. 88-97.
Luoma M (2006) A play of four arenas. Management Learning Vol. 37 No.1, pp 101–123.
Maltz, E. and Kohli,A.K. (2000). "Reducing Marketing's Conflict with Other Functions: The Differential Effects of Integrating Mechanisms." Journal of the Academy of Marketing Science 28(4), 479–492.
Marton, F., SljG, R., (1984). Approaches to learning. In Marton, F., Hounsell, D., Entwistle, N. (ed.), The Experience of Learning. Edinburgh: Scottish University Press, 36-58
McKenzie, J and van Winkelen, C (2004). Understanding the Knowledgeable Organisation: Nurturing knowledge competence. London: International Thomson.
Makhija, M.V. and Ganesh, U. (1997). "The Relationship Between Control and Partner Learning in Learning-Related Joint Ventures," Organization Science, October.
Nonaka, I. (1994). "A dynamic theory of organizational knowledge creation," Organization Science, 5 (1), Feburary.
Nonaka, I. and von Krogh (2009). Tacit Knowledge and Knowledge Conversion: Controversy and Advancement in Organizational Knowledge Creation Theory," Organization Science, Vol. 20. No. 3. pp. 635-652
Nonaka, I., and Takeuchi, H. (1997). "A new organizational structure." In Prusak, L.(Eds.), Knowledge in Organizations. Butterworth-Heinemann. 99-133.
Polanyi, M., (1967). Tacit Dimension. Routledge & Kegan Paul PLC.
Rogers, D. L. (2016) The Digital Transformation Playbook: Rethink Your Business for the Digital Age, Columbia Business School Publishing.
Russell B (1972) A history of western philosophy.Simon and Schuster, New York.
Saldanha, T. (2019) Why Digital Transformation Fail?: The Surprising Disciplines of How to take off and Stay Ahead, Berrett-Koehler Publishers.
Schein, E. (1972) Professional Education: Some New Directions. McGraw-Hill Inc.,US
Schon, D. A. (1982) The Reflective Practitioner: How Professional Think in Action. Basic Books.
Schumpeter, J.A. (1934) The Theory of Economic Development: An Inquiry into Profits, Capital, Credits, Interest, and the Business Cycle. Transaction Publishers.
Schumpeter, J.A. (1942) Capitalism, Socialism and Democracy. Vol. 36, Harper & Row, New York, pp.132-145.
Sveiby, K. (2001), "A Knowledge-based Theory of the Firm To guide Strategy Formulation," Journal of Intellectual Capital vol 2, 4.
Szulanski, G.(1996). "Exploring internal stickness: impediments to the transfer of best practice within the firm," Strategic Management Journal. 17, 27-43.
Taylor, S., and Osland, J.S. (2003). "The impact of Intercultural communication." In Easterby-Smith, M., and Lyles, M. A. (Eds.). Handbook of Organizational Learning and Knowledge Management, The Blackwell.
Thorpe, R., Holt, R., Macpherson, A., and Pittaway, L. (2005). "Using knowledge within small and medium-sized firms: A systematic review of the evidence." International Journal of Management Reviews, 7 (4), 257-281.
Todorova, G. and Durisin, B. (2007) "Absorptive Capacity: Valuing a Reconceptualization", Academy of Management Review, Vol. 32, pp 774-786.
Tushman, M. L., and Anderson, P. (1986). "Technological Discontinuities and Organizational Environments, "Administrative Science Quarterly, Vol. 31, No. 3, pp. 439-465
Van Winkeen,C., and McKenzie, J (2007). "Integrating Individual and Organizational Learning Initiatives: Working Across Knowledge Management and Human Resource Management Functional Boundaries," The Electronic Journal of Knowledge Management, 5 (4) December, p527-538.

Wade, R, Macauray, J., Noronha, A., and Barbier, J. (2019). Orchestrating Transformation: How to Deliver Winning Performance with a Connected Approach to Change, DBT Center Press.

Walsham, G. (2002), "What can knowledge management systems deliver?" Management Communication Quarterly, Vol.16, No.2, November, pp267-273.

Zahra, S. and George, G. (2002) Absorptive Capacity: A Review, Reconceptualization and Extension. Academy of Management Review, 27, 185-203.

The Role of Knowledge Management Enablers in a South African Transport Agency

Ike Hlongwane[1] and Kamogelo Molekwa[2]
[1]The Department of Information science, University of South Africa (UNISA), Pretoria, South Africa
[2]City of Tshwane (CoT) Metropolitan municipality, Pretoria, South Africa

Hlongik@unisa.ac.za
Kamogelom@tshwane.gov.za

Abstract: Many organisations are exploring the field of knowledge management to improve and sustain their competitiveness and competitive edge over their rivals. Knowledge Management (KM) can be referred to set of processes and activities to change organisations' knowledge processing pattern, and organisations need to focus on management of knowledge for obtaining optimum results and efficiency to draw various benefits towards gaining competitive advantage. There are several enablers of KM that have a bearing on the success of KM in an organisation. Enablers of KM can be defined as factors that positively influence the success of KM activities to implement changes or are conducive to effective KM to take place in organisations. However, not all organisations are affected by these factors the same way. Most of these factors are associated with the organisation within which KM processes are carried out. A qualitative study was conducted in one of the government transport agencies, which has recently embarked on KM initiatives to find out which KM enablers played a key role in the successful implementation of KM activities in the transport agency and how this played a role (impact). The study used the Knowledge Management Capability Assessment Tool (KM CAT) theory to assess the role of KM enablers in the transport agency. The data were collected by purposefully interviewing senior officials/managers in the agency's KM directorate. The results showed that several factors played a positive role in the success of KM activities in the transport agency. The study recommends a holistic approach to KM with less emphasis on a single aspect or a few factors presumed to have a positive influence on or are important in creating a conducive environment for the successful implementation of KM in organisations. There is limited literature or research on the use of KM strategies in South African transport industry. Therefore, this study is worth sharing with scholars, practitioners, and policymakers to contribute to the scientific dialogue of KM in all sectors, including the transport industry, to create an enabling environment for the successful implementation of KM activities.

Keywords: Knowledge, Knowledge Management, Knowledge Management Enablers, Government Transport Agency, Knowledge Management Capability Assessment Tool (KM CAT), Holistic Approach

1. Introduction

Many organisations are exploring the field of knowledge management (KM) to improve and sustain their competitiveness and competitive edge over their rivals (Kumar, Singh & Haleem, 2014). KM may be referred to set of processes and activities to change an organisation's knowledge processing pattern (Joseph & Elroy, 2005), and organisations need to focus on the management of knowledge for obtaining optimum results and efficiency (Wong, 2005) to draw various benefits towards gaining competitive advantage (King, 2001; Ofek & Sarvary, 2001). Much literature has defined KM, but Davenport (1994) postulates KM as "the process of capturing, developing, sharing, and effectively using organizational knowledge." Later, Duhon (1998) provided another definition: "KM is a discipline that promotes an integrated approach to identifying, capturing, evaluating, retrieving, and sharing all of an enterprise's information assets". According to Gloet and Terziovski (2004), KM is the interpretation of experience and how to access that knowledge and proficiency, which produce new competencies, empower superior routine, boost innovation, and increase customer satisfaction. Thus, knowledge is considered a valuable asset for organisations, critical for achieving long-term sustainable competitive advantage. As a result, many organisations are making efforts toward the implementation of KM initiatives, recognising that their competitive advantage depends on their ability to effectively collect, capture, retain, store, transfer and share knowledge. Although companies are increasingly competing based on their ability to effectively manage knowledge, there are still numerous challenges for organisations that intend to implement a KM system. Thus, for a successful implementation of KM in organisations, it is crucial to understand which factors are critical in creating an enabling environment for the successful implementation of KM processes and lead to competitive advantage (Onofre & Teixeira, 2022). Although there are many studies related to enablers of KM in organisations, few have been explored within the context of the transport industry in a developing country like South Africa.

As a developing country, South Africa is witnessing fast population growth, which drives up the travel demand. Many of the country's citizens continue to rely on public transport to get to work, school, healthcare, recreation and tourism sites. To manage an innovative, rapid rail transport system in the country, an agency was formed as

a public-private partnership (PPP) project to provide a more affordable and accessible transport system to alleviate traffic congestion, while also providing a reliable and quick mode of public transport. In the intervening process, a wealth of skills and technical knowledge, particularly in the management of the protracted design and construction review process and the legal and environmental compliance processes, are organically produced. Today, organisations are increasingly dynamic, ever changing and continuously re-inventing themselves to achieve sustainable competitive advantage to an extent that what works for one organisation may not necessarily work for others with the same degree of impact.

This paper provides an overview of a qualitative study conducted in one of the government transport agencies in South Africa. The purpose of the study was to answer the following research questions:

- What are key enablers of KM systems?
- Which KM enablers played a key role in the successful implementation of KM activities in the transport agency?
- How do these KM enablers interact with each other for the successful implementation of KM initiative.

For practical purposes, this study used the Knowledge Management Capability Assessment Tool (KM CAT) theory to assess the role of KM enablers in the transport agency. The data were collected by purposefully interviewing senior officials/managers in the agency's KM directorate. A thematic approach was used to analyse the data to obtain the results.

The results showed that several factors played a positive role in the success of KM activities in the transport agency. The study recommends a holistic approach to KM with less emphasis on a single aspect or a few factors presumed to have a positive influence on or are important in creating an environment that is conducive to the successful implementation of KM in organisations.

Given that there is limited literature or research on the use of KM strategies in the South African transport industry, this study is worth sharing with scholars, practitioners, and policymakers to contribute to the scientific dialogue of KM in all sectors including the transport industry to create an enabling environment for the successful implementation of KM activities.

2. Knowledge Management Capability Assessment Tool

To assess knowledge management maturity in the organisation, the study used the KM CAT. The KM CAT is divided into four major sections, each of which is subdivided into subcategories assess as follows:

- Strategy (objectives, business case and budgets)
- People (resources, governance structure and roles, change management and communication)
- Process (knowledge flow process, KM approaches and measurement)
- Content and information technology (content management and IT processes and tools)

The KM CAT is best suited for reviewing procedures, recognising intellectual assets in an organisation. According to APQC (2022), the KM CAT helps an organisation assess its capabilities and maturity in KM and focus its KM investments on producing the highest return on value. Thus, the use of KM CAT gave the researcher a broad perspective when assessing the role of KM enablers in the transport agency for improved efficiency, increased productivity and enhanced organisational performance.

3. Overview of KM Initiative in the South African Transport Agency

The agency's KM strategy (2016) was firmly established by the South African transport Act, (Act No. 5 of 2006). Section 5(e) and (f) of the Act requires the agency to establish and operate information and management systems for transport projects in the Gauteng province, and liaise and exchange information with institutions, authorities or professional bodies regarding rail matters in South Africa or in other countries. As part of the Gauteng province, the agency is required to support and contribute to the implementation of the Gauteng 25-year Integrated Transport Master Plan (ITMP25). Given the mandate of the agency and public transport development imperatives for the province, a KM strategy is critical for the organisation. Tremendous efforts have been made on electronic document control and management, particularly during the development phase of the transport projects in Gauteng province.

4. Literature Review

Knowledge is a vital resource for having a sustainable competitive advantage (Manesh, Pellegrini, Marzi & Dabic, 2020). Two types of knowledge can be distinguished, namely tacit knowledge and explicit knowledge. According to Powell (2023), tacit knowledge, is often difficult to share or articulate. This is because this type of knowledge resides in human minds. It is often acquired through personal experiences, intuition and expertise. One of the primary challenges with tacit knowledge in an organisation is that, due to its intangible and often subconscious nature, it has proven to be to transfer and share tacit knowledge throughout the organisation (Chen, Nunes, Ragsdell & An (2018). On the other hand, explicit knowledge can be easily communicated and shared. Due to its tangible nature, explicit knowledge can be communicated through perceptible channels such as documents or computer programs, or in a personal context such as verbalisation to knowledge workers through networking competence (Fryczynska & Ciecierski, 2020). Tacit knowledge is generally accepted as expertise that exists solely in the minds of individuals and is intangible, while explicit knowledge is the know-what aspect of knowledge, which is tangible and exists outside the human mind. Therefore, tacit and explicit knowledge can be seen not as two distinct knowledge typologies (Gamble, 2020), but as two sides of the same coin. This further was initially alluded to by Panahi, Watson and Partridge (2016), stating that "there exists many cases of a middle ground between them."

KM is defined in many ways because it has been increasingly evolving and integrating business strategies, processes and goals. Zvobgo, Chivivi and Marufu (2015) define KM as the systematic process for organisations to create, identify, capture, obtain, secure, share, and control knowledge. However, Yee, Tan and Thurasamy (2019) define KM as the systematic management of an organisation's knowledge assets for the purpose of creating value and meeting tactical and strategic requirements. It consists of the processes, strategies and systems that sustain and enhance the creation, storage and sharing of knowledge. It is evident in the literature that KM plays a strategic role for the survival, competitiveness and profitability of the organisation (Omotayo, 2015; Clark, 2020).

5. Knowledge Management Enablers

KM enablers are the operational or service settings in an organisation that are accountable for the success of a KM initiative and treated as the mechanism or factors for facilitating knowledge creation, sharing, application and protection within the organisation (Yang, Marlow & Luc, 2009). In the literature, several critical enablers in successfully implementing effective KM initiatives and techniques in organisations are explored. Some of the key KM enablers identified from previous studies consist of organisational culture, organisational structure, management support, leadership, strategy, champion support, design of KM strategy, performance and evaluation, training and technologies (Boamah et al., 2022); Gupta, Singh, Kamble & Ruchi Mishra, 2022; Aldhaheri & Ahmad, 2024); Dang, Wipulanusat, Nuaklong & Witchayangkoon, 2024); Shehzad, Zhang, *Dost*, *Ahmad* & *Alam*, *2024)*. These KM enablers are the key focus in many studies on KM processes across several and diverse industries or fields such as education, health, libraries, engineering, construction, among others.

In another study by Menon and Suresh (2021), rewards and recognition and employee empowerment were among the highest driving force behind KM. However, management support was found to be the most crucial KM enabler. In addition, teamwork, reward structure, learning, collaboration and employee empowerment (Atapattu & Huybers, 2021; Osupile & Makambe, 2021), are motivational antecedents of KM engagement and sharing. Furthermore, knowledge-oriented leadership, environmental uncertainty (Sahibzada, Latif & Xu, 2022), organisational climate (Farooq Sahibzada, Thomas, Sumbal and Malik (2023) and trust have a significant impact on KM processes.

Another study by Iftikhar and Lions (2022) sought to identify the different KM enablers at different levels of the organisation. The found that, at individual level, interpersonal relationships and social interactions are knowledge-sharing enablers. In contrast, the study found that well-defined objectives were found to be team level enablers; while at organisational level, appropriate knowledge sharing requires organisation to design their structures adequately to be consistent with both the environment and the necessary level of interaction among employees. Pham, Lokuge, Nguyen and Adamopoulos (2024) conducted a study to explore KM enablers for blockchain-enabled food supply chain implementations. The study found external enablers, including regulation and market competition, and internal enablers, such as people, organisational learning, strategy and leadership, culture, information technology, organisational infrastructure, processes and activities.

6. Methodology

To address the main research question, this qualitative study used a case study research design because a case study enabled the researcher to conduct an in-depth study of the KM process in the agency. The case study research design enabled the researcher to explain the complex situations where important factors could be lost or not described completely enough in a generalised method. This study used semi-structured interviews to gain an understanding of how the loss of knowledge (tacit) affected this South African government agency, rather than acquiring a more superficial overview.

The researcher purposefully selected senior management involved in the agency's KM directorate. The interview guide was prepared to help the researcher to comprehensively cover identified topics relevant to the study objectives. Each participant was allocated one and a half hours for the interview.

The interviews were conducted using the Microsoft Teams app, which is a virtual platform the researcher deemed fit to use due to the Covid-19 pandemic. The interviews were recorded with the consent of the participants.

Owing to the semi-structured nature of the interviews, participants were encouraged to elaborate on the subject and provide as much information as they could. Apart from the interviews, internal documents of the agency, such as the KM policy and strategy plan, were used to achieve data triangulation to enrich the data collected.

The collected data were analysed using Atlas.ti version 9 according to a thematic approach, in which the data were aligned to the study themes, and a coding procedure was followed.

7. Profile of the Participants

The study initially targeted 10 senior managers in the KM directorate who were actively involved in the agency's KM projects and processes. These included the executive manager of KM, five KM specialists, a senior records officer, a registry officer, a senior manager for reputation and a senior manager in stakeholder relations. Owing to the Covid-19 pandemic, four employees were unavailable because of ill health and death. Finally, six senior managers in the KM directorate with the relevant knowledge and experience in KM programmes and processes of the agency were interviewed.

8. Discussion of the Findings

8.1 Key Enablers Of Knowledge Management System

The study results revealed that several factors play a critical role as KM enablers in the implementation of a KM system in the transport agency in South Africa just like in any organisation throughout the world. The general view of the participants in the South African transport agency, was that these KM enablers include, but are not limited to, organisational culture, organisational structure, management support, champion support, design of KM strategy, performance and evaluation, training and technologies. In addition, the participants also indicated that policies, organisational philosophy, business innovation, business procedure and populace also affect the KM strategy in the transport agency.

8.2 Role of KM Enablers in the Successful Implementation of KM Activities in the Transport Agency

Most participants noted that, in different measures or degree, several KM enablers positively influence or are conducive to effective KM in agency. The support of top management is crucial for providing necessary resources, communicating the importance of developing the KM system. Senior management in the transport agency was also credited for giving essential directions for successfully integrating the KM system in the transport agency. The participants also indicated that it was important to develop suitable strategies with the active participation of all stakeholders from various departments in the transport agency to align the strategies with organisational goals and objectives. Regarding organisational culture, most participants in the transport agency were of the view that a knowledge-friendly culture encourages and embraces better ways of knowledge sharing, it helps adopt new tools and techniques. Apart from creating awareness and knowledge of KM theory and practice, the view of most participants was that top management should also focus on the provision of the necessary information and communication technology (ICT) and training. Training provides skill and expertise to human resources of how KM operates and functions. On the other hand, technology is usually seen as the enabler of KM practice. The all-encompassing view of the participants was that advanced ICT infrastructure was needed to promote KM through improved knowledge sharing. In addition, the participants indicated that KM

policy provides a context of rules and methods to guide how the KM system is implemented in the transport agency.

8.3 Interaction of KM Enablers for the Successful Implementation of KM Initiative

The study revealed that collaboration and coordination between and among the various KM enablers were crucial for organisational performance, survival, profitability and competitiveness. The results strongly suggest that all the KM enablers in the organisation should be harnessed to create value by aligning with the overall organisational strategy, goals and objective. This is because the results showed that several factors, and not just one factor or enabler, played a positive role in the success of KM activities in the transport agency. A holistic approach to KM practice is important in creating an environment that is conducive to the successful implementation of the KM initiative in organisations.

9. Conclusion

This study showed that there are several key KM enablers that positively influence or are conducive to effective KM to take place in organisations, which include, but are not limited to, organisational culture, organisational structure, management support, champion support, design of KM strategy, performance and evaluation, training and technologies. Individually, each of these KM enablers plays a vital role. However, organisations should strive to holistically harness and coordinate all the KM enables systematically to accomplish organisational functions, operate and succeed in the current global knowledge-based economy.

References

Aldhaheri, S.M. and Ahmad, S.Z. (2024), The influence of transformational leadership on organizational performance and knowledge management capability, International Journal of Productivity and Performance Management, Vol. ahead-of-print No. ahead-of-print. https://doi.org/10.1108/IJPPM-10-2022-0532

American productivity and quality center (APQC). 2022 Knowledge Management capability assessment tool (KM CAT). https://www.apqc.org/what-we-do/benchmarking/assessment-survey/knowledge-management-capability-assessment-tool (Accessed 15 February 2024)

Atapattu, M.M. and Huybers, T. (2021), Motivational antecedents, employee engagement and knowledge management performance, Journal of Knowledge Management, 26 (3): 528-547. https://doi.org/10.1108/JKM-12-2020-0898

Bitkowska, A. (2015). The orientation of business process management toward the creation of knowledge in enterprises. Human Factors and Ergonomics In Manufacturing. https://doi.org/10.1002/hfm.20533. (Accessed 15 February 2024).

Boamah, F.A., Zhang, J., Wen, D., Sherani, M., Hayat, A. and Horbanenko, O. (2022), Enablers of knowledge management: practical research-based in the construction industry, International Journal of Innovation Science, 14 (1):121-137. https://doi.org/10.1108/IJIS-09-2020-0142

Dang, C.N., Wipulanusat, W., Nuaklong, P. and Witchayangkoon, B. (2024), Exploring the relationships between knowledge management enablers, employee innovativeness and market development performance in A/E/C firms: a developing country perspective, Construction Innovation, Vol. ahead-of-print No. ahead-of-print. https://doi.org/10.1108/CI-02-2023-0022

Chen, H., Nunes, M.B., Ragsdell, G. and An, X. (2018), Extrinsic and intrinsic motivation for experience grounded tacit knowledge sharing in Chinese software organisations, Journal of Knowledge Management, 22 (2): 478-498.

Clark, S. (2020). The state of knowledge management in 2020. https://www.reworked.co/knowledge-findability/the-state-ofknowledge-management-in-2020/. (Accessed 15 February 2024)

Farooq Sahibzada, U., Thomas, A., Sumbal, M.S.U.K. and Malik, M. (2023), Nexus of knowledge management and organisational performance: a cross-country study of China and Pakistan higher educational institutes, Kybernetes, 52 (12): 6348-6378. https://doi.org/10.1108/K-08-2021-0768

Fryczynska, M. and Ciecierski, C. (2020), Networking competence and its impact on the employability of knowledge workers, Journal of Organisational Change Management, 33 (2): 349-365.

Gamble, J.R. (2020), Tacit vs explicit knowledge as antecedents for organizational change, Journal of Organisational Change Management, 33 (6): 1123-1141. https://0-doi-org.oasis.unisa.ac.za/10.1108/JOCM-04-2020-0121

Gupta, A, Singh, R.K, Kamble, S, and Mishra, R (2022) Knowledge management in industry 4.0 environment for sustainable competitive advantage: a strategic framework, Knowledge Management Research & Practice, 20 (6): 878-892, DOI: 10.1080/14778238.2022.2144512

Iftikhar, R. and Lions, C. (2022), Interorganizational knowledge sharing barriers and enablers: the case of Peshawar Bus Rapid Transit project, International Journal of Managing Projects in Business, 15 (5): 769-792. https://doi.org/10.1108/IJMPB-11-2021-0313

GMA KM strategy, 2016/17-2018/19 FY. https://gma.gautrain.co.za/about/pages/knowledge-sharing.html. (Accessed 4 March 2024).

Manesh, M. F., Pellegrini, M. M., Marzi, G., and Dabic, M. (2020). Knowledge management in the fourth industrial revolution: Mapping the literature and scoping future avenues. IEEE Transactions on Engineering Management.

Menon, S. and Suresh, M. (2021), Enablers of workforce agility in engineering educational institutions, Journal of Applied Research in Higher Education, 13 (2): 504-539. https://doi.org/10.1108/JARHE-12-2019-0304

Onofre, I., andTeixeira, L., 2022.Critical Factors for a Successful Knowledge Management Implementation: A Systematic Literature Review. The Electronic Journal of Knowledge Management, 20 (2): 93-109.

Omotayo, F. O. (2015). Knowledge management as an important tool in organisational management: A review of literature. Library Philosophy and Practice (e-journal), 1-23.

Osupile, K. and Makambe, U. (2021), The nexus between organisational culture and knowledge sharing in a government department in Botswana, International Journal of Public Sector Management, 34 (2):118-136. https://doi.org/10.1108/IJPSM-06-2020-0149

Panahi, S., Watson, J. and Partridge, H. (2016), Conceptualising social media support for tacit knowledge sharing: physicians' perspectives and experiences, Journal of Knowledge Management, 20 (2): 344-363.

Pham, C.M., Lokuge, S., Nguyen, T.-T. and Adamopoulos, A. (2024), Exploring knowledge management enablers for blockchain-enabled food supply chain implementations, Journal of Knowledge Management, 28 (1): 210-231. https://doi.org/10.1108/JKM-07-2022-0586

Powell, B.C. (2023), Sharing intractably tacit knowledge: the case for nepotistic selection, Development and Learning in Organizations, 37(5):11-13. https://doi.org/10.1108/DLO-08-2022-0154

Republic of South Africa. 2006. Department of Transport: National Land Transport Transition Act 5. Government Printer. Pretoria.

Sahibzada, U.F., Latif, K.F. and Xu, Y. (2022), Symmetric and asymmetric modeling of knowledge management enablers to knowledge management processes and knowledge worker productivity in higher education institutes, Journal of Enterprise Information Management, 35 (3): 729-756. https://doi.org/10.1108/JEIM-08-2020-0346

Shehzad, M.U., Zhang, J., Dost, M., Ahmad, M.S. and Alam, S. (2024), Knowledge management enablers and knowledge management processes: a direct and configurational approach to stimulate green innovation, European Journal of Innovation Management, 27 (1):123-152. https://doi.org/10.1108/EJIM-02-2022-0076

Yee, Y.M., Tan, C.L. and Thurasamy, R. (2019), Back to basics: building a knowledge management system, Strategic Direction, 35(2):1-3. https://0-doi-org.oasis.unisa.ac.za/10.1108/SD-07-2018-0163

Zvobgo, C., Chivivi, O. O., and Marufu, B. (2015). Knowledge management as a survival strategy to enhance competitive advantage in the Zimbabwean tourism and hospitality industry. European Journal of Business and Management, 62-72.

Beyond the Ivory Tower: Teaching Non-Rational Knowledge to Business Students and Practitioners

Alexander Kaiser[1], Clemens Kerschbaum[2], Florian Kragulj[1], Markus F. Peschl[3] and Cindy Zivkovic[1]

[1] Vienna University of Economics and Business, Vienna, Austria
[2] New Design University, St. Pölten, Austria
[3] University of Vienna, Vienna, Austria

alexander.kaiser@wu.ac.at
clemens.kerschbaum@ndu.ac.at
florian.kragulj@wu.ac.at
franz-markus.peschl@univie.ac.at
cindy.zivkovic@wu.ac.at

Abstract: Recent publications in the field of KM emphasize the importance of topics such as Spirituality (e.g. Bratianu, 2017; Kaiser, 2023; Rocha & Pinheiro, 2021), Phronesis (practical wisdom) (Kragulj, 2022; Nonaka & Takeuchi, 2019; Rocha et al., 2022; Serenko, 2024), Organizational Purpose (Kerschbaum, 2022), dealing with future potentials and future-oriented innovation (Peschl, 2018, 2020) and Responsible KM (Durst, 2021) as future avenues for KM research. However, it seems that these topics have not yet entirely found their way into practice, or, although the phenomena described are inherently present in organizations, they do not receive much attention from practitioners these days. With this paper we seek to initiate discussion on how to deploy research results on topics like Spirituality, Practical Wisdom, non-rational Knowledge, future-oriented knowledge work, and Organizational Purpose into applied contexts. We argue that an essential step is to adequately train students at universities with the new content. Todays students are the leaders, entrepreneurs, and managers of tomorrow. Therefore, we present selected educational concepts that help students build competencies in understanding and applying non-rational forms of knowledge. The intention of these newly designed teaching concepts is to move our field of research out of the metaphoric ivory tower towards the application in organizations. We argue that this is a necessary step for the development of the field of KM, enabling our research to remain relevant in modern-day business and organizational environments.

Keywords: Non-rational Knowledge, Phronesis, Practical Wisdom, Spirituality, Future Orientation, Management Education

1. Introduction

The field of Knowledge Management (KM) has recently been facing somewhat of a decline in popularity (Davenport, 2015). Arguably, this development has begun with the rise of ever-so-efficient web search technologies and culminated in the widespread application of artificial intelligence, which started to be accessible to everybody who knows how to operate a personal computer. However, although successful in addressing clear and defined problems, rational-analytic problem-solving methods face challenges when applied to ambiguous or ill-defined problems, indicating also the need for different approaches in KM (Kragulj *et al.*, 2018). As a result, we believe in a renaissance of Knowledge Management at its core, which has made it a social science endeavor (Nonaka and Takeuchi, 1995): tacit knowledge. This renewed interest in the manifold types of non-codified and subjective knowledge has led to new topics in KM, such as spirituality (e.g. Bratianu, 2017; Rocha and Pinheiro, 2021; Kaiser, 2023), phronesis (practical wisdom) (Nonaka and Takeuchi, 2021; Rocha, Kragulj and Pinheiro, 2022; Kragulj, 2023), organizational purpose (Kerschbaum, 2022), dealing with future potentials and future-oriented innovation (Peschl, 2018, 2020) and responsible management (Durst, 2021). Moreover, the focus on non-rational knowledge (Warren, 2008) signals a shift from a mere analytic-rational understanding towards a deeper, more nuanced engagement with knowledge. For instance, Serenko (2024) recently published the first large-scale empirical study of practical wisdom (phronesis) in KM, reigniting the discourse surrounding the significance of practical wisdom in work environments (Serenko, 2024). Consequently, the traditional understanding of explicit and implicit knowledge has long been dissolved and expanded into a more holistic definition of KM (Peschl, Kaiser and Fordinal, 2023).

For this new wave of knowledge management to be effective in organizational practice, universities are key to helping students understand forms of non-rational knowledge and their relevance to real-world problems, shaping the behavior and attitudes of future leaders, entrepreneurs and managers. This aligns with universities' primary goal of growing students' skills and preparedness for real-world organizational learning environments while simultaneously being forced to adapt to an ever-changing environment rapidly (Brewer and Brewer, 2010). Effectively sharing knowledge to create a lasting learning impact requires innovative and diverse teaching

strategies that create personal and emotional engagement, promoting reflection-in-action as well as active learning involvement amongst students (Kragulj *et al.*, 2018). To promote learning and the cultivation of skills, Bratianu and Vatamanescu (2017) propose supplementing lectures with practical activities such as simulations, gaming, or real-world projects, which enhance the tacit knowledge base (Bratianu and Vatamanescu, 2017).

In an earlier contribution, we reported on the importance of teaching students feasible ways to deal with unstructured, ill-defined problems. There, we used the Design Thinking Framework to equip students with creative strategies for problem-solving, enabling them to integrate theories of Organizational Learning and KM into live case studies provided by business partners (Kragulj *et al.*, 2018). With this contribution, however, we aim to go a step further and reflect on the types of knowledge required to engage in contemporary challenges of KM and how we can convey them to students utilizing innovative course designs. By doing so, we extend the existing body of knowledge in the field of KM by introducing innovative didactic approaches that convey the mentioned new types of knowledge. After providing a theoretical background on management education in terms of the relevant knowledge, the paper presents three examples of course/curriculum designs and summarizes the findings and implications in the final section.

2. Theoretical Background

Typically, study programs in business and management emphasize formal learning and qualification (Adams & Ingersoll, 1990; Schön, 1987). It is considered important to know, understand, and be able to apply well-known models of prominent management thinkers, as well as to be able to read, understand and interpret a balance sheet. While these things are undoubtedly important, there exists somewhat of a counter-movement, whose proponents argue that management is more about tacit knowledge of organizations than about technical-rational analytical thinking and that managers can benefit from cultivating non-rational forms of knowledge in decision-making in order to foster more sustainable and responsible business practice (Hedlund *et al.*, 2003; Schaltegger and Wagner, 2011; Bas, Sinclair and Dörfler, 2023). As early as in the 1930s, management theorist Chester Barnard wrote that in addition to its rational, analytical component the process of management is characterized by “the sensing of the organization as a whole and the total situation relevant to it” (Barnard, 1938, p. 123). Accordingly, management may rather be a matter of art than science (Barnard, 1938). In line with Mintzberg’s concise formulation that we need managers, not MBAs (Mintzberg, 2004; Chia, 2005), we were looking for course designs that would build students capacity to manage in between the lines of formal theories and tools. An essential requirement resulting from the tacit nature of the knowledge we aim to teach, is that respective course designs must enable experiential learning. Following Polanyi (1966), tacit knowledge can only be acquired through direct, personal, and often sensory-based experience within the learning context (Polanyi, 1966). In addition to direct experience, participants need reflective practice to acquire knowledge (Schön, 1987). In this regard, the university setting allows for the unique opportunity to incorporate both direct experience as well as reflection-in-action and reflection-on-action in a safe learning environment and under the supervision of methodically and substantively experienced lecturers. Such course designs can incorporate elements of problem-based-learning that introduce the students to complex real-world problems in order to develop their problem-solving and self-directed learning skills (Savery, 2006). Yet, it appears that university education often falls short of these goals and relies heavily on the teaching and assessment of explicit knowledge. This is partly due to the lack of well-developed teaching concepts for spiritual KM, practical wisdom, responsible KM, and future-oriented thinking. With our contribution, we aim to address this gap by presenting blueprints for teaching these concepts. By doing so, we provide an initial basis for discussion and pave the way for the integration of non-rational knowledge into university- and vocational education.

According to the criteria described above, we will progress by presenting three course- or curricular designs and our experience and learnings from them. All courses were initially designed against the background of conveying non-rational forms of knowledge, ideally from both an analytical perspective, i.e. understanding what types of knowledge are in use (know what) and an applied perspective, i.e. learning by doing, experimenting and reflecting the students' learning experience. The courses were part of different study programs held at two Austrian universities and a c-VET training program delivered by an international Erasmus+ consortium. One university is a large public business university focusing on business and economics, and the other is the country's largest public university offering a wide variety of study programs.

We first evaluated the courses on the basis of formal evaluations, according to the respective formats that each institution suggests. Those evaluations partly include Likert-scale questions and also written answers to open questions. The formal evaluation was complemented by verbal feedback that we received from students during

and after class as well as insights from the reflection exercises within the courses. The c-VET training program reported is about to be piloted and has not yet been evaluated by the learners.

3. Course Designs

In the following we will give the reader a detailed picture of the respective course or curriculum designs.

3.1 Course: "Knowledge, Wisdom and Innovation"

This course is part of a specialization program titled "Knowledge Management" at a public business university. Undergraduate students have to choose up to two specialization programs from around 35 available options. Each specialization program consists of five courses with 4 ECTS points each. The respective course "Knowledge, Wisdom and Innovation" is the follow-up course to the introductory course "Knowledge-based Management" within the KM specialization. It can, therefore, be expected that students have already acquired basic competencies in KM and organizational learning. In total, each semester 16 students take part in this course.

3.1.1 Content and aim of the Course

The course "Knowledge, Wisdom and Innovation" targets students who enjoy interdisciplinary thinking and are open to exploring "non-mainstream" content from arts, literature, philosophy, and theology, which can be considered extraordinary for a business university.

The concept of this course is to address the topic of wisdom in a collaborative learning lab and try to learn and discover step-by-step how wisdom can be integrated and fostered in organizations and companies. Questions addressed within the course include: What is wisdom in general and can wisdom be "learned"? What processes help us to make wise decisions in companies and organizations? How can we recognize the effects of wise decisions? What is the connection between wisdom, knowledge, and innovation? And how can insights in the field of wisdom from entirely different disciplines (art, literature, biology, philosophy, theology, etc.) help us make wise decisions in business and our personal lives?

The goal is to convey to the students contemporary research in wisdom, innovation, and organizational learning, including current approaches and discourses in various fields of wisdom research, dealing with interdisciplinarity and applying the acquired knowledge in practice, including the reflection of its impact.

The course content is taught within an open classroom environment driven by situational questions. Presentations and input from the lecturers, exercises, and project work in small groups as well as discussions and reflections in plenary sessions allow the defined learning objectives to be achieved.

3.1.2 Structure of the Course

The course consists of a theoretical part and a practical part. The central idea is to teach students a few selected concepts of wisdom in the theoretical part so that they can then apply them in a case study. This only works if the theoretical part includes a few specific exercises. As the entire course only covers 4 ECTS credits, we had to make a selection of wisdom concepts that we teach in the theory part. Hence, we decided to focus on the following wisdom-related aspects:

- The multi-layered nature of knowledge in the late modern age and the shift towards an information age
- Egyptian wisdom, also known as Ma'at
- Plato's philosophical ethics which is deeply rooted in the idea that virtue and knowledge are inseparably linked
- Chapter 13 of the Nicomachean Ethics by Aristotle which explains the practical importance of prudence and wisdom.
- Wisdom, education and science. The complex relationships between wisdom, education and science are briefly examined, as considered by philosophers such as Nietzsche and Hegel.
- A short introduction to the wisdom literature of the Hebrew Bible
- Ina Roesing's wisdom triangle which is a concept that places wisdom in the context of essentiality, meaning and value.
- The aspect of resonance in the context of wisdom inspired by Hartmut Rosa

In the practical part of the course, we used a live case study of a consulting and training company that had to decide on its further development. The students worked in small groups and not only had to solve the case and try to make wise decisions in various situations in the company concerning further development but also had to justify their decisions in detail and transparently. They were asked to explain which concepts of wisdom they used as a basis for their decisions and how they applied them to the specific case. The students presented their findings in a plenary session and then critically discussed them with the lecturers. The results were compelling and exceeded the expectations of the lecturers. Almost all students not only made interesting and creative suggestions for the company's decision-making situations but were also able to link their decisions very well with the concepts of wisdom they had learned in the theory section.

3.1.3 Evaluation of the Course

Students evaluation at the end of the course revealed impressive results. 100 % of the participants indicated that they would recommend this course to their colleagues, 91 % rated the ratio between theory and practice as the highest possible. 100 % of the participants mentioned that the practical part of the course was an added value for them and 83 % of participants rated the course as helpful for their professional future.

In two open questions, we asked what was particularly positive about the course and what should be improved. What impressed the students the most was the fact that the content of this course was completely different from any other course offered at a business university. Furthermore, most students emphasized that the content of the course also touched them personally and encouraged them to reflect on aspects of their own lives. This finding was underlined by several personal conversations and questions between some students and the lecturers at the end of the final exam. On the other hand, the students argued that the course content was not easy to understand because the wisdom approaches were new and unfamiliar to them. This is precisely why good course materials (slides, handouts, etc.) are essential.

3.2 Curriculum: “Co-Creating and Enacting Future Purpose Through Future-Oriented Innovation”

The following educational design is based on Otto Scharmer's (2016) concepts of "learning from the future as it emerges" and Emergent Innovation (Peschl and Fundneider, 2017; Peschl, 2020). It is a transformative and future-oriented approach to innovation that is centred around the Theory U framework (Scharmer, 2016), anticipation and futures literacies (Miller, 2015, 2018; Poli, 2021; UNESCO, 2021), as well as dealing with self-transcending knowledge (Scharmer, 2001), future purpose and making use of future potentials (Glaveanu, 2022). These approaches propose that the most important sources of innovative change do not come primarily from traditional data, trend analysis, design thinking methods or extrapolation from past knowledge; rather, they claim that (radical) novelty arises from deep and mindful engagement with the world and its possibilities that are unfolding in the present moment and directing towards an emergent future purpose. In that sense, innovation is not brought into being by materializing our own creative ideas in the world in a hylomorphic manner (e.g. Ingold, 2013, 2014); rather, future is co-created by integrating the creative agency of the creator’s mind with the creative agency of the world by enacting both the cognitive system and its environment (Newen, Burin and Gallagher, 2018; Gallagher, 2023; Hutto, 2023).

3.2.1 Content and aim of the Curriculum

Compared to classical innovation strategies (e.g. Chen, Brem and Wong, 2019; Tidd and Bessant, 2020), such a radically future-oriented and purpose-driven approach to innovation involves alternative forms of socio-epistemic processes (e.g., knowledge about potentials and future purpose, self-transcending knowledge [e.g., Scharmer, 2001], dialogical social formats, etc.). Consequently, one needs to develop strategies of how to deal with these forms of knowledge and how to “teach” necessary alternative (epistemic and social) skills and mindsets supporting them. That is why we designed and implemented a so-called extension curriculum entitled “Innovation and Knowledge Creation: How novelty comes into the world”[1]. It is a 15 ECTS “mini curriculum” that is open to bachelor students from all disciples and comprises 3 courses (see below).

The primary objective of this curriculum is to foster processes and capabilities of collaborative knowledge creation as well as futures literacies (Miller, 2015, 2018; Ehlers and Eigbrecht, 2024). The goal is to develop an innovation (project) that culminates in the realization of a tangible prototype over the course of the semester.

[1] https://innovation.univie.ac.at/

Admitting students from various disciplines promotes diversity, which in turn stimulates different perspectives, knowledge cultures, and creativity. This curriculum is designed in a project-based and open-ended manner encouraging and promoting group work, interdisciplinary interaction, collaboration, self-reflection, as well as challenging students' assumptions and beliefs.

The instructors' self-conception rests on the belief that they do not offer definitive or "true" knowledge or solutions. Instead, they prioritize guiding and facilitating the innovation process while providing an enabling learning environment ("enabling spaces", Peschl and Fundneider, 2012, 2014). They focus on establishing an atmosphere of trust and appreciation, creating a setting in which students independently collaborate in groups to develop their own perspectives, arguments, and innovation concepts/projects.

3.2.2 Structure of the Curriculum

The curriculum is organized around an innovation process that is based on Scharmer's (2016) Theory-U and Emergent Innovation (Peschl, 2020). It is structured as a sequence of interlinked and recursive phases, workshops, and class events. Formally, it is organized as 3 courses: (i) a lecture providing theoretical foundations, (ii) a course bridging theoretical and practical topics, and (iii) an "innovation atelier" where students have to work practically on an innovation project. These courses are closely interwoven and teach both theoretical knowledge and practical skills (including innovation attitudes) over the course of a semester.

Between these courses in-person events, workshops, and coaching sessions are provided for the innovation teams, which serve as a forum for receiving feedback, asking in-depth questions, and discussing social issues within the group with the instructors. The most important phases of the innovation process are described below. Further details can be found in Peschl *et al.* (2014) and Hartner-Tiefenthaler *et al.* (2018).

In the first phase, students identify a personally meaningful question and develop their topic of genuine interest. This fosters personal engagement throughout the process. After reflecting on hidden assumptions, students form Knowledge Creation Teams (= KCTs) around shared interests using semantic mapping techniques. They then enter a phase of deep observation, exploring their chosen field through mostly qualitative methods, such as ethnographic observation, generative interviews, or desk research. Afterwards, insights are discussed in a world café (Brown and Isaacs, 2005) and dialogue setting, enabling participants to challenge, reflect, and integrate diverse perspectives, fostering creative synthesis.

Students then enter the presencing phase (Scharmer, 2016), spending a day in nature to encourage new ideas in a silent, distraction-free environment. They suspend their own ideas and engage in a process of "listening to what wants to emerge," encountering future potentials and novel knowledge. The insights gained are then shared within the KCTs, where initial intuitions and concrete ideas for an innovation artifact or prototype begin to crystallize. During iterative prototyping and coaching, ideas are refined, implemented, or discarded in a fast cycle learning process, leading to a final prototype. Finally, this prototype is presented in class, receiving feedback from instructors and peers. At the end, the KCTs and the whole class reflect on the entire knowledge creation process, discussing both theoretical and experiential insights.

3.2.3 Evaluation of the Curriculum

This curriculum was accompanied by a multi-year research project by using mostly triangulation of qualitative and quantitative methods, focusing primarily on qualitative approaches to describe how new knowledge emerges in a future-driven manner (see Peschl *et al.*, 2014, 2019; Hartner-Tiefenthaler *et al.*, 2018). In the instance evaluated in the research project, a total of 30 students participated, including both PhD and Master's students.

Based on diary entries, observations, personal conversations, and group reflections, several key socio-epistemological aspects for this knowledge creation process leading to innovations were identified. These include social and personal identity, individual and group mindsets, decision-making, emotions, course design impact, and the transition from uncertainty to clarity. Basic ground values such as trust and respect turned out to be essential for fostering an innovative and enabling learning environment; they were crucial for providing a "safe space" and effective group dynamics. Fairness ensured equal engagement and valuing individual contributions. This led to (epistemic) openness and curiosity driving creative thinking and being led by future potentials.

Uncertainty played a significant role in the innovation process, initially causing discomfort but ultimately driving creativity and knowledge creation. Effective coping strategies included personal and emotional involvement,

creating a playful atmosphere, and enjoying group interactions. High-performing groups exhibited intrinsic motivation, taking collective responsibility for their projects and engaging deeply in the creative process, often planning to continue their work beyond the course. In contrast, low-performing groups struggled with internal conflicts and lacked cohesive responsibility, highlighting the importance of shared commitment for successful innovation. Although it was a challenge at first, students appreciated that their creative autonomy was taken seriously and that they had to take a great deal of responsibility for their own innovation process.

3.3 Curriculum: "Cultivating Phronesis for Practically Wise Entrepreneurial Decision"

According to Bachmann et al., "practical wisdom can be a source for integrating the multifarious social, moral, cultural, and environmental realities and challenges that business has to meet" (Bachmann, Sasse and Habisch, 2018, p. 126). The concept of practical wisdom (phronesis) originates with Aristotle who defines it as an intellectual virtue rooted in a person's character that "is a true state involving reason, concerned with action in relation to human goods". After reviewing more recent literature on practical wisdom, we can differentiate the concept, namely in relation to the phronimos, i.e., the practically wise person, in three different ways: such a person can 'be' phronetic, they 'have' phronesis, or they 'act' practically wise. While the first notion aligns with the perspective of phronesis as a personality trait, the latter point at its quality of being a learnable skill or behavioral pattern over time (Kragulj, 2023; Rocha, Pinheiro and Kragulj, 2024). This aligns with the argument that 'good' decision-making stems from managerial experience (c.f. tacit knowledge) more than from applying universal management rules (c.f. explicit knowledge) (Thomassen and Jørgensen, 2021). From this ontological point of view, it seems particularly important to systematically cultivate practical wisdom and develop a praxis of 'good' decision-making. To this end, providing learning environments that leverage practical decision-making (e.g., moral dilemma or case study) as the 'learning vehicle' to cultivate practical wisdom (phronesis) seems promising. In this way, learners can build their decision-making skills for business sustainability and responsibility (Melé, 2010).

3.3.1 Content and aim of the Curriculum

The "Wise Up to Succeed" Erasmus+ project[2] aims to strengthen the decision-making competencies of business successors by cultivating their practical wisdom (Kragulj *et al.*, 2024). In continuous vocational education and training (c-VET), it pioneers in converting our conceptual understanding of practical wisdom (phronesis) into education practice. The project leverages the perspective of phronesis as being a skill that manifests in action. In building practical wisdom in managers, decision-making is considered the focal point (i.e., action) of learning and applying.

The core of the project is an educational framework (Kragulj et al., 2024) that aligns with the Principles of Responsible Management Education (Storey, Killian and O'Regan, 2017) and is substantiated by three key theories on critical pedagogy and social development: Freire's (1970) Pedagogy of the Oppressed, Piaget's (1983) cognitive development theory and complimentarily Vygotsky's 'activity theory' (1986).

3.3.2 Structure of the Curriculum

Derived from the educational framework, the project offers a curriculum and a blended training program (2 ECVET credits / 50 working hours) on wise decision-making for business successors. These target six skills of practically wise business successors, which inform current decision-making (Kragulj *et al.*, 2024):

1. Phronetic business successors think future-oriented and plan strategically. Adopting a future perspective, they think long-term and anticipate the consequences of their decisions.
2. They critically reflect on past failures and successes to understand the legacy of their organization, both from a within and outside perspective.
3. They take a holistic perspective on a decision situation. This is to realize the "social, cultural, ecological and ethical complexity and interdependence in which they have to make their decisions".
4. They "seek an in-depth analysis of the decision-making situation" at hand. They understand the particular circumstance of this situation and consider the "subjective influences on a decision-making situation".
5. They gain from the experiences of peers. They can transfer what they have learned to their own field.

[2] https://www.wiseup2succeed.eu

6. They have an open mind in their thoughts and actions. In this way, they can deal with ambiguity in complex environments using a wide behavioral repertoire.

Table 1: Learning Perspectives and Axis (Kragulj *et al.*, 2024).

Axis	Learning Perspective	Short Description
"Time: Vision and Reflection"	"Viewing Ahead"	Envisioning the future outcomes of a decision, anticipating future developments, and, complementarily, shaping future scenarios that are desirable and normative.
"Time: Vision and Reflection"	"Viewing Backwards"	Reflection on personal and others' experiences (success and failure) involving thorough analysis.
"Locus: Ego and Eco Transcendence"	"Viewing from Above"	Understanding the ecological complexity, embeddedness, and interconnectedness of cause-and-effect relationships beyond the decision situation; awareness of the influence of overarching ecosystems and their impact.
"Locus: Ego and Eco Transcendence"	"Viewing from Below"	Empathy and understanding of stakeholders' contexts, comprehending diverse perspectives, and sensing the social and situational aspects of the decision-making situation.
"Ethos: Peer Learning and Inspiration"	"Viewing Near"	Interdisciplinary learning from peers by engaging with their experiences and wisdom, using these insights as a valuable resource.
"Ethos: Peer Learning and Inspiration"	"Viewing Far"	Creativity and open-mindedness toward alternative decision-making approaches; engaging with the practices of professionals from other fields.

The training program implements the educational framework. As a blended format, it comprises six online learning units (reflecting the six learning perspectives) for individual learning and an on-site workshop for peer learning. It draws from six learning perspectives organized along three axis (see Table 1).

The six online learning units consist of pre-recorded lectures that introduce concepts or methods, outline their relevance to the context of the target group, and provide examples, as well as ad-hoc and long-term tasks and quizzes to anchor what they learned in their own decision-making practice. In the peer workshop, business successors from different industries but at the same career stage (i.e., business succession) apply the learning perspectives to decision-making situations that reflect moral dilemmas in teams. By applying the concepts and methods provided in the decision-making process, learners can gain experience and cultivate their practical wisdom. In conclusion, the project aims to improve the decision-making skills of business successors for more sustainable and responsible business management. This group has been largely neglected in the literature despite its importance to the European business landscape (De Freyman and Durst, 2023). In particular, the training program provides young entrepreneurs with tools to methodically substitute the decision-making experience of their predecessors, which is commonly seen as an important source of practical wisdom. The training program is being piloted in a consortium of three European universities in different countries. The results of the evaluation are expected later this year.

4. Conclusion

Recent contributions highlight that a considerable branch of knowledge management is shifting towards non-rational forms of knowledge. Increasing demand for and interest in topics such as practical wisdom, spirituality, organizational purpose, and responsible (knowledge) management requires respective means to acquire such knowledge. Academia, on the other hand, is in charge of teaching non-rational forms of knowledge to future practitioners. We argue that incorporating experiential learning, collaborative knowledge creation, and reflective practice in course designs is crucial for effectively conveying those tacit types and non-rational forms of knowledge to students. Accordingly, we have developed three different course designs that apply these principles and evaluated them with regard to students' learning experiences and the emergence of new knowledge. Results show promising outcomes in terms of students' engagement and intrinsic motivation to learn. In particular, the element of creative autonomy was very well received by students. We also noticed that mutual trust and respect were essential to facilitate an enabling learning environment. The lecturers in such settings must create and uphold a "safe space" in which experimentation can take place, and mistakes are seen as a necessary and inevitable part of learning. In comparison, non-rational knowledge requires more open and less structured tasks than rational-analytic knowledge, which can be challenging for some students because it confronts them with the discomfort of uncertainty that may lead to internal conflicts and a lack of responsibility if the situation is framed incorrectly or insufficiently by the lecturer. Overall, through these first attempts of teaching non-rational, future-oriented types of knowledge, we seek to contribute to knowledge management education by firstly emphasizing the need to bring forth non-rational types of knowledge into practice and, secondly, providing initial cues on how to design respective formats to educate people in practically wise decision making, spirituality, and innovation through self-transcending knowledge.

Acknowledgements

Parts of this research were funded by the European Union ("Wise up to Succeed: Learning Spaces for Sustainable and Responsible Decision-Making" project, 2023-1-AT01-KA220-VET-000166057). Views and opinions expressed are however those of the authors only and do not necessarily reflect those of the European Union or the OeAD-GmbH. Neither the European Union nor the granting authority can be held responsible for them.

References

Bachmann, C., Sasse, L. and Habisch, A. (2018) 'Applying the Practical Wisdom Lenses in Decision-Making: An Integrative Approach to Humanistic Management', *Humanistic Management Journal*, 2(2), pp. 125–150.

Barnard, C.I. (1938) *The functions of the executive*. Harvard university press.

Bas, A., Sinclair, M. and Dörfler, V. (2023) 'Sensing: The elephant in the room of management learning', *Management Learning*, 54(4), pp. 489–510.

Bratianu, C. (2017) 'Emotional and spiritual knowledge', *Knowledge and project management: A shared approach to improve performance*, pp. 69–91.

Bratianu, C. and Vatamanescu, E.-M. (2017) 'Students' perception on developing conceptual generic skills for business: a knowledge-based approach', *VINE Journal of Information and Knowledge Management Systems*, 47(4), pp. 490–505.

Brewer, P.D. and Brewer, K.L. (2010) 'Knowledge Management, Human Resource Management, and Higher Education: A Theoretical Model', *Journal of Education for Business*, 85(6), pp. 330–335.

Brown, J. and Isaacs, D. (2005) *The world cafe. Shaping our futures through conversations that matter*. San Francisco, CA: Berrett-Koehler.

Chen, J., Brem, A. and Wong, P.K. (eds) (2019) *The Routledge Companion to innovation management*. Oxon, New York: Routledge.

Chia, R. (2005) 'Book Review: The Aim of Management Education: Reflections on Mintzberg's Managers not MBAs', *Organization Studies*, 26(7), pp. 1090–1092.

Davenport, T.H. (2015) 'Whatever Happened to Knowledge Management?', *The Wall Street Journal*, p. 2.

De Freyman, J. and Durst, S. (2023) 'Business Transfer Paradox in Entrepreneurship Education: A research agenda for increasing the number of successors', *Journal of Innovation Management*, 11(2), pp. 1–21.

Durst, S. (2021) 'A plea for responsible and inclusive knowledge management at the world level', *VINE Journal of Information and Knowledge Management Systems* [Preprint].

Ehlers, U.-D. and Eigbrecht, L. (eds) (2024) *Creating the University of the Future: A Global View on Future Skills and Future Higher Education*. Wiesbaden: Springer Fachmedien Wiesbaden (Zukunft der Hochschulbildung - Future Higher Education).

Gallagher, S. (2023) *Embodied and Enactive Approaches to Cognition*. 1st edn. Cambridge: Cambridge University Press.

Glaveanu, V.P. (2022) 'Possibility studies: A manifesto', *Possibility Studies & Society*, 0(0), pp. 1–6.

Hartner-Tiefenthaler, M. *et al.* (2018) 'When relational and epistemological uncertainty act as driving forces in collaborative knowledge creation processes among university students', *Thinking Skills and Creativity*, 28(June 2018), pp. 21–40.

Hedlund, J. *et al.* (2003) 'Identifying and assessing tacit knowledge: understanding the practical intelligence of military leaders', *The Leadership Quarterly*, 14(2), pp. 117–140.

Hutto, D. (2023) 'Enactivism', *The Internet Encyclopedia of Philosophy, ISSN 2161-0002*, 2023.

Ingold, T. (2013) *Making. Anthropology, archaeology, art and architecture*. Abingdon, Oxon; New York, NY: Routledge.

Ingold, T. (2014) 'The creativity of undergoing', *Pragmatics & Cognition*, 22(1), pp. 124–139.

Kaiser, A. (2023) 'Spiritual Knowledge Management: Proposing a new approach and defining a Research Agenda', *Proceedings of the 56th Hawaii International Conference on System Sciences. Hawaii International Conference on System Sciences (HICSS)* [Preprint].

Kerschbaum, C. (2022) 'A beautiful strategy – bridging the gap between the (aesthetic) perception and (strategic) realization of the organizations purpose', *VINE Journal of Information and Knowledge Management Systems* [Preprint].

Kragulj, F. *et al.* (2018) 'Teaching Organizational Learning to Undergraduates: Applying Design Thinking in Problem-Based Learning', *European Conference on Knowledge Management (09): 414-422* [Preprint].

Kragulj, F. (2023) *Knowledge Management and Sustainable Value Creation: Needs as a Strategic Focus for Organizations*. 1st ed. 2023 edition. S.l.: Springer.

Kragulj, F. *et al.* (2024) 'Kragulj, F., Rocha, R., Durst, S., Pungartnik, K. (2024). Wise up to Succeed: An Educational Framework for Cultivating Practical Wisdom of Business Successors. EURAM-2024 European Academy of Management Conference', in *EURAM-2024 European Academy of Management Conference*.

Melé, D. (2010) 'Practical wisdom in managerial decision making', *Journal of Management Development*. Edited by M. Naughton, 29(7/8), pp. 637–645.

Miller, R. (2015) 'Learning, the future, and complexity. An essay on the emergence of futures literacy', *European Journal of Education*, 50(4), pp. 513–523.

Miller, R. (ed.) (2018) *Transforming the future. Anticipation in the 21st century*. Oxon, New York: Routledge.

Mintzberg, H. (2004) *Managers not MBAs: a hard look at the soft practice of managing and management development*. 1. paperback ed. San Francisco, Calif: Berrett-Koehler.
Newen, A., Burin, L. de and Gallagher, S. (eds) (2018) *The Oxford Handbook of 4E cognition*. Oxford: Oxford University Press.
Nonaka, I. and Takeuchi, H. (1995) 'The Knowledge-Creating Company', in *The Economic Impact of Knowledge*. Elsevier, pp. 175–187.
Nonaka, I. and Takeuchi, H. (2021) 'Humanizing strategy', *Long Range Planning*, p. 102070.
Peschl, M.F. *et al.* (2014) 'Learning how to innovate as a socio-epistemological process of co-creation. Towards a constructivist teaching strategy for innovation', *Constructivist Foundations*, 9(3), pp. 421–433.
Peschl, M.F. (2018) 'Shifting from collaboration with others to collaboration with the future in design and innovation processes', in DMI Design Management Institute (ed.) *Next wave. The21st dmi: Academic Design Management Conference Proceedings*. Boston, Mass: DMI, pp. 279–288.
Peschl, M.F. *et al.* (2019) 'The role of the shift from I-to-We and Theory-U in overcoming 21st century illiteracies', in O. Gunnlaugson and W. Brendel (eds) *Advances in Presencing (Vol 1)*. Vancouver: Trifoss Business Press, pp. 161–210.
Peschl, M.F. (2020) 'Theory U: From potentials and co-becoming to bringing forth emergent innovation and shaping a thriving future. On what it means to "learn from the future as it emerges"', in O. Gunnlaugson and W. Brendel (eds) *Advances in Presencing*. Vancouver: Trifoss Business Press, pp. 65–112.
Peschl, M.F. and Fundneider, T. (2012) 'Spaces enabling game-changing and sustaining innovations: Why space matters for knowledge creation and innovation', *Journal of Organisational Transformation and Social Change (OTSC)*, 9(1), pp. 41–61.
Peschl, M.F. and Fundneider, T. (2014) 'Designing and enabling interfaces for collaborative knowledge creation and innovation. From managing to enabling innovation as socio-epistemological technology', *Computers and Human Behavior*, 37, pp. 346–359.
Peschl, M.F. and Fundneider, T. (2017) 'Future-oriented innovation. How affordances and potentials can teach us how to learn from the future as it emerges', in W. Hofkirchner and M. Burgin (eds) *The future information society. Social and technological problems*. Singapore: World Scientific Publishing, pp. 223–240.
Peschl, M.F., Kaiser, A. and Fordinal, B. (2023) 'Enabling the Phronetically Enacted Self: A Path toward Spiritual Knowledge Management', *Sustainability*, 15(18), p. 13957.
Piaget, J. (1983) *Piaget's Theory, Handbook of Child Psychology*. Wiley.
Polanyi, M. (1966) *The tacit dimension*. Garden City, N.Y.: Doubleday.
Poli, R. (2021) 'The challenges of futures literacy', *Futures*, 132, pp. 1–9.
Rocha, R.G., Kragulj, F. and Pinheiro, P. (2022) 'Practical wisdom, the (not so) secret ingredient for responsible knowledge management', *VINE Journal of Information and Knowledge Management Systems* [Preprint].
Rocha, R.G. and Pinheiro, P.G. (2021) 'Organizational spirituality: Concept and perspectives', *Journal of Business Ethics*, 171(2), pp. 241–252.
Rocha, R.G., Pinheiro, P.G. and Kragulj, F. (2024) 'Organizational Practical Wisdom', in *Reference Module in Social Sciences*. Elsevier.
Savery, J.R. (2006) 'Overview of Problem-based Learning: Definitions and Distinctions', *Interdisciplinary Journal of Problem-Based Learning*, 1(1).
Schaltegger, S. and Wagner, M. (2011) 'Sustainable entrepreneurship and sustainability innovation: categories and interactions', *Business Strategy and the Environment*, 20(4), pp. 222–237.
Scharmer, C.O. (2001) 'Self-transcending knowledge. Sensing and organizing around emerging opportunities', *Journal of Knowledge Management*, 5(2), pp. 137–150.
Scharmer, C.O. (2016) *Theory U. Leading from the future as it emerges. The social technology of presencing*. second. San Francisco, CA: Berrett-Koehler Publishers.
Schön, D.A. (1987) 'Educating the reflective practitioner'.
Serenko, A. (2024) 'Practical wisdom in the workplace: conceptualization, instrument development, and predictive power', *Journal of Knowledge Management* [Preprint].
Storey, M., Killian, S. and O'Regan, P. (2017) 'Responsible management education: Mapping the field in the context of the SDGs', *The International Journal of Management Education*, 15(2), pp. 93–103.
Thomassen, A.O. and Jørgensen, K.M. (2021) 'John Dewey and continuing management education: problem-based learning for organizational sustainability', *Journal of Workplace Learning*, 33(3), pp. 229–242.
Tidd, J. and Bessant, J. (2020) *Managing innovation. Integrating technological, market and organizational change*. 7th edn. Chichester: John Wiley & Sons.
UNESCO (2021) *Learning to become with the world: education for future survival*. Paris: UNESCO (Futures of Education). Available at: https://unesdoc.unesco.org/ark:/48223/pf0000374032?fbclid=IwAR0YU-sJserzEoHPvkRHkYAYO1Eq_nyFjHmcH8Em0n4KJx0BZib4hP5bk8A (date of download: 07.12.2021).
Warren, S. (2008) 'Empirical Challenges in Organizational Aesthetics Research: Towards a Sensual Methodology', *Organization Studies*, 29(4), pp. 559–580.

Co-funded by the European Union

Knowledge Continuity Aspects in Designs and Contracts of Dutch Storm Surge Barriers

Merlijn Kamps[1,2], Johan van den Bogaard[3], Martine van den Boomen[4,5] and Marcel Hertogh[6,7]

[1]Rotterdam University of Applied Sciences, department of Civil Engineering, Rotterdam, Zuid-Holland, NL,
[2]Delft University of Technology, Faculty of Civil Engineering and Geosciences, Department of Materials, Mechanics, Management & Design, Section of Integral Design and Management, Delft, Zuid-Holland, NL
[3]Rijkswaterstaat, Ministry of Infrastructure and Water Management, Den Haag, Zuid Holland, NL.
[4]Rotterdam University for Applied Sciences, CoE HRTech, Rotterdam, Zuid-Holland, NL,
[5]Delft University of Technology, Faculty of Civil Engineering and Geosciences, Department of Hydraulic Engineering, Section of Hydraulic Structures and Flood Risk, Delft, Zuid-Holland, NL
[6]Delft University of Technology, Department of Materials, Mechanics, Management & Design, Section of Integral Design and Management, Delft, Zuid-Holland, NL,
[7]Erasmus University Rotterdam, Resilience Convergence and Design, Rotterdam, Zuid-Holland, NL

m.kamps@hr.nl
johan.vd.bogaard@rism.eu
m.van.den.boomen@hr.nl
m.j.c.m.hertogh@tudelft.nl

Abstract: The infrastructure we build is increasingly complicated and automated. After it is designed and constructed, it needs to be maintained and updated to sustain its functioning for far longer than the careers of its designers and builders. Continuity of engineering knowledge is necessary to make future updates and adapt to changing demands, conditions and technology in a safe and reliable manner. The Dutch storm surge barriers protect the low-lying hinterlands from flooding during extreme weather events. Each of the six barriers managed by the Directorate General of Public Works (Rijkswaterstaat) was designed at a different time, to different requirements, and using different types of contracts. This has resulted in six unique structures, some of which use systems and components found nowhere else. In 1997, the Maeslant Storm Surge Barrier was completed, pioneering the use of Design and Construct contracts for major hydraulic structures. Experience with maintaining this hallmark structure through its first decades of operation provides a valuable opportunity to reflect on the effect of contracting- and design choices. Little work has been done to evaluate different contract types on the basis of delivering long-term maintainability and reducing the knowledge continuity challenge. This study views the Maeslant Barrier in the context of the earlier storm surge barriers with regard to facilitating knowledge continuity through design. It was found that the interdependent behaviour of subsystems in a high-reliability structure results in a notable increase in engineering complexity, especially in the control systems, increasing the challenge of achieving knowledge continuity. Examining the knowledge flows in a design-and-construct contract shows several advantages, but also that it does not naturally facilitate attention to important but less obvious aspects of maintainability, such as those related to knowledge continuity.

Keywords: Knowledge Continuity, Continuity Management, Maintainability, Storm Surge Barrier, Obsolescence, Life-Cycle Engineering

1. Introduction

Hydraulic structures such as locks, weirs, and storm surge barriers play a critical role in managing water levels in river delta waterways. These structures are major investments, and it is crucial that their functionality and reliability are sustained for the intended service life, typically about 100 years (Walraven, Vrolijk, and Kotshuis, 2022). Storm surge barriers are also unique structures, which are operated only when necessitated by external conditions, yet as critical infrastructure their reliability and availability must be guaranteed throughout the life-cycle (Kharoubi, 2023).

During these structures' long service life, many changes occur in their environment. These may include changes in laws on water regulation, advancements in technology, shifts in environmental- and safety regulations, and the impact of climate change, including altered water levels and storm intensities (Walraven, Vrolijk and Kotshuis, 2022). The Directorate-General of Public Works in the Netherlands, Rijkswaterstaat (RWS), has a rich history of designing, building, and managing major hydraulic structures. This paper will focus on the Dutch storm

surge barriers, the oldest of which has been continuously operational since 1958 and remains of vital importance to flood safety to this day. The long experience managing storm surge barriers has shown that the changing environment of these engineering structures has caused many cases of partial or subsystem obsolescence. (Walraven, Vrolijk and Kotshuis, 2022). A major source of obsolescence at the barriers is the control system. Electronics and operating systems need to be replaced when they are no longer supported by industry. Efforts to replace barrier control systems have proven to be challenging.

In the 1990s, RWS started outsourcing more of its (re)design work, and has since continued this policy (Brink, 2009). The outsourcing policy has reduced the number of knowledgeable engineers directly employed by RWS. RWS still requires procurement process and engineering knowledge to be an effective principal (Vinke, 2013; Walraven, Vrolijk and Kotshuis, 2022). In 2018 a program was started specifically for managing key engineering and operational knowledge of RWS's storm surge barriers.

2. Literature

Managing knowledge for complex, long lived assets has received considerable scholarly attention, especially in the nuclear energy sector, where there are scientific journals dedicated specifically to the subject. The impact of decisions in the design and procurement phase on the knowledge continuity challenge during the life-cycle of the asset has received little attention. The majority of papers take the engineering knowledge to be managed as a given. Boy and Barnard (2019) briefly touch on design choices in their study on knowledge management for safety-critical systems. Reducing knowledge continuity challenges through early design and contracting decisions remains an understudied topic.

Unique and complex storm surge barriers are found challenging to maintain long term (Walraven, Vrolijk, and Kotshuis, 2022). The science of maintainability aims to cover all design aspects affecting maintenance during the life-cycle. Dhillon (1999) offers design principles contributing to maintainability. In Section 5, we examine if these principles contribute to or oppose knowledge continuity.

Ivory, Thwaites and Vaughan (2001) studied the process of designing for maintainability in multiple cases. They found that for good results, the design process must be conceptualized from the beginning to integrate maintainability. Design for maintainability should be supported by data and practical maintenance experience (Dhillon, 1999). This knowledge is generally outside the core competence of the primary contractor and engineering consultant of a project delivery organization, forcing buyers to rethink and adjust their contracting strategy to better facilitate maintainability (Ivory, Thwaites and Vaughan, 2001). In Section 6, we examine key knowledge contributions and flows between partners in two contracting strategies used for storm surge barriers.

3. Method

The research is situated at RWS, in the research group on asset management of storm surge barriers. Work is also physically located in the asset management office for four of the six storm surge barriers. Research data collection is primarily based on interviews with current and former storm surge barrier professionals. Other data sources are public writings on the storm surge barriers and confidential policy- and consultancy documents. For this paper, only public sources are referenced, while the available confidential reports were used for validation through triangulation. Ten initial interviews were held. Participants include storm surge barrier engineering and asset management professionals, an external engineering consultant, a reliability expert and a barrier manager. The participants were selected to cover teams from multiple storm surge barriers, multiple roles, and include both current and retired professionals. The aim was to cover the distinct perspectives. Interview questions centered on current knowledge management practice, knowledge management history and experience with knowledge management challenges. During the interviews, the topic of barrier complexity recurred almost exclusively in relationship to the Maeslant Barrier. To explore this further, an ongoing series of adaptive interviews was conducted focusing specifically on barrier design choices and their effects on barrier complexity. In these complementary interviews, the main topics were complexity in barrier engineering, complexity of barrier control systems, trade-offs in complexity versus simplicity, and the process and history of how these (design) decisions were made. Interviews were recorded by audio recording and transcription or by taking minutes, depending on the preference of the participant. Transcriptions or minutes were then sent to the participant for review and approval.

Interview analyses of both initial and follow-up interviews were done using the Thematic Analysis method (Braun and Clarke, 2021). Atlas.ti was used to code the interviews, and also to facilitate the review of public and

confidential reports. Because of the immersive character of the research, any apparent contradictions between interviews or between interviews and documents could be quickly resolved by additional questions to participants or their colleagues at the barrier's office.

4. Controlling the Maeslant Storm Surge Barrier

A storm surge barrier is a very large gate, or set of gates, that can open or close a waterway depending on what hydraulic conditions require. This function by itself does not require a very complex structure. The most common type of storm surge barrier is the lifting gate (Mooyaart and Jonkman, 2017). Lifting gates, as well as the second most common design, segment gates, are 'passive' gates. When open, the gates are above the water and lowered into it to close the waterway. A passive barrier can be closed without an external power source. Lifting gates and segment gates can be closed by force of gravity if electric power fails. The potential to close by force of gravity contributes to the reliability of a storm surge barrier. Although the structures may be very large, expensive, and take a long time to build, the engineering and control systems involved are not overly complicated. All the Dutch storm surge barriers preceding the Maeslant Barrier are of the lifting gate and segment gate types. Ponsioen and Nederend (2023) provide a description of all six RWS storm surge barriers.

The design requirements of the Maeslant Barrier called for a normally open storm surge barrier that posed no height restrictions on shipping, and introduced no obstacles in the shipping lane. Because of these requirements, the Maeslant Barrier needed to be of a different type than the earlier barriers. A design and construct contract was tendered, resulting in the design of the Maeslant Barrier. It is a barrier of the floating sector-gate type, and was chosen from five proposals and a reference design (sliding gates). The working principle of all six designs is depicted in Figure 1. RWS (2012) provides a more detailed description of the Maeslant Barrier's working, engineering, and procurement process.

Because of the importance of the Maeslant Barrier for flood safety, a high reliability target was set. To avoid the possibility of operational mistakes, the barrier was designed to be fully automatic. The design and construct contract featured a maintenance period of five years, starting after completion of its construction in 1997. While RWS was preparing to take over maintenance and design responsibilities of the barrier, it became clear that the automatic closure reliability of the barrier (software reliability) could not yet be accurately assessed. It was also noticed that knowledge continuity of its complex software was going to be a major challenge. The Maeslant Barrier was the first barrier where RWS was not directly participating in the design. Because of this, RWS staff was not immediately familiar with the finer details of the hardware and software. A major improvement effort was started in 2001 to address these issues. A full barrier reliability analysis showed that the probability of failure of the automated control system was a major contributor to not meeting reliability targets for the barrier, but also that it could not be accurately determined (Nieuwenhuizen Wijbenga, 2019). To meet reliability requirements and to bypass potential software failure, a backup procedure of human intervention was instated. Also, a first knowledge management program was started as part of the improvement effort. This involved hiring knowledgeable engineers from the building combination into RWS and establishing a digital knowledge management system. These efforts led to the barrier passing audits in 2007.

Even though it has been established that primary automatic control with a highly trained operational backup team present is sufficient to meet reliability targets, accurately assessing the reliability of automated control of the Maeslant Barrier has remained elusive. To prepare the barrier for the rest of its service life, a new control system was required, but the first two attempts at its development were halted before completion (Nieuwenhuizen Wijbenga, 2019; Osch and Amerongen, 2023). The new control system must have proven reliability, modernized security features, and be more hardware-independent. Being able to provide a direct proof of a new system's reliability is very important. Because the existing system has been proven in use, a new system must be proven at least as reliable without the need for additional maritime-traffic disrupting live-tests. Efforts thus far could not prove reliability improvement beyond doubt.

Difficulties and delays in proving reliability of software systems for hypothetical adverse situations have been common in the Netherlands for other infrastructure as well, and are described for tunnels in Ruland et al. (2012). The long-term maintenance of complex legacy software systems remains a major challenge, and is largely due to inevitable attrition of knowledge during the life cycle (Anquetil et al., 2007). Experience managing its various complex assets has lead RWS to investigate whether some of the software complexity can be avoided through early design choices. Traditionally, early design focusses on the civil and hydraulic engineering aspects of the design, as these influence construction costs the most. Lately however, this view is shifting towards an early

involvement of software and control, at both RWS and the major Dutch infrastructure contractors (Rijkswaterstaat, 2019).

5. A Knowledge Continuity View on Storm Surge Barrier Design

Within RWS, many of the challenges with sustaining the control systems and other complex systems in storm surge barriers are attributed to the inability to achieve continuity of designer-level engineering knowledge. The timeframes between initial- and re-design are typically twenty to thirty-five years. During this time, knowledge loss from attrition will affect RWS, as well as the companies that designed and built the structure.

Challenges to knowledge continuity can potentially become a serious impediment to long-term sustainment. Designing systems in such a way that knowledge continuity challenges are reduced, can therefore make a meaningful contribution to the long-term maintainability of a barrier. Major contributors to the challenge of achieving knowledge continuity are the complexity of engineering, the uniqueness of some of the systems and components, long redesign cycles of systems, and high-reliability requirements. With the exclusion of the long redesign cycles, these challenge-driving characteristics can be recognized as being almost direct opposites to the established maintainability principles of simplicity, modularity, standardization, and testability (Dhillon, 1999). Complexity is the opposite of simplicity and modularity. Uniqueness is the opposite of standardization, and reliability requirements preclude most live-testing at the barriers. The long redesign cycles constitute a significant challenge to knowledge continuity, but given the cost of redesigning and updating a barrier, long cycles are desirable from a maintainability perspective.

The effect of simplicity on knowledge continuity is largely self-evident. If a design is easy to understand, less engineering knowledge needs to be passed down through generations of engineers. A modular design has a loose-coupling and clear interfaces between the modules. Therefore any module can be redesigned without having to worry about unforeseen knock-on effects on other parts. This avoids the requirement of a deep understanding of the integral workings of the whole barrier to redesign one module. Standardization means that there are many identical or very similar systems used elsewhere, increasing availability of knowledge. In a testable system, modifications and improvements can be verified before they need to be relied upon.

The Dutch storm surge barriers show significant differences in the knowledge continuity challenge over their life-cycle. The differences in knowledge continuity challenge can be related to the variations in the basic design of the barriers. The following paragraphs will show that when a storm surge barrier features a redundancy at the gate level, a favorable knowledge continuity profile is created. This will be explained in the following paragraphs using the principles of simplicity, standardization, modularity and testability.

Three of the Dutch storm surge barriers feature redundancy at the gate level. The Eastern Scheldt Barrier has 62 parallel gates. The Haringvliet sluice features 17 parallel openings. The Dutch IJssel Barrier has two gates in series, each fully capable of closing the waterway. Redundancy at the gate level is very beneficial to achieve simplicity of the operating system of the barrier. When one gate fails in a barrier with gate-level redundancy, the other barriers can close in the same way as always. The control system therefore does not need to feature separate provisions for every combination of working and non-working gates. This keeps the control program short and simple.

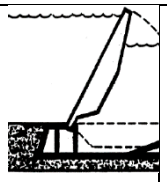
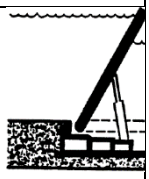
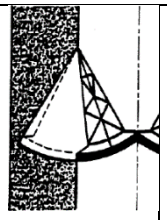
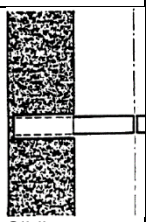
The control system of the Maeslant Barrier has proven to be the most challenging system to sustain in the face of obsolescence. The case of barrier control, where all systems work as intended, is referred to as the ‘happy flow’. Most of the complexity comes from what engineers involved with the barrier call ‘the unhappy flow’ of barrier control, in which the control system has to allow for one or more failed components. The Maeslant Barrier has no redundancy at the gate level, as both gates must close for the barrier to be effective against a storm surge . The barrier does have redundancy at the level of its pumps and valves. This creates a large number of possible partially failed but still operational states to account for in the control system. Allowing operation for a multitude of cases of component failure increases the reliability of the barrier, but also the complexity of the controls. The unhappy flow makes up roughly three quarters of the control program of the Maeslant Barrier. Rewriting the control system to avoid technical obsolescence requires highly case-specific and detailed knowledge of the set of built-in ‘unhappy flows’. It is very challenging to credibly and verifiably prove the reliability of this complex system with limited testability.

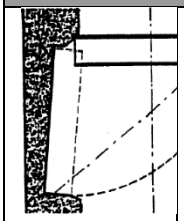
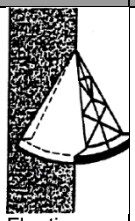
When a barrier has redundancy at the gate level, the failure to close one gate does not create a large enough opening to cause flooding. Redundancy of gates creates internal modularity, standardization, and testability. Having multiple identical gates to maintain increases internal opportunities for learning and intergenerational

transfer of knowledge during maintenance. This internally re-creates the benefits of standardization, even if the technology used becomes obsolete by outside standards. A barrier with multiple (almost) identical gates is also inherently modular. Each gate is a module, when its operation is independent of the other gates. When one gate fails during a storm closure, the other gates can close the same way as otherwise. Testability is guaranteed because any modification or upgrade can be tested on one gate, and only be applied at the other gates after thorough verification.

As the Maeslant Barrier was the first storm surge barrier that does not feature redundancy at the gate level. It therefore has a less favorable profile for the knowledge continuity-aspect of maintainability. In the selection of the design, general maintainability was nonetheless a major concern. Figure 1 divides the six barrier types of which designs were developed for the Maeslant Barrier into three groups. The basic designs of group 1 offer a simple, modular design with a high number of identical 'valves' or partial gates. Failure of one 'valve' or partial gate does not cause the whole storm closure to fail, providing redundancy at the gate-level. Group 2 offers fixed paths of movement, so relatively simple controls, but no gate-level redundancy. The third group has floating gates which require more complex controls, and also no redundancy. Hydraulic aspects of maintainability are however most favorable for the third group, as these designs are relatively insensitive to silting-up and require little underwater maintenance. The first group is both sensitive to silting and requires underwater maintenance, and the second group once again takes the middle position. It can be seen that avoiding complexity of controls through basic design choices is feasible for the design requirements of the Maeslant Barreir, but comes with important trade-offs in other aspects of maintainability. Participating senior engineers consider simplicity an important concern, but still secondary to other design aspects. Since all height-restriction free barrier types shown in Figure 1 are in use somewhere in the world, there is an important opportunity to record and share sustainment challenges and performance, so all relevant actors can learn more about the development of the relative importance of aspects of maintainability and knowledge continuity. The I-storm network of storm surge barrier managers is a good platform for this.

Table 1:Adapted from (Riteco, 2017)

Design & schematics	Simplicity	Standardization, Modularity & Testability	Other maintainability
Group1: Tumble gates / flap gates.  Pneumatic tumble gate  Hydraulic tumble gate	- Fixed path of movement and independent valves will result in a simple operating system	- Reliable parallel systems (14 and 24 independent gates) - Modifications can be tested on one gate before the others are renovated - Best for standardization, modularity and testability	- Silting up of valves - Underwater maintenance
Group 2: Rolling and sliding gates  Rolling sector gate  Sliding gate	- Fixed path of movement and independent valves will result in a simple operating system	- No gate-level redundancy - Modifications need to be applied to the whole barrier at once	- Gates need to plough through sediment deposits
Group 3: Floating gates	- Process control of gate closure		

Design & schematics		Simplicity	Standardization, Modularity & Testability	Other maintainability
 Barge gate	 Floating sector gate	not easy, especially for barge gate	- No gate-level redundancy - Modifications need to be applied to the whole barrier at once	- Insensitive to silting up - Ease of physical maintenance

6. An Inter-Organization Knowledge-Transfer View on Storm Surge Barrier Design

General knowledge management theory has established that knowledge exchange between departments or organizations working together can be slow and ineffective, see for example Szulanski (1996). Given that knowledge transfers best when people work together, it is possible to consider the effects of different setups for promoting or impeding the flow of knowledge. Figure 2 identifies five knowledge flows related to building a new structure. From 2a to 2b, it is shown which knowledge flows are improved or impeded, switching from a traditional Bid & Build procedure where RWS designed its barriers itself, to the Design & Construct (D&C) contract used for the Maeslant Barrier.

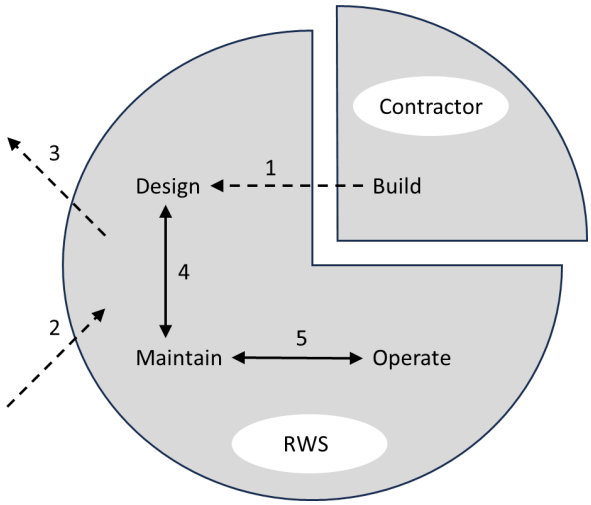


Figure 1: Dutch IJssel Barrier and Haringvliet Sluices (Bid & Build, self-designed and initially self-maintained)

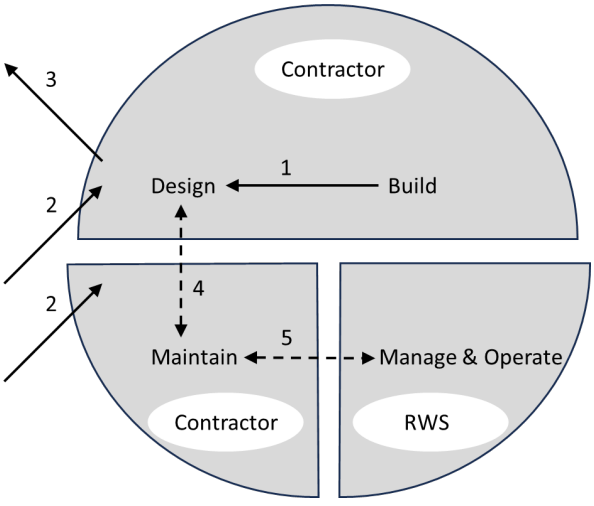


Figure 2: Maeslant Barrier (D&C, outsourced maintenance)

The dashed arrows in Figure 2 represent relatively more difficult, and the solid arrows relatively more effective flows of knowledge. The traditional Bid & Build, self-maintained model in Figure 2a has three dashed arrows. Since RWS designed, maintained, and operated the barriers by itself, there was less room to benefit from knowledge and innovation available from construction companies (Rijkswaterstaat, 2004). This is represented by arrow 1. Private engineering firms had less opportunity to input the latest design knowledge (arrow 2), and there was also less opportunity for re-use of design experience by the market (arrow 3).

Figure 2b represents a D&C contract with an outsourced maintenance model. Design services are provided by market parties (arrow 2). Re-use opportunity of design experience in the market (arrow 3) has arguably improved. Dutch firms that regularly work for RWS also consult for major hydraulic projects around the world, see e.g. Zwaan (2018). For the design of the Maeslant Barrier, RWS was specifically not to interfere with the engineering. This left little room to input its own knowledge regarding barrier maintainability to the design, leaving decades of experience managing the earlier barriers unused (arrow 4). Responding former design engineers and consulting engineers consider limited attention to maintainability in the Maeslant Barrier design as a result of the D&C contract. The contractor had a five-year maintenance obligation, and no further maintainability clauses were part of the D&C requirements. This gave the contractor little incentive to consider the impact of design choices on knowledge continuity as a factor in long-term maintainability. RWS not insisting on having a say in maintainability is also illustrative of a limited focus on maintainability from RWS during its early transition years from leading designer to professional principal. Herd and Pirretti (2022) identify a lessons learned program as a key function of knowledge management in an organization driven by a succession of major engineering projects. It is important for the transition at RWS to continue the development of internal knowledge on maintainability and design for knowledge continuity.

Finally, arrow 5 deals with the knowledge exchange between asset management and the maintenance contractor. Professionals report that detailed access to maintenance information indicating the state of the asset is less accessible compared to when internal technical services provided maintenance to the barriers. As more experience is gained with the new outsourced setup, procedures are being improved, resulting in a better flow of knowledge.

In summary, when developing truly new solutions through a D&C contract, there is a vulnerability to insufficient attention to maintainability, because a D&C contract does not create a shared work environment for those with experiential knowledge of maintainability, and those in charge of the design. The use of integrated contracts for design, therefore, requires extra attention to maintainability in general and those parameters that are crucial to knowledge continuity in particular.

7. Discussion

The benefits of producing goods in high numbers is so well-known nearly everyone has become familiar with the expression ‘economics of scale’. Flyvbjerg and Gardner (2023) note that projects in sectors with a high degree of repetition and modularity like solar and windfarms are far less likely to experience considerable cost-overruns. This study sees the benefits of standardization and modularity also applying to the long-term knowledge continuity management of complex assets. What is perhaps most surprising is that these benefits start from very small numbers. Participants from the Dutch IJssel Barrier report few issues, despite it being the oldest barrier. The paper offers an explanation to differences between respondents from different barriers in knowledge continuity challenges reported. The benefits of simplicity, standardization, modularity and testability which are present in the design of the older barriers explain the why less challenges are reported there. When making a design they must however be carefully weighed against other factors. As was seen in the discussion of Figure 1, the designs for the Maeslant Barrier that most allign with the principles of simplicity, standardization, maintainability and testability, had major drawbacks on other aspects of maintainability.

This paper has shown that with regards to knowledge continuity, even within a specific domain like storm surge barrier design and contracting, not all design and contracting methods are created equal, and it is well possible to analyze these for their knowledge continuity profile. This does however not necessarily offer a method for selecting a better design outright, as there are other major factors to consider as well. Its value is in showing how knowledge continuity can be made a key topic from the earliest discussion of design and contracting options.

8. Conclusion

It was shown that engineering complexity in the design and control of a storm surge barrier is a feature that emerges through design choices, but does not result from the design requirements as an absolute necessity. It was also shown that designs featuring redundancy at the gate level, either through parallel partitioning in a relatively large number of gates, or by putting gates in series, create favorable conditions for long-term maintainability and sustainment of function. The design principles are simplicity, modularity, standardization and testability. Achieving a high degree of simplicity requires a favorable 'unhappy flow' of control. Finally, while there are currently a multitude of commissioning or procurement contract types available, none of these are specifically geared toward the long-term sustainment and knowledge continuity of assets. It is, therefore, of vital importance to internally collect experiential knowledge on these topics and make it a consideration in future (re)designs.

References

Anquetil, N., de Oliveira, K.M., de Sousa, K.D., Batista Dias, M.G. (2007), "Software maintenance seen as a knowledge management issue", *Information and Software Technology*, 49(5), pp. 515–529. Available at: https://doi.org/10.1016/j.infsof.2006.07.007.

Boy, G. and Barnard, Y. (2019) 'Knowledge Management in the Design of Safety-Critical Systems', in F. Schmalhofer, R. Young, and G. Katz (eds) *Proceedings of EuroCogSci 03*. 1st edn. Routledge, pp. 67–72. Available at: https://doi.org/10.4324/9781315782362-21.

Braun, V. and Clarke, V. (2021), "*Thematic Analysis: A Practical Guide"*. SAGE Publications.

Brink, M. A. v. d. (2009), "*Rijkswaterstaat on the horns of a dilemma"*. Eburon, Netherlands

Dhillon, B.S. (1999) *Engineering Maintainability*. Houston: Gulf Professional Publishing. Available at: https://doi.org/10.1016/B978-088415257-6/50001-6.

Flyvbjerg, B and Gardner, D (2023). *HOW BIG THINGS GET DONE: The Surprising Factors Behind Every Successful Project, from Home Renovations to Space Exploration.* Penguin Random House, New York.

Ivory, C.J., Thwaites, A., Vaughan, R. (2001) 'DESIGN FOR MAINTAINABILITY: THE INNOVATION PROCESS IN LONG TERM ENGINEERING PROJECTS' *Conference "The Future of Innovation Studies"* Eindhoven University of Technology, the Netherlands. Available at: https://www.maintenanceworld.com/wp-content/uploads/2013/06/DESIGN-FOR-MAINTAINABILITY-THE-INNOVATION-PROCESS-IN-LONG-TERM-ENGINEERING-PROJECTS.pdf

Kharoubi, Y., van den Boomen, M., Hertogh, M.J.C.M., van den Bogaard, J., (2023), "Foundation for risk-based asset management for storm surge barriers: IALCCE 2023", *Life-Cycle of Structures and Infrastructure Systems*. Edited by F. Biondini and D.M. Frangopol, pp. 3214–3221. Available at: https://doi.org/10.1201/9781003323020-392.

Osch, H.J.A. and Amerongen, van, S.J. (2023) "Definitief BIT-advies project BEST2DO*" Adviescollege ICT-toetsing*. No. 2023-0000435345. Available at: https://www.rijksoverheid.nl/binaries/rijksoverheid/documenten/rapporten/2023/08/22/bijlage-definitief-bit-advies-best2do/bijlage-definitief-bit-advies-best2do.pdf

Mooyaart, L.F. and Jonkman, S.N. (2017) 'Overview and Design Considerations of Storm Surge Barriers', *Journal of Waterway, Port, Coastal, and Ocean Engineering*, 143(4), p. 06017001. Available at: https://doi.org/10.1061/(ASCE)WW.1943-5460.0000383.

Herd, A. and Piretti, F. (2022) 'Lessons Learned process case study: An unintended enabler of upstream and downstream knowledge management capabilities at the European Space Agency', *European Conference on Knowledge Management*, 23, pp. 510–518. Available at: https://doi.org/10.34190/eckm.23.1.675.

Nieuwenhuizen Wijbenga, C. (2019) "Vaststelling van d ebegrotingsstaat van het Detafonds voor het jaar 2019", *BRIEF VAN DE MINISTER VAN INFRASTRUCTUUR EN WATERSTAAT* [online], Officiele Bekendmakingen, available at: https://zoek.officielebekendmakingen.nl/kst-35000-J-34.html

Ponsioen, L.A. and Nederend, J.M. (2023) *Investigation and development of a Digital Twin for the Maeslant barrier: Exploring the application of digital twins in the maintenance and operation of storm surge barriers*. Delft University of Technology. Available at: https://research.tudelft.nl/en/publications/investigation-and-development-of-a-digital-twin-for-the-maeslant-

Rijkswaterstaat (2004), "*Ondernemingsplan: Een nieuw perspectief voor Rijkswaterstaat: doorpakken, wel degelijk",* Directoraat-Generaal Rijkswaterstaat, Den Haag. Available at: https://open.rijkswaterstaat.nl/zoeken/@29231/ondernemingsplan-nieuw-perspectief/#highlight=ondernemingsplan%202004

Rijkswaterstaat (2012). '*Basic documentation Maeslant Barrier'*, Ministry of Infrastructure and Environment. Available at: https://repository.tudelft.nl/islandora/object/uuid%3A2cacc100-f8b7-4ec3-9d3b-3e08c0eddf18

TEC Tunnel Engineering Consultants | TEC Tunnel (tec-tunnel.com)

Rijkswaterstaat (2019) '*Toekomstige Opgave Rijkswaterstaat: Perspectief op de uitdagingen en verbetermogelijkheden in de GWW-sector',* Rijkswaterstaat. Available at: https://repository.tudelft.nl/islandora/object/uuid:4adbc7c8-b41d-4193-8b73-2ba3759d9022/datastream/OBJ/download

Riteco, J. (2017) "*Maeslant barrier: Alternative solution for the upgrading of the Maeslant barrier*". Available at: https://repository.tudelft.nl/islandora/object/uuid%3A0d0d0de6-4807-4ae3-8c6f-af92b1cf064b

Ruland, M.F. et. al. (2012) 'An integrated functional design approach for safety related tunnel processes', *Proceedings from the Fifth International Symposium on Tunnel Safety and Security*, Edited by Lönnermark, E.A. and Ingason, H. New York, USA, March 14-16, 2012

Szulanski, G. (1996) 'Exploring Internal Stickiness: Impediments to the Transfer of Best Practice Within the Firm', *Strategic Management Journal (1986-1998)*, 17(Winter Special Issue), p. 27.

Vinke, D. (2013) 'RIJKSWATERSTAAT From Skilful Technical Specialist Towards Strategic Professional Procurer'. Available at : https://repository.tudelft.nl/islandora/object/uuid:4adbc7c8-b41d-4193-8b73-2ba3759d9022/datastream/OBJ/download

Walraven, M., Vrolijk, K. and Kothuis, B.B. (2022) 'Chapter 20 - Design, maintain and operate movable storm surge barriers for flood risk reduction', in S. Brody, Y. Lee, and B.B. Kothuis (eds) *Coastal Flood Risk Reduction*. Elsevier, pp. 271–286. Available at: https://doi.org/10.1016/B978-0-323-85251-7.00020-2.

Zwaan, I. de (2018) *Een Nederlands ingenieursbedrijf maakte de langste zeebrug op Chinese bodem: 'Ons land is wereldmarktleider op dat gebied'.* de Volkskrant. Available at: https://www.volkskrant.nl/nieuws-achtergrond/een-nederlands-ingenieursbedrijf-maakte-de-langste-zeebrug-op-chinese-bodem-ons-land-is-wereldmarktleider-op-dat-gebied~b97c5d66/

Knowledge Sharing in the Adminship Communities of the Eastern-European Versions of Wikipedia Pages

Anna Karczewska
Częstochowa University of Technology, Częstochowa, Poland

anna.karczewska@pcz.pl

Abstract: Adminship in the Wikipedia community represents a specific kind of organizing activity of a virtual community of practice. It requires a high level of trust amongst the users and the engagement of an admin in the life of the community as a non-paid function, which is significant in terms of sharing and creating knowledge in the form of the content of Wikipedia. As in every form of human cooperation, it is subject to the cultural influences of the country, whose language version it represents. The aim of the research was to distinguish and describe the characteristics of the adminship and admins' social and content-creating activities in the seven East European versions of Wikipedia (among others, Poland, the Czech Republic, Hungary), while taking into consideration the cultural characteristics of the cultures involved. The method used was the quantitative content analysis of the admins' activity in different spaces of Wikipedia activity (organizing, content-creating). In order to obtain the data of admins' activity, the xTool was used, which is a dedicated online tool and database of Wikipedia's users' activity. To analyze and determine the trends and correlations of admins' activity in different language versions of Wikipedia, Statistica software was used. The results of the study suggest that despite the common history and characteristics of East European countries, there are some differences characterizing adminship work in terms of organizing and creating the knowledge process in different Wikipedia language versions, particularly considering certain cultural dimensions distinguished by Hofstede (e.g. power distance, masculinity).

Keywords: Adminship, Community Of Practice, Knowledge-Sharing, Organizing, Wikipedia

1. Introduction

In today's knowledge sharing practices, a notable role is played by the virtual communities, thus many studies have been conducted to examine this phenomenon. Wikipedia advances to become a virtual community of practice aimed at producing and organizing knowledge in numerous language versions. Organizing large numbers of volunteers for activity in a knowledge project such as Wikipedia poses certain challenges (Konieczny, 2018). It requires attracting and retaining competent and willing volunteers who learn and constantly improve the editorial policies, thus ensuring the high quality of content. The collaboration of volunteers includes a clash of opinions and resolution of conflicts which require some type of coordination of activities. Eric Raymond's portrait of "a great babbling bazaar of differing agendas and approaches" leading to a stable community of users is widely recognized in open source software development (Capiluppi, Michlmayr, 2007, p.32). Researchers have been absorbed by the concept of this complex social environment for over a decade, which prompted them to examine how individuals coordinate actions to achieve goals in open source initiatives such as Wikipedia.

In the process of the creation of open knowledge content in Wikipedia, effective management of volunteers means not only aligning people with common goals, but also taking care of the well-being of the users and providing them with technical and substantive support. Self-governing communities of practice such as Wikipedia face challenges in meeting content creation goals by optimizing volunteer efforts and a division of tasks (Smirnov, Oprea and Strohmaier 2023). Providing users with an engaging and rewarding experience is essential to attracting and retaining user participation, which is often addressed through discussions about motivations and non-material rewards. Although the information content in online communities plays a key role and serves as an important motivator of engagement, online communities go beyond the mere dissemination of information. They represent social systems that exhibit the key characteristics of small groups, voluntary associations and formal organizations (Bürger, Schlögl and Schmid-Petri 2023). Similar to the dynamics observed in various groups and organizational settings, integration into an online community typically involves establishing connections with the collective entity or its individual members, ultimately strengthening a sense of commitment to these relationships (Butler 2004, Kraut et al. 2008). Hence, there are not only pages or spaces where the knowledge content is produced, but also the so-called "meta" spaces in Wikipedia, where coordination of work, communication and discussion take place.

One of the groups of Wikipedia users which is very significant for the whole community are admins, who concentrate on "meta" tasks connected with ensuring the level of productivity of the Wikipedia community. Their main role is to monitor community activities and look for opportunities to provide help or correct mistakes, which involve removing vandalism, blocking IP addresses or editing secure pages (Kraut et al. 2010). The route to becoming an administrator is to request for the adminship (RFA). The RFA process includes three steps as

follows: a nomination statement, questions and answers about the previous and future behaviours of a user, and statements of support, opposition, or neutrality by Wikipedia community members. The voting process is transparent, thus allowing any editor to review the nominated editor's records, inquire about the nominee, and assess their proficiency in terms of using administrator privileges (Ren, Zhang and Kraut 2023).

The aim of this paper is to investigate the adminship activity in the seven languages of Wikipedia chosen from South Eastern Europe (Poland, Slovenia, the Czech Republic, Hungary, Romania, Bulgaria, Ukraine) and its relations with the cultural dimensions of the countries studied. This paper is structured as follows: Section 2 highlights the literature review by explaining the major theoretical foundations of the current trends of Wikipedia community of practices in the analyzed field. Section 3 presents the method of data collection. Section 4 reports and discusses the findings, while Section 5 concludes the paper and provides the implications of this study.

2. Literature Review

The social roles theory explains the development and influences of social roles on human behaviour, e.g., analyzing role-taking and role-playing behaviours (Eagly and Wood 2016). Likewise, in online communities there are certain roles that users may take on and perform. In Wikipedia projects in general, the relationship between users is a partnership, however, one of the roles that stands out is that of adminship. This role is based on the level of commitment to the community and eagerness to contribute to the community (Teng et al. 2022). What plays a crucial role in the emergence of leaders in Wikipedia is that of merit (Ren, Zhang and Kraut 2023). Wikipedia adminship includes not only knowledge contribution, but also social contribution, while also, among others: providing support and ensuring the quality of work.

Large-scale open source projects face management problems that involve controlling the integration of distributed knowledge resources and how to coordinate such activities in order to create shared value. Wikipedia editing activity is knowledge-intensive (Arazy and Gellatly 2013). Millions of minuscule contributions must be assessed, selected, adapted and sometimes rejected, which means that editing work should be directed to create value (Aaltonen and Lanzara 2015). For effective collaboration to prevail among project volunteers, the work is broken down into small parts. This allows individuals with different expertise, interest levels, while also availability to take part in editing. The integration of these contributions is crucial for the project's success, which is usually managed by project leaders who hold the final decision-making power. Despite the common trend of a few individuals carrying most of the workload in peer production systems, short-term contributors also play a significant role. The organizers of online collaborative projects are tasked with recruiting new members and ensuring continued engagement from the existing ones. (Bruckman 2022, pp 59-62) This is the reason why administrators' activity is so crucial for unhindered production of knowledge on Wikipedia.

The authority of the managerial activity of administrators is inclined towards facilitating rather than dictating. Although admins influence significant policy implementation, they do not dictate the specific assignments to the users. This could be attributed to admins potentially lacking the necessary time or focus to address individual personnel matters. Alternatively, the reduced managerial control observed in peer production systems may be inherently linked to the voluntary nature of these communities (Kittur, Pendelton and Kraut 2009).

Ung and Dalle (2010) investigated 644 French WikiProjects in terms of the relationship between discussion activity on the project's talk page and editing activity and concluded that the most active discussion participants were not the most active editors. In most cases, a small group of active discussion participants played a major role in organizing the work of a wider group of peripheral members rather than being involved in the larger article content creation. These smaller groups of project members may function as a hub acting as facilitators and technical support by answering questions etc.

The English language version of Wikipedia defines administrators of the user group as follows: "administrators are volunteer editors trusted with access to certain tools on the English Wikipedia. They are expected to observe a high standard of conduct, use the tools fairly, and never use them to gain advantage in a dispute" (https://en.wikipedia.org/wiki/Wikipedia:Administrators). Meanwhile, in the Polish version they are described as: "a group of committed and trustworthy users who are members of the community and have additional permissions." The tools at their disposal do not include editorial control over Wikipedia; they primarily serve organizational and preventive functions. Administrators also provide assistance in editing Wikipedia, especially for newcomers. (https://pl.wikipedia.org/wiki/Wikipedia:Administratorzy)

Administrators (also referred to as sysops, system operators or admins) have such technical abilities as the following:

- deleting and undeleting pages, while also viewing deleted revisions of pages;
- blocking and unblocking users, IP addresses (or ranges of IP);
- protecting and unprotecting pages, editing protected pages;

Other additional rights are regulated individually in different language versions of Wikipedia. Administrators commonly take responsibility for making decisions about the outcomes of certain discussions, such as deleting or moving discussions, but other editors may also close discussions in certain cases (https://en.wikipedia.org/wiki/Wikipedia:Administrators). Wikipedia's administrative tools are compared to a janitor's mop, which leads to describing the act of being granted the adminship as being "given the mop" (Figure 1).

Figure 1: Picture representing admins' work in Wikipedia

Source: https://en.wikipedia.org/wiki/Wikipedia:Administrators

Wikipedia editors and participants in other online volunteer collaborations are not ordered to participate by any manager and they are not remunerated in any material way. The question arises as to why do they do it? Benkler (2008) maintains that social–psychological rewards replace material ones. Hence, the social aspect of Wikipedia membership and adminship is significant for the users. The users with admin status perform this role with a sense of responsibility for the community, not for the economic reward. Their activity is connected with the substance of their role (fighting with vandalism, while also deleting, correcting, organizing work on the content of articles), as well as discussing, supporting, helping the users, including newcomers, thus making them more socially oriented.

Wikipedists are individuals who are loosely connected by common goals and policies creating the code of conduct. Administrators are not traditional leaders, as the leaders cannot dictate the tasks to be executed. The leadership is based on "the hierarchy that results from the respect held for experts and the rules for actions defined within the communities" (Skolik 2012; Benkler 2008). Skolik and Jemielniak (2011) analyze the partnership and leadership characteristics of Wikimedia projects particularly focusing on the process of leader emergence and projects created by them. Initially, the adminship rights in Wikipedia were granted through consensus without the need for formal procedures. However, due to growing disparities in rights access, a voting system was implemented. This process lasts 7 days, during which candidates seeking these rights are evaluated based on their past contributions and responses to questions posed during the voting process.

The user's contribution in knowledge is the main criterion to be considered in the assessment of the candidate for an admin, in which a lack of contribution results in failure. Proving the competence in the creation of knowledge and the willingness to perform admin's tasks, including interacting with people, building relationships with the community's core members are the prerequisites to be granted the rights in question. Hence, both content-creating and social aspects seem significant (Clémente, Bothorel and Jullien 2015). Burke and Kraut (2008) identified important characteristics for an administrator and created a model which may be applied as an AdminFinderBot for choosing possible future admins, as a tool for self-evaluation, or as a dashboard with statistics for voters assessing candidates for administrators. Leader emergence processes in Wikipedia were also studied by Das, Lavoie and Magdon-Ismail (2016), especially the procedures to determine if an editor would use admin rights for malicious activity, which could prevent trolling by helping to detect possible vandals before they are granted admin rights. Selecting a suitable candidate for the administrator is crucial due to the threat of overuse of admin's rights, e.g. the cases have been observed, in which post-appointment administrators focused

on more controversial topics than before their promotion or appeared to push positions which violated Wikipedia's policy on neutral points of view.

The impact of diversity of tenure and interest of users of Wikipedia on their productivity and withdrawal from Wikiprojects were investigated by Ren, Chen and Riedel (2015). The investigated variables influence the level of productivity and withdrawal of the users. Projects with a moderate level of tenure disparity had higher productivity than projects with a low or high level of tenure disparity. High tenure disparity was also related to higher withdrawal. The tenure studied concerned Wikipedia users in general.

In terms of public and private activity of administrators of an online community, Teng et al. (2022) investigated these issues in terms of administrator roles based on the case of a popular online community in Taiwan Bahamut. The results indicate that taking on the social role of an administrator helps to initiate the role-appropriate behaviour of opinion leadership and public space contribution rather than private space contribution. This analysis of the administrators' behaviour is very insightful, however, it did not include the admins' contribution in the Wikipedia community.

In order to investigate the differences between cultures, five dimensions of cultural diversity were distinguished by Hofstede, such as the following: power distance, individualism (versus collectivism), masculinity (versus femininity), uncertainty avoidance and long or short-term orientation (Hofstede, Hofstede and Minkov 2010). Some of the researchers studied what kind of impact cultural differences have on online communities or web content contribution. Pfeil et al. (2006) studied the influence of cultural differences on Wikipedia contribution with the use of Hofstede dimensions, albeit studying only the history of one article in four language versions of Wikipedia and without any particular focus on administrators. Moreover, cross-cultural analysis of four language versions' content was conducted by Hara, Shachaf and Hew (2010). The authors analyzed the typical behaviours of users in three types of discussion spaces (Talk, User Talk, and Wikipedia Talk) and obtained the results confirming the existence of culturally dependent differences in various cultural dimensions.

However, at least one gap exists in this line of research, as little has been done to investigate how different types of admins' contributions are influenced by particular cultural factors and what kinds of contributions are shaped by cultural context. Thus, this paper aims to fill in the afore-mentioned gap by examining how these phenomena occur.

The hypotheses set in this research are as follows:

1. The tenure of an admin is correlated with his/her social activity and content creating activity. The more experienced an admin is, the more active he/she is in both spheres.
2. The tenure of an admin is culturally dependent. All cultural dimensions distinguished by Hofstede are correlated with the Wikipedia admins' tenure.
3. Social activities in the seven East European versions of Wikipedia chosen are culturally dependent. All cultural dimensions distinguished by Hofstede are correlated with Wikipedia admins' activities.
4. Content creating activities in the seven East European versions of Wikipedia chosen are culturally dependent. All cultural dimensions distinguished by Hofstede are correlated with Wikipedia admins' activities.

3. Methodology

The aim of the conducted research was to study the activity of Internet users fulfilling the role of admins within Wikipedia in the East European versions of Wikipedia chosen (Poland, Slovakia, the Czech Republic, Slovenia, Hungary, Ukraine, Bulgaria), while taking into consideration the cultural characteristics of the cultures involved. The research questions asked in the research process were as follows:

Q1: What are the characteristics of the admins' social and content-creating activities in the East European versions of Wikipedia chosen?

Q2: Are tenure, social and content-creating activities of admins in the East European versions of Wikipedia chosen culturally dependent? If so, what cultural dimensions are correlated with their activities and tenure?

The method used in the research is the content analysis method, which included quantitative tools. The calculations were made on a sample of 259 users – the admins from seven language versions of Wikipedia. At the first stage of the research, the candidates lists were collected from the selected Wikipedia of seven language versions. The following number of admins from particular countries was studied: Poland –97 Slovenia –21 Hungary –23 Czech –32, Romania –15, Bulgaria –23 Ukraine -48 , in sum –259 admins.

Then, the *xTools* tool was used to generate the data about the activity of the admins. *XTools* collects statistical data for each registered account on Wikipedia and its related projects. The collected data included the following:

- the number of deleted editions of the admin,
- the number of editions deleted by the admins,
- the number of all editions made by the admin in Wikipedia,
- the number of activities in article space concerning the creation of the articles' content,
- the number of activities in the "talk" and "meta" space (discussing the content and quality of articles; interaction with others, as well as the organization of work),
- date of registration of the admin,
- date of the last activity of the admin,
- number of times thanks was expressed to the admin for his/her input,
- number of times thanks was expressed by the admin to other users.

Deletionism will be understood in this article as defined in Wikipedia, namely: the philosophy of: "selective coverage and removal of articles seen as poorly defended. Deletionist viewpoints are commonly motivated by a desire for Wikipedia to be focused on and cover significant topics, along with the desire to place a firm cap upon the proliferation of promotional use, trivia, and articles which are, in their opinion, of no general interest, the lack of suitable source material for high-quality coverage, are too short or otherwise unacceptably poor in quality, or may cause maintenance overload to the community" (https://en.wikipedia.org/wiki/Deletionism_and_inclusionism_in_Wikipedia). The proportion of editions deleted by and admin to the number of users in a language version, as well as the percentage of deleted editions of an admin may be treated as the indicators of deletionism in a given Wikipedia language version. The proportion of the sum of all activities concerning the admin's work to the number of active users may represent an indicator of the admin's general activity. The quotients with the number of people in the denominator were counted to take into consideration the variable of the size of a particular Wikipedia community. The proportion of social activities (in talk/discussions/"meta" spaces) to sum of article editions in Wikipedia was also calculated, as well as the proportion of the number of expressions of thanks to the sum of all editions of an admin as characteristics of social activity of the admins. Article space editions of an admin was treated as an indicator of the content-oriented activity of an admin. The tenure/seniority of an admin was determined by calculating the difference between his/her first and last edition (in terms of years).

At the second stage of the research, the data was collected and statistically analysed using Statistica software. The Rho-Spearman statistical measure of correlation between variables was used (with the adopted $p<0.05$). Descriptive statistics were also used to investigate the main trends in the behaviour of admins in different Wikipedia language versions.

4. Research Results and Discussion

In order to answer the research questions, the descriptive statistics concerning the studied variables were analysed. The Spearman's rho correlation was calculated between the tenure of admins in all researched versions and their social activity, the percentage of deleted editions, expressions of thanks received, article editions and Hofstede cultural dimensions (Table 1). Only uncertainty avoidance did not correlate with the tenure of an admin.

Table 1: Correlations between tenure and chosen indicators of admins' activity

	Social Activities No./Sum Of Articles' Editions	Percentage Of Deleted Editions	Thanks No./ Sum Of All Editions	Article Editions In The Space: Article (Content Activity)	Pd	Ind	Masc	Ua	Lo	Indulg
tenure	0.1435	0.2828	-0.5048	0.17242	-0.1332	-0.1905	0.1939	-0.0935	-0.2399	0.2038

N=259, p<0,05. PD – power distance, Ind – individualism, Masc – masculinity, UA – uncertainty avoidance, LO – long-term orientation, Indulg– indulgence.

The indicators of the admin's activity (relation of the entire sum of editions to the number of active users of a language version) and the level of deletionism were developed for each language version of Wikipedia. The average tenure of an admin was also calculated (Table 2).

Table 2: Average tenure, activity and deletionism in the seven East European language versions of Wikipedia. Activities concerned admins' work from the period of the last 12 months (III 2023 – III 2024)

	Language version of Wikipedia	Average tenure (in years)	Activity (sum of all editions /active users no.)	Deletionism (sum of deleted editions/ active users no.)	Social activities no./sum of articles' editions
1.	Poland	16.36	1.43	1.18	70.79
2.	Slovenia	15.14	0.92	0.71	23.22
3.	Hungary	15.30	0.78	0.61	66.92
4.	Czech Republic	12.94	0.60	0.27	41.52
5.	Romania	15.27	1.01	0.82	55.04
6.	Bulgaria	16.43	0.65	0.39	0.29
7.	Ukraine	12.54	1.08	0.87	34.72

N=259, p<0,05

The average tenure of an admin is similar for the majority of versions (15-16 years) – two are distinct from the rest, namely the Czech and Ukrainian ones (12-13 years).The highest level of activity is characteristic of the Polish, Romanian and Ukrainian versions, while the lowest – the Czech one. The highest deletionism is in the Polish version, while the lowest is in the Czech one. Subsequently, admins' activity (activities concerning admins' work) from all seven countries in sum and each country separately in the period of the last 12 months were calculated (Figure 2).

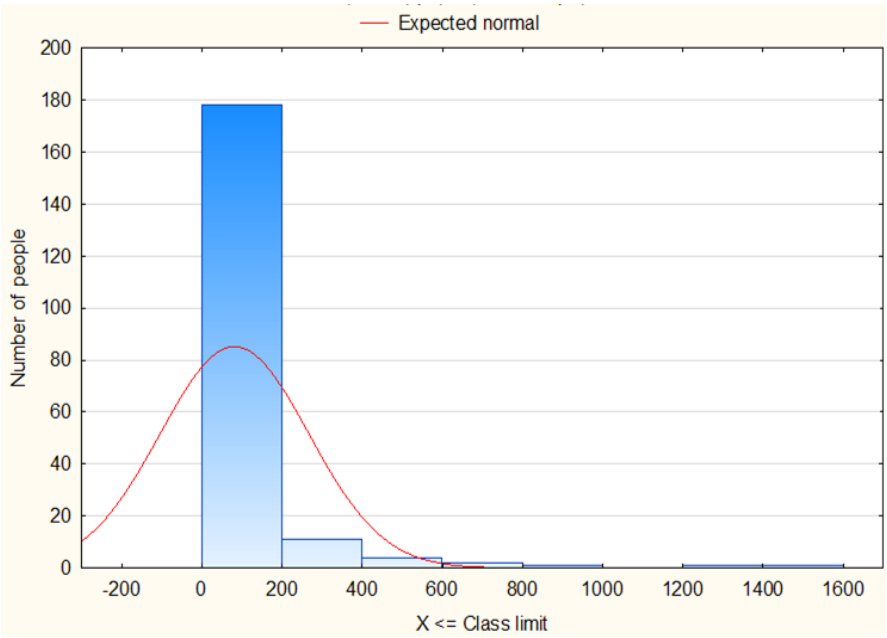


Figure 2: Admins' activity from all seven countries in sum and each country separately in the period of the last 12 months (III 2023 – III 2024)

As indicated in the diagram, the majority of admins conducts between 0-200 admin activities a year, in which the highest activity is performed by the minority of admins. Similarly, admins' activity from Poland, Slovenia and Bulgaria in the period of the last 12 months was calculated (Figure 3).

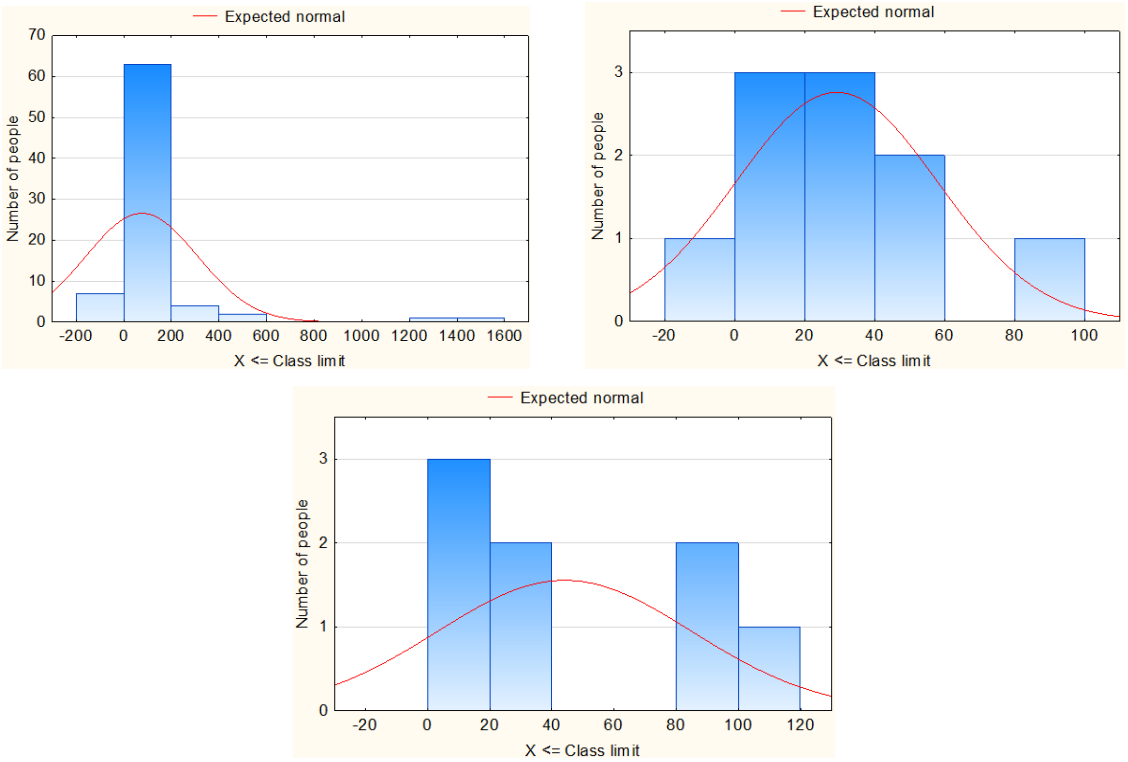


Figure 3: Admins' activity from Poland, Slovenia and Bulgaria (from left to right) in the period of the last 12 months (III 2023 – III 2024)

It turns out that in the countries with smaller numbers of admins, the work and responsibility are distributed more evenly than in the countries with relatively higher number of admins.

The descriptive statistics concerning admins' activity in the period of the last 12 months– all seven countries in sum and individually were prepared, while the mean, median and quartiles of the number of created articles were also determined.

Table 3: Descriptive statistics describing admins' activity in the period of the last 12 months– all seven countries in sum and individually

	Language version of Wikipedia	Mean	Median	Minimum	Maximum	Lower quartile	Upper quartile	SD
1.	Admins' activity in the last 12 months period (from all 7 studied versions)	81.49	16.50	1	1482	3	74	185.53
2.	Poland	91.33	14	1	1482	4	52	242.27
3.	Slovenia	38	35.50	1	101	2	68	36.89
4.	Hungary	81.83	13.50	1	456	5	142	130.37
5.	Czech Republic	55.36	16	1	310	4	82.50	77.88
6.	Romania	79	17	1	732	4	64	190.23
7.	Bulgaria	74.50	63.50	7	162	28.50	121.50	56.79
8.	Ukraine	93.02	16.50	1	858	2	114	174.74

N=259, $p<0,05$

As indicated in the calculations, some countries are characterized with increased levels of average admins' activity (Poland, Ukraine), while some are placed below the average (the Czech Republic, Slovenia). The highest median of activity was in turn displayed by Bulgaria. The complete data are presented in Table 3.

There were no statistically significant correlations observed between cultural dimensions and content-oriented activity. Power distance correlated with deletionism, social activities no., and the proportion of social activities

no. to article editing. Long-term orientation correlated with three variables: deletionism, expression of thanks, and social activities no. Uncertainty avoidance correlated only with the proportion of social activities no. to article editing, and masculinity with the proportion of social activities no. to article editing, deletionism, and social activities no. The more individualized and long-term oriented culture was, the more thanks were expressed per edition. The lower power distance, individuality, and femininity characterised a culture, the more deletionism was in its version of Wikipedia. All correlations are presented in Table 4.

Table 4: Correlations of Spearman's rho between cultural dimensions of Hofstede and social and content-oriented activity of admins

Hofstede cultural dimensions		Social activities no./ Sum of articles' editions	Deletionism (average percentage of deleted editions)	Expression of thanks (thanks/sum of all editions)	Editions in the space: article (content-oriented)	Social activities no.
1.	PD	-0.56727	-0.48102	-0.12165	-0.02418	-0.16130
2.	Indiv	-0.28559	-0.74024	0.14343	-0.08670	-0.09231
3.	Masc	0.42138	0.79939	0.01982	0.08244	0.23033
4.	UA	-0.47857	0.05437	0.00430	0.03774	-0.03732
5.	LO	0.10714	-0.54779	0.24931	-0.06864	-0.20248
6.	Indulg	0.01468	0.18698	-0.18057	-0.01672	0.04608

N=259, p<0,05

Pfeil et al. (2006) indicates that culture influences numerous web behaviours of Wikipedia users, e.g. high power distance decreases deleting activity, while individualism facilitates adding and corrective actions. High uncertainty avoidance would have a negative impact on the total contributions of all these three types of activities. In this study, only masculinity correlation confirmed the expectation. Orientation towards success and effects, typical of more masculine cultures facilitates making more deletions. Contrary to the Pfeil study, in terms of administrators, both levels of PD and individualism decreased the level of deletions made to the admins' editions. This may be explained by potential intimidation before correcting someone who has got some "power" in the community. Social activities were positively correlated with masculinity and negatively correlated with power distance and long-term orientation. The third hypothesis was only partly confirmed.

Teng et al. (2022)in their study of Bahamut community administrators concluded that taking on a social role of an administrator helps to initiate the role-appropriate behaviour of opinion leadership and public space contribution rather than private space contribution. As results from the conducted study in the space of Wikipedia, the administrators in South Eastern European versions of Wikipedia take public responsibility for the community and their proportion of social activity editions to all editions is high (with the exception of one version). However, they do not abandon the content contribution and continue to create articles. Their content-oriented activity does not seem to be culturally dependent, thus it may be oriented towards the common ethos of work to the benefit of Wikipedia. The fourth hypothesis was rejected.

Taking up an administrator's role may be connected with expecting peers' recognition, whereas in Wikipedia this role is respected by the users, which is a socio-psychological form of reward for the efforts for the community (Kuznetsov 2006, p.5). The longer the tenure of an admin, the higher the level of social engagement observed. Likewise, the longer the tenure, the higher the contribution to the content of Wikipedia. Moreover, in more masculine cultures the tenure tends to be longer. The first hypothesis was confirmed and the latter was partly confirmed (only uncertainty avoidance was not correlated with tenure). More experienced editors see Wikipedia not only as a set of articles, but also as a community of editors, so are more likely to admit to social and community factors as important motivators to contribute (Baytiyeh and Pfaffman 2009). Wikipedia administrators place great value on social motivations and the creation of Wikipedia articles as public artefacts comparing to other aspects of their activity.

Research by Picot-Clémente, Bothorel, and Jullien (2015) emphasizes the significance of contribution quality and peer recognition in the admin selection process. In the space of Wikipedia, 80% of contributions are made by only 2.4% of users (Crowston, Fagnot, 2018, p. 90). Similarly in the results of this study, the highest number of

editions are performed by the minority of admins. However, it turned out that in the countries with smaller numbers of admins, both the work and responsibility are distributed more evenly than in the countries with relatively higher numbers of admins, where the responsibility may be dispersed.

5. Conclusion

This study focused on determining how different types of admins' contributions are influenced by particular cultural factors and what kinds of contributions are shaped by cultural context. Based on the data that the author collected, it appears that the tenure of an admin is correlated with his/her social activity and content activity. The more experienced the admin is, the more active he/she is in both spheres. When analyzing how contributions are shaped by cultural context, there are a few aspects that we determined. Firstly, the tenure of admins is correlated with all cultural dimensions, except uncertainty avoidance. While social activity, including expressing thanks for contributions and making deletions are at least partly culturally dependent, the content-oriented activity did not correlate with any of Hofstede cultural dimensions. While analyzing the data, the author found unexpected results, particularly relating to the fact that in Wikipedia versions with fewer administrators, there is a trend towards a more equitable distribution of work and responsibilities compared to countries with a larger administrative group. This results in a potentially more balanced dispersion of responsibilities across administrators.

The conclusions from the study may be of interest to the administrators of volunteer virtual communities, where the engagement and contributions of participants may be unstable and varied, while also not remunerated. Organization of this type of communities of practice is specific and different from typical virtual teams. It is also varied in terms of cultures engaged in knowledge creation. The administrators or managers could adapt to different conditions in terms of their quality-oriented activity (such as deleting/correcting participant contribution) or motivating activity (such as thanks offered for the contribution). The community could also put forward a subject of discussion regarding the length of administrators' rights and number of administrators, as it may have an influence on the activity and division of responsibilities between admins. Additionally, future analysis of a wider group of language versions of Wikipedia would help in understanding the cultural conditioning of management and organization of work better in virtual communities of practice.

References

Aaltonen, A. and Lanzara, G.F. (2015) "Building Governance Capability in Online Social Production: Insights from Wikipedia", *Organization Studies*, Vol. 36, Iss 12, pp. 1649–1673.

Arazy, O. and Gellatly, I.R. (2013) "Corporate wikis: the effects of owners' motivation and behavior on group members' engagement", *Journal of Management Information Systems*, Vol. 29, No. 3, pp 87-116.

Baytiyeh, H. and Pfaffman, J. (2009) "Why be a Wikipedian", *Proceedings of the 9th International Conference on Computer supported collaborative learning*, Vol.1 , pp. 434–443.

Benkler, Y. (2008) *The Wealth of Networks: How Social Production Transforms Markets and Freedom*, New Haven and London, Yale University Press.

Bruckman, A.S. (2022), *Should You believe Wikipedia? Online Communities and the Construction of Knowledge*, Cambridge University Press, Cambridge.

Bürger, M., Schlögl, S. and Schmid-Petri, H. (2023) "Conflict dynamics in collaborative knowledge production. A study of network gatekeeping on Wikipedia", *Social Networks*, Vol. 72, pp 13-21.

Burke, M. and Kraut, R.E. (2008) „Mopping up: Modeling Wikipedia promotion processes", *CSCW 2008: Proceedings of the ACM conference on computer-supported cooperative work*, New York, ACM Press.

Butler, B.S. (2004) *When is a Group not a Group: An Empirical Examination of Metaphors for Online Social Structure*, New Orleans, LA.

Capiluppi, A. and Michlmayr, M. (2007) "From the cathedral to the bazaar: an empirical study of the lifecycle of volunteer community projects", in: J. Feller, B. Fitzgerald, W. Scacchi, A. Sillitti (eds.), *Open Source Development, Adoption and Innovation, IFIP – International Federation for Information Processing*, Vol. 234, Springer US, Limerick, pp 31–44.

Crowston, K. and Fagnot, I. (2018) "Stages of motivation for contributing user-generated content: A theory and empirical test", *International Journal of Human-Computer Studies*, Vol. 109, pp. 89–101.

Das, S., Lavoie, A. and Magdon-Ismail, M., (2016) "Manipulation among the arbiters of collective intelligence: How Wikipedia administrators mold public opinion". *ACM Transactions on the Web (TWEB)* Vol. 10, No. 4, pp 1–25.

Eagly, M. and Wood, W, (2016) "Social Role Theory", in: *The Wiley Blackwell Encyclopedia of Gender and Sexuality Studie*", John Wiley & Sons, pp. 458-472.

Hara, N., Shachaf, P. and Hew, K.F. (2010) "Wikipedia Community Spaces: Comparative Analysis of Behaviors Across Talk Pages in Four Languages", *iConference 2010 Proceedings, University of Illinois at Urbana-Champaign*, pp 93-97.

Hofstede, H. , Hofstede, G.J. and Minkov, M. (2010) *Cultures and Organizations: Software of the Mind, Third Edition: Intercultural Cooperation and Its Importance for Survival,* McGraw-Hill Education Ltd., NY.

https://en.wikipedia.org/wiki/Deletionism_and_inclusionism_in_Wikipedia (accessed on: 05.01.23)
https://en.wikipedia.org/wiki/Wikipedia:Administrators (accessed on: 05.01.23)
https://pl.wikipedia.org/wiki/Wikipedia:Administratorzy (accessed on: 05.01.23)
Kittur, A., Pendelton, B. and Kraut, R.E. (2009) "Herding the Cats: The Influence of Groups in Coordinating Peer Production", *WikiSym 2009: Proceedings of the 5th International Symposium on Wikis and Open Collaboration*, NY, ACM Press.
Konieczny, P. (2018) "Volunteer Retention, Burnout and Dropout in Online Voluntary Organizations: Stress, Conflict and Retirement of Wikipedians", *Research in Social Movements, Conflicts and Change*, Vol 42, Emerald Publishing Limited.
Kraut R., Wang, X., Butle,r B., Joyce, E. and Burke, M. (2010), *Beyond Information: Developing the Relationship between Individual and the Group in Online Communities*, "Information Systems Research", Vol. 10, p. 1-37.
Kuznetsov, S. (2006), *Motivations of contributors to Wikipedia*, *ACM SIGCAS Computers and Society*, Vol. 36, No. 2, pp. 1–7.
Pfeil, U., Zaphiris, P. and Ang, C. (2006) "Cultural Differences in Collaborative Authoring of Wikipedia", *Journal of Computer Mediated Communication*, Vol. 12, pp 88-113.
Picot-Clémente, R., Bothorel, C. and Jullien, N. (2015) "Contribution, Social networking, and the Request for Adminship process in Wikipedia", *Proceedings of the 11th International Symposium on Open Collaboration*, pp 1-2.
Ren, Y., Chen, J. and Riedl, J. (2015) "The Impact and Evolution of Group Diversity in Online Open Collaboration", "Management Science" Vol. 62, No.6, pp. 1668-1686.
Ren, Y., Zhang, H. and Kraut, R. E., (2023) "How Did They Build the Free Encyclopedia? A Literature Review of Collaboration and Coordination among Wikipedia Editors", *ACM Transactions on Computer-Human Interaction*, Vol. 31, No.1, pp. 1-48.
Skolik, S. (2012) "Partnership and leadership as main relationship in Wikimedia projects", in: C.B. Illes, F. Bylok, A. Dunay (eds), *Human Resource Management and Corporate Competitiveness*, Gödöllö, pp 124-134.
Skolik, S. and Jemielniak, D. (2011) „Otwartość i zaufanie w organizacji opartej na wolnych licencjach na przykładzie Wikipedii", P. Sochaczewski (ed.) *W kierunku zrównoważonej gospodarki opartej na wiedzy w Polsce*, WSE w Białymstoku, Białystok, pp 92-104.
Smirnov, Oprea, Strohmaier (2023) "Toxic comments are associated with reduced activity of volunteer editors on Wikipedia", *PNAS Nexus*, Vol.2, pp.1-10.
Teng, C., Huang, T-L., Liao, G-H. and Dennis A.R. (2022) "Administrator-users contribute more to online communities", *Information & Management*, Vol. 59, Art. 103717.
Ung, H. and Dalle, J.-M. (2010) "Project management in the Wikipedia community", *Proceedings of the 6th International Symposium on Wikis and Open Collaboration*, pp 1-4.

Knowledge Sharing and Dynamic Capabilities: Does Gender Matter?

Elżbieta Karwowska and Wioleta Kucharska
Department of Management, Faculty of Management and Economics, Gdańsk University of Technology, Gdańsk, Poland

elzbieta.karwowska@pg.edu.pl
wioleta.kucharska@pg.edu.pl

Abstract: Knowledge sharing in organizations is a focal process leading to organizational adaptability and sustainable growth. Dynamic capabilities development is critical for this. Diversity, inclusive culture, and gender balance are seen as factors that also support organizations' development. The question of the role of gender in sharing and using knowledge to initiate change in organizations remains open. This study aims to fill this gap. Based on a survey targeted to Polish knowledge workers (495 cases), our data was analyzed using OLS regression (SPSS PROCESS software ver. 3.4). Our research shows that for a manager position, gender matters for the reconfiguring dynamic capability (DCR) building in the organization, thanks to tacit knowledge sharing (TKS). The results show that female managers support DCR in the organization even if TKS does not support their efforts. If supported, their positive influence on DCR grows but not as fast as observed for men with lower starting skills. So, when holding managerial positions, women lose motivation to support changes. The question that arises is "why"? There are some hypothetical assumptions: it might be that since women worked so hard to earn their managerial positions, they want to secure them and avoid any risks connected to changes. In the particular case presented, women managers' lower willingness to support changes may be also caused by their lower level of self-confidence. However, it might be that the reasons are quite different, thus solving this issue requires further studies. The critical value of the presented research is that it delivers one more proof, this time from the knowledge management (TKS) and change implementation (DCR) perspective, that gender inequality in workplaces has negative consequences for organizations.

Keywords: Gender, Tacit Knowledge Sharing, Explicit Knowledge Sharing, Dynamic Capabilities, Reconfiguring Dynamic Capability (DCR)

1. Introduction

Organizations operate in unpredictable environments and face various internal and external conditions that often force them to change, and the best of them can reshape quickly. Challenging conditions act as stimuli, making an unexpectedly good environment for companies to gain or maintain an advantage over competitors through constant learning and innovativeness (Kucharska and Rebelo, 2022). That is possible due to the agility and reconfiguring aspect of dynamic capabilities. Both agility and dynamic capabilities are supported by knowledge management, especially while selecting the best approaches, suitable to particular circumstances (Zięba et al., 2022).

Teece et al. (1997) defined dynamic capabilities as “the firm’s ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments.” (Teece, et al., 1997, p. 516). In other words, dynamic capabilities are the organizations‘ abilities to sense and shape external factors, seize opportunities, and improve, merge, protect, and reconfigure assets when necessary to sustain competitiveness. To do so, unique processes of learning about market conditions and customer's needs are applied (Teece, 2014). Reconfiguring dynamic capability (DRC) directly impacts innovation and organizational development. The capabilities of acquiring and creating knowledge contribute to the reconfiguring capability; therefore, they contribute to innovation indirectly (Zheng et al., 2011). It is evident in the incorporation of existing knowledge to create new frameworks. Those processes are especially the implementation of open innovation, cooperation, application of market needs (Ince and Hahn, 2020), development of technology, rearrangement of the workplace (Khan et al., 2020) decentralization of power (Bhardwaj et al., 2021), flexible connecting structures, and cost-cutting (Vallaster et al., 2021), to name a few. Knowledge management systematically implements techniques and tools to identify, analyze, and respond to any knowledge-related issues in an organization (Durst et al., 2016), and this way support dynamic capabilities.

Knowledge may be labeled as explicit or tacit (Nonaka and Takeuchi, 1995) and those categories significantly differ. The more formalizable, manageable, and transferable knowledge pieces belong to the category of explicit ones (Nonaka and Takeuchi, 1995; Faccin et al., 2019). On the contrary, tacit knowledge is often stored in people's minds as experiences, personal beliefs, values, and ways of looking at things (Saint-Onge, 1996). Both types are crucial for innovation (Henri, 2016) and change adaptability (Park and Kim, 2015) when distributed across structures and systems. However, tacit knowledge awareness and sharing through ‘learning by doing’ or ‘social interactions’ are widely acknowledged to be an important component of organizational innovations in

particular (Kucharska and Erickson, 2023). So, knowledge sharing is a focal process for the constant transformation of the tacit kind to explicit and the creation of new tacit thanks to grounded explicit.

Wang and Noe (2010) defined knowledge sharing as a set of behaviors regarding information exchange or assistance. It goes beyond passing the information since the information must be internalized and integrated into the knowledge base of the individual first (Heisig and Kannan, 2020). When knowledge is well distributed and used in processes like task completion, decision-making, and problem-solving it has an impact on organizational innovation and performance (Heisig and Kannan, 2020). Reportedly, knowledge sharing increases team effectiveness (Yoo et al., 2022), making it critical for achieving, sustaining, and improving team effectiveness in environments characterized by unpredictability (Edmondson et al., 2007; Mesmer-Magnus and Dechurch, 2009). Also, it is linked to employee satisfaction (Wang and Noe, 2010; Zheng et al., 2010). The better knowledge-sharing practices among the team members, the more learning opportunities, and individual sense of achievement (Yoo et al., 2022). The learning climate, psychological safety, trust, collaboration (Kucharska and Kowalczyk, 2016; Andersson et al., 2020), social interactions (Ryan and O'Connor, 2013), mentoring (Olaisen and Revang, 2018) and stakeholder engagement (Easterby-Smith and Prieto, 2008) facilitate knowledge sharing, in its both explicit and tacit forms. Thus, knowledge sharing in organizations is a focal process leading to organizational adaptability and sustainable growth. Dynamic capabilities development is critical for this. Diversity, inclusive culture, and gender balance are perceived as factors that also support organizations' development. The question of the role of gender in sharing and using knowledge to initiate change in organizations remains open. This study aims to fill this gap.

2. Conceptual Framework

Recently, some researchers have argued that gender must be included in knowledge-sharing research since it influences organizational structure and behavior (Paoloni and Lombardi, 2018; Scuotto et al., 2022). At the same time, others note that this issue has not been properly investigated, and there are still too few studies analyzing the link between knowledge sharing and gender (Heisig and Kannan, 2020; Yoo et al., 2022). Existing studies show that this research area is an interesting topic to take a closer look at (Paoloni et al., 2022). For instance, it has been shown that women are more prone to knowledge-sharing than men in certain circumstances (Nguyen et al., 2019). They generally spend more time on socialization which fosters knowledge sharing (Denise and Byosiere, 2007). It indicates that gender diversity positively influences knowledge-sharing (Jayasingam et al., 2016), possibly because diversity makes internal communication more open (Lee et al., 2020). So, gender factor studied in the context of knowledge sharing can bring interesting implications. This study focuses then on the role of gender in sharing and using knowledge to initiate change in organizations.

Analyzing the 'state of the art', in many research papers on knowledge management, gender is being used as a moderating factor to analyze the relationships between practices, culture, and engagement. Some of them prove that gender moderates the influence of knowledge-sharing (along with unfair promotion) on affective commitment (Jayasingam et al., 2016), and the relationship between knowledge-sharing intention and knowledge-sharing behavior is stronger for females (Amin et al., 2011; Grubic–Nesic et al., 2015). Contrary to the above statements, some other works prove a lack of a significant relationship between gender and knowledge sharing (Killingsworth et al., 2016; Makela et al., 2012; Al Muzaffar and Alshare, 2015). Instead, Marouf (2015) showed that the combination of gender with other factors had a significant effect on knowledge sharing, precisely sector factor (public vs private), and Heisig and Kannan (2020) noticed gender differences when different levels of education were considered. Among aspects impacting knowledge sharing among individuals, may be gender, personality, role, KM activity, behavior, and cognition (Heisig and Kannan, 2020). It shows that gender does not impact the system individually, but rather in coexistence with other factors.

One such factors is the role (or position) in an organizational structure. There is interesting evidence on how women managers are more motivated to share knowledge among internal and external stakeholders (Sheerin et al., 2020), and how their stronger (than men's) social connections impact their engagement in external knowledge management (Tonnessen et al., 2021). Paoloni and Lombardi (2022) state that greater diversity on the board of directors could improve the knowledge-sharing system. For this reason, we are especially interested in researching the moderating effect of gender and position on knowledge-sharing and reconfiguring dynamic capability (fig. 1). Recently, Kucharska and Karwowska (2024) proved that explicit and tacit knowledge-sharing impacts the 'reconfiguring' component of dynamic capability (Jantunen et al., 2018; Teece, 2007). Kucharska (2024) and Kucharska and Kopytko (2024) showed that gender factors that influence power are often related to position. Therefore, taking into consideration all the above, the following hypotheses were developed:

H1: Gender moderated by position does moderate the relationship between explicit knowledge sharing and reconfiguring dynamic capability (moderated moderation is expected).

H2: Gender moderated by position does moderate the relationship between tacit knowledge sharing and reconfiguring dynamic capability (moderated moderation is expected).

Figure 1 below visualizes the explored relations.

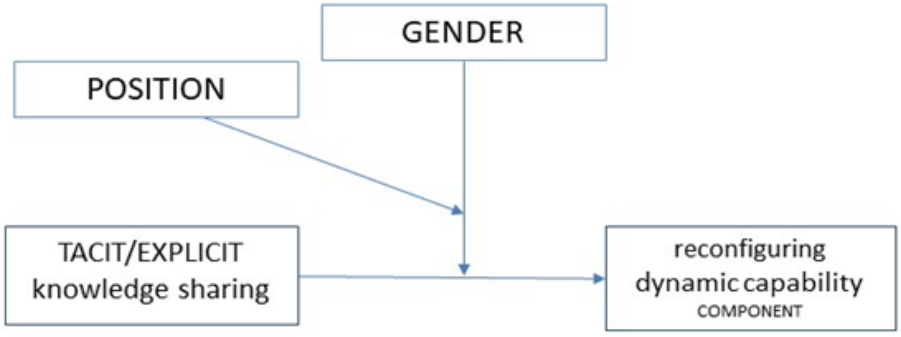


Figure 1: The moderating effect of gender and position on knowledge sharing and reconfiguring dynamic capability

3. Method

This study is based on a survey targeted at Polish knowledge workers (495 cases). Data collection took place in March 2023 using the computer-assisted web interviewing method. Classified respondents declared their 'knowledge worker' status as persons whose work input and output is knowledge. Next, they referred to statements measuring constructs of the interest using a 7-point Likert scale, which was transformed to composite variables for this particular study and method of data analysis purpose. Collected data were next analyzed using OLS regression (SPSS PROCESS software ver. 3.4; Hayes, 2018). Scales measuring particular constructs were adapted from the following sources: tacit and explicit knowledge sharing (Kucharska and Erickson) and dynamic capability 'reconfiguration' component (Jantunen et al., 2018, after Teece, 2007).

The sample structure included 247 specialists and 249 managers, 251 women and 249 men working mostly in private (77%) companies in different sectors. Micro (14%), small (28%), medium (31%), and large companies (26%) were almost equally represented. Measures quality was conducted based on implemented construct measurement consistency tests: the average of variance extracted (AVE), composite reliability (CR), and Cronbach's alpha. AVE exceeded 0.57 for all constructs, which was acceptable (Hair et al., 2017). Cronbach's alpha test was used to confirm the consistency of the construct measurement model. The alpha coefficient was greater than 0.89 for all constructs, which was adequate (Hair et al., 2017, p.112). The CR was greater than 0.80 for all loadings, which was more than the required minimum of 0.7 (Hair et al., 2017).

4. Results

Explicit knowledge sharing and reconfiguring dynamic capability analyzed per gender and position based on this sample did not expose a significant result (H1). The tacit knowledge sharing and reconfiguring dynamic capability analyzed per gender and position based on this sample – opposite (H2). Figure 2 and 'model summary' expose the details of the results obtained.

The results showed that gender does not moderate the relationship between tacit knowledge sharing and dynamic capability – reconfiguring as long as the 'position' factor is not included in the analysis. After the 'position' factor inclusion (moderated moderation analysis), it is visible that for specialist women and men, the explored relation is equally insignificant. But, for a manager position, gender matters for the reconfiguring dynamic capability (DCR) building in the organization, thanks to tacit knowledge sharing (TKS). The results show that female managers support DCR in the organization even if TKS does not support their efforts. If supported, their positive influence on DCR grows but not as fast as observed for men with lower starting skills. In other words, male managers better support organizational DCR if others support them.

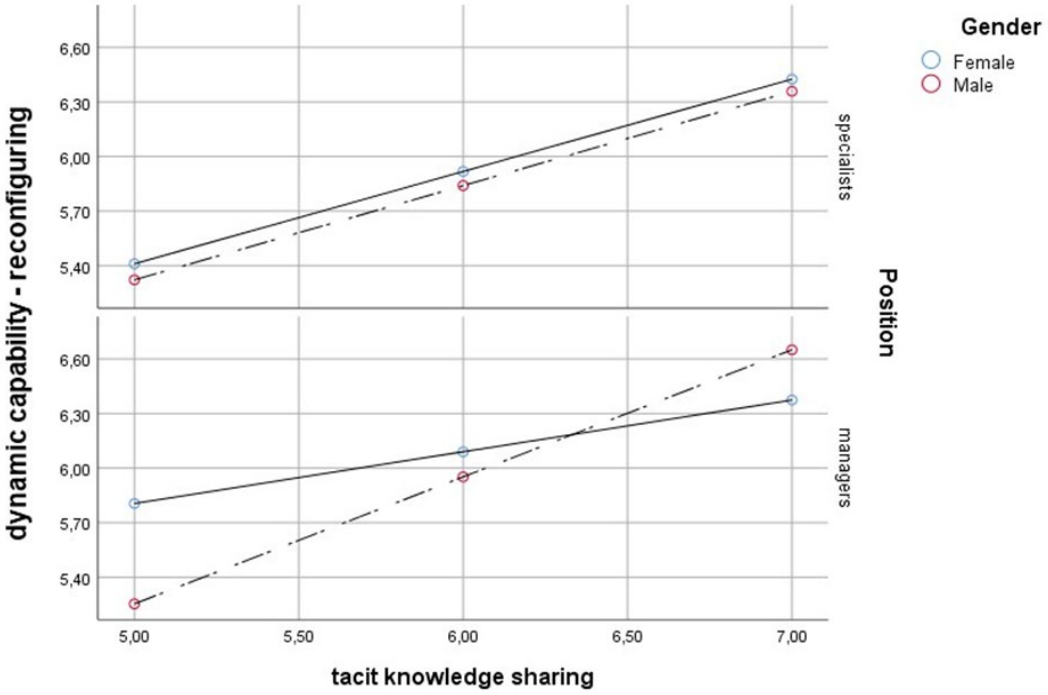


Figure 2: Tacit knowledge sharing and reconfiguring dynamic capability analyzed per gender and position

4.1 Model Summary

```
Sample Size:  495, OUTCOME VARIABLE: DCR
         R       R-sq      MSE          F        df1        df2          p
      ,5552     ,3082     ,8709    30,9935     7,0000   487,0000      ,0000
Model
             coeff         se          t          p       LLCI       ULCI
constant     -,9770     2,1086     -,4633      ,6433    -5,1201     3,1661
TKS          1,1232      ,3583     3,1348      ,0018      ,4192     1,8273
Gender       2,1378     1,1405     1,5441      ,0518     -,2960     4,9716
Int_1        -,3925      ,2293    -1,7120      ,0875     -,8430      ,0580
Position     3,9917     1,3938     2,8639      ,0044     1,2531     6,7303
Int_2        -,6265      ,2329    -2,6901      ,0074    -1,0841     -,1689
Int_3       -2,4805      ,8788    -2,8226      ,0050    -4,2072     -,7538
Int_4         ,4034      ,1482     2,7214      ,0067      ,1121      ,6946
Product terms key:
 Int_1    :        TKS       x        Gender
 Int_2    :        TKS       x        Position
 Int_3    :        Gender    x        Position
 Int_4    :        TKS       x        Gender    x        Position
Test(s) of highest order unconditional interaction(s):
        R2-chng         F        df1        df2         p
X*W*Z      ,0105     7,4060     1,0000   487,0000      ,0067
----------
    Focal predict: TKS      (X)
          Mod var: Gender   (W)
          Mod var: Position (Z)
Test of conditional X*W interaction at value(s) of Z:
   Position     Effect          F        df1        df2         p
     1,0000      ,0109      ,0116     1,0000   487,0000      ,9144
     2,0000      ,4142    14,5758     1,0000   487,0000      ,0002
Conditional effects of the focal predictor at values of the moderator(s):
     Gender    Position     Effect         se          t          p       LLCI       ULCI
     1,0000     1,0000      ,5076      ,0696     7,2966      ,0000      ,3709      ,6443
     1,0000     2,0000      ,2845      ,0769     3,6982      ,0002      ,1333      ,4356
     2,0000     1,0000      ,5185      ,0732     7,0828      ,0000      ,3746      ,6623
     2,0000     2,0000      ,6987      ,0765     9,1308      ,0000      ,5483      ,8490
************************ ANALYSIS NOTES AND ERRORS ************************
Level of confidence for all confidence intervals in output:
  95,0000
```

Figure 3

Note: 1-female 2- male 1- specialist 2-manager; insignificant results are bolded

5. Discussion

Our research findings indicate that women who are supported better support others regarding knowledge sharing. Those results enrich previous research findings as an important voice in the discussion on the role of gender and position in KS and DCR processes.

Till today, some researchers have not found a link between gender diversity and knowledge sharing, rather indicating the moderating effect of age or regional diversity (Li et al., 2022). Others show that the biological sex of employees moderates the impact of managers' inclusive leadership on knowledge-sharing behavior (Morinaga et al., 2023). Inclusive leadership impacts knowledge-donating practices in groups with higher biological-sex diversity and does not affect groups with lower biological-sex diversity (Morinaga et al. 2023). Our findings support the latter part.

Still, one may ask a question: how do organizations support women so they can support others and facilitate the KS and DCR practices? Taking into consideration our research findings, inclusive leadership is one of the key concepts to apply in organizations. Nembhard and Edmondson (2006) characterized inclusive leaders as those who demonstrate openness, accessibility, and willingness to interact with subordinates (Carmeli et al., 2010). This idea was conceptualized by Randel et al. (2018) as a combination of leadership behaviors that make the team members feel they belong to their team and foster their creativity (Mansoor et al., 2021; Ye et al., 2019). Those behaviors include providing support, ensuring justice and equal opportunities, encouraging diverse contributions and participation in decision-making (Al-Atwi and Al-Hassani, 2021; Randel et al., 2018), while promoting team members' uniqueness without changing their key identities (Randel et al., 2018; Nguyen et al., 2022). It suggests that welcoming and supporting women on higher organizational levels and celebrating their uniqueness is beneficial for the companies.

Randel et al. (2018) argued that inclusive leadership trickles down: the supervisor's behavior encourages similar behavior among team members, so they support and include their colleagues. Similarly, other researchers observed that "when a leader shows inclusiveness, team members who feel psychologically attached to a team are more likely to exchange their knowledge with each other, which further influences team performance" (Yoo et al., 2022). It is also evident in our research findings.

6. Limitation, Implications and Further Studies Suggestions

The key limitation of this research is that it is based on data collected in only one country. Still, more studies is needed to understand the role of gender and position in KS and DCR. Experts gather that the gender aspect is a relevant topic of study in the future (Heisig, 2015). Our findings as well as other recent works in the majority show that gender does matter regarding knowledge sharing but more research is needed to contribute more substantial evidence to these first initial results and avoid "the risk of replicating or overemphasizing the influence of gender" (Heisig and Kannan, 2020). One of the interesting research directions inspired by the results of this study is why women lose the motivation to support changes when become managers. There are some hypothetical assumptions: it might be that since women worked so hard to earn their managerial positions, they want to secure them and avoid any risks connected to changes. Women managers' lower willingness to support changes may be also caused by their lower level of self-confidence. However, the reasons may be quite different thus solving this issue requires further studies. In this study we also have not considered how stereotypes and expectations related to gender affect the knowledge-sharing experiences in organizations, which may be another interesting research focus (Miralles–Vazquez and McGaughey, 2015). Researchers warn that expertise is often regarded as gendered (Azocar and Marx Ferree, 2015), meaning that stereotypes and gendered expectations about role behavior affect how knowledge is created and distributed across the organization (Heisig and Kannan, 2020). Consequently, managers, leaders, and all employees should be aware that gender stereotypes are deeply rooted in society till these times (Haines et al., 2016) so they can self-reflect on their performance. While supporting women leaders in the workplace, organizations may then support their uniqueness and cease the prejudices, rather than nourishing general roles assigned to their gender. It will benefit both organizations and their women employees.

7. Conclusion

The results showed that gender does not moderate the relationship between tacit knowledge sharing and dynamic capability – reconfiguring as long as the 'position' factor is not included in the analysis. After the 'position' factor inclusion (moderated moderation analysis), it is visible that for a manager position, gender

matters for reconfiguring dynamic capability (DCR) building in the organization, thanks to tacit knowledge sharing (TKS). Results showed that the more intensive tacit knowledge sharing in the organization, the more intensively managers support organizational changes. However, this relationship is more robust for male managers than females. This relationship is as strong as that of male managers for male and female specialists. So, when holding managerial positions, women lose motivation to support changes. The question that arises is "why"? There are some hypothetical assumptions: it might be that since women worked so hard to earn their managerial positions, they want to secure them and avoid any risks connected to changes. Women managers' lower willingness to support changes may be also caused by their lower level of self-confidence. However, the reasons may be quite different thus and solving this issue requires further studies.

References

Amin, A., Hassan, M.F., Ariffin, M.B.M. and Rehman, M. (2011), "Knowledge sharing: two-dimensional motivation perspective and the role of demographic variables", *Journal of Information & Knowledge Management*, Vol. 10 No. 2, pp. 135-149. https://doi.org/10.1142/S0219649211002882

Azocar, M.J. and Marx Ferree, M. (2015), "Gendered Expertise", *Gender & Society,* Vol. 29 No. 6, pp. 841-862. https://doi.org/10.1177/08912432156021

Bhardwaj, R., Srivastava, S., Taggar, R. and Bindra, S. (2021), "Exploring micro-foundations of dynamic capabilities for social enterprises", *Social Enterprise Journal*, https://doi.org/10.1108/SEJ-08-2021-0071

Denise, J.L. and Byosiere, P. (2007), "Japanese corporations: gender differences in re-defining tacit knowledge", *Women in Management Review,* Vol. 22 No. 1, pp. 33-48. https://doi.org/10.1108/09649420710726210

Durst, S., Bruns, G. and Henschel, T. (2016), "The management of knowledge risks: what do we really know?", *International Journal of Knowledge and Systems Science*, Vol. 7 No. 3, pp. 19-29. https://doi.org/10.4018/IJKSS.2016070102

Easterby-Smith, M. and Prieto, I.M. (2008), "Dynamic capabilities and knowledge management: an integrative role for learning?", *British Journal of Management,* Vol. 19 No. 3, pp. 235-249. https://doi.org/10.1111/j.1467-8551.2007.00543.x

Edmondson, A.C., Dillon, J.R. and Roloff, K.S. (2007), "Three perspectives on team learning: outcome improvement, task mastery, and group process", *The Academy of Management Annals*, Vol. 1 No. 1, pp. 269-314. https://doi.org/10.1080/078559811

Faccin, K., Balestrin, A., Volkmer Martins, B. and Bitencourt, C.C. (2019), "Knowledge-based dynamic capabilities: a joint R&D project in the French semiconductor industry", *Journal of Knowledge Management,* Vol. 23 No. 3, pp. 439-465. https://doi.org/10.1108/JKM-04-2018-0233

Grubic-Nesic, L., Matic, D. and Mitrovic, S. (2015), "The influence of demographic and organizational factors on knowledge sharing among employees in organizations", *Tehnicki Vjesnik-Technical Gazette*, Vol. 22 No. 4, pp. 1005-1010.

Haines, E.L., Deaux, K., and Lofaro, N. (2016), "The times they are a-Changing ... or are they not? A comparison of gender stereotypes, 1983-2014", *Psychology of Women Quarterly*, Vol. 40 No. 3, pp. 353-363. https://doi.org/10.1177/0361684316634081

Hair, J.F., G.T. Hult, C.M. Ringle and Sarstedt, M. (2017), "*A primer on partial least squares structural equation modeling"*, Beverly Hills: Sage, available at: https://library.oapen.org/handle/20.500.12657/51463

Hayes, A. (2018), "*Introduction to mediation, moderation and conditional process analysis: A regression-based approach"*, New York, NY: Guilford Press. https://doi.org/10.1111/jedm.12050

Heisig, P. (2015), "*Future research about knowledge and knowledge management – results from the global knowledge research network study*", Bolisani, E. and Handzic, M. (Eds), Advances in Knowledge Management - Celebrating Twenty Years of Research and Practice, Springer-Verlag, Berlin, London, New York, NY, pp. 151-182, available at: https://link.springer.com/book/10.1007/978-3-319-09501-1

Heisig, P. and Kannan, S. (2020), "Knowledge management: does gender matter? A systematic review of literature", *Journal of Knowledge Management,* Vol. 24 No. 6, pp. 1315-1342. https://doi.org/10.1108/JKM-09-2020-0701

Henri, I. (2016), "Review of empirical research on knowledge management practices and firm performance", *Journal of Knowledge Management*, Vol. 20 No. 2, pp. 230-257. https://doi.org/10.1108/JKM-09-2015-0336

Ince, I. and Hahn, R. (2020), "How dynamic capabilities facilitate the survivability of social enterprises: a qualitative analysis of sensing and seizing capacities", *Journal of Small Business Management*, Vol. 58 No. 6, pp. 1256-1290. https://doi.org/10.1177/21582440221123200

Jantunen, A., Tarkiainen, A. Chari, S. and Oghazi, P. (2018), "Dynamic capabilities, operational changes, and performance outcomes in the media industry", *Journal of Business Research*, Vol. 89, pp. 251-257. https://doi.org/10.1016/j.jbusres.2018.01.037

Jayasingam, S., Govindasamy, M. and Garib Singh, S.K. (2016), "Instilling affective commitment: insights on what makes knowledge workers want to stay", *Management Research Review*, Vol. 39 No. 3, pp. 266-288. https://doi.org/10.1108/MRR-03-2014-0060

Kaba, A., Eletter, S., Ramaiah, C.K. and El Refae, G.A. (2023), "Demographic differences in attitude, subjective norms, behavioral intention, and knowledge sharing behavior: an empirical study of non-academic staff from India and the UAE", *VINE Journal of Information and Knowledge Management Systems,* Vol. ahead-of-print No. ahead-of-print. https://doi.org/10.1108/VJIKMS-07-2022-0235

Khan, O., Daddi, T. and Iraldo, F. (2020), "Microfoundations of dynamic capabilities: insights from circular economy business cases", *Business Strategy and the Environment, Vol*. 29 No. 3, pp. 1479-1493. https://doi.org/10.1002/bse.2447

Killingsworth, B., Xue, Y. and Liu, Y. (2016), "Factors influencing knowledge sharing among global virtual teams", team performance management", *Team Performance Management: An International Journal*, Vol. 22 Nos 5/6, pp. 284-300. https://doi.org/10.1108/TPM-10-2015-0042

Kucharska W. (2024), Self-Perceived Personal Brand Equity of Knowledge Workers by Gender in Light of Knowledge-Driven Organizational Culture: Evidence From Poland and the United States, *Sage OPEN*, Vol. 14 No.1. https://doi.org/10.1177/21582440241227280

Kucharska W. and Kopytko A. (2024), Gender as a moderator of the double bias of mistakes – knowledge culture and sharing effects, Proceedings of the 7th International Conference on Gender Research, 25-26 April 2024, Barcelona, Spain.

Kucharska, W. and Erickson, G.S. (2023), "Tacit knowledge acquisition & sharing, and its influence on innovations: A Polish/US cross-country study", *International Journal of Information Management*, Vol. 71, 102647. https://doi.org/10.1016/j.ijinfomgt.2023.102647

Kucharska, W. and Karwowska, E. (2024), "Company Culture Matters! Knowledge-Driven Companies' Way to Innovations and Sustainability Through Learning and Social Interactions", available at SSRN: https://ssrn.com/abstract=4780014 or http://dx.doi.org/10.2139/ssrn.4780014

Kucharska, W. and Rebelo, T. (2022), "Transformational Leadership for Researcher's Innovativeness in the Context of Tacit Knowledge and Change Adaptability", *International Journal of Leadership in Education.* https://doi.org/10.1080/13603124.2022.2068189

Lee, Y., Tao, W., Li, J.Y.Q. and Sun, R. (2020), "Enhancing employees' knowledge sharing through diversity-oriented leadership and strategic internal communication during the COVID-19 outbreak", *Journal of Knowledge Management*, Vol. 25 No. 6, pp. 1526-1549. https://doi.org/10.1108/JKM-06-2020-0483

Li, Y., Shao, Y., Wang, M., Fang, Y., Gong, Y. and Li, C. (2022), "From inclusive climate to organizational innovation: Examining internal and external enablers for knowledge management capacity", *Journal of Applied Psychology,* 107(12), 2285–2305. https://doi.org/10.1037/apl0001014

Makela, K., Andersson, U. and Seppaa, T. (2012), "Interpersonal similarity and knowledge sharing within multinational organizations", *International Business Review*, Vol. 21 No. 3, pp. 439-451. https://doi.org/10.1177/0258042X14535160

Marouf, L. (2015), "Employee perception of the knowledge sharing culture in Kuwaiti companies: effect of demographic characteristics", LIBRES-Library and information ", *Science Research Electronic Journal*, Vol. 25 No. 2, pp. 103-118. https://doi.org/10.32655/LIBRES.2015.2.3

Mesmer-Magnus, J.R. and Dechurch, L.A. (2009), "Information sharing and team performance: a metaanalysis", *Journal of Applied Psychology,* Vol. 94 No. 2, pp. 535-546. https://doi.org/10.1037/a0017328

Miralles-Vazquez, L. and McGaughey, S.L. (2015), "Non-traditional international assignments, knowledge and innovation: an exploratory study of women's experiences", *Prometheus*, Vol. 33 No. 3, pp. 277-303. https://doi.org/10.1080/08109028.2015.1122952

Morinaga, Y., Sato, Y., Hayashi, S. and Shimanuki, T. (2023), "Inclusive leadership and knowledge sharing in Japanese workplaces: the role of diversity in the biological sex of workplace personnel", *Personnel Review,* Vol. 52 No. 5, pp. 1405-1419. https://doi.org/10.1108/PR-02-2021-0111

Nguyen, T. V. T., Nguyen, H. T., Nong, T. X., and Nguyen, T. T. T. (2022), "Inclusive Leadership and Creative Teaching: The Mediating Role of Knowledge Sharing and Innovative Climate", *Creativity Research Journal,* https://doi.org:10.1080/10400419.2022.2134543

Nguyen, T.M., Nham, T.P., Froese, F.J. and Malik, A. (2019), "Motivation and knowledge sharing: a metaanalysis of main and moderating effects", *Journal of Knowledge Management*, Vol. 23 No. 5, pp. 998-1016. https://doi.org/10.1108/JKM-01-2019-0029

Nonaka, I. and Takeuchi, H. (1995), "*The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation"*, Oxford University Press.

Olaisen, J. and Revang, O. (2018), "Exploring the performance of tacit knowledge: how to make ordinary people deliver extraordinary results in teams", *International Journal of Information Management*, Vol. 43, pp. 295-304, https://doi.org:10.1016/j.ijinfomgt.2018.08.016

Olaisen, J. and Revang, O. (2018), "Exploring the performance of tacit knowledge: how to make ordinary people deliver extraordinary results in teams", *International Journal of Information Management*, Vol. 43, pp. 295-304, https://doi.org:10.1016/j.ijinfomgt.2018.08.016

Paoloni, P. and Lombardi, R. (2022), "*Organizational resilience and female entrepreneurship during crises*", 1st ed., Vol. Sidrea, Springer, https://doi.org/10.1007/978-3-030-89412-2

Paoloni, P. Lombardi, R., and Principale, S. (2023), "The impact of gender diversity on corporate social responsibility knowledge: empirical analysis in European context", *Journal of Knowledge Management*, VOL. 27 NO. 9 2023, pp. 2484-2498. https://doi.org/10.1108/JKM-07-2022-0512

Park, S. and Kim, E.-J. (2015), "Revisiting knowledge sharing from the organizational change perspective", *European Journal of Training and Development,* Vol. 39 No. 9, pp. 769-797. https://doi.org/10.1108/EJTD-06-2015-0042

Ryan, S. and O'Connor, R.V. (2013), "Acquiring and sharing tacit knowledge in software development teams: an empirical study", *Information and Software Technology,* Vol. 55 No. 9, pp. 1614-1624. https://doi.org/10.1016/j.infsof.2013.02.013

Scuotto, V., Le Loarne Lemaire, S., Magni, D. and Maalaoui, A. (2022), "Extending knowledge-based view: future trends of corporate social entrepreneurship to fight the gig economy challenges", *Journal of Business Research,* Vol. 139, pp. 1111-1122. https://doi.org/10.1016/j.jbusres.2021.10.060

Sheerin, C., Hughes, C. and Garavan, T. (2020), "Gendered practices and tacit knowledge sharing in organizations: a structuration perspective", *Human Resource Development International*, Vol. 23 No. 5, pp. 542-568, https://doi.org:10.1080/13678868.2020.1769402

Teece, D.J. (2007), "Explicating dynamic capabilities: the nature and micro foundations of (sustainable) enterprise performance", *Strategic Management Journal*, Vol. 28 No.13, pp. 1319- 1350. https://doi.org/10.1002/smj.640

Teece, D.J. (2014), "The foundations of enterprise performance: dynamic and ordinary capabilities in an (economic) theory of firms", *The Academy of Management Perspectives*, Vol. 28 No. 4, pp. 328-352, available at: https://www.jstor.org/stable/43822373

Teece, D.J., Pisano, G. and Schuen, A. (1997), "Dynamic capabilities and strategic management", *Strategic Management Journal,* Vol. 18 No. 7, pp. 509-533, available at: https://josephmahoney.web.illinois.edu/BA545_Fall%202022/Teece,%20Pisano%20and%20Shuen%20(1997).pdf

Tonnessen, O., Dhir, A. and Flaten, B.T. (2021), "Digital knowledge sharing and creative performance: work from home during the COVID-19 pandemic", *Technological Forecasting and Social Change,* Vol. 170, p. 120866. https://doi.org/10.1016/j.techfore.2021.120866

Vallaster, C., Maon, F., Lindgreen, A. and Vanhamme, J. (2021), "Serving multiple masters: the role of micro-foundations of dynamic capabilities in addressing tensions in for-profit hybrid organizations", *Organization Studies,* Vol. 42 No. 6, pp. 911-947. https://doi.org/10.1177/0170840619856034

Van den Brink, M. (2015), "The politics of knowledge: the responses to feminist research from academic leaders", *Equality, Diversity and Inclusion,* Vol. 34 No. 6, pp. 483-495. https://doi.org/10.1108/EDI-01-2015-0004

Wang, S. and Noe, R.A. (2010), "Knowledge sharing: a review and directions for future research", *Human Resource Management Review,* Vol. 20 No. 2, pp. 115-131. https://doi.org/10.1016/j.hrmr.2009.10.001

Yoo, S., Joo, B.-K.(B). and Noh, J.H. (2022), "Team emergent states and team effectiveness: the roles of inclusive leadership and knowledge sharing", *Journal of Organizational Effectiveness: People and Performance,* Vol. 9 No. 3, pp. 353-371. https://doi.org/10.1108/JOEPP-05-2021-0120

Zheng, S., Zhang, W. and Du, J. (2011), "Knowledge-based dynamic capabilities and innovation in networked environments", *Journal of Knowledge Management,* Vol. 15 No. 6, pp. 1035-1051. https://doi.org/10.1108/13673271111179352

Zheng, W., Yang, B. and McLean, G.N. (2010), "Linking organizational culture, structure, strategy, and organizational effectiveness: mediating role of knowledge management", *Journal of Business Research*, Vol. 63 No. 7, pp. 763-771. http://dx.doi.org/10.1016/j.jbusres.2009.06.005

Zieba, M., Durst, S., and Hinteregger, C. (2022), "The impact of knowledge risk management on sustainability", *Journal Of Knowledge Management*, Vol. 26 No. 11 2022, pp. 234-258. https://doi.org/10.1108/JKM-09-2021-0691

Emergency Preparedness Training Using Virtual Reality Games: Allowing Knowledge Transfer in the Digital Age

Rashika Tasnim Keya[1], Ilona Heldal[1], Tord Hettervik Frøland[1], Orsolya Székely-Keresztesi[2], Zoltán Székely[2] and Espen Kon[3]

[1]Western Norway University of Applied Sciences, Bergen, Norway
[2]Székely Family & Co. Nonprofit Kft., Budapest, Hungary
[3]Ekon Modeling Software Systems Ltd

rashika.tasnim.keya@hvl.no
ilona.heldal@hvl.no
tord.hettervik.froland@hvl.no
info@szekely.family
zoltan@szekely.family
espen.kon@ekonm.com

Abstract: When unexpected incidents occur, such as fire outbreaks or floods, individuals who lack knowledge on how to handle such events are often shocked and unable to act efficiently. Virtual Reality (VR) technology promises to compensate for the lack of traditional teaching environments by immersing users in virtual learning environments with real-life relevance for many emergency scenarios. The primary objective of this paper is to provide a better understanding of how to raise awareness of emergencies and learn to manage unforeseen situations using VR games. Based on a theoretical background examining available literature on Knowledge Transfer (KT), VR and learning theories, we illustrate a case depicting how to handle a fire emergency at a school building. The case describes a VR game to inform students about the necessary steps for preparedness and discuss its utilization as an educational module in a course. Based on this, an Inclusive VR for KT (IVR-KT) framework is proposed that contributes to increasing the understanding of planning and assessing emergency preparedness training in education. The games included in IVR-KT will be developed using retrieved real-time and historical data with a special emphasis on inclusivity aspects by addressing a wide range of users regardless of their personal limitations and constraints. By presenting the framework and providing examples of its key components, the paper introduces new ways of considering KT for emergency preparedness training in education for handling unforeseen incidents.

Keywords: Emergency Preparedness, Evaluation, Knowledge Transfer, Virtual Reality, Serious Games, Education.

1. Introduction

With an increasing demand for practice-based learning and Knowledge Transfer (KT), new innovative ways of learning are crucial. Virtual reality (VR) based Serious Games (SG) are games designed for educational purposes rather than just entertainment. They offer a unique opportunity to simulate various scenarios where the participant can interact in a computer-generated environment while experience the consequences of their actions simultaneously. These actions are critical in emergency services, and therefore, hands-on training plays a crucial role in building skills, maintaining expertise, and strengthening readiness for unforeseen circumstances. Besides natural disasters, there are many man-made unexpected situations, such as fire, terrorist attacks, and transport accidents that may occur in our daily lives. These events can also cause injuries and damage, extensive and lasting physical and mental harm (Valcik and Tracy, 2017), as well as economic losses (Shaluf, 2007). According to the European Fire Safety Alliance, cautious estimates suggest that every year, over 5,000 people die from residential fires in Europe (European Fire Safety Alliance, 2024). Economic losses from natural disasters affected 50 million people in the EU between 1980-2020, and caused an economic loss of €12 billion per year (Majdik et al, 2023). Losses at such a large scale may cause unexpected ripple effects, for example, delaying Eurozone membership and enabling democratic backsliding (Arató, Koller and Pelle, 2021).

Emergency preparedness training is essential in conveying the importance of self-help and mutual assistance. Historically, various methods have been used, including videos, posters, and physical disaster exercises. Nowadays, the integration of cutting-edge technologies such as VR and SG presents promising new avenues for effectively training citizens (Hsu et al., 2013, Heldal, 2016). VR technology, widely recognized for its immersive capabilities, offers a versatile tool applicable across various educational contexts (Collins et al., 2021, Goedicke et al., 2018), and it is already gaining presence in training and decision support for first responders and civil defense (Székely, 2015).

Handling an emergency can be difficult for citizens involved, who must act in an organized way under time pressure. People are also more prone to commit errors in stressful conditions. By integrating VR via module into

a training program that teaches how to cope with life-threatening incidents, learners can repeatedly practice mastering the required knowledge and skills without the risk of incurring costs or triggering accidents that often may occur in real-life situations (Hammar Wijkmark et al., 2019, Song et al., 2021). This module is part of a European Union-funded project, B-prepared (see B-prepared, 2024), and the knowledge assessments are tracked via a back-to-back LMS (Learning Management System) solution between the B-prepared LMS and the LMS of the educational institution. This can allow tracking both individual knowledge progression as well as organizational level KT, for example the KT Metrics developed by the European Commission Expert Group (2009, 2022) for public research organizations. In this context, we further investigate the possibilities of VR interaction mediums (voice command, gesture recognition) and dynamic scenario design (e.g. wheelchair users' evacuation process), allowing to consider escape opportunities for people with, e.g., visual and motor impairment.

In such context, this paper presents the Inclusive VR for KT (IVR-KT) framework for achieving the KT within an educational institution of self-help in emergencies. The structure of the article is as follows: Based on existing projects in the field of VR-supported training, we first describe the fundamentals of KT in VR. We then explain how inclusive immersive training may help KT in disaster preparedness and engage students and teachers to learn by using new technologies. A case presenting a pilot VR prototype for a school fire evacuation scenario is sketched. We conclude this paper by discussing the opportunities of utilizing VR for KT and presenting the potential of the framework to teach life-threatening situations in a more engaging way by introducing an elective course module.

2. Background

2.1 Knowledge Transfer and Virtual Reality for Training Emergency Preparedness

Numerous publications have addressed issues related to Knowledge Management (KM), emphasizing the pursuit of efficient KM by seeking optimal methods and approaches (Wiig, 1997). A pivotal aspect of KM involves the dissemination and accessibility of knowledge within and across selected organizations. Schwartz (2006) asserts that knowledge transfer (KT) is a foundational societal process crucial for learning, which, in turn, drives development. While knowledge sharing (KS) and knowledge transfer (KT) are sometimes used interchangeably, the literature suggests that KS is predominantly utilized when focusing on individuals, whereas KT is more commonly employed when examining groups, departments, organizations, or businesses (Argote and Ingram, 2000; Choo and de Alvarenga Neto, 2010).

But how does anyone know whether the knowledge acquired in a VR environment is effectively transferred to the real world, and which basic characteristics will ensure KT from VR training to real world practices? While VR training has many already identified benefits (Xie et al., 2021), virtual simulations offer a significant advantage in terms of cost-effectiveness compared to traditional training methods for, e.g., firefighters on training grounds or in classrooms (Heldal and Hammar, 2017; Lamb et al., 2020; Hammar Wijkmark et al., 2021) or relevance, confidence (Ooi et al., 2019; Pedram et al., 2021).

In the last decades, many research studies have addressed the potential of VR for KT. For instance, Khanal et al. (2022), Grassini and Laumann (2020) report in their literature review that VR training can help prepare individuals for real-life emergency scenarios. VR has also changed how we engage with the type of VR we using, which, in turn, influences experiences and performance (Heldal, 2004). While there are VR technologies running on everyday computers, these are called non-immersive technologies, and others immerse the users in the simulated 3D technologies, e.g., head-mounted displays (HMDs); and these are called immersive technologies (Slater et al., 2018). VR is also useful for training in scenarios that are difficult to simulate in the real world, e.g., large forest fires, incidents in large buildings, or large public places (Williams-Bell et al., 2015; Heldal, 2016; Reis and Neves, 2019).

According to the learning pyramid (The Learning Pyramid, 2024), students remember only 10% of what they read, 20% of what they hear, and 75% when they simulate, model, or experience the material. Since allowing high experiences is one of the main benefits of VR, our proposed (IVR-KT) allows students to experience life-threatening situations in advance, thus VR games can help learners learn more effectively since they allow users to experience the intended scenarios firsthand and respond accordingly.

From the literature, it has been seen that VR continues to serve as a valuable tool for educating individuals on essential knowledge and skills. However, challenges related to the operational aspects of VR seem to introduce unnecessary obstacles, thereby diminishing learning outcomes (Song et al., 2021) and reducing gameplay self-

efficacy (Hong et al., 2023). This disparity is largely attributed to the inadequate and reflexive utilization of VR technology, failing to account for its full spectrum of capabilities, such as permitting errors for learning purposes. Hence, the development of VR applications should adhere to sound educational theories to ensure optimal learning outcomes. It is important to determine how guidance can negatively affect the acceptance of new learning ways (Fomin et al., 2024) or how leaders contribute to the outcome (Danielsson and Sjöstedt-Landén, 2020). If the user does not know how to make progress in the training, frustration can arise, and their willingness to learn may be reduced. Simplified representation of work steps as well as the lack of multimodal stimuli during VR training, can negatively influence the learning effect. In these contexts, human-computer interaction (HCI) guidelines play a significant role in the design of VR applications (Luo et al., 2021).

3. Methods

We propose the IVR KT framework based on literature from Knowledge Management (KT and KS), VR-based learning, e.g., investigating learning theories and cognitive learning models. It is inspired by the Trifecta model suggested by de Vaujany and his colleagues (De Vaujany et al., 2018), further developed for identifying patterns for VR for training for emergency professionals (Heldal et al., 2018).

The framework identifies aspects of how to teach emergency preparedness in a course module utilizing VR game via B-prepared created LMS API (Application Programming Interface) integration to educational institutions' own LMS, and the knowledge assessments are tracked via a back-to-back LMS solution between those two LMSs. B-prepared LMS has developed in such a way that it can automatically detect knowledge transfer metrics where players can see their individual progress (Majdik et al., 2023). Students can also learn relevant disaster-related knowledge by getting access to 'Disastropedia', a knowledge-sharing platform (see Disastropedia, 2024). In a course module, students receive all the available resources that fit this concept. To allow VR training to be handled via a solution between two LMS systems in a course module, the B-prepared LMS has a built-in player knowledge assessment tracking feature, and the educational institution provides all other resources, IT tools, and rules.

The defined IVR KT framework (see Figure 1) has five layers: a) the technology and other resources utilized, e.g. databases, repositories, resources for games (as the "IT technology" from Trifecta) together with b) influencing rules from the organization (as the "Rules" from Trifecta), c) information on managing VR training (this is a new layer, but necessary to be designed separately), d) involving practices for utilizing VR game based learning (as the "Practices" from Trifecta) and e) for the participants (this is a new layer, for teachers and students). Considering a new training module (a layer a) may influence some or each other layers since they have different mechanisms. Accordingly, we can use the same framework for different training situations. For example, if students want to learn how to handle a school fire systematically, the specific steps they need to take will depend highly on the scenario. The scenario depends on many circumstances, such as accessible buildings, people around, or the exact place of the incidents. This framework can potentially be used for various courses and students, but it is essential to consider issues that may vary. This should possibly be used for various courses and students, one needs to consider issues that may vary. For example, a and b) the technical resources, the current rules needed to be considered (how emergency training needs to be planned at a school) c) considering an existing scenario that needs to be used and further developed for a specific training situation, d) providing examples of applied practices, e.g. who needs to do what for finding escape routes, helping others, or reporting to emergency professionals, and e) considering the participants and their abilities (e.g. with or without functional problems). Through this, we intend to provide a better understanding of important parts of a situation necessary for KT for trainees.

4. Emergency Training

4.1 The Proposed Framework

For VR training in an educational institution as part of the course curriculum, teachers and students will have access to current VR resources and can also update the framework with information continuously. The aim is that teachers could get support for setting up VR training, and students will form teams and thoroughly brainstorm in order to learn about various emergency preparedness in immersive environment. They can experience VR games with the aid of API integration to existing game code repositories as well as design their own scenarios or new design ideas. Accordingly, new features and scenarios may be developed, which will make

learning more interesting and rewarding. For the architecture of the IVR KT framework, inspired by the Trifecta model) see Figure 1.

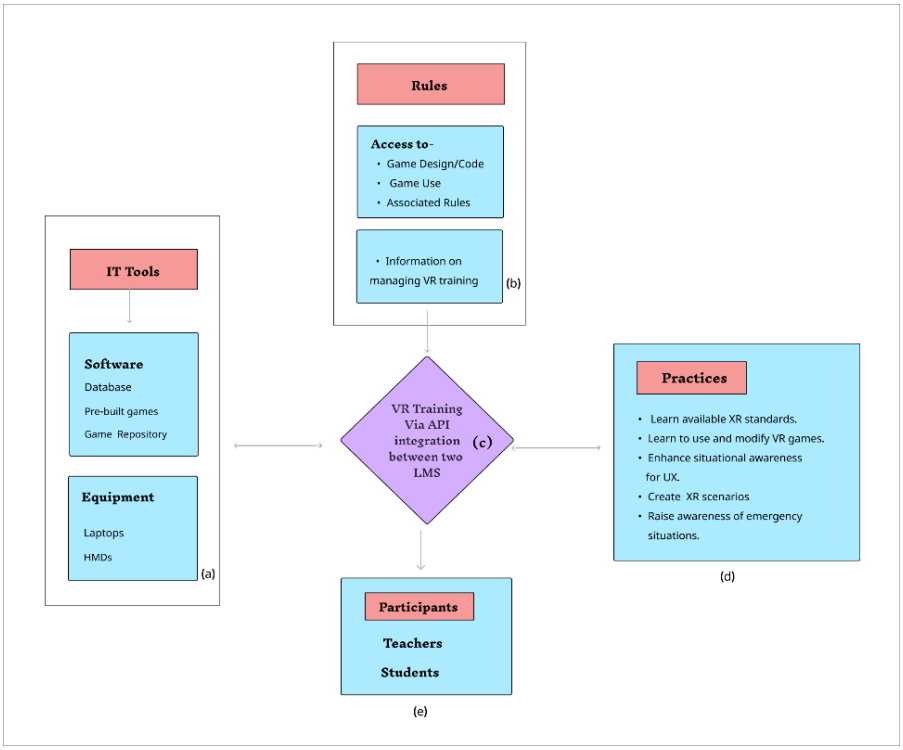


Figure 1: IVR-KT Framework. It has a total of five layers where layers a and b may vary depending on necessity. Layer c is the VR training that will be done via B-prepared LMS API integration into the educational institution's LMS.

We are using the terminology introduced by De Vaujany et al. (2018) for considering digital technologies in organizations. This terminology focused separately on IT technology (a), Rules (b) and Practices (c), but additionally accentuates the main participants due to their different roles and enhances the necessary integration between the two LMS for the actual training (c). Every module can be modified, e.g., the software extended by new games, equipment with new technologies, or the used game with new storylines for different educational modules.

4.2 The Proposed Architecture for VR Games Framework

Since existing games play a central role in the framework, we discuss here some basics that can be included in most of the VR training situations. The proposed VR application is a 3D game environment designed to familiarize students with emergency situations as well as teaching about new technology and XR standards. The design aims to produce an engaging game to increase public awareness and support decision-making in emergencies. The main parts of the architecture (Figure 2) include a data layer, VR game models, and user interface (UI). The game utilizes gamification techniques based on historical data to trigger engagement and learning. The design follows specific learning goals related to situational emergency incidents and general safety knowledge on that field (e.g. fire, flood) and consists of various learning elements. Time-constrained tasks require players to make prompt decisions under stress and provide a unique opportunity to study user behavior. Players will be able to choose from existing locations for scenarios (e.g., Norway school fire incidents) or create a custom scene by setting various parameters. Voice input and gesture recognition are also planned to be used to analyze players' reactions to game-related incidents and detect emotional and psychological states.

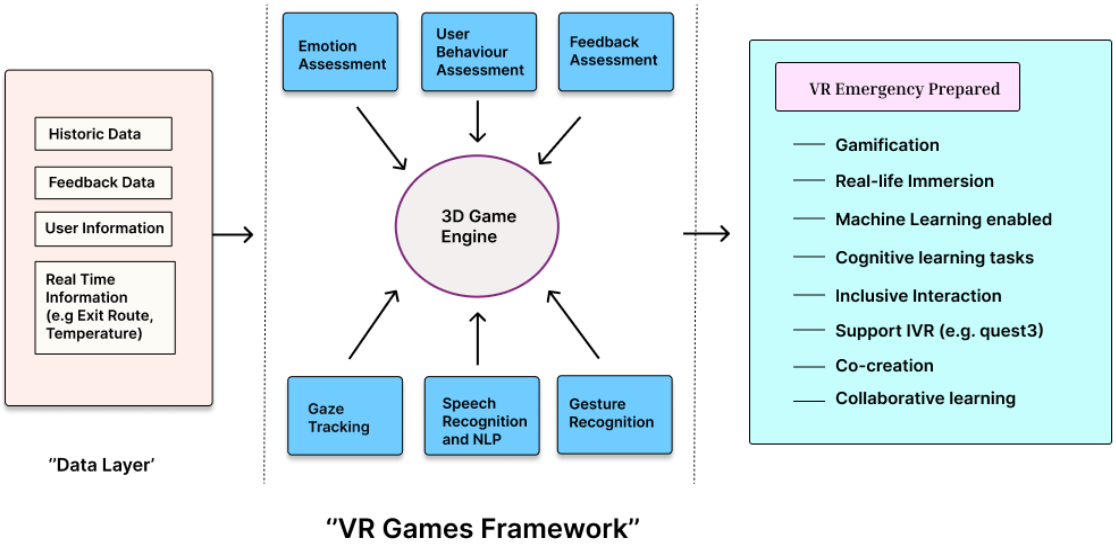


Figure 2: Main architecture for supporting KT via VR games for training. The game architecture includes a 3D game engine with different interaction mediums. Data Layer consists of different types of data which plays a significant role in the VR game framework.

The increasing interest students have in technology and VR provides an opportunity to improve the effectiveness of teaching environmental sciences and social responsibility by implementing this framework. The application incorporates retrieved real-time drill data to generate the environmental conditions necessary for simulating scenarios accurately. The temperature, visibility, smoke detection, length, and intensity of the precipitation, as well as the observation location and time, are all included in the retrieved real-time and historical drill data. Players will be able to wear a haptic suit to feel the temperature of specific scenarios (e.g. feeling warm when fire breaks) to increase the presence of the application as well as user experience and realism. Users will be able to select places and interact with accessible scenarios if data is stored in those specific locations. Different drill data from various locations are stored following the FLAIM framework to protect individual privacy while facilitating collaborative data exchange (Slagell et al., 2006). The game requires players to complete a variety of activities in a timed round to keep it interesting and effective. One of the important aspects of the framework is that users themselves can create scenarios in the game engine and provide feedback for improvement. Those feedback and user behavioural analysis data will work as a base for continuous improvements. From user behaviour patterns, it is possible to detect the most common patterns, e.g., mistakes, navigation, orientation, manipulation, data can help to design more user-centric tasks.

Under the United Nations' social inclusion principle, the Convention on the Rights of Persons with Disabilities (CRPD) requires all UN member countries to ensure that disaster awareness, preparedness, and response efforts are inclusive and accessible to individuals with disabilities (Inclusion Made Easy, 2012). Therefore, emergency preparedness training should follow Universal Design Principles (European Disability Forum, 2010). Our suggested system provides gaze tracking, gesture recognition, and voice interaction with natural language commands. These features increase accessibility and create an inclusive learning environment for everyone, regardless of their personal limitations. Additionally, Machine Learning algorithms will be used to evaluate behavioral analysis, feedback, and student learning patterns to adjust VR content in real-time scenarios. This will support the creation of more user-centric tasks design to ensure learning outcomes, which are necessary for KT. VR interaction can be difficult for untrained and disabled users, therefore our framework offers a variety of interaction methods, including voice command, gesture detection, controllers, and touchpads, in addition to language change possibilities, to provide an inclusive learning environment for diverse users. This ensures that a wide range of users, irrespective of their requirements and constraints, will be able to access our systems.

4.3 A Case: Considerations for a VR Game for Classroom Training

Under the guidance of our IVR KT framework, this experiment uses VR technology to build a Fire safety learning application for school scenarios. We split the fire safety education content into two categories: fire safety knowledge and practical application. The knowledge segment covers topics such as fire alarms, fire protection,

and fire hazards. First students are taught the safety information of the domain, and then they are exposed to the second category where players navigate through different fire safety scenarios. They receive interactive feedback to rectify mistakes and enhance their understanding. Essential guidelines and quizzes are pre-established to ensure students grasp the fundamental concepts. For example: What should you do if you encounter smoke while evacuating during a fire?

A. Keep running to exit quickly

B. Hold your breath and continue evacuating

C. Go back and find an alternate route

D. Stay low and crawl to the nearest exit

The game play part includes simple fire evacuation scenarios based on situational learning theory (see Figure 3). Situational learning theory ensures that learning should be placed in meaningful and complex situations so that users can take the initiative to learn and improve their ability to solve problems while making stories or, based on the available models, build up new stories within the VR app. In a game scene, a flame suddenly erupts from a cabinet in a classroom, causing the students to flee. The scenario unfolds with detailed descriptions, and users must select the correct actions. Currently there are two scenarios: the fire starts in a classroom (first floor) with all emergency exits available (Scenario 1), and the fire starts in a classroom (first floor) and only the right emergency exit is available (Scenario 2). Incorrect responses result in a potential "death," accompanied by alerts highlighting mistakes. For example, if the user is running towards the left emergency exit for scenario 2, an alert will pop up showing that the left emergency exit is closed. The simulations also feature students with disabilities to increase awareness. In one scenario, a wheelchair-using student tries to use the lift when smoke bursts. A pop-up alert shows 'wrong' choice, and help is coming within the scenarios. When the player will click "continue," it will show that help with evacuation chairs is on the way to ensure the student's safe and prompt evacuation. This situation not only teaches wheelchair users to wait for assistance and not panic, but it also raises awareness that special equipment is essential to kept in every fire safety department. The fire rescue department is not responsible for such a scenario. Thus, the organization's general evacuation plan and personal evacuation plan should include those special needs.

(a) (b)

Figure 3: Interface of the IVR KT, showing (a) the start screen, and (b) the entrance of two modules for our case.

4.4 Connection to Actual, Real Incidents and Real-life Implications

Around the world, occurrences involving school fires or residential fires are not uncommon. There's a good probability that the newspaper that contains details on a residential fire. There were twice-weekly arson attacks at schools in the small Norwegian village of 'Nordkjosbotn.' Luckily no injuries were recorded from this incident, but the damage was significant. What if the same incidents happened during school hours? Are the students ready for unforeseen circumstances? And how can we implement prevention measures? For this case VR can work as a great medium for KT on how to be prepared by themselves and increase awareness in emergency situations (Luo et al., 2021), we can implement alike situations and use the questions for discussions.

(a) (b)

Figure 4: Before the Arson Attack at Nordkjosbotn school and town hall (a) and after the attack (b).

An additional example from the beginning of the year, a deadly fire incident at a primary school in China took 13 students' lives (BBC (2024)). VR training can play a great role in preparing individuals for emergency situations not only at the physical level but also at the psychological level. To provide students with a close-to-real-life experience, our framework supports haptic devices. The scenarios are built using real-life incidents, so trainees can feel the heat, smell the smoke, and have a limited time to choose the correct exit route whenever a fire breaks out (Eilaki et al., 2022). If they go through the training multiple times, they will gain more self-assurance and be more mentally and physically equipped to deal with these situations when they arise.

4.5 The Possibilities of IVR KT Framework

As previously stated, the proposed games in the framework are based on actual events that have occurred. The tasks and scenarios are developed using detailed information from the local rescue agency. For example, the arson attack that occurred in Norway is still being investigated, and it was a pre-planned attack. Although the school has a fire alarm and the incident happened in the middle of the night, such an attack cannot be prevented by just placing a fire alarm because it takes the firefighters approximately fifteen minutes to arrive. In addition, the fire alarms identify when a fire has already started, but intruder alarms identify when someone has entered without authorization. This way, if someone is planning to create a fire from within the school building, they can be caught in the act before they even try. CCTV and automatic security lighting outside the school building can lower the likelihood of these events. By utilizing contemporary technologies, educational institutions can improve fire safety plans. VR game framework consists of two parts: 1) Educational content 2) Gameplay. The educational contents are created with a wide range of safety information, including how to prevent them, how to evacuate, and what to do if an incident occurs. This content can raise awareness among educators, students, and other authorities to take more action. Even a tiny error could potentially lead to an accident. Educational institutions may be reluctant to spend enough money on fire safety and installing all the needed equipment for night safety.

Thus, in that regard, the game scenario could look into whether all the windows and doors are properly locked at night so that no one can enter, how by installing an intruder alarm, the suspect can be caught, how not wanting to invest in fire safety led to an arson attack and what happened to recover from it, as well as presenting financial loss to give a real-life example. Everyone related to educational institutes can get all those resources, which can inspire them to be more be-prepared, in addition, for task design and improve user experience, they can also come up with new ideas to improve games design. By working together, IVR KT can contribute to a more conscious society within educational institutions, with implications for other areas.

5. Challenges for Utilizing VR for KT for Emergency Preparedness

Emergency training can be complex and challenging. While having individuals read procedures and ensuring their understanding is a good initial step, it is often insufficient. Based on the literature, we can infer that VR holds significant promise for emergency training due to its risk-free immersive experiences. Despite the great potential of VR, implementing successful VR applications can be challenging due to various social and technical factors, including task design, realism, hardware and software requirements. Since it can be challenging to evaluate and enhance the impact and value of VR training, this paper made a first approach by suggested IVR KT framework. It is based on already-existing resources e.g., data, source code, and considering existing hardware (e.g. HMDs),

but also on enabling students to gain familiarity with common XR applications and critical emergency knowledge (e.g., fire safety information). VR training should be also accessible, inclusive, and respectful of the users' preferences, needs, and rights. For example, the proposed framework can be supported by voice & gesture recognition and gaze tracking to make the system inclusive for everyone, including people with disabilities. Having a simulation that is as realistic as feasible is a desirable quality. However, users may experience psychological distress from an intensely realistic disaster simulation, and certainly, they would not like to be burned in a simulation. In VR and safety science research, there may be a trade-off between mental safety and realism in a disaster-related simulation where more research, new design ideas, and technological advancement in emergency preparedness through virtual reality training is necessary. Therefore, we think the IVR KT framework may play a significant role in imparting relevant knowledge to students and teachers so they can create new, practical ideas through a collaborative approach and the provision of already-existing materials. Since public awareness plays an important role in the effective mitigation of a disaster by arousing community interest and educating society to reduce risk from potential threats (Davis, 1989). In that regard, IVR KT can monitor and assess the learners' performance, progress, and feedback and also provides them with timely and constructive support and guidance.

6. Conclusions

This paper argues for the possibility of offering an immersive and interactive setting for training and teaching emergency planning in education. To this end, it proposes the IVR-KT framework, with the goal of addressing the challenges of making learning more engaging and increasing effectiveness by helping students create collaborative strategies for resolving real-world, life-threatening problems using VR games.

The framework uses historical data as a basis to support the creation of an inclusive VR learning environment where users have various interaction options and can collaborate in a realistic and immersive experience. We extended the Trifecta model to fit emergency training at schools and provide a seamless solution between two LMS for tracking KT. We have illustrated the basic elements of a framework that can be used for developing inclusive immersive games with a focus on accessibility, scalability, and adaptation to use cases, to enhance students' understanding of critical issues in handling emergencies. Future work includes using the IVR-KT framework and adding examples of VR games we recently developed based on the presented principles, utilizing it as a data hub for future students to achieve our goal of KT in emergencies using VR games within an educational institution.

Acknowledgements

This project has received funding from the European Union's Horizon Europe research and innovation programme under the Grant Agreement No. 101121134.

References

ARGOTE, L. & INGRAM, P. 2000. Knowledge transfer: A basis for competitive advantage in firms. *Organizational behavior and human decision processes,* 82**,** 150-169.

ARATÓ, K. KOLLER, B. PELLE, A. 2021. Seventeen years in the European Union. In *The Political Economy of the Eurozone in Central and Eastern Europe: Why In, Why Out? (2021)* ISBN: 9780429261411, Scopus: 85114583444 (pp. 3-10)

BBC. (2024). China: 13 dead after school dormitory fire in Henan province. *BBC*,[online] Available at: https://www.bbc.com/news/world-asia-68038976 [Accessed 20 January. 2024].

B-PREPARED, 2024. A freely accessible massive collaborative knowledge base and data hub. Available at: https://b-prepared-project.com/ [Accessed 26 May.2024].

CHOO, C. W. & DE ALVARENGA NETO, R. C. D. 2010. Beyond the ba: managing enabling contexts in knowledge organizations. *Journal of knowledge management,* 14**,** 592-610.

COLLINS, J., REGENBRECHT, H. & LANGLOTZ, T. 2021. Expertise and Experience in VR-supported learning: Achieving a deep non-verbal comprehension of four-dimensional space. *International Journal of Human-Computer Studies,* 152.

DANIELSSON, E. & SJÖSTEDT-LANDÉN, A. 2020. Leader normativity in crisis management: Tales from a school fire. *Risk, Hazards & Crisis in Public Policy,* 11**,** 139-165.

DAVIS, F. D. 1989. Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. *MIS Quarterly,* 13**,** 319-340.

DE VAUJANY, F.-X., FOMIN, V. V., HAEFLIGER, S. & LYYTINEN, K. 2018. Rules, practices, and information technology: A trifecta of organizational regulation. *Information Systems Research,* 29**,** 755-773.

DISASTROPEDIA. 2024. A learning and communication platform for the B-Prepared project. See www.disastropedia.com [Accessed 28 May 2024, At the present stage working only for project members and stakeholders.]

EUROPEAN COMMISSION. 2009. EUR-23894 - Metrics for Knowledge Transfer from Public Resarch Organisations In Europe. Report. Luxembourg. Office for Official Publication of the European Communities. ISBN 9789279120091

EUROPEAN COMMISSION, Joint Research Centre, Campbell, A., Cavalade, C., Haunold, C. et al., Knowledge transfer metrics – Exploration of composite indicators for knowledge transfer – Phase 2, Grande, S.(editor), Publications Office of the European Union, 2022, https://data.europa.eu/doi/10.2760/077637 [Accessed: 26 May 2024]

FOMIN, V., HAMMAR WIJKMARK, C. & HELDAL, I. 2024. Implementation of a weakly structured system as a case of digital transformation–a study of an emergency response training organization.

EILAKI, N. K., NORDVIK, T., HELDAL, I., AHMER, C. & HAGEN, B. C. At-Risk People's Safety in Fire Incidents: Insights Learned from Applying Reliability Index Method. 2022 6th International Conference on System Reliability and Safety (ICSRS), 2022. IEEE, 202-211.

European Fire Safety Alliance, 2024). https://www.europeanfiresafetyalliance.org/ (Accessed: 11 April, 2024)

European disability Forum,2010. https://www.edf-feph.org/standards/ (Accessed: 11 April, 2024)

GOEDICKE, D., LI, J., EVERS, V. & JU, W. Vr-oom: Virtual reality on-road driving simulation. Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems, 2018. 1-11.

GRASSINI, S. & LAUMANN, K. Evaluating the use of virtual reality in work safety: A literature review. Proceedings of the 30th European safety and reliability conf. and the 15th prob. safety assessment and mgm. conf. 2020.

HAMMAR WIJKMARK, C., HELDAL, I. and METALLINOU, M.M., 2019. Can remote virtual simulation improve practice-based training? Presence and performance in incident commander education. *PRESENCE: Virtual and Augmented Reality, 28, pp.127-152.*

HAMMAR WIJKMARK, C., METALLINOU, M. M. & HELDAL, I. 2021. Remote Virtual Simulation for Incident Commanders—Cognitive Aspects. *Applied Sciences,* 11**,** 6434.

HELDAL, I. 2004. *The Usability of Collaborative Virtual Environments: Towards an Evaluation Framework.* PhD, Chalmers.

HELDAL, I. Simulation and Serious Games in Emergency Management: Experiences from two case studies. 2016 22nd International Conference on Virtual System & Multimedia (VSMM), 2016. IEEE, 1-9.

HELDAL, I., FOMIN, V. & WIJKMARK, C. H. Technology Adoption Failure Through the Prism of an Organizational Regulation Model. European Conference on Knowledge Management, 2018. 324-XIX.

HELDAL, I. & HAMMAR, C. Simulations and Serious Games for Firefighter Training: Users' Perspective. Proc. Int. Conf. on Inf. Systems for Crisis Response and Management. Albi, France, 2017.

HONG, J.-C., CHAN, H.-Y., TENG, Y.-H., TAI, K.-H. & LIN, C.-Z. 2023. VR training program for fire escape: Learning progress predicted by the perception of fire presence, VR operational frustration, and gameplay self-efficacy. *Computers & Education: X Reality,* 3**,** 100029.

HSU, E. B., LI, Y., BAYRAM, J. D., LEVINSON, D., YANG, S. & MONAHAN, C. 2013. State of virtual reality based disaster preparedness and response training. *PLoS currents,* 5.

Inclusion Made Easy (2012). *Tech. Report,* Mumbai: CBM, https://reliefweb.int/report/world/inclusion-made-easy-quick-program-guide-disability-development (Accessed: 11 April 2024).

KHANAL, S., MEDASETTI, U. S., MASHAL, M., SAVAGE, B. & KHADKA, R. 2022. Virtual and augmented reality in the disaster management technology: a literature review of the past 11 years. *Frontiers in Virtual Reality,* 3**,** 30.

LAMB, K., FARROW, M., OLYMBIOS, C., LAUNDER, D. & GREATBATCH, I. 2020. Systematic incident command training and organisational competence. *International Journal of Emergency Services*.

LUO, Y., LI, M., TANG, J., REN, J., ZHENG, Y., YU, X., JIANG, L., FAN, D. & CHEN, Y. 2021. Design of a virtual reality interactive training system for public health emergency preparedness for major emerging infectious diseases: theory and framework. *JMIR Serious Games,* 9**,** e29956.

MAJDIK, A. L. SZÉKELY, Z. KESZLER, A. MÁRKUS, ZS. L. SZIRÁNYI, T. 2023. Teaching to Survive: A Citizen-centred Disaster Preparedness Project. *Climate Resilient Society,* ERCIM NEWS 135. October 2023

OOI, S., TANIMOTO, T. & SANO, M. Virtual reality fire disaster training system for improving disaster awareness. Proceedings of the 2019 8th international conference on educational and information technology, 301-307.

PEDRAM, S., OGIE, R., PALMISANO, S., FARRELLY, M. & PEREZ, P. 2021. Cost–benefit analysis of virtual reality-based training for emergency rescue workers: a socio-technical systems approach. *Virtual Reality*.

REIS, V. & NEVES, C. Application of virtual reality simulation in firefighter training for the development of decision-making competences. International Symposium on Computers in Education (SIIE), 2019. IEEE, 1-6.

SHALUF, I. M. 2007. An overview on disasters. *Disaster Prevention and Management: An International Journal,* 16.

SLAGELL, A. J., LAKKARAJU, K. & LUO, K. FLAIM: A Multi-level Anonymization Framework for Computer and Network Logs. LISA, 2006. 3-8.

SLATER, M. 2018. Immersion and the illusion of presence in virtual reality. *British Journal of Psychology,* 109**,** 431-433.

SONG, H., KIM, T., KIM, J., AHN, D. & KANG, Y. 2021. Effectiveness of VR crane training with head-mounted display: Double mediation of presence and perceived usefulness. *Automation in Construction,* 122**,** 103506.

SZÉKELY, Z. 2015. A kiterjesztett valóság és a robot alkalmazási lehetősége [Application of Augmented Reality and Robotics] Hadtudomány [Military Science] 25:1-2 (2015), 158-162. pp.

THE LEARNING PYRAMID (2024): Education Corner. https://www.educationcorner.com/the-learning-pyramid (Accessed 11 April, 2024)

VALCIK, N. A. & TRACY, P. E. 2017. *Case studies in disaster response and emergency management*, Routledge.

WIIG, K. M. 1997. Knowledge management: an introduction and perspective. *Journal of knowledge Management,* 1**,** 6-14.

WILLIAMS-BELL, F. M., KAPRALOS, B., HOGUE, A., MURPHY, B. & WECKMAN, E. 2015. Using serious games and virtual simulation for training in the fire service: a review. *Fire Technology,* 51**,** 553-584.

XIE, B., LIU, H., ALGHOFAILI, R., ZHANG, Y., JIANG, Y., LOBO, F. D., LI, C., LI, W., HUANG, H. & AKDERE, M. 2021. A review on virtual reality skill training applications. *Frontiers in Virtual Reality,* 2**,** 645153.

How Enterprises Engage Generation Z in Crowdsourcing: Differences Between Poland and Great Britain

Anna Korombel and Olga Ławińska
Czestochowa University of Technology, Czestochowa, Poland

anna.korombel@pcz.pl
olga.lawinska@pcz.pl

Abstract: Companies are increasingly using crowdsourcing to gain the knowledge, experience and creativity of a given community, commonly referred to as 'crowd wisdom'. The use of crowdsourcing on a large scale is possible thanks to the space created by the Internet and social media. This space is also an environment in which the digital Generation Z, an important partner for businesses, now comprising more than a third of the world's population, is eager to spend time. Already recognized as revolutionizing for economies and markets, this generation is the most technologically advanced of all cohorts. Previously, older generations have passed on knowledge and experience to younger generations, but now we are faced with the opposite: for the first time, the youngest generation is an authority and has a wealth of knowledge that other generations do not have. The aim of the article is to identify and assess the factors that determine the involvement of Generation Z representatives in solving enterprise problems in the form of crowdsourcing and to indicate the impact of gender and place of residence of Generation Z representatives on their involvement in this activity. Empirical studies conducted in Poland and Great Britain in 2023 using the CAWI technique and a questionnaire helped to achieve the objective of this study. The results of the survey allow to indicate the most important motives for engagement of Generation Z in crowdsourcing in both countries. Relationships between the above-mentioned motives and gender and the place of residence of members of Generation Z were also identified. The conclusions of the study are only an extension of theoretical knowledge, but also implications for managers that want to encourage members of Generation Z to cooperate on the basis of crowdsourcing.

Keywords: Crowdsourcing, Generation Z, Social Media, Enterprise, Management, Gender and Place of Residence Differences

1. Introduction

Howe defined the concept of crowdsourcing as "the act of a company or institution taking a function once performed by employees and outsourcing it to an undefined (and generally large) network of people in the form of an open call. This can take the form of peer production (when the job is performed collaboratively), but is also often undertaken by sole individuals. The crucial prerequisite is the use of the open call format and the large network of potential laborers" (Howe, 2006b). Enterprises wanting to develop are increasingly using crowdsourcing to draw on the knowledge, experience and creativity of the crowd (Benoit et al., 2022; Gu et al., 2022), expecting customers to be simultaneously involved in the relationship with the brand and strengthening the brand-client relationship (Brunneder et al., 2020; Mo et al., 2021; Fazli-Salehi et al., 2022). Today's level of digitization means that an invitation to participate in crowdsourcing can be addressed to virtually residents of any geographic location. This means that companies are eager to use this tool to solve their problems by creating innovative solutions.

The generation that is becoming an important market partner for modern enterprises is Generation Z. The role this generation plays in the market game, being an important consumer who expects products and services that strictly meet their expectations, is proven by numbers – according to a trend study conducted on markets in Australia, France, Germany, the Netherlands, Great Britain and the United States (Oxford Economics, 2021), Generation Z will become driving force of economic growth in the next 10 years. This means that Generation Z will become a very important independent source of consumer spending – Generation Z spending will support spending in the six markets mentioned above by USD 30 trillion in 2030, which means a six-fold increase compared to 2019 (Oxford Economics, 2021). Encouraging representatives of Generation Z to participate in this form of communication and cooperation with the company, on the one hand, seems to be simple - the Internet space is, for Generation Z, the environment in which it operates best of all generations, but on the other hand, it requires knowledge from the company, how to motivate representatives of Generation Z to participate in this form of activity.

The aim of the article is to identify and assess the factors that determine the involvement of Generation Z representatives in solving enterprise problems in the form of crowdsourcing. Achieving the goal will deepen knowledge and fill the research gap by identifying the factors that most determine the involvement of Generation Z representatives in solving enterprise problems in the form of crowdsourcing, as well as by

indicating the impact of gender and place of residence of Generation Z representatives on their involvement in this activity.

2. Literature Review

Building and sustaining trust-based partnerships is key to fostering growth, innovation and organizational resilience, particularly in an ever-changing business environment characterized by uncertainty and liquidity (Otola, Grabowska, Krupka, 2023). On the Internet, brand communities are formed around a given brand. The aim of these communities is not only to exchange information and views between its members, but also to interact and build relationships with a given brand (Woisetschläger, Hartleb, Blut, 2008). What features should a brand have to attract consumers and keep them in brand communities? It should have a clear, strong image, a long tradition and the ability to build bonds and relationships, which requires knowledge about the expectations, preferences and value system of members of a given community (Cova, 1997). The generation that knows and uses technology and the Internet very well to carry out everyday activities is Generation Z (Priporas, Stylos, Fotiadis, 2017). These are creative and innovative people open to new experiences. Learning, acquiring knowledge and development take place in accordance with the just-in-time principle, they want to know and have everything immediately, preferably online" (Wiktorowicz et al., 2016). Representatives of this generation are ruthless towards those companies that have failed their trust – most of them, in order to warn their friends, will very gladly pass on negative information about the company's activities or their products to them (Witek, Hall, 2016). The authors assumed 1995 (and later years) as the year of birth of people representing Generation Z (Priporas, Stylos, Fotiadis, 2017; Francis, Hoefel, 2018; Kamenidou et al., 2019), while they accepted 2009 as the last year of birth. Crowdsourcing can be an effective tool for brands to engage with their customers to solve a variety of problems, but it is not suitable for every brand. Crowdsourcing used incorrectly can harm the brand (Heidenreich et al., 2015). Crowdsourcing should be used by brands whose communities are characterized by strong bonds. Brands whose communities do not have strong ties should use crowdsourcing with great caution, considering that in this situation it may cause the crowd to turn against the brand, generating more negative than positive actions. Brands with weaker communities should focus primarily on implementing activities that will strengthen the customer's bond with the brand and/or contribute to the creation of a stronger community (Bal et al., 2017).

The concept of crowdsourcing is created by combining two words: crowd and outsourcing. This concept was first used in 2006 by Howe, which appeared in Wired Magazine (Howe, 2006a), but the idea of crowdsourcing, as Howe himself notes, can be found in the publications of Mackay (Mackay, 1841) and Surowiecki (2005). Howe's (2006a; 2006b) ideas were continued by Brabham (2008) defines crowdsourcing as "It is a model capable of aggregating talent, leveraging ingenuity while reducing the costs and time formerly needed to solve problems. Finally, crowdsourcing is enabled only through the technology of the web, which is a creative mode of user interaction, not merely a medium between messages and people". Brabham (2008), using the term "online community" in his publications, pointed to the close relationship between crowdsourcing and the Internet. Brabham and Guth (2008) found that the effectiveness of ideas presented on crowdsourcing platforms by the "online community" is influenced not only by their quality, but also by communication between the participants of this community. In cases where people creating a given community communicate with each other and discuss the ideas presented, the quality of these solutions is higher than in a situation where participants of the online community communicate only with the online platform. There are many different classifications of crowdsourcing in the literature, e.g. Howe (2008) distinguishes collective intelligence/crowd wisdom, crowd creation, crowd voting and crowdfunding.

The motives determining the involvement of Generation Z representatives in solving enterprise problems in the form of crowdsourcing, which are the subject of the authors' research, are classified in the literature in a very diverse way (Zhao, Zhu, 2014; Wijnhoven, Ehrenhard, Kuhn, 2015). The most frequently mentioned division is the division into external motives and internal motives (Ghezzi et al., 2018): (1) External motives: monetary rewards, reputation, company recognition, increase in professional status, benefits from having a job, reciprocity, responsibility and social capital, self-marketing, social motives, learning; and (2) Internal motives: entrepreneurial mindset, opportunity to express individual creativity; attachment to the group, sense of belonging, ideology; pleasure; fun and entertainment; psychological compensation and self-efficacy; social influence and social identity, information exchange; sense of cooperation; opportunity to establish new contacts; self-esteem; learning.

Zhang et al. (2022), based on the literature review, identified the 8 most significant motives for individuals engaging in crowdsourcing: 1. Cash prizes, 2. Learning or developing competences, 3. Access to a new job, 4.

Gaining reputation and recognition, 5. Taking on challenges and having fun, 6. Self-esteem, 7. Altruism, 8. Sense of belonging to a community.

The motive with the greatest impact on people's involvement in crowdsourcing is the possibility of receiving a monetary reward for presenting the best solution. Prizes and their amounts may increase the likelihood of people participating in crowdsourcing, but at the same time they will not guarantee their appropriate contribution or winning the competition (Patel et al., 2023). Some researchers advise against using monetary rewards to stimulate creativity (Hennessey, Amabile, 2010), while others argue that monetary rewards increase creativity as long as they are linked to a creativity goal (Eisenberger, Rhoades, 2001). This controversial relationship between rewards and creativity has been called the "reward paradox" in the literature (Zhou, Shalley, 2003).

The types and effects of undertaken motivating actions are not independent of each other – some motives strengthen each other, while others reduce the effect of the others. Research has shown that intrinsic and prosocial motives (e.g. motives related to having fun and helping) mutually strengthen their influence on crowd involvement in crowdsourcing problem solving, while monetary rewards combined with prosocial motivation reduce this influence (Acar, 2014). The content of the instructions explaining how to perform a given task also influences the involvement of people in solving enterprise problems in the form of crowdsourcing. Empirical results support a U-shaped relationship between the use of restrictive words and the number of participants, as well as an inverted U-shaped relationship between the use of terminology and participation (Yin et al., 2022). The literature review allows to conclude that there are no studies on the relationship between the gender and place of residence of Generation Z and the motives for this generation's participation in crowdsourcing. The authors formulated the following research questions:

Q1. Which factors most determine the engagement of Generation Z in solving enterprise problems by crowdsourcing?

Q2. Does the gender of a Generation Z representative influence his or her engagement in crowdsourcing? If so, how?

Q3. Does the place of residence of a representative of Generation Z influence his engagement in crowdsourcing? If so, how?

Q4. Is this engagement the same among the representatives of Generation Z in Poland and the Great Britain?

3. Methodology

The research on Gen Zers' attitudes towards brands on social media is a part of a broader study conducted by the authors among students in Poland and Great Britain in 2023. The research employed a combination of qualitative and quantitative approaches, utilizing survey research as an indirect measurement method. It employed survey as the research technique and survey questionnaire as the research tool. The selection of variables used in the study was based on a critical analysis of relevant literature (Gummerus et al., 2012; Gregor, Kubiak, 2014).

Regarding the birth year of Generation Z representatives, there is no consensus in the literature. The most frequently cited date is the year 1995, which the authors of the paper adopted as the cutoff year for their study. The authors also assumed that the independent variable in their study is the specific group of respondents being tested, rather than the entire population of Generation Z. Due to the challenge of definitively determining the age range of Generation Z, it becomes problematic to treat this variable as independent. However, the authors found that utilizing Generation Z as a heuristic is valuable, as generational profiling is now prevalent in popular media and popular culture, providing a descriptive framework.

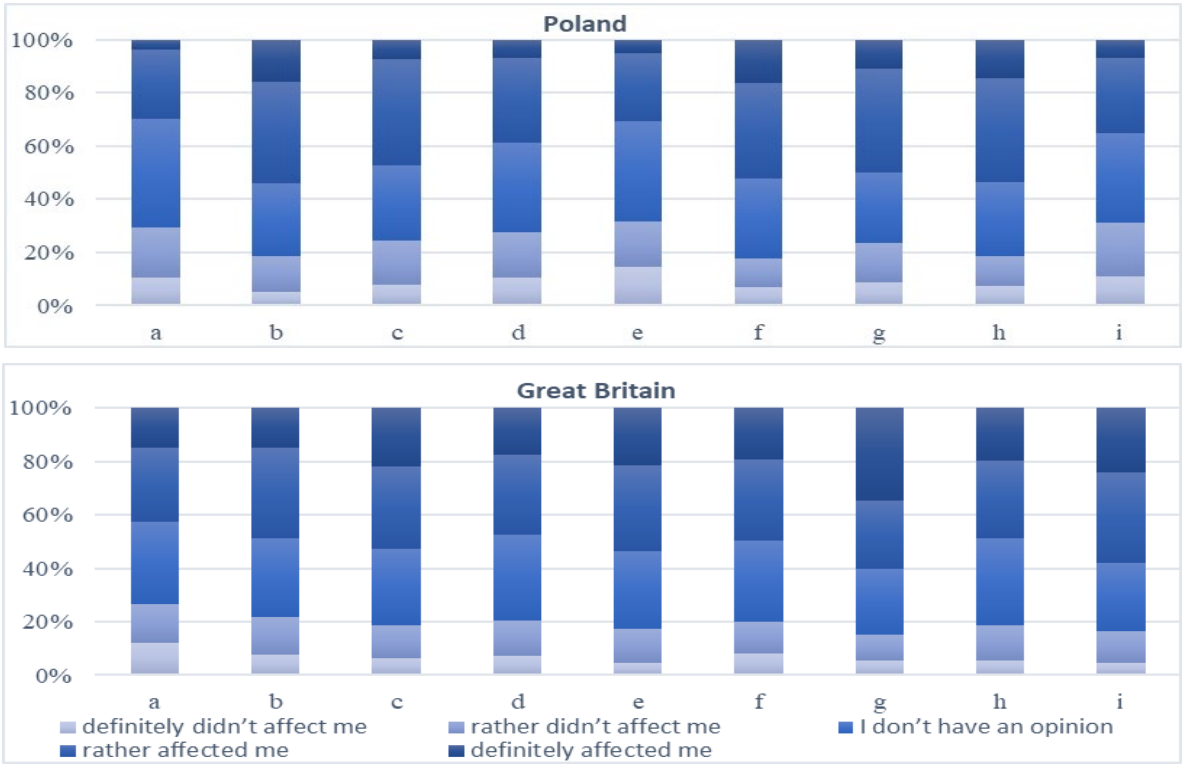
Prior to commencing the main research, the authors conducted a pilot study in 2018, enabling them to identify and rectify any errors in the survey questionnaire before proceeding with the main study. In Poland, a total of 322 students participated (166 females and 156 males), while in Great Britain, a total of 318 students participated (199 females and 119 males). The research employed the CAWI (Computer-Assisted Web Interviewing) technique. In Poland, an online survey questionnaire was administered through the Webankieta.pl platform, while data collection in Great Britain was outsourced to an external institution specializing in survey administration. It is important to note that the sampling method used in both studies was non-probabilistic. While utilizing non-probabilistic sampling, the authors employed statistical inference as an opportunity to identify relationships within the studied groups, as descriptive statistics alone would not allow for such analysis.

Based on the research results, the authors calculated the number and frequency of respondents' responses to each question in the survey. The authors are aware that the sampling technique employed does not allow for the estimation of errors that may arise when generalizing the observed patterns in the sample to the entire population. To identify potential relationships within the studied groups, the authors utilized statistical inference, for which they adopted a certain level of significance, as descriptive statistics alone cannot provide such analysis. Statistical inference was conducted with a predetermined significance level set at $\alpha = 0.05$, and a p-value was calculated for each test. Non-parametric tests were used to examine the relationship between variables: the Mann Whitney U test and Spearman's rank correlation coefficient. The authors compared the p-value with the level of statistical significance to determine whether there was sufficient evidence to reject the null hypothesis (H_0) in favor of the alternative hypothesis (H_1) ($p < \alpha$), or not ($p \geq \alpha$). All analyses were performed using Statistica software, version 13.3.

The authors acknowledge that survey research has certain limitations, such as providing only a surface-level understanding of the phenomena under study and the possibility of respondents providing inaccurate answers. One potential criticism of the presented research results is that the study was conducted on a small group of participants. While small sample sizes can raise methodological concerns, such as limitations in generalization, they can still provide valuable insights when proper statistical tests are applied for inference (Yates, 1934; Nachar, 2008).

4. Results

The presented results are a fragment of research conducted by the authors in Poland and Great Britain at the beginning of 2023. Respondents were asked the following question: "Which of the following factors will make you respond to the company's invitation addressed to a wide group of people (crowdsourcing) and solve a specific problem, e.g. come up with an improvement for a good/service, design a new function for a good/service, design a new good/service, you will come up with a new flavor or name for a good/service?. Evaluate each factor." The obtained numbers (in %) of responses in Poland and Great Britain in 2023 are presented in Figure 1.



a. Desire to interact with a favourite brand, b. Desire to receive a material prize or money, c. Desire to test your skills and knowledge in practice, d. Possibility of participating in a big project without being hired in the organisation, e. Recognition among social media users, f. Developing your own career by building a portfolio and reputation through proving participation in various projects, g. Networking, h. Sharing experiences, possibility of learning from the experience of others, i. Desire to belong to a specific group

Figure 1: Assessment of factors determining the participation of a Generation Z respondent in crowdsourcing - number of responses (in %) in Poland and Great Britain in 2023

Factors rated highest by respondents in Poland: (1) Desire to receive a material prize or money, (2) Developing your own career by building a portfolio and reputation through proving participation in various projects, (3) Networking, (4) Sharing experiences, possibility of learning from the experience of others.

Factors rated highest by respondents in Great Britain: (1) Desire to test your skills and knowledge in practice, (2) Recognition among social media users, (3) Networking, (4) Desire to belong to a specific group.

The next step was to examine whether there is a relationship between individual assessments of factors determining participation in crowdsourcing and the respondent's gender. For this purpose, non-parametric tests were used for two independent groups. These tests verify the hypothesis that the two analyzed samples come from different general populations (statistical communities). The Mann Whitney U test was used (Tables 1 and 2) because the data are measurable, but their distribution is not normal and the data are ordinal (Nachar, 2008; Walters, 2021). In the case of ordinal data, the null hypothesis (H_0) assumes that the types of distributions of the analyzed groups do not differ significantly from each other.

Table 1: Results of the Mann-Whitney U test (with continuity correction) regarding the relationship between the assessment of factors determining participation in crowdsourcing and the gender of the Generation Z respondent in Poland in 2023

Variables	Sum of ranks Male	Sum of ranks Female	U	Z	p
Desire to interact with a favourite brand & Gender	23750.5	28252.5	11504.5	-1.82	0.0692
Desire to receive a material prize or money & Gender	23775.0	28228.0	11529.0	-1.77	0.0761
Desire to test your skills and knowledge in practice & Gender	23989.5	28013.5	11743.5	-1.52	0.1303
Possibility of participating in a big project without being hired in the organisation & Gender	25083.5	26919.5	12837.5	-0.14	0.8909
Recognition among social media users & Gender	23883.5	28119.5	11637.5	-1.63	0.1023
Developing your own career by building a portfolio and reputation through proving participation in various projects & Gender	25621.5	26381.5	12520.5	0.53	0.5939
Networking & Gender	23143.5	28859.5	10897.5	**-2.56**	**0.0104**
Sharing experiences, possibility of learning from the experience of others & Gender	24245.0	27758.0	11999.0	-1.19	0.2347
Desire to belong to a specific group & Gender	24925.5	27077.5	12679.5	-0.33	0.7392

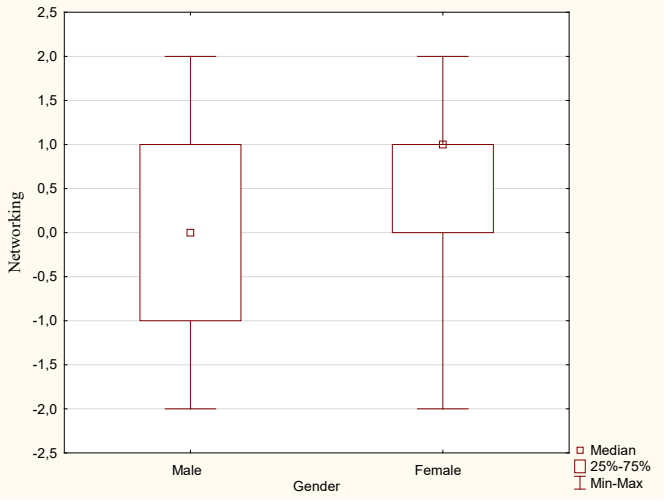


Figure 2: Assessment of the "networking" factor determining participation in crowdsourcing by Generation Z respondents by gender in Poland in 2023

The results of the Mann-Whitney U test for data from the study in Poland (Table 1) provide grounds for rejecting the assumed null hypothesis ($p > 0.05$) only in the case of assessing one factor: "networking".

Based on the adopted level of $\alpha = 0.05$, the Z statistics of the Mann Whitney U test with continuity correction, as well as on the basis of the exact U statistics, it can be assumed that there are statistically significant differences between female and male respondents of Generation Z in Poland in terms of the assessment of only one factor determining the participation in crowdsourcing. These differences consist in the fact that women rated the described factor higher than men. They can be described based on the median, quartiles and the largest and smallest values, which are also visible on the box plot chart (Figure 2).

In the case of the remaining factors mentioned, the types of distributions of the analyzed groups do not differ significantly from each other. Therefore, there is no relationship between individual assessments of factors determining participation in crowdsourcing and the gender of the Generation Z respondent in Poland in 2023.

Table 2: Results of the Mann-Whitney U test (with continuity correction) regarding the relationship between the assessment of factors determining participation in crowdsourcing and the gender of the Generation Z respondent in Great Britain in 2023

Variables	Sum of ranks Female	Sum of ranks Male	U	Z	p
Desire to interact with a favourite brand & Gender	32275.5	18445.5	11305.5	0.70	0.4857
Desire to receive a material prize or money & Gender	33241.5	17479.5	10339.5	**1.97**	**0.0486**
Desire to test your skills and knowledge in practice & Gender	31960.5	18760.5	11620.5	0.29	0.7722
Possibility of participating in a big project without being hired in the organisation & Gender	32624.0	18097.0	10957.0	1.15	0.2500
Recognition among social media users & Gender	30986.0	19735.0	11086,0	-0.98	0.3250
Developing your own career by building a portfolio and reputation through proving participation in various projects & Gender	32271.0	18450.0	11310,0	0.69	0.4890
Networking & Gender	32448.0	17955.0	10934,0	1.06	0.2889
Sharing experiences, possibility of learning from the experience of others & Gender	32928.0	17793.0	10653,0	1.56	0.1193
Desire to belong to a specific group & Gender	30824.5	19896.5	10924,5	-1.19	0.2323

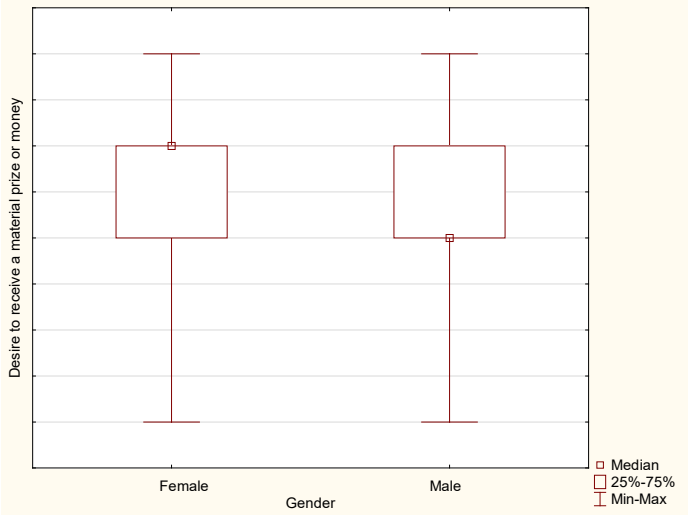


Figure 3: Assessment of the "desire to receive a material prize or money" factor determining participation in crowdsourcing by Generation Z respondents by gender in Great Britain in 2023

Based on the adopted level of $\alpha = 0.05$, the Z statistics of the Mann Whitney U test with continuity correction, as well as on the basis of the exact U statistics, it can be assumed that there are statistically significant differences

between female and male respondents of Generation Z in Great Britain in terms of the assessment of only one factor determining the participation in crowdsourcing. These differences consist in the fact that women rated "Desire to receive a material prize" higher than men. These differences can be described based on the median, quartiles and the largest and smallest values, which are also visible on the box plot chart (Figure 3).

In the case of the remaining factors mentioned, the types of distributions of the analyzed groups do not differ significantly from each other. Therefore, there is no relationship between individual assessments of factors determining participation in crowdsourcing and the gender of the Generation Z respondent in Great Britain in 2023.

The next stage of the analysis was to verify whether there is a relationship between the variables: the assessment of factors determining participation in crowdsourcing (variable X) and the respondent's place of residence (variable Y). To assess the correlation between two qualitative characteristics, the non-parametric correlation coefficient was calculated – Spearman's rank correlation coefficient (Tables 3 and 4). The Rxy coefficient calculated from the sample is an estimate of the correlation coefficient ρ in the general population, and its numerical value is a point assessment of the strength of the connection in the entire population (Akoglu, 2018; Wiśnienwski, 2014). The following set of hypotheses was verified:

$$H_0: \rho = 0$$

towards the alternative hypothesis:

$$H_1: \rho \neq 0$$

Verification of the null hypothesis helped in assessing whether the existing relationship between the studied variables (X and Y) in the sample is only accidental or may also be a regularity in the studied population.

Table 3: Spearman's rank order correlation regarding the relationship between the assessment of factors determining participation in crowdsourcing and the place of residence of the Generation Z respondent in Poland in 2023

Variables	N of valid ones	Spearman's rank R	t (N-2)	p
Desire to interact with a favourite brand & Place of residence	322	-0.0308	-0.55	0.5824
Desire to receive a material prize or money & Place of residence	322	-0.0349	-0.63	0.5323
Desire to test your skills and knowledge in practice & Place of residence	322	0.0206	0.37	0.7122
Possibility of participating in a big project without being hired in the organisation & Place of residence	322	0.0928	1.67	0.0965
Recognition among social media users & Place of residence	322	-0.0138	-0.25	0.8055
Developing your own career by building a portfolio and reputation through proving participation in various projects & Place of residence	322	0.0889	1.60	0.1114
Networking & Place of residence	322	-0.0723	-1.30	0.1954
Sharing experiences, possibility of learning from the experience of others & Place of residence	322	0.0183	0.33	0.7430
Desire to belong to a specific group & Place of residence	322	-0.0652	-1.17	0.2435

The obtained Spearman's R coefficients are not statistically significant. The analysis did not provide grounds for finding statistically significant correlations between the studied variables: the assessment of individual factors determining participation in crowdsourcing and the respondents' place of residence in Poland in 2023.

Table 4: Spearman's rank order correlation regarding the relationship between the assessment of factors determining participation in crowdsourcing and the place of residence of the Generation Z respondent in Great Britain in 2023

Variables	N of valid ones	Spearman's rank R	t (N-2)	p
Desire to interact with a favourite brand & Place of residence	318	-0.0016	-0.03	0.9773
Desire to receive a material prize or money & Place of residence	318	0.0412	0.73	0.4638
Desire to test your skills and knowledge in practice & Place of residence	318	0.0482	0.86	0.3921
Possibility of participating in a big project without being hired in the organisation & Place of residence	318	-0.0582	-1.04	0.3004
Recognition among social media users & Place of residence	318	0.0404	0.72	0.4727
Developing your own career by building a portfolio and reputation through proving participation in various projects & Place of residence	318	0.0846	1.51	0.1322
Networking & Place of residence	318	0.0662	1.18	0.2393
Sharing experiences, possibility of learning from the experience of others & Place of residence	318	0.0024	0.04	0.9665
Desire to belong to a specific group & Place of residence	318	-0.0371	-0.66	0.5103

Similarly to the coefficients calculated for data collected in Poland in 2023, the obtained Spearman's R coefficients for data obtained in Great Britain are not statistically significant ($p > 0.05$). The analysis did not provide any basis for finding statistically significant correlations between the studied variables: the assessment of individual factors determining participation in crowdsourcing and the respondents' place of residence.

5. Conclusion

The results of the conducted research allow us to conclude that representatives of Generation Z living in different countries are guided by different motives when actively participating in crowdsourcing, and that different motives are important for women and different for men. The obtained research results should also draw managers' attention to the use of non-monetary incentives towards representatives of Generation Z. Incentives in the form of rewards (material and/or monetary) turned out to be the most important motivating factor only in the group of Polish respondents.

For both representatives of Generation Z from Poland and Great Britain, non-monetary internal benefits are of great importance. The expectation of receiving a monetary reward turned out to be the most important motivating factor only in the case of representatives of Generation Z from Poland. The obtained results are identical to those of Zhang et al. (2022). For representatives of Generation Z from Great Britain, the most important motivating factor was the desire to test your skills and knowledge in practice. The positive impact of internal factors on the involvement of Generation Z representatives in crowdsourcing is identical to the research results presented in the literature on the subject, which were conducted on other groups of respondents (Brabham, 2010; Zheng et al., 2011). Women representing Generation Z in Poland rated the impact of networking on their involvement in crowdsourcing higher than men, while women representing Generation Z in Great Britain rated the desire to receive a material reward or money higher than men. The obtained results are not consistent with the research results presented in the literature on other groups of respondents (Krishnamurthy, 2006; Zheng et al., 2011; Yin et al., 2022; Patel et al., 2023).

The knowledge obtained as a result of the research will allow managers to plan and carry out activities using crowdsourcing in a way that takes into account the motives that guide representatives of Generation Z when deciding to participate in crowdsourcing. This increases the chance of engaging Generation Z representatives in solving enterprise problems.

Managers, wanting to encourage representatives of Generation Z to cooperate on the basis of crowdsourcing, should not only guarantee Polish authors of winning solutions material prizes or earnings, but at the same time create an environment enabling representatives of Generation Z to feel recognized among social media participants, as well as develop their own career path by building a portfolio and reputation as a result of

demonstrating participation in various projects. Using crowdsourcing, managers do not have to take into account the place of residence of representatives of Generation Z by city/town village if it is not the subject of cooperation.

The conducted survey research is characterized by limitations, which include, among others: the possibility of superficial knowledge of the studied phenomena, or respondents giving false answers. However, the relatively small number of respondents does not allow the obtained research results to be treated as representative. Although small samples may be methodologically questionable (e.g., generalization is difficult), they can be useful for making inferences if appropriate statistical tests are used (Nachar, 2008).

Undoubtedly, future research should be conducted on a larger sample, and quantitative research should be supplemented with qualitative research, including an explanation of the reasons for the variation in motives of Generation Z's involvement in crowdsourcing. Undertaking research in other countries would make it possible to compare crowdsourcing motives among Generation Z representatives of different nationalities and determine which of them occur regardless of geographical location.

References

Acar, O.A. (2014). Crowdsourcing for Innovation: Unpacking Motivational, Knowledge and Relational Mechanisms of Innovative Behavior in Crowdsourcing Platforms, ERIM PhD Series in Research in Management, Vol. 321, Rotterdam.

Akoglu, H. (2018). "User's guide to correlation coefficients", Turkish Journal of Emergency Medicine, Vol. 18, Iss. 3, 91-93, doi: 10.1016/j.tjem.2018.08.001

Bal, A.S., Weidner, K., Hanna, R. and Mills, A.J. (2017). "Crowdsourcing and brand control", Business Horizons, Vol. 60, No. 2, 219-228, doi: 10.1016/j.bushor.2016.11.006.

Benoit, S., Wang, Y., Teng, L., Hampson, D.P. and Li, X. (2022). "Innovation in the sharing economy: a framework and future research agenda", Journal of Business Research, Vol. 149, 207-216, doi: 10.1016/j.jbusres.2022.05.020.

Brabham, D.C. (2008). "Crowdsourcing as a Model for Problem Solving. An Introduction and Cases", The International Journal of Research into New Media Technologies, Vol 14(1), 75-90, DOI:10.1177/1354856507084420.

Brunneder, J., Acar, O.A., Deichmann, D. and Sarwal, T. (2020). "A new model for crowdsourcing innovation", Harvard Business Review, 31 January.

Cova B. (1997). "Community and Consumption. Towards a Definition of the 'Linking Value' of Product or Services", European Journal of Marketing, Vol. 31, No. 3-4, 297-316.

Eisenberger, R. and Rhoades, L. (2001). "Incremental effects of reward on creativity", Journal of Personality and Social Psychology, Vol. 81(4), 728-741.

Fazli-Salehi, R., Torres, I.M., Madadi, R. and Zúñiga, M.Á. (2022). "The impact of interpersonal traits (extraversion and agreeableness) on consumers' self-brand connection and communal-brand connection with anthropomorphized brands", Journal of Brand Management, Vol. 29, No. 1, 13-34, doi: 10.1057/s41262-021-00251-9.

Francis, T. and Hoefel, F. (2018). 'True Gen': Generation Z and its implications for companies. The influence of Gen Z - the first generation of true digital natives – is expanding, McKinsey & Company, [online], https://www.mckinsey.com/~/media/McKinsey/Industries/Consumer%20Packaged%20Goods/Our%20Insights/True%20Gen%20Generation%20Z%20and%20its%20implications%20for%20companies/Generation-Z-and-its-implication-for-companies.pdf, (access: 29.11.2023).

Ghezzi, A., Gabelloni, D., Martini, A. and Natalicchio, A. (2018). „Crowdsourcing: A Review and Suggestions for Future Research", International Journal of Management Reviews, Vol. 20, 343-363.

Gregor, B. and Kubiak, T. (2014). "Ocena działań prowadzonych przez firmy w mediach społecznościowych w świetle wyników badań ich użytkowników", Marketing Instytucji Naukowych i Badawczych, No. 4(14), 3-27, doi: 10.14611/minib.14.04.2014.03.

Gu, Z., Bapna, R., Chan, J. and Gupta, A. (2022). "Measuring the impact of crowdsourcing features on mobile app user engagement and retention: a randomized field experiment", Management Science, Vol. 68 No. 2, 1297-1329, doi: 10.1287/mnsc.2020.3943.

Gummerus, J., Liljander, V., Weman, E. and Pihlström, P. (2012). "Customer engagement in a Facebook brand community", Management Research Review, No. 35(9), 857-877, doi: 10.1108/01409171211256578

Guth, K.L. and Brabham, D.C. (2017). "Finding the diamond in the rough: Exploring communication and platform in crowdsourcing performance", Communication Monographs, Vol. 84, Issue 4, 510-533.

Heidenreich, S., Wittkowski, K., Handrich, M. and Falk, T. (2015). "The dark side of customer co-creation: exploring the consequences of failed co-created services", Journal of the Academy of Marketing Science, Vol. 43, No. 3, 279-296, doi: 10.1007/s11747-014-0387-4.

Hennessey, B. and Amabile, T. (2010). "Creativity", Annual Review of Psychology, Vol. 61, 569-598.

Howe, J. (2006a). The Rise of Crowdsourcing, „Wired Magazine", Issue 14.06. – June, [online], https://www.wired.com/2006/06/crowds/ (access 09.11.2023).

Howe, J. (2006b). Crowdsourcing, [online], https://crowdsourcing.typepad.com/cs/2006/06/ crowdsourcing_a.html (access 09.11.2023).

Howe, J. (2008). Crowdsourcing: Why the Power of the Crowd Is Driving the Future of Business, Crown Publishing Group, USA.

Kamenidou, I.C., Mamalis, S.A., Pavlidis, S. and Bara, E.-Z.G. (2019). "Segmenting the Generation Z cohort university students based on sustainable food consumption behavior: A preliminary study", Sustainability, Vol. 11(3), 837, 1-22.

Krishnamurthy, S. (2006). "On the intrinsic and extrinsic motivation of free/libre/open source (floss) developers", Knowledge, Technology & Policy, Vol. 18, No. 4, 17-39.

Mackay, C. (1841). Memoirs of Extraordinary Popular Delusions, Richard Bentley, New Burlington Street, London.

Mo, J., Sarkar, S. and Menon, S. (2021). "Competing tasks and task quality: an empirical study of crowdsourcing contests", MIS Quarterly, Vol. 45 No. 4, 1921-1948, doi: 10.25300/MISQ/2021/14639.

Nachar, N. (2008). "The Mann-Whitney U: A test for assessing whether two independent samples come from the same distribution", Tutorials in Quantitative Methods for Psychology, No. 4(1), 13-20, doi:10.20982/tqmp.04.1.p013.

Otola, I., Grabowska, M. and Krupka Z. (2023). The Importance of Trust in Relationships for Creating Organizational Resilience, [in:] Trust and Organizational Resilience, Routledge, New York, 77-88, doi:10.4324/9781003433798-11.

Oxford Economics (2021). Gen Z's role in shaping the digital economy, [online], https://www.oxfordeconomics.com/resource/gen-z-role-in-shaping-the-digital-economy/ (Access: 22.02.2024).

Patel, C., Husairi, M.A., Haon, C. and Oberoi, P. (2023). "Monetary rewards and self-selection in design crowdsourcing contests: Managing participation, contribution appropriateness, and winning trade-offs", Technological Forecasting and Social Change, Vol. 191, 122447.

Priporas, C-V., Stylos, N. and Fotiadis, A.K. (2017). "Generation Z consumers' expectations of interactions in smart retailing: A future agenda", Computers in Human Behavior, Vol. 77, 374-381.

Surowiecki, J. (2005). The Wisdom of Crowds, Anchor Books.

Wijnhoven, F., Ehrenhard, M. and Kuhn, J. (2015). "Open government objectives and participation motivations", Government Information Quarterly, Vol. 32, 30-42.

Wiktorowicz J., Warwas I., Kuba M., Staszewska E., Woszczyk P., Stankiewicz A. and Kliombka-Jarzyna J. (2016). Pokolenia – co się zmienia? Kompendium zarządzania multigeneracyjnego, Wolters Kluwer, Warszawa.

Wiśniewski, J.W. (2014). „Dylematy stosowania współczynnika korelacji Spearmana", In: W. Szkutnik (ed.) Zarządzanie ryzykiem kapitałowym i ubezpieczeniowym oraz społecznymi uwarunkowaniami ryzyka rynku pracy. Studia Ekonomiczne, Uniwersytet Ekonomiczny: Katowice, Vol. 181, 174-184.

Witek, L. and Hall, H. (2016). "Prosumption use in creation of cause related marketing programs through crowdsourcing", Procedia Economics and Finance, Vol. 39, 212-218.

Woisetschläger, D.M., Hartleb, V. and Blut, M. (2008). "How to make brand communities work: Antecedents and consequences of consumer participation", Journal of Relationship Marketing, Vol. 7, No. 3, 237-256.

Yates, F. (1934). "Contingency tables involving small numbers and the Chi-Square Test", Journal of the Royal Statistical Society, Vol. 1(2), 217-235, doi:10.2307/2983604.

Yin, X., Zhu, K., Wang, H., Zhang, J., Wang, W. and Zhang, H. (2022). "Motivating participation in crowdsourcing contests: The role of instruction-writing strategy", Information & Management, Vol. 59(103616), Issue 3, 1-17.

Zhang, X., Xia, E., Shen, C. and Su, J. (2022). "Factors Influencing Solvers' Behaviors in Knowledge-Intensive Crowdsourcing: A Systematic Literature Review", Journal of Theoretical Applied Electronic Commerce Research, Vol. 17, 1297-1319, https://doi.org/10.3390/jtaer17040066.

Zhao, Y.C. and Zhu, Q. (2014). "Effects of extrinsic and intrinsic motivation on participation in crowdsourcing contest: A perspective of self-determination theory", Online Information Review, Vol. 38, 896-917.

Zheng, H., Li, D., and Hou, W. (2011). "Task Design, Motivation, and Participation in Crowdsourcing Contests", International Journal of Electronic Commerce, Vol. 15(4), 57-88.

Zhou, J. and Shalley, C. (2003). "Research on employee creativity: A critical review and directions for future research", Research in Personnel and Human Resources Management, Vol. 22, 165-217.

Corporate Social Responsibility: Understanding the Concept

Patrycja Krawczyk and Justyna Łukomska-Szarek
Czestochowa University of Technology (CUT), Częstochowa, Poland

patrycja.krawczyk@pcz.pl
j.lukomska-szarek@pcz.pl

Abstract: The concept that organisations consider social and environmental interests and relationships at the strategy-building stage has been around for many years. The first definition of CSR dates back to the 1970s. It was created by the American economist Archie Carroll. His theory was presented as a pyramid of CSR, with economic responsibility as the base and legal, ethical and philanthropic responsibility as the next tiers. The foundations of modern CSR are the principles formalised in 2010 as the ISO 26000 standard. The dynamic development of the concept has gone beyond the level of good practice and has become an obligation for many businesses as reflected in mandatory non-financial reports. In order for the CSR strategy to benefit companies and society, knowledge about it should be widely known The purpose of the article is to show what is the level of understanding of corporate social responsibility (CSR) in society. Corporate social responsibility is a management strategy designed for society. It is a concept analyzed in many academic centers around the world. The assumptions of this strategy are also familiar to most managers of organizations. The word society is repeated many times in its definition. The basis of this concept is concern for people. Many organizations take on the challenge of making profits while respecting human resources and the environment, for social and economic sustainability. The strategy is aimed at employees, local communities and the environment in which people live. Therefore, it is necessary to ask how the state of knowledge about CSR among the main addressees of the strategy. The article will present the results of the research of the first stage of testing the understanding of the concept. Understanding of the concept of CSR in society will be carried out using a survey conducted among a group of students at Częstochowa University of Technology. In the next stages, it is planned to extend the survey to larger social groups. People as the starting points of the entire CSR concept should be aware of what this rapidly growing economic trend is. But, are they? What is their knowledge in this area? Without an understanding of the concept in society, it will remain only an element of the scientific community's discourses or an element of companies' PR.

Keywords: Knowledge, CSR Corporate Social Responsibility

1. Introduction

Global economic development based on sustainability is only possible through broadly understood knowledge (Krawczyk, 2024). The term sustainability is the result of understanding the three aspects: social, environmental, and economic, taking into account the costs of current decisions for future generations. Sustainability is a contemporary and current issue recognized by researchers (Al-Ali Mubarak, Gorgenyi-Hegyes and Fekete-Farkas, 2020) and is the main derivative of this concept for business. Corporate Social Responsibility (CSR), as an issue at the intersection of management, economics and ethics, is an extremely capacious category that can be considered in many dimensions: from social, to environmental, to political (public), to market (Otola and Tylec, 2016). The communication of an organisation's performance in its economic, social, and environmental dimensions to the concerned parties is the principal function of the CSR reporting process. In this way, an enterprise demonstrates the effectiveness of its actions in the area of social responsibility management. Thus, the CSR reporting should be part of the process of creating an organisation's strategy, implementation of its action plans (Krištofik, Lament and Musa, 2016). Entrepreneurs should invest in CSR and seek to improve the quality of their relationships with their funders(Mastrangelo, Cruz-Ros and Miquel-Romero, 2019). Sustainable development should be a core principle of long-term development, both for countries or organisations and for companies. In the private sector, the concept of corporate social responsibility (CSR) is an important, if not the most important, pillar in the process of implementing sustainable development. Knowledge is increasingly important in the management process in today's economy. It serves as a strategic resource of the organization (Piersiala, 2014). CSR has been shown to be an effective means of doing well for the environment and society (Rupp and Mallory, 2015).

According to the Global Reporting Initiative, a CSR report can be defined as: “A sustainability report is a report published by a company or organization about the economic, environmental and social impacts caused by its everyday activities. A sustainability report also presents the organization’s values and governance model, and demonstrates the link between its strategy and its commitment to a sustainable global economy.”

A whole group of related issues can be identified, such as sustainable development, regenerative value creation, greenwashing, European Green Deal, ESG (Environmental, Social and Governance). And although the issues listed here do not exhaust the group of related issues, this study will test the understanding of the concepts

listed. Sustainable development (Liu *et al.*, 2013; Yadavl *et al.*, 2023) is one of hot issue under the current background of resources and environmental crises. Other well knowne – ESG (Environmental, social, and governance), is a set of aspects, including environmental issues, social issues and corporate governance that can be considered in investing (Sabbaghi, 2024). Regenerative Value Creation (or regenerative business models) is the new logic for the urgently needed regenerative economy. It integrates economic success with regenerative impact for people and planet, and equitably benefits all stakeholders, including shareholders and Nature (Konietzko, Das and Bocken, 2023). Implementing Regenerative Value Creation is both a challenge and a tremendous opportunity, as demonstrated by the following corporate examples. It requires fundamental transformation as well as pragmatic transition as companies need to stay profitable while fundamentally reinventing their business models. Greenwashing (Sundarasen, Zyznarska-Dworczak and Goel, 2024; Todaro and Torelli, 2024) is the process of conveying a false impression or misleading information about how a company's products are environmentally sound. Greenwashing involves making an unsubstantiated claim to deceive consumers into believing that a company's products are environmentally friendly or have a greater positive environmental impact than they actually do.

2. Literature Review

Corporate social responsibility is a trend in the economic space that have been developing some time now. Recent years have given rise to the academic discourse of this issue. This shows literature review (Sofian, Mohd-Sabrun and Muhamad, 2022; Bhargava and Ligade, 2023; Effah *et al.*, 2023). To see how widespread CSR considerations are, type the term in the Web of Science search. This brings up more than 40,000 publications from a wide range of scientific disciplines. The oldest date back to 1975 (Clark, 1975; Denham, 1975; Gavin and Maynard, 1975; Mason and Maxwell, 1975). Since the 2000s, the subject has become increasingly popular. Today, more than 4,000 new publications are added to the WoS database every year. These are mainly academic articles. The dominant WoS categories include economics, management and environmental studies. Primarily, the general analysis of the research shows exponential growth in the interest of the scientific community, derived from the continuous growth of articles, authors, and citations (Fernandez-Gago, Cabeza-Garcia and Godos-Diez, 2020).

However, there are not many publications that describe the perception of the concept among the strategy's addressees. Publications can be found on the importance of CSR for employees (Jia *et al.*, 2016; Lemon, 2019; Lee, 2022; Jing, Keasey and Xu, 2023), investors (Cohen, Holder-Webb and Zamora, 2015; Glossner, 2019; Naughton, Wang and Yeung, 2019), local community (Barrio Fraile and Enrique Jimenez, 2018; Crowther and Vilke, 2018; Bojanic and Vucemilovic, 2020), consumers (Vitell, 2015; Quazi, Amran and Nejati, 2016; Deng and Xu, 2017; Nugroho *et al.*, 2024).

Z. Antczak presents the concept of Corporate Social Responsibility (CSR) from a consumer perspective. She analyses the significance of consumer behavior and also presents CSR in the light of the latest research on consumer attitudes (Antczak, 2010).

Enterprises that see the importance of CSR values have quickly noticed that the fact of being socially responsible should be presented. CSR should be an element of knowledge management within an enterprise (Krawczyk, 2022). These conclusions are correct. But this raises another question: can CSR knowledge stay within the organisation? Maybe we should move one step further and communicate the importance of this strategy to the broader public.

The analysis of the literature and the initially prepared research material allows the formulation main task - What is the general public's knowledge of CSR? Problems can be solved by asking a series of specific questions:

RQ1. Whether the concept of CSR is known in general?

RQ2. Whether related concepts are?

RQ3. What is the state of knowledge about the tools used in a CSR strategy?

RQ4. What are the benefits of implementing a CSR strategy?

All considerations have been made from the point of view of those targeted by the CSR strategy, rather than those managing. For such a widely discussed topic, this is a new and unique perspective.

3. Research Methodology

The social sciences have at their disposal a range of methods, techniques and tools for collecting empirical material (Szyjewski, 2018; Skuza, 2019). A survey questionnaire was used as part of this study. The survey questionnaire is one of the most popular and frequently used measurement instruments in practice (Kieżel and Sobczyk-Kolbuch, 2002; Piersiala, 2023). Such studies provide the most economical way of gathering information from representations giving data that apply to general populations (Bihu, 2021). The article will present the figures from the survey that was carried out.

Table 1: Reserch agenda

Link	https://docs.google.com/forms/d/e/1FAIpQLSdBxhC5OBph-nFpw4xvIr3X8lbxccderFbYUm90Rkr8faHA_g/viewform?usp=sf_link
Time	14.03.24. – 09.04.24.
Number of responses	149
Language	Polish / English
Number of question	10 core questions plus a questionnaire
Type of quistion	Single-choice, multiple-choice, with a single-choice grid
The research group	Students of Częstochowa University of Technology (CUT), Faculty of Management
Scale values	1 - low, 2 low medium, 3 - medium, 4 - medium high, 5 - high

Source: own elaboration.

The survey was conducted using Google Form tools. The form is available at the link in Table 1. The research group consisted of students of Częstochowa University of Technology, Faculty of Management, from various fields of study. With the help of an online form, they answered 10 questions related to the topic of the research. The questions were:

- Are you familiar with the term CSR (Corporate Social Responsibility)?
- Which of the terms are familiar to you (1 or more answers)?
- Which term do you think is synonymous with CSR (1 or more answers)?
- Do you know of any tools used in CSR strategy?
- What do you think is a CSR tool?
- What benefits do you see from implementing a CSR strategy in company?
- Implementation of CSR can have an impact on increasing economic benefits (scal: small - 1, large - 5).
- Implementation of CSR can have an impact on the social environment (scal: small -1, large - 5).
- Implementation of CSR may have an impact on the environment (scal: small -1, large - 5).
- CSR implementation can affect employees (scal: small -1, large - 5).

The next section of the article presents the results of the survey.

4. Research Results

The group of respondents who were interviewed gave answers on the basis of which it is possible to formulate the following conclusions.

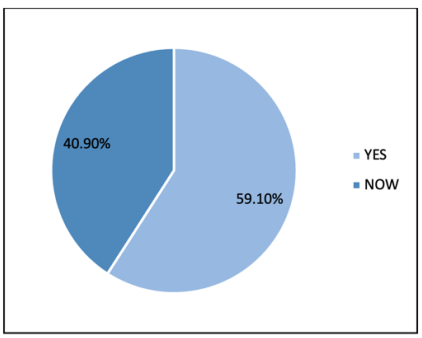


Figure 1: Knowledge of the Corporate Social Responsibility (CSR) concept

Source: owne elaborartion.

The results of the survey showed that more than 40 per cent of the respondents were not familiar with the concept of CSR. Such a result would be satisfactory for the general public (figure 1.). However, it should be noted that the survey was conducted among management students, people who should understand the subject well. There is no correlation between which students from which faculties, which type of study or which age group are unfamiliar with the concept.

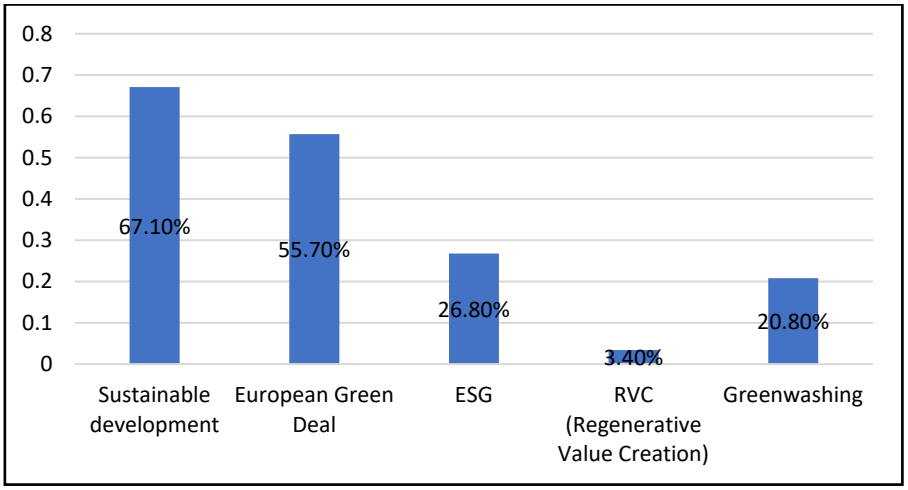


Figure 2: Knowledge of other concepts associated with CSR

Source: owne elaborartion.

Awareness of other related concepts was examined as well, see figure 2. Most people, 67%, are familiar with the term 'sustainable development'. Fewer people, only 3.4%, are familiar with the term 'Regenerative Value Creation' (RCV).

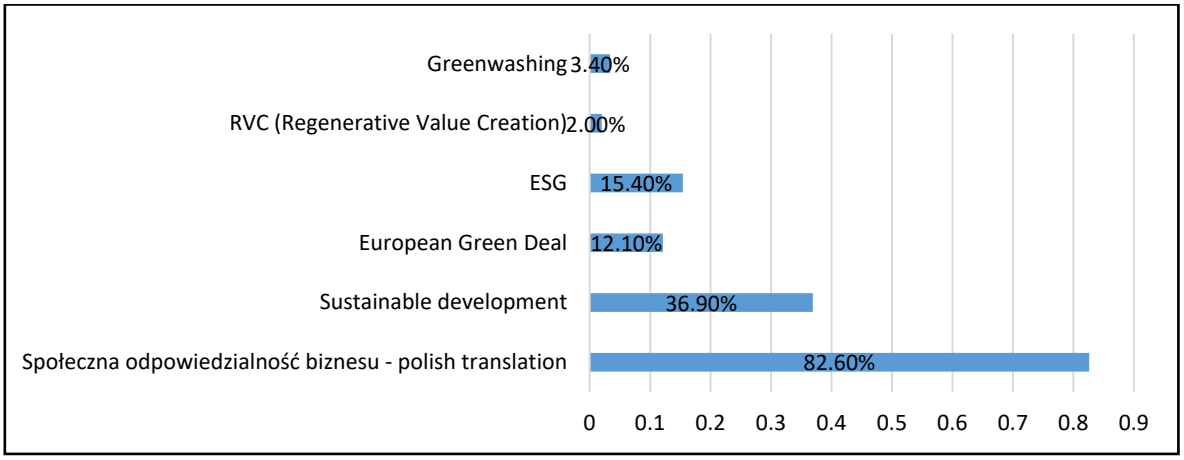


Figure 3: Synonyms for the term CSR

Source: owne elaborartion.

Respondents were also asked which words are synonyms for CSR (figure 3.). In response to this question, more than 82 per cent of respondents were very accurate in pointing out the Polish translation of the term. A synonym for almost 37% was Sustain Develeopment, for 12% European Green Deal and around 15% ESG.

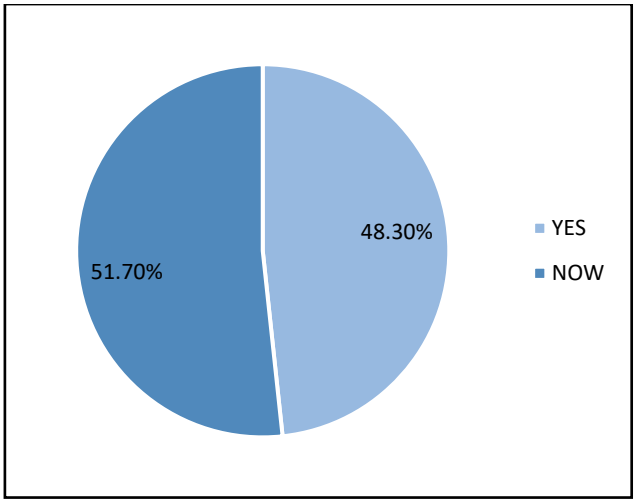


Figure 4: Knowledge of the tools used in CSR strategy

Source: owne elaborartion.

Slightly more than half of the respondents have no idea what tools are being used in CSR strategies. This is a surprising result for the group surveyed - management students. Participants also indicated which tools they were familiar with. Most respondents (68%) knew about community activities. About half said environmental activities - 50.5% - and social campaigns - 49.5%. Slightly less familiar were employee programmes (43.7%) and social reports (39.8%). Management systems (e.g. ISO) and employee volunteering reached similar levels (see Figure 4). The lowest awareness levels were for supply chain management (13.6 per cent) and product labelling (14.6 per cent).

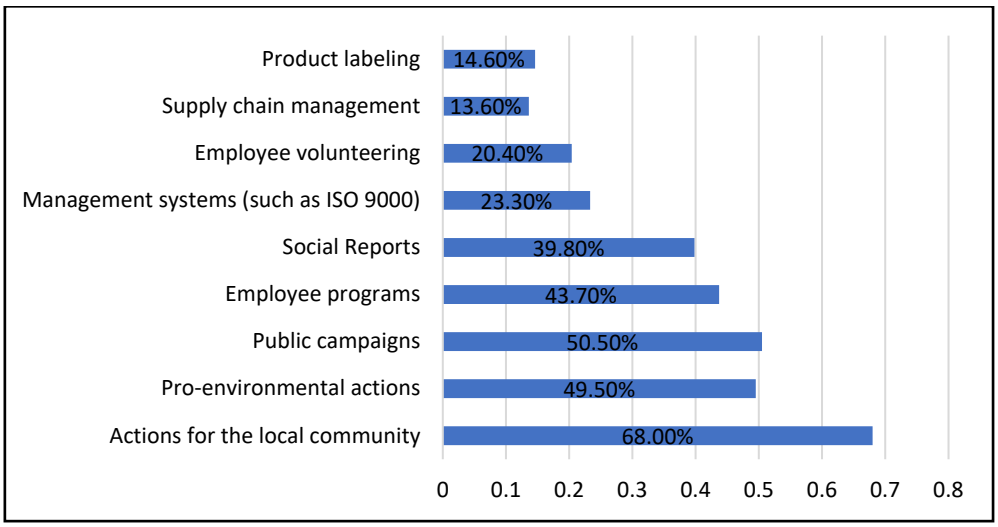


Figure 5: Knowledge of the tools used in CSR strategy

Source: owne elaborartion.

Students were also asked to identify the benefits they see from implementing CSR strategies. They began by identifying specific groups of benefits: economic benefits, social benefits, environmental benefits and image enhancement. Social benefits were seen as the most important by more than 73% of respondents. 58% pointed to economic benefits, almost 50% to environmental benefits and 42.3% to image improvement. The question was deepened. Participants were asked to rate the level of impact in each area on a scale of importance from 1 to 5. Due to the formal requirements of publication (quantitative limitations), the data are not presented graphically in this study.

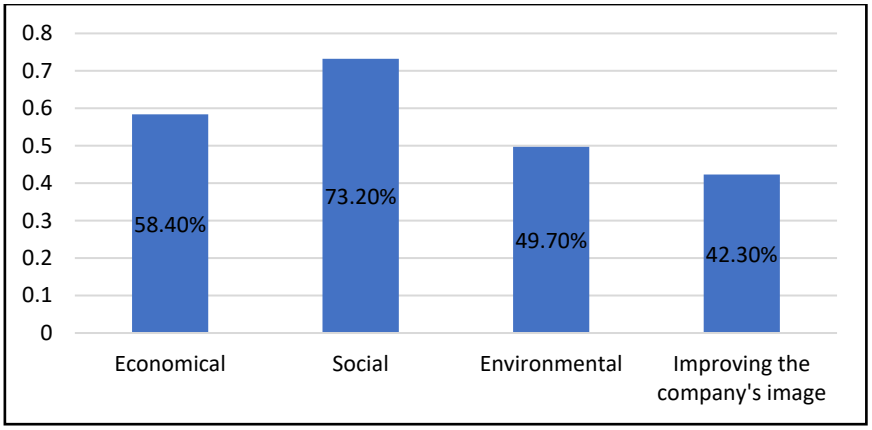


Figure 6: The benefits of implementing CSR strategy

Source: owne elaborartion.

As far as the economic benefits are concerned, they were divided into 4 specific categories: increased profitability of sales, increased investments, better use of fixed assets for human capital, increased liquidity. For the most part, they indicated a medium or medium-high level of impact.

Regarding the impact on the social environment, the following were mentioned: improving the level of culture and safety at work, achieving social goals that would not be possible without business support, reducing the negative impact of business on the environment. In this area, respondents mostly indicated a high, medium or high level. A very small number (up to 4%) reported a low level of commitment.

The third group, the environment, was divided into: Following best practices, managing natural resources and waste rationally, involving business partners in the chain of environmental responsibility and initiating joint pro-environmental activities, popularising pro-environmental ideas. In this area, the survey results show that the level is medium or medium-high. Only a small number of respondents reported a low level.

5. Conclusion And Future Work

Knowledge is an asset in all areas of activity, both for the individual and for the organisation. Managers are under great pressure to demonstrate their social responsibility. This covers issues like the environment, relations with the community and internal relations with staff. The implementation of CSR (Corporate Social Responsibility) strategies can be a response to these needs on the part of companies. Business leaders, scientists and government agencies have spent years studying this issue. It is a very popular topic. However, it is not a widely known topic in society. The results of the survey show that almost 41% of management students are not familiar with the concept. They are not familiar with the tools used in this strategy (more than 50%). They do not fully understand related issues such as sustainable development, regenerative value creation, greenwashing, European Green Deal, ESG (Environmental, Social and Governance). Reliable, substantive, but at the same time simple and accessible knowledge about this strategy should reach the public so that they can expect concrete benefits from the implementation of CSR strategies.

The study has several limitations. Firstly, students from one university and one department were surveyed. The study should be extended to include a wider research group. It would be interesting to survey students from different universities in management and related fields. The average citizen's level of knowledge about this strategy should also be checked. The survey can be conducted at the level of one country, but comparative results from different countries can be very interesting. The present results are therefore the first, preliminary stage of a broader study.

It is obvious that knowledge of the CSR strategy should be spred within the organisation. Knowledge that builds the image of a socially responsible company ensuring its long-term development. Transparency of company knowledge promotes sustainable development. Nowadays, this means going one step further and explain what the CSR strategy is to the general public.

Reference

Al-Ali Mubarak, N.Y.M., Gorgenyi-Hegyes, E. and Fekete-Farkas, M. (2020) 'PERCEIVED CORPORATE SUSTAINABILITY PRACTICES AND PERFORMANCE OF SMALL AND MEDIUM ENTERPRISES (SMES) IN QATAR', *Polish Journal of Management Studies*, 22(1), pp. 26–42. Available at: https://doi.org/10.17512/pjms.2020.22.1.02.

Antczak, Z. (2010) 'CSR a konsumenci (wybrane zagadnienia eksploracyjno-ontologiczne)', *Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu. Nauki Społeczne*, 2(nr 129 Współczesne społeczeństwa-nadzieje i zagrożenia), pp. 199–208.

Barrio Fraile, E. and Enrique Jimenez, A.M. (2018) 'Analysis of a multinational company CSR strategy for use with a local community', *OBRA DIGITAL-REVISTA DE COMUNICACION*, (15), pp. 117–131.

Bhargava, A. and Ligade, P. (2023) 'Corporate social responsibility (CSR) and sustainability - a scientometric analysis of the interrelationship', *JOURNAL OF INDIAN BUSINESS RESEARCH*, 15(1), pp. 110–124. Available at: https://doi.org/10.1108/JIBR-04-2022-0096.

Bihu, R. (2021) 'Questionnaire Survey Methodology in Educational and Social Science Studies'. Rochester, NY. Available at: https://papers.ssrn.com/abstract=4435809 (Accessed: 5 April 2024).

Bojanic, I.B. and Vucemilovic, V. (2020) 'Business Entity Relationship with the Local Community as Part of Corporate Social Responsibility', in M.L. Simic and B. Crnkovic (eds) *9TH INTERNATIONAL SCIENTIFIC SYMPOSIUM REGION ENTREPRENEURSHIP DEVELOPMENT (RED 2020)*. *9th International Scientific Symposium on Region Entrepreneurship Development (RED)*, Osijek: Josip Juraj Strossmayer Univ Osijek (Medunarodni Znanstveni Simpozij Gospodarstvo Istocne Hrvatske-Jucer Danas Sutra), pp. 843–854. Available at: https://www.webofscience.com/wos/woscc/full-record/WOS:000728402200061 (Accessed: 5 April 2024).

Clark, C. (1975) 'Managements Perceptions of Corporate Social Responsibilities', *JOURNAL OF CONTEMPORARY BUSINESS*, 4(3), pp. 15–30.

Cohen, J.R., Holder-Webb, L. and Zamora, V.L. (2015) 'Nonfinancial Information Preferences of Professional Investors', *BEHAVIORAL RESEARCH IN ACCOUNTING*, 27(2), pp. 127–153. Available at: https://doi.org/10.2308/bria-51185.

Crowther, D. and Vilke, R. (2018) 'Farmers' Social Responsibility to Local Community: Does Education Matter?', *MANAGEMENT THEORY AND STUDIES FOR RURAL BUSINESS AND INFRASTRUCTURE DEVELOPMENT*, 40(2), pp. 167–174. Available at: https://doi.org/10.15544/mts.2018.16.

Deng, X. and Xu, Y. (2017) 'Consumers' Responses to Corporate Social Responsibility Initiatives: The Mediating Role of Consumer-Company Identification', *JOURNAL OF BUSINESS ETHICS*, 142(3), pp. 515–526. Available at: https://doi.org/10.1007/s10551-015-2742-x.

Denham, R. (1975) 'Corporate Power and Social Responsibility - Blueprint for Future - Jacoby,nh', *SECURITIES REGULATION LAW JOURNAL*, 3(1), pp. 104–107.

Effah, N.A.A. *et al.* (2023) 'Contributions toward sustainable development: a bibliometric analysis of sustainability reporting research', *ENVIRONMENTAL SCIENCE AND POLLUTION RESEARCH*, 30(1), pp. 104–126. Available at: https://doi.org/10.1007/s11356-022-24010-8.

Fernandez-Gago, R., Cabeza-Garcia, L. and Godos-Diez, J.-L. (2020) 'How significant is corporate social responsibility to business research?', *CORPORATE SOCIAL RESPONSIBILITY AND ENVIRONMENTAL MANAGEMENT*, 27(4), pp. 1809–1817. Available at: https://doi.org/10.1002/csr.1927.

Gavin, J. and Maynard, W. (1975) 'Perceptions of Corporate Social-Responsibility', *PERSONNEL PSYCHOLOGY*, 28(3), pp. 377–387. Available at: https://doi.org/10.1111/j.1744-6570.1975.tb01545.x.

Glossner, S. (2019) 'Investor horizons, long-term blockholders, and corporate social responsibility', *JOURNAL OF BANKING & FINANCE*, 103, pp. 78–97. Available at: https://doi.org/10.1016/j.jbankfin.2019.03.020.

Jia, Y. *et al.* (2016) 'Employee-oriented Corporate Social Responsibility and Employee Innovation Behavior: The Mediating of Job Involvement', in J. Xiaowen, X. Erming, and A. Woodside (eds) *INNOVATION, ENTREPRENEURSHIP AND STRATEGY IN THE ERA OF INTERNET*. *International Conference on Strategic Management (ICSM 2016)*, Chengdu: Sichuan Univ Press, pp. 850–856. Available at: https://www.webofscience.com/wos/woscc/full-record/WOS:000386192500138 (Accessed: 5 April 2024).

Jing, C., Keasey, K. and Xu, B. (2023) 'Environmental sustainability and employee satisfaction', *ECONOMICS LETTERS*, 233, p. 111402. Available at: https://doi.org/10.1016/j.econlet.2023.111402.

Kieżel, M. and Sobczyk-Kolbuch, A. (2002) 'Kwestionariusz ankiety jako narzędzie pomiaru w badaniach marketingowych', *Zeszyty Naukowe / Górnośląska Wyższa Szkoła Handlowa w Katowicach*, (nr 13 Zeszyt Naukowy Katedry Zarządzania i Marketingu), pp. 175–207.

Konietzko, J., Das, A. and Bocken, N. (2023) 'Towards regenerative business models: A necessary shift?', *Sustainable Production and Consumption*, 38, pp. 372–388. Available at: https://doi.org/10.1016/j.spc.2023.04.014.

Krawczyk, P. (2022) 'Knowledge management and corporate social responsibility interactions in theory and practice', *European Conference on Knowledge Management*, 23(1), pp. 654–661. Available at: https://doi.org/10.34190/eckm.23.1.471.

Krawczyk, P. (2024) 'Non-financial reporting: identifying the role of accounting through bibliometric analysis', *Ekonomia i Prawo. Economics and Law*, 23(2 (Forthcoming)). Available at: https://apcz.umk.pl/EiP/article/view/44501 (Accessed: 12 April 2024).

Krištofik, P., Lament, M. and Musa, H. (2016) 'The reporting of non-financial information and the rationale for its standardisation', *E+M Ekonomie a Management*, 19(2), pp. 157–175. Available at: https://doi.org/10.15240/tul/001/2016-2-011.

Lee, Y. (2022) 'Linking internal CSR with the positive communicative behaviors of employees: the role of social exchange relationships and employee engagement', *SOCIAL RESPONSIBILITY JOURNAL*, 18(2), pp. 348–367. Available at: https://doi.org/10.1108/SRJ-04-2020-0121.

Lemon, L.L. (2019) 'The employee experience: how employees make meaning of employee engagement', *JOURNAL OF PUBLIC RELATIONS RESEARCH*, 31(5–6), pp. 176–199. Available at: https://doi.org/10.1080/1062726X.2019.1704288.

Liu, K. *et al.* (2013) 'Evaluation on Sustainable Development Level - A Case Study of Liaocheng City', in N. Xu, L. Tian, and F. Dai (eds) *SUSTAINABLE CITIES DEVELOPMENT AND ENVIRONMENT PROTECTION, PTS 1-3*. *3rd International Conference on Civil Engineering, Architecture and Building Materials (CEABM 2013)*, Durnten-Zurich: Trans Tech Publications Ltd (Applied Mechanics and Materials), pp. 111-+. Available at: https://doi.org/10.4028/www.scientific.net/AMM.361-363.111.

Mason, A. and Maxwell, S. (1975) 'Changing Attitude to Corporate Social-Responsibility', *BUSINESS QUARTERLY*, 40(4), pp. 42–50.

Mastrangelo, L., Cruz-Ros, S. and Miquel-Romero, M.-J. (2019) 'Crowdfunding success: the role of co-creation, feedback, and corporate social responsibility', *International Journal of Entrepreneurial Behavior & Research*, 26(3), pp. 449–466. Available at: https://doi.org/10.1108/IJEBR-06-2019-0391.

Naughton, J.P., Wang, C. and Yeung, I. (2019) 'Investor Sentiment for Corporate Social Performance', *ACCOUNTING REVIEW*, 94(4), pp. 401–420. Available at: https://doi.org/10.2308/accr-52303.

Nugroho, D.P.D. *et al.* (2024) 'Investigating the Interconnection between Environmental, Social, and Governance (ESG), and Corporate Social Responsibility (CSR) Strategies: An Examination of the Influence on Consumer Behavior', *SUSTAINABILITY*, 16(2), p. 614. Available at: https://doi.org/10.3390/su16020614.

Otola, I. and Tylec, A. (2016) 'SPOŁECZNA ODPOWIEDZIALNOŚĆ BIZNESU A WYNIKI FINANSOWE PRZEDSIĘBIORSTW', *Zeszyty Naukowe Politechniki Częstochowskiej Zarządzanie*, 24(1), pp. 81–89. Available at: https://doi.org/10.17512/znpcz.2016.4.1.08.

Piersiala, L. (2014) 'Rozwój przedsiębiorczości kreowanej przez działalność badawczą i prace rozwojowe', *Ekonomia i Zarządzanie*, (6(3) 2014), pp. 302–3014. Available at: https://doi.org/10.12846/j.em.2014.03.21.

Piersiala, L. (2023) 'Digital natives and their learning habits in acquiring knowledge', *European Conference on Knowledge Management*, 24(2), pp. 1069–1073. Available at: https://doi.org/10.34190/eckm.24.2.1611.

Quazi, A., Amran, A. and Nejati, M. (2016) 'Conceptualizing and measuring consumer social responsibility: a neglected aspect of consumer research', *INTERNATIONAL JOURNAL OF CONSUMER STUDIES*, 40(1), pp. 48–56. Available at: https://doi.org/10.1111/ijcs.12211.

Rupp, D.E. and Mallory, D.B. (2015) 'Corporate Social Responsibility: Psychological, Person-Centric, and Progressing', *Annual Review of Organizational Psychology and Organizational Behavior*, 2(1), pp. 211–236. Available at: https://doi.org/10.1146/annurev-orgpsych-032414-111505.

Sabbaghi, O. (2024) 'The United Nations Sustainable Development Goals and global finance: Recent evidence', *CORPORATE SOCIAL RESPONSIBILITY AND ENVIRONMENTAL MANAGEMENT* [Preprint]. Available at: https://doi.org/10.1002/csr.2785.

Skuza, Z. (2019) 'Analysis of use of Methods and Quality Management Tools in a Group of Production Enterprises', *New Trends in Production Engineering*, 2(2), pp. 241–253. Available at: https://doi.org/10.2478/ntpe-2019-0089.

Sofian, F.N.R.M., Mohd-Sabrun, I. and Muhamad, R. (2022) 'Past, Present, and Future of Corporate Social Responsibility and Earnings Management Research', *AUSTRALASIAN ACCOUNTING BUSINESS AND FINANCE JOURNAL*, 16(2), pp. 116–144. Available at: https://doi.org/10.14453/aabfj.v16i2.9.

Sundarasen, S., Zyznarska-Dworczak, B. and Goel, S. (2024) 'Sustainability reporting and greenwashing: a bibliometrics assessment in G7 and non-G7 nations', *COGENT BUSINESS & MANAGEMENT*, 11(1), p. 2320812. Available at: https://doi.org/10.1080/23311975.2024.2320812.

Szyjewski, Z. (2018) 'Methods of studying social behavior', *Studia i Prace WNEiZ*, 54, pp. 147–162. Available at: https://doi.org/10.18276/sip.2018.54/2-10.

Todaro, D.L. and Torelli, R. (2024) 'From greenwashing to ESG -washing: A focus on the circular economy field', *Corporate Social Responsibility and Environmental Management*, p. csr.2786. Available at: https://doi.org/10.1002/csr.2786.

Vitell, S.J. (2015) 'A Case for *Consumer* Social Responsibility (CnSR): Including a Selected Review of Consumer Ethics/Social Responsibility Research', *JOURNAL OF BUSINESS ETHICS*, 130(4), pp. 767–774. Available at: https://doi.org/10.1007/s10551-014-2110-2.

Yadavl, N. *et al.* (2023) 'A Bibliometric Survey on Sustainable Finance: Research Patterns and Trends', *ACTA POLYTECHNICA HUNGARICA*, 20(10), pp. 109–125. Available at: https://doi.org/10.12700/APH.20.10.2023.10.7.

How does the Relationship Between the Mistakes Acceptance Component of Learning Culture and Tacit Knowledge-Sharing Drive Organizational Agility? Risk as a Moderator

Wioleta Kucharska[1], Tomasz Balcerowski[1, 2], Maciej Kucharski[1] and Jari Jussila[3]
[1]Gdansk University of Technology – Gdansk TECH, Fahrenheit Universities Association, Gdansk, Poland
[2]Ekoinbud Sp. z o.o. Gdańsk, Poland
[3]Häme University of Applied Sciences, HAMK Design Factory, Finland

wioleta.kucharska@pg.edu.pl

Abstract: Changes in the business context create the need to adjust organizational knowledge to new contexts to enable the organizational agile responses to secure competitiveness. Tacit knowledge is strongly contextual. This study is based on the assumption that business context determines tacit knowledge creation and acquisition, and thanks to this, the tacit knowledge-sharing processes support agility. Therefore, this study aims to expose that there is a strong link between the tacit knowledge flow across the organization and its ability to respond agilely (timely, accurately, and creatively) to contextual changes. Based on the sample composed of 640 Polish knowledge workers and data analyzed with the structural equation modeling method (SEM), this study delivers empirical evidence that tacit knowledge flow is vital for organizational agility. The obtained results confirmed that tacit knowledge sharing mediates between the mistakes acceptance component of learning culture and agility. It means agility, understood as the ability to respond agilely to contextual changes, requires being charged by new, contextual, tacit knowledge obtained thanks to trial-error actions (learning by doing) achievable thanks to breaking conventions and experimentation. Moreover, risk management skills have been proven to be one of the critical characteristics of agile organizations today.

Keywords: Mistakes Acceptance, Learning Culture, Tacit Knowledge Sharing, Organizational Agility, Risk Management

1. Introduction

Although there is no single definition of agility that is universally followed, all definitions commonly share the basic concepts of speed and flexibility for responding to changes in dynamic market environments (Kettunen and Laanti, 2008). It is because agility secures competitiveness (Zastempowski and Cyfert, 2023). In a Finnish survey study of agility in organizations, the most common aims why organizations wanted to become more agile included: productivity and quality, responsiveness to customer/market changes, job satisfaction, fast/continuous learning in rapidly changing operating environments, and competitive and desirable products (Kettunen et al., 2019). So, agile response to the market requires constant acquisition of up-to-date, relevant knowledge about the market and the entire business context to secure business continuity. Since learning culture supports tacit knowledge awareness and sharing and next change adaptability (Kucharska and Rebelo, 2022), then this relation matters also for agility building. This is because change adaptability and agility are related (Park and Park, 2021).

Therefore, this study explores the link between tacit knowledge and organizational agility. It specifically seeks the answer to the question: *Does the relationship between the mistakes acceptance component of learning culture and tacit knowledge-sharing drive organizational agility?*

1.1 Research Gap

This study is framed by Organizational Knowledge Creation Theory, understood as a continuous process of tacit knowledge acquisition and its transformation into explicit form thanks to social interactions (Nonaka and Takeuchi, 1995). Tacit knowledge in contrast to explicit is enormously personal. Tacit knowledge is difficult to express directly in words, and often the only ways of presenting it are through drawings, metaphors, analogies, and different methods of expression that do not require a formal use of language (Koskinen et al., 2003). Thanks to experimentation and learning through interactions and collaborations, its acquisition enables its awareness and, as a result, also sharing, which in more and more remote-work-dominated business environments is often supported by technology and IT competency of the workforce (Kucharska and Erickson, 2023a-b). Technology development forces business conditions change that next provoke changes in working methods. So, technology then forces agility (Lu, and Ramamurthy, 2011; Orłowski et al., 2017) and facilitates agility. Moreover, agility is developed thanks to learning (Dries et al., 2012). Experimentation, that supports trial-error learning (Ambituuni et al., 2021). Trial-error learning (Hull, 1930; Young, 2009) enables individuals and organizations to grow. Therefore, organizational learning is one of the crucial collective skills enabling organizational ability to respond

timely and accurately, and to creatively adapt to changes. Learning culture development is then required to support agility implementation in organizations. Kucharska and Bedford (2020) proved that organizational learning culture is composed of two dimensions: the motivational climate factor and the factor of acceptance of mistakes as a potential source of learning. Moreover, Kucharska (2021a-b) also proved that the mistakes acceptance component of learning culture supports tacit knowledge sharing. Therefore, this study aims to explore whether there is a strong link between the tacit knowledge flow across the organization and its ability to respond agilely (timely, accurately, and creatively) to contextual changes driven by the mistakes acceptance component of a learning culture. Moreover, this study aims to explore how a positive risk-taking attitude is related to organizational agility. Such formulated study aims are important because tacit knowledge's impact on agility has not yet been considered a significant force supporting agility. Altarawneh and Al-Adaileh (2023) proved that agility mediates between knowledge management and organizational transformation ability, but their study generally concerned knowledge management without analyzing in detail how tacit and explicit knowledge supports these processes. Kucharska and Bedford (2020) and Kucharska and Rebelo (2022a) proved that, indeed, the mistakes acceptance component of learning culture supports tacit knowledge sharing and next adaptability, but the risk-taking attitude as related to organizational agility has not been examined in this context yet. So, examining these relations matters to understand better factors influencing the successful agility implementation in knowledge-driven organizations. This study aims to do so.

2. Theoretical Framework

The mistakes acceptance component of learning culture is defined as the organizational acceptance of the case that somebody can be wrong, and reflects the readiness to correct the way of action (Kucharska and Bedford, 2020). This acceptance component opens employees to critical thinking about their own actions without "blame and shame" but with motivation to gain new knowledge sharing instead of hiding (Kucharska and Rebelo, 2022b) and with motivation to make positive change. Maes and Van Hootegem's (2019) model of organizational change assumes that the reflection from a mistake (understood as input to the organizational system) can trigger change. Moreover, Kucharska and Kucharski (2023) exposed that the mistakes acceptance component of learning culture supports change adaptability of employees characterized by technological and non-technological mindsets. Based on this, the hypothesis was developed as below:

H1: Mistake acceptance component of learning culture impact positively on organizational agility

Based on studies of Love et al. (2013, 2016, 2018) or Gelfand et al. (2011), we can assume that learning culture can transform erroneous events into experiences, leading to tacit knowledge creation. Moreover, Kucharska and Bedford (2020) and Kucharska and Rebelo (2022a) proved that, indeed, the mistakes acceptance component of learning culture supports tacit knowledge sharing and organizational adaptability to changes. Based on this, the hypothesis was developed as below:

H2: Mistake acceptance component of learning culture impact positively on tacit knowledge sharing

The tacit knowledge creation and alignment processes are vital for the successful response to uncertainty and must be facilitated by the company culture to support organizational learning. Organizational tacit knowledge creation is an effect of sharing knowledge across departments and teams (social interactions) but also through experimentation and simulation - learning by doing (Kucharska and Erickson, 2023a-b). Al-Omoush et al. (2020), Baran and Woznyj (2020), Cegarra-Navarro and Martelo-Landroguez (2020), and Cegarra-Navarro et al. (2016), Pitafi et al. (2023) claimed that efficient knowledge management matters for successfully implementing agility. Tacit knowledge sharing is one of the key processes that knowledge management focuses on. So, based on this, the hypothesis was proposed as below:

H3: Tacit knowledge sharing impact positively on organizational agility

Control variable – A control variable (CV) represents an additional factor (third variable) that may influence the relationship between an independent and dependent variable in the model tested. A CV may act as a confound, a moderator, or a suppressor (Spector and Brannick, 2011). The CV's imputation methodology enables extraneous variables to be included in a model–control variables are not the focal point of the study yet remain theoretically important (Becker et al., 2016). For this study, such a theoretically important variable is risk-taking attitude. A risk-taking attitude is needed to cross boundaries and comfort zones, which matters for new learning. "(...) learning as one of the organization's core values, a focus on people, concern for all stakeholders, stimulation of experimentation, encouraging an attitude of responsible risk, readiness to recognize errors and learn from them, and promotion of open and intense communication, as well as the promotion of cooperation,

interdependence, and share of knowledge" (Rebelo and Gomes, 2011, p.174). Moreover, works by Funston and Wagner (2010), Galli and Lopez (2018), Moran and Moran (2014), and Rael (2017) enable us to expect that risk management is significantly tied to organizational agility competency building. Based on all the above, we see a risk-taking attitude as a factor that can affect the relation between the mistakes acceptance component of learning culture and tacit knowledge sharing on organizational agility. Therefore, the hypothesis was formulated as below:

$H_{cv}1$: Risk-taking attitude affects organizational agility

Mediation – An intermediate variable that brings a deeper understanding of the relation between two variables is considered to be a mediator. For this research, tacit knowledge sharing is considered to be a mediating variable between the mistakes acceptance component of learning culture and agility, assumed as influenced by this component. Figure 1 visualizes the theoretical framework elaborated above.

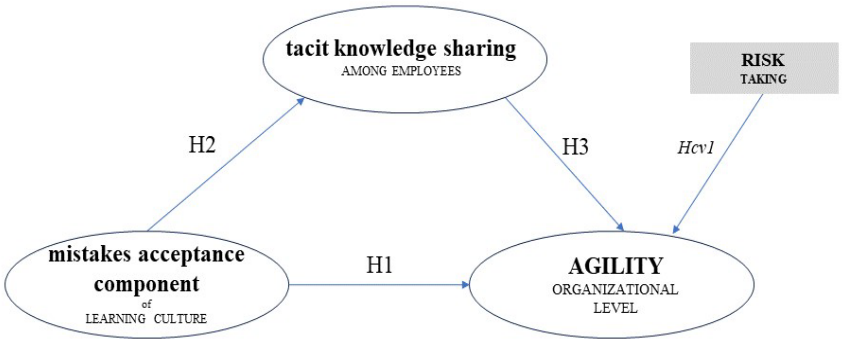


Figure 1: Theoretical model

3. Methodology

Sampling procedure: this study targeted Polish knowledge workers; therefore, qualified respondents declared that their work's first input and output is knowledge. Moreover, to secure the respondents' familiarity with their organizations' issues, we qualified only those who worked a minimum of one year for their current employer. Data were collected in March 2023 by applying the CAWI method.

Sample characteristics: The sample is composed of 640 Polish knowledge workers: 306 specialists and 334 managers; 329 women and 311 men representing mostly private (77%) companies from different sectors to illustrate the general view on Poland (dominating sectors: production and knowledge services 19% each). Measures: respondents referred to most questions using a 7-point Likert scale. Control variables were inputted as composites. Table 1 presents measured constructs scales and their sources. Obtained reliabilities are given in Table 2.

Table 1: Scales and their sources

Mistakes acceptance component **Learning culture** (Kucharska and Bedford, 2020)	• People know that mistakes are a learning consequence and tolerate it up to a certain limit. • Most people freely declare mistakes. • We discuss problems openly without blaming others. • Mistakes are tolerated and treated as learning opportunities.
Tacit knowledge sharing (Kucharska and Erickson, 2023a)	• I share knowledge learned from my own experience. • I have the opportunity to learn from the experiences of others. • Colleagues share new ideas with me. • Colleagues include me in discussions about the best practices.
Organizational agility proxy bases on the Change adaptability scale (Kucharska and Bedford, 2020)	• We are flexible to changes. • We can adjust ourselves to changes. • We adapt to changes easily. • We used changes.
RISK-TAKING ATTITUDE (Kucharska, 2021a based on Zinn, 2020)	• I have a risk-taking attitude. • My boss exposes a risk-taking attitude. • My workmates have a risk-taking attitude.

Method of analysis: structural equation modeling (SEM) using SPSS Amos 26 software (Byrne, 2016).

Sample quality: Kaiser–Meyer–Olkin (KMO) test: .909, the total variance extracted: 70%, and Common method bias: 46% justify the acceptable quality of the sample.

Table 2: Basic statistics obtained AVE root square and correlations between constructs

	Mean	SD	AVE	CR	Cronbach alpha	$_{cv}$**R**	**TKS**	**LCm**	**A**
$_{cv}$**R**	-	-	-	-	-				
LCm	3.16	1.80	0,81	0,93	.93	-0,063	**0,902**		
TKS	3.62	1.20	0,50	0,86	.86	-0,032	0,503	**0,927**	
A	3.64	1.15	0,59	0,85	.85	-0,124	0,6	0,779	**0,922**

Note: n=640, TKS-Tacit knowledge sharing, LCm-Learning culture mistakes acceptance component, A-organizational agility; control variable: $_{cv}$R– Risk-taking attitude; squared root of AVE is bolded, ML- maximum likelihood

4. Results

Control variables imputation requires first running and comparing empirical models with and without control variables (CV), and if the model with CVs is better fitted to the data, then the CVs imputation is justified, and the model results can be analyzed (Becker et al., 2016). The results (Table 3) showed that the model with CVs fits the data better (Model A) than the model without them (Model B). So, this paper further discusses and analyzes the Model A with CVs.

Table 3: Hypotheses verification

Model A with CVs; RMSEA=.058(.046-.069) χ2=125.13(40) Cmin/df=3.12 CFI=.980 TLI=.972					Model B without CVs; RMSEA=.065(.052-.078) χ2=117.84(32) Cmin/df=3.68 CFI=.979 TLI=.971				
Hypothesis	**Significance**		**Verification**		**Hypothesis**	**Significance**		**Verification**	
H1	.27***		*sustained*		**H1**	.28***		*sustained*	
H2	.50***		*sustained*		**H2**	.50***		*sustained*	
H3	.64***		*sustained*		**H3**	.64***		*sustained*	
H_{cv}1	-.09**		*rejected*						
Mediation	direct	indirect	*total*	*Mediation type*	Mediation	direct	indirect	*total*	*Mediation type*
LCm->TKS->A	.27***	.32***	*.59***	*complementary mediation*	LCm->TKS->A	.28***	.32***	.60***	complementary mediation

Note: n=640, ML- maximum likelihood; p<.05 **p<.01 ***p<.001 ns-not significant result

Generally, all hypotheses except the H_{cv}1 were sustained (Table 3; Figure 2). H_{cv}1 assumed the positive impact of the risk-taking attitude on organizational agility. Surprisingly, this impact is observed as negative (β=-.09**). This means that the stronger the positive attitude toward risk for employees, the less successful the organizational agility achievement. Moreover, regarding the expected tacit knowledge-sharing moderation between the mistakes acceptance component of learning culture and agility, this relation is confirmed as complementary mediation (Table 3).

The entire model R^2 =.67 enables us to summarize other factors that are not included in this model (33%), which must be considered to fully understand the influence of the mistakes acceptance component of learning culture on organizational agility, which requires further studies. Figure 2 below visualizes the obtained effects.

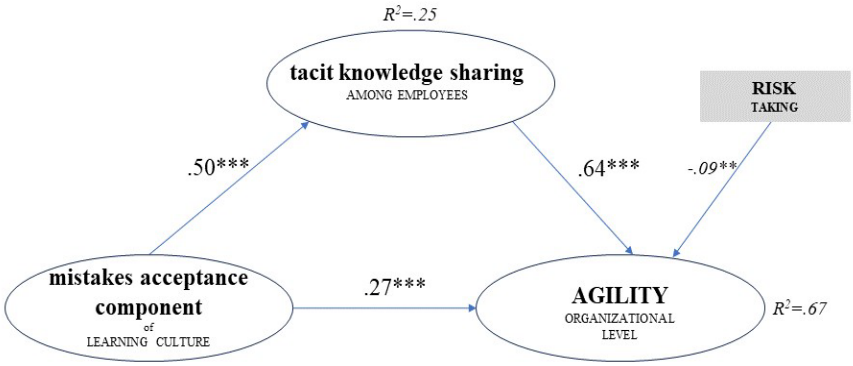


Figure 2: Empirical model

Note: n=640, ML- maximum likelihood; χ2=125.13(40) Cmin/df=3.12 CFI=.980 TLI=.972 RMSEA=.058(.046-.069); p<.05 **p<.01 ***p<.001 ns-not significant result

5. Discussion

The obtained results confirmed that the tacit knowledge sharing mediates between the mistakes acceptance component of learning culture and agility. It means that agility, understood as the ability to respond agilely (timely, accurately, and creatively) to contextual changes, requires being charged by new, contextual, tacit knowledge obtained thanks to trial-error actions (learning by doing) achievable thanks to breaking conventions and experimentation. This revelation expands earlier suggestions by Ambituuni et al. (2021) and Kucharska and Erickson (2023a) that a risk-taking attitude is necessary to break conventions, experiment, learn new things, and share newly gained (not verified yet) tacit knowledge. Also, Denning (2016, 2018) identified next to such vital agile CEO qualities as a customer-first mindset, a company vision for the future, and the ability to continuously create new business models that match employees' skills and create multiple paths to the same aim (scenarios creation), also the readiness to take risks and acquire new institutional skills to develop new paths – as a base for leaders agility, vital for organizational agility.

This study revealed that a positive attitude toward risk blocks agility. And it is the most surprising finding of this research. Instead of the positive influence of the risk-taking attitude of organization members on organizational agility, the negative effect was noted (Hcv1=-.09**). However, this result sheds light on Zanjirchi et al.'s (2017) study, which claimed that supply chain risk factors could be considered drivers of organizational agility. This is because agility, understood as smooth adaptability, is often seen as the effect of efficient risk management. It is because risk is a constant factor in a dynamic business environment. So, on the one hand, the positive attitude towards risk-taking facilitates tacit knowledge sharing (Kucharska 2021a), but at the same time, only efficient risk management leads to organizational agility seen as a smooth collective action toward changing market needs adaptability – as our study results suggest.

Taking a particular innovative action is risky, and non-taking it is risky as well. So, the essence is to select the risk that an organization can afford in the particular business context. Thanks to efficient risk management, the negative impact of inaction can often be seen as higher than the risks of very innovative actions taken, or in other words, very innovative actions are worth risk-taking to avoid risks caused if these innovative actions remain untaken. Summing up, the essence of agility can be, in the light of the given results, seen as the ability to smoothly select the acceptable risk, as suggested by Kucharska et al. (2024). Therefore, risk management skills should be included in the list of key characteristics of agile leaders and agile organizations today.

Moreover, this study targeted Polish knowledge workers. It is because the majority of previous studies concerning learning culture components, precisely the mistakes acceptance component as a source of learning, influence tacit knowledge sharing and change adaptability (Kucharska and Bedford, 2020, 2023; Kucharska and Rebelo, 2022; Kucharska 2021a,b) based on Poland. So, this study gave us a picture of risk-taking attitudes and organizational agility in the same national context previously studied. Thanks to this, we can recognize the difference between the risk-taking attitude meaning, for the tacit knowledge sharing and, the risk-taking attitude meaning, for the agility building. However, the more interesting the findings are, the more critical further studies will be based on countries other than Poland. Such studies are needed to understand the risk-management phenomena for agility in more in-depth. Precisely, for tacit knowledge sharing, the positive attitude of risk-taking is beneficial, whereas for agility building – the opposite – a negative attitude works better.

6. Practical Implications

From the practical perspective, the given results enhance the implementation of a learning culture in knowledge-driven organizations with special attention to the mistake acceptance component. This component is vital for the development of a positive attitude towards the fact that somebody can be wrong and, thanks to this, reflects on one's own actions. Such reflection leads to revealing the contextual tacit knowledge that can be shared among workmates. So, such a shared positive attitude towards the fact that people can be wrong also brings the shared readiness to correct wrong ways of action at work without "blame and shame." The reflection from a mistake can act as a trigger to positive change, enabling better adaptability and competitiveness. Without it, in light of the given results, agility achievement seems to be impossible. The second, very important practical implication concerns risk management. As our study results suggest, only efficient risk management leads to organizational agility, which is seen as a smooth collective action toward changing market needs and adaptability. Therefore, risk management skills should be included in the list of key characteristics of agile leaders and agile organizations today.

7. Limitation and Further Research

The key limitation of this research is that it is based on data collected in only one country. The other critical limitation of this research is that the organizational adaptability scale was adapted here as a proxy for organizational agility. Precisely, the adapted scale omits the factor of organizational ability to respond timely, accurately, and creatively to changes. So, further studies with developed scales for organizational agility are needed to confirm the given findings and conclusions. Furthermore, the analyzed model (Figure 2) explains the phenomenon studied in 67%, while the other 33% remains unrevealed. This means that other factors influencing the relationship between the mistakes acceptance component of learning culture and organizational agility are omitted in the analyzed model and should be identified and studied in more depth in further studies.

8. Conclusion

Answering the question: *Does the relationship between the mistakes acceptance component of learning culture and tacit knowledge-sharing drive organizational agility?* The answer is yes, it does. The results confirmed that the acceptance component of learning culture supports tacit knowledge sharing that fosters agility. Precisely, tacit knowledge sharing mediates between the mistakes acceptance component of learning culture and agility. It means that agility, understood as the ability to respond agilely (timely, accurately, and creatively) to contextual changes, requires being charged by new, contextual, tacit knowledge obtained thanks to trial-error actions (learning by doing) achievable thanks to breaking conventions and experimentation.

Moreover, risk management skills have been proven to be one of the critical characteristics of agile organizations today.

Acknowledgement

The presented research is a result of the project '*Agile learning culture influence on dynamic capabilities of knowledge-based organizations: Polish-Finnish cross-country analysis*,' No. UMO-2022/47/B/HS4/00597 financed by the funds of the National Science Center (NCN) Poland.

References

Al-Omoush, K.S., Simon-Moya, V. and Sendra-Garcia, J. (2020), "The impact of social capital and collaborative knowledge creation on e-business proactiveness and organisational agility in responding to the COVID-19 crisis", *Journal of Innovation and Knowledge*, Vol.5 No.4, pp. 279-288.

Altarawneh, S.J. and Al-Adaileh, R. (2023), "Can knowledge management processes support business transformation? The mediating role of business agility", *Global Knowledge, Memory and Communication*, Vol.72 No. 8/9, pp. 864-881. https://doi.org/10.1108/GKMC-01-2022-0004

Ambituuni, A., Azizsafaei, F. and Keegan, A. (2021), "HRM operational models and practices to enable strategic agility in PBOs: Managing paradoxical tensions", *Journal of Business Research*, Vol.133, pp. 170-182. https://dx.doi.org/10.1016/j.jbusres.2021.04.048

Baran, B.E. and Woznyj, H.M. (2020). Managing VUCA: The human dynamics of agility. *Organizational Dynamics*, S. pp. 100787. https://dx.doi.org/10.1016/j.orgdyn.2020.100787.

Becker, T.E., G. Atnic, J.A. Breaugh, K.D. Carlson, J.R. Edwards and Spector, P.E. (2016), „Statistical control in correlational studies: 10 essential recommendations for organizational researchers," *Journal of Organizational Behavior*, Vol.37, pp. 157–167.

Cegarra-Navarro, J.-G., Soto-Acosta, P. and Wensley, A.K.P. (2016), "Structured knowledge processes and firm performance: The role of organizational agility," *Journal of Business Research*, Vol.69, pp. 1544–1549. https://doi.org/10.1016/j.jbusres.2015.10.014

Cegarra-Navarro, J.-G. and Martelo-Landroguez, S. (2020), "The effect of organizational memory on organizational agility: Testing the role of counter-knowledge and knowledge application", *Journal of Intellectual Capital*, Vol.21 No.3, pp. 459-479. https://doi.org/10.1108/JIC-03-2019-0048

Denning, S. (2016), Agile's Ten İmplementation Challenges, *Strategy & Leadership*, Vol.44 No.5, pp. 15-20.

Denning, S. (2018), "The role of the C-suite in Agile transformation: the case of Amazon", *Strategy & Leadership*, Vol.46 No.6, pp. 14-21. https://doi.org/10.1108/SL-10-2018-0094

Dries, N., Vantilborgh, T. and Pepermans, R. (2012), "The role of learning agility and career variety in the identification and development of high potential employees", *Personnel Review*, Vol.41 No.3, pp. 340-358. https://doi.org/10.1108/00483481211212977

Funston, F. and Wagner, S. (2010), *Surviving and thriving in uncertainty: Creating the risk intelligent enterprise*. John Wiley & Sons.

Galli, B.J. and Lopez, P.A.H. (2018), Risks management in agile new product development project environments: A review of literature. *International Journal of Risk and Contingency Management* (IJRCM), Vol.7 No.4, pp. 37-67.

Gelfand, M. J., Frese, M. and Salmon, E. (2011), *Cultural influences on errors: Planning, detection, and management*. In M. Frese and D. Hoffman (Eds), Errors in organizations (SIOP Organizational Frontier Series, pp.273–315, London, UK: Taylor and Francis.

Hull, C.L. (1930), "Simple trial and error learning: A study in psychological theory", *Psychological Review*, Vol.37, pp. 241–56.

Kettunen, P., Laanti, M., Fagerholm, F. and Mikkonen, T. (2019). *Agile in the Era of Digitalization: A Finnish Survey Study*. In: Franch, X., Männistö, T., Martínez-Fernández, S. (eds) Product-Focused Software Process Improvement. PROFES 2019. Lecture Notes in Computer Science, vol. 11915. Springer, Cham. https://doi.org/10.1007/978-3-030-35333-9_28

Kettunen, P. and Laanti, M. (2008). Combining agile software projects and large-scale organizational agility. Software Process: Improvement and Practice, Vol.13 No.2, pp.183-193. https://doi.org/10.1002/spip.354

Koskinen, K. U., Pihlanto, P. and Vanharanta, H. (2003). Tacit knowledge acquisition and sharing in a project work context. International journal of project management, Vol.21 No.4, pp. 281-290. https://doi.org/10.1016/S0263-7863(02)00030-3

Kucharska, W. and Bedford, D.A.D. (2020), "Love your mistakes!—they help you adapt to change. How do knowledge, collaboration and learning cultures foster organizational intelligence?", *Journal of Organizational Change Management*, Vol.33 No.7, pp. 1329-1354. https://doi.org/10.1108/JOCM-02-2020-0052

Kucharska, W. and Bedford, D. (2023), *The Cultures of Knowledge Organizations: Knowledge, Learning, Collaboration (KLC)*, Emerald Publishing Limited, Leeds, pp. i-xviii. https://doi.org/10.1108/978-1-83909-336-420231013

Kucharska, W. and Erickson, G.S. (2023a), "Tacit knowledge acquisition & sharing, and its influence on innovations: A Polish/US cross-country study", *International Journal of Information Management*, Vol.71, 102647. https://doi.org/10.1016/j.ijinfomgt.2023.102647

Kucharska, W. and Erickson, G.S. (2023b), "A multi-industry and cross-country comparison of technology contribution to formal and informal knowledge sharing processes for innovativeness", *Knowledge and Process Management*, Vol.30 No.3, pp. 300-316. https://doi.org/10.1002/kpm.1755

Kucharska, W. and Rebelo, T. (2022a), "Transformational leadership for researcher's innovativeness in the context of tacit knowledge and change adaptability", *International Journal of Leadership in Education*. https://doi.org/10.1080/13603124.2022.2068189

Kucharska, W. and Rebelo, T. (2022b), "Knowledge sharing and knowledge hiding in light of the mistakes acceptance component of learning culture- knowledge culture and human capital implications", *The Learning Organization*, Vol.29 No.6, pp. 635-655. https://doi.org/10.1108/TLO-03-2022-0032

Kucharska, W. (2021a), "Do mistakes acceptance foster innovation? Polish and US cross-country study of tacit knowledge sharing in IT", *Journal of Knowledge Management*, Vol.25 No.11, pp. 105-128. https://doi.org/10.1108/JKM-12-2020-0922

Kucharska, W. (2021b), "Leadership, culture, intellectual capital and knowledge processes for organizational innovativeness across industries: the case of Poland", *Journal of Intellectual Capital*, Vol.22 No.7, pp. 121-141. https://doi.org/10.1108/JIC-02-2021-0047

Kucharska, W. and Bedford, D.A.D. (2020), „Love your mistakes! – They help you adapt to change. How do knowledge, collaboration, and learning cultures foster organizational intelligence?" *Journal of Organizational Change Management*, Vol.33 No.7, pp. 1329–1354. https://doi.org/ 10.1108/JOCM-02-2020-0052.

Kucharska. W. and Kucharski, M. (2023), *Technological vs. Non-Technological Mindsets: Learning From Mistakes, and Organizational Change Adaptability to Remote Work*. Proceedings of the 19th European Conference on Management Leadership and Governance, Vol.19, pp. 205-214. London, UK.

Kucharska, W., Kucharski, M. and Balcerowski, T. (2024), *The KLC cultures approach for organizational agility. Trust, risk-taking attitude, and critical thinking as mediators.* Proceedings of the 25th European Conference on Knowledge management, 5-6 September 2024, Veszprém, Hungary.

Love, P.E.D. and Smith, J. (2016), "Toward error management in construction: moving beyond a zero vision", *Journal of Construction Engineering and Management*, Vol.142 No.11, pp.04016058.

Love, P.E.D., Lopez, R. and Edwards, D.J. (2013), "Reviewing the past learn in the failure: making sense of design errors and failures in construction", *Structure and Infrastructure Engineering*, Vol.9 No.7, pp.675-688.

Love, P.E.D., Smith, J. and Teo, P. (2018), "Putting into practice error management theory: unlearning and learning to manage action errors in construction", *Applied Ergonomics*, Vol.69, pp.104-111.

Lu, Y. and Ramamurthy, K. (2011), Understanding the link between information technology capability and organizational agility: An empirical examination. *MIS Quarterly*, Vol.35 No.4, pp. 931–954.

Maes, G. and Van Hootegem, G. (2019), "A systems model of organizational change", *Journal of Organizational Change Management*, Vol.32 No.7, pp. 725-738. https://doi.org/10.1108/JOCM-07-2017-0268

Moran, A. and Moran, A. (2014), *Agile risk management* (pp. 33-60). In: Agile Risk Management. Springer Briefs in Computer Science. Springer, Cham. https://doi.org/10.1007/978-3-319-05008-9_3

Nonaka, I. and Takeuchi, H. (1995). *The knowledge-creating company: How Japanese companies create the dynamics of innovation*, Oxford University Press.

Orłowski, C., Deręgowski, T., Kurzawski, M. and Ziółkowski, A. (2017), "Evaluation of readiness of IT organizations to agile transformation based on case-based reasoning", *ACIIDS 2017: Intelligent Information and Database Systems*, Vol.10192, pp. 787-797.

Park, S. and Park Park, S. (2021), "How can employees adapt to change? Clarifying the adaptive performance concepts", *Human Resource Development Quarterly*, Vol.32 No.1, pp. E1-E15. https://doi.org/10.1002/hrdq.21411

Pitafi, A.H., Rasheed, M.I., Islam, N. and Dhir, A. (2023), Investigating visibility affordance, knowledge transfer and employee agility performance. A study of enterprise social media, *Technovation*, Vol.128, 102874. https://doi.org/10.1016/j.technovation.2023.102874.

Rael, R. (2017), *Smart Risk Management: A guide to identifying and calibrating business risks*. John Wiley & Sons.

Rebelo, T. and Gomes, A.D. (2011), "Conditioning factors of an organizational learning culture", *Journal of Workplace Learning*, Vol.23 No.3, pp. 173-194. https://doi.org/10.1108/13665621111117215.

Spector, P.E. and Brannick, M.T. (2011), "Methodological urban legends: the misuse of statistical control variables", Organizational Research Methods, Vol.14 No.2, pp. 287-305. https://doi.org/ 1094428110369842.

Young, H.P. (2009), "Learning by trial and error", *Games and Economic Behavior*, Vol.65 No.2, pp. 626-643.

Zanjirchi, S.M., Jalilian, N. and Mirhoseini, A. (2017), "Risk-agility interactive model: a new look at agility drivers", *Journal of Modelling in Management*, Vol.12 No.4, pp. 690-711. https://doi.org/10.1108/JM2-01-2016-0007

Zastempowski, M. and Cyfert, S. (2023), "A new angle on SMEs' competitiveness. How do agility capabilities affect a firm's competitive position?", *Journal of Organizational Change Management*, Vol.36 No.4, pp. 635-662. https://doi.org/10.1108/JOCM-09-2022-0255

Zinn, J.O. (2020), *Understanding Risk-Taking: Critical Studies in Risk and Uncertainty*, Palgrave Macmillan, Cham.

The KLC Cultures Synergy for Organizational Agility. Trust, Risk-Taking Attitude, and Critical Thinking as Moderators

Wioleta Kucharska[1], Maciej Kucharski[1] and Tomasz Balcerowski[1,2]
[1]Gdansk University of Technology – Gdansk TECH, Fahrenheit Universities Association, Gdansk, Poland;
[2] Ekoinbud Sp. z o.o. Gdańsk, Poland

wioleta.kucharska@pg.edu.pl

Abstract: Organizational agility is visible in organizational change adaptability, and it is based on the development of dynamic capabilities, strategic sensitivity of leaders, accuracy and timing of decision-making, learning aptitude, flexibility in thinking and acting, and smooth resource flow across organizations, including the knowledge resource. In such a context, this study aimed to expose how the knowledge, learning, and collaboration cultures approach (KLC) supports organizational agility when this relation is moderated by mutual trust among employees, risk-taking attitude, and critical thinking abilities. Based on the sample composed of 640 Polish knowledge workers and data analyzed with the structural equation modeling method (SEM), this study's results proved that the KLC culture synergy supports organizational agility building and that the mistakes acceptance component of learning culture is critical. Moreover, trust among workmates, risk-taking readiness, and critical thinking skills are significant mediators. The key novelty was exposed through the negative influence of a risk-taking attitude (uncertainty acceptance) on agility. Precisely, the lack of risk acceptance or, reversely, the risk-avoidance attitude supports agility. This is because agility, understood as smooth adaptability, is the effect of efficient risk management. Thanks to risk management and critical thinking, the negative impact of inaction risks can often be seen as higher than the risks of very innovative actions. The KLC approach, critical thinking, and trust among workmates support the smooth selection of risks that must be taken in today's dynamic business. Risk is inevitable. So, from this point, the essence of agility is the ability to smoothly and wisely select among risks that should be taken or avoided. In summary, agility can be considered to be the smooth selection of acceptable risks.

Keywords: Knowledge Culture, Learning Culture, Collaborative Culture, Knowledge-Driven Organization, Agility, Risk Management, Critical Thinking, Trust, The KLC Approach

1. Introduction

Business turbulences recently pushed organizations to increase attention to agility as a skill that supports organizational competitiveness and survival (Cegarra-Navarro et al., 2016; Cyfert et al., 2023; Franco et al., 2023; Zastempowski and Cyfert, 2022). Liu (2021) claims that organizational agility is an organizational capacity to achieve high responsiveness and deal effectively and efficiently with market changes to reduce operational uncertainty. Company culture is vital for any organizational capacity building. So, the question arises: how can we describe the culture that supports organizational agility?

Recently, Kucharska and Bedford (2023a-b) introduced the KLC approach and proved that regarding knowledge-driven organizations, knowledge, learning, and collaboration cultures synergy (the KLC approach) supports organizations in their adaptability to changing business conditions. So, the KLC approach seems to be a theoretically very promising supporter for organizations interested in agility building. Since the KLC approach has not yet been studied as an agility predictor – this study aims to do this and additionally expand the body of knowledge by examining if trust, critical thinking, and risk-taking attitudes matter for the organizational level of agility if supported by the KLC cultures approach.

2. Conceptual Framework

2.1 KLC Cultures

The focal point to clarify the KLC culture approach to knowledge-driven organizational culture introduced by (Kucharska and Bedford, 2023a) is the clarification of the key characteristics of each of them and the exposition of their relations. A culture of knowledge dominates in knowledge-oriented organizations that focus more on static knowledge exploitation (Kucharska and Bedford, 2023a; Van Wijk et al., 2012), whereas learning culture dominates in organizations that focus more on dynamic, constantly breaking 'the status quo.' Furthermore, knowledge culture is a base for learning culture. The easiest way to expose the differences between these cultures is to compare the effects of such a different organizational focus. It is easy to predict that if any organization is stuck in the knowledge-orientation stage, then it exists in a reality where static exploitation of knowledge and control dominates, and the new knowledge is rejected. In such organizations, old, proven

methods of cultivating acting are more appreciated than new solutions seeking, and any risk is rejected; consequently, mistakes tied to this risk are avoided. Organizations based chiefly on proven knowledge often prefer to "keep things as they are" - and that "safe, well-known routines control-oriented" organizational attitude might block these organizations' development. In contrast, a learning culture leads to constant, dynamic knowledge acquisition provoked by "intelligence in action" (Erickson and Rothberg, 2012). A pervasive and persistent learning culture is essential to the development and growth of learning organizations in the current economic climate of continuous change (Maes and Van Hootegem, 2019; Rass et al., 2023). An organizational learning culture can facilitate the creation and sharing of knowledge (Kucharska and Bedford, 2023a-b). By itself, a knowledge culture does not have this effect, though it is a basis for fostering curiosity and exposing knowledge gaps that lead to learning. This finding is consistent with the research of Webster and Pearce (2008), who highlighted the importance of situational learning, which is essential to active learning. Situational learning is aligned with the current context. It is especially relevant today in a dynamic and rapidly changing business environment. Acting in such a dynamic business environment might naturally cause many mistakes. Moreover, the lack of mistakes acceptance component of a learning culture can block learning from them at the organizational level. Therefore, a learning culture without developed mistakes' acceptance component is an illusion of learning culture (Kucharska and Bedford, 2020). Based on the above, the hypotheses are given below:

H1a: Knowledge culture positively influences the learning climate component of a learning culture.

H1b: Knowledge culture negatively influences the mistakes acceptance component of a learning culture.

A culture of learning is an organization's ability to create, acquire, and exchange knowledge, modify organizational behaviors and choices, and integrate that new knowledge and insights into its organizational level (Garvin, 1993). Moreover, Kucharska and Bedford (2020; 2023a-b) empirically proved that organizational ability to learn collectively depends on two dimensions: learning climate and mistakes acceptance, and that the climate component (motivational) influences the mistakes acceptance component as a potential source of learning (readiness to be mistaken and to correct actions). Therefore, the hypothesis is added as below:

H1c: The learning climate component of learning culture positively influences the mistakes acceptance component

Moreover, suppose an organization is seen as a group of people coordinated to achieve the aim none of them can achieve alone. In that case, collaborative culture is the essence of any organization's existence (Kucharska and Bedford, 2023a-b). Without collaboration among workmates, there is no reason to name the group of people organization. Organizational learning requires collaboration. Without collaboration, learning in an organization is not collective. Individual learning or even the sum of individual learning does not increase collective knowledge. Organizational learning is based on continuing lessons taken by the entire community together. Otherwise, there is no impact on collective intelligence (Kucharska and Bedford, 2020, 2023a-b). Collaboration supports learning as a source of new knowledge (Nugroho, 2018). Collaboration is the core competency that enables organizations to acquire knowledge collectively. So, collaboration supports the culture of learning that is seen as a favorable learning climate (collective motivation) and the acceptance of being ready to be wrong (Senge, 2006). Based on this, the hypotheses are formulated:

H1d: Collaborative culture influences the learning climate component of learning culture positively

H1e: Collaborative culture positively influences the mistakes acceptance component of learning culture

Collaboration culture supports knowledge culture in knowledge-driven organizations because, for such entities, knowledge is a key resource. Simultaneously, knowledge culture in knowledge-driven organizations simplifies a shared mindset of knowledge appreciation, and knowledge culture supports this way collaboration (Alshwayat et al., 2021). The Kucharska and Bedford (2023b) study empirically proved that knowledge and collaborative cultures correlate. This is characteristic of knowledge-driven organizations where knowledge is perceived as a critical value carrier, object of exchange, and base for strong personal brand creation (Kucharska, 2024). Therefore, following them, the hypothesis is added:

H1f: Knowledge culture and collaborative culture are correlated

2.2 Organizational Agility

In the business context, organizational agility was termed in 1982 as the ability to respond promptly to rapidly changing events (Brown and Agnew, 1982, p. 29). Organizational adaptability reflects how an organization responds to change by managing stress and uncertainty, exposing flexibility or resilience, and supporting those who tackle problems to face the change (Reupert, 2020). Kucharska and Kucharski (2023) proved that the mistakes acceptance component of learning culture supports change adaptability. Martin et al. (2013, p. 1) defined adaptability as 'appropriate cognitive, behavioral and/or emotional adjustment in the face of uncertainty and novelty.' This suggests the dependency of agility on a company culture (Goncalves et al., 2019). Enterprises usually achieve varying levels of agility (Orłowski et al., 2017). These levels depend primarily on human resources' abilities to be agile (Conboy et al., 2011; Harsch and Festing, 2020). This is because agility enables the smooth seize advantage of available opportunities and is connected with social capital and collaborative knowledge creation (Al-Omoush et al., 2020). This is why the implemented KLC approach can be assumed to be a potentially strong predictor of organizational agility. Based on this assumption, hypotheses are formulated as below:

H2: Knowledge culture supports organizational agility.

H3: The learning climate component of learning culture supports organizational agility.

H4: The mistakes acceptance component of learning culture supports organizational agility.

H5: Collaborative culture supports organizational agility.

2.3 Control Variables

A control variable (CV) represents an additional factor (third variable) that may influence the relationship between an independent and dependent variable in the model tested. A CV may act as a confound, a moderator, or a suppressor (Spector and Brannick, 2011). The CV's imputation methodology enables extraneous variables to be included in a model–control variables are not the focal point of the study yet remain theoretically important (Becker et al., 2016). For this study, such theoretically important variables are trust, critical thinking, and risk-taking attitude. Trust is seen as a focal factor affecting the activation of organizational intelligence thanks to its support for tacit knowledge sharing focal for collective learning and adaptability (Kucharska and Bedford, 2023b; Kucharska et al., 2017). "Critical thinking (CT) is constructive thinking about the world of ours that questions and evaluates its operations, history, and management" (Oswald and Mascarenhas, 2019, p.151). Critical thinking is then a base for any learning leading to change. Risk-taking implies uncertainty acceptance (Zinn, 2020). A risk-taking attitude is needed to cross boundaries and comfort zones, which matters for new learning. "(...) learning as one of the organization's core values, a focus on people, concern for all stakeholders, stimulation of experimentation, encouraging an attitude of responsible risk, readiness to recognize errors and learn from them, and promotion of open and intense communication, as well as the promotion of cooperation, interdependence, and share of knowledge" (Rebelo and Gomes, 2011, p.174). Moreover works by Funston and Wagner (2010), Galli and Lopez (2018); Moran and Moran (2014) or Rael (2017) enable us to expect that risk management is significantly tied with the organizational agility competency building. Based on all the above, we see trust, critical thinking, and risk-taking attitude as factors that can affect the relation between the KLC cultures and organizational agility. Therefore, the hypotheses were formulated as below:

$H_{cv}1$: Trust affects the organizational agility driven by the KLC-approach.

$H_{cv}2$: Critical thinking affects the organizational agility driven by the KLC-approach.

$H_{cv}3$: Risk-taking attitude affects organizational agility driven by the KLC-approach.

Figure 1 below visualizes the theoretical framework elaborated above.

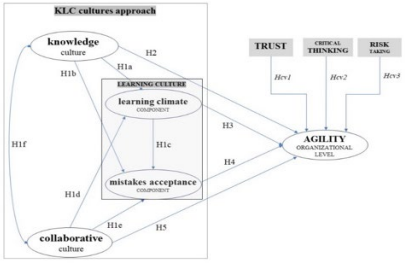


Figure 1: Theoretical model

3. Methodology

Sampling procedure: this study targeted Polish knowledge workers; therefore, qualified respondents declared that their work's first input and output is knowledge. Moreover, to secure the respondents' familiarity with their organizations' issues, we qualified only those who worked a minimum of one year for their current employer. Data were collected in March 2023 by applying the CAWI method.

Sample characteristics: The sample is composed of 640 Polish knowledge workers: 306 specialists and 334 managers; 329 women and 311 men - mainly representing private (77%) companies from different sectors to illustrate the general view on Poland (dominating sectors: production and knowledge services 19% each). Measures: respondents referred to most questions using a 7-point Likert scale. Control variables were inputted as composites. Appendix 1 presents measured constructs scales and their sources. Obtained reliabilities are given in Table 1. Method of analysis: structural equation modeling (SEM) using SPSS Amos 26 software (Byrne, 2016).

Sample quality: Kaiser–Meyer–Olkin (KMO) test: .944, the total variance extracted: 78%, and Common method bias: 37% justify the good quality of the sample.

Table 1: Basic statistics obtained AVE root square and correlations between constructs

	Mean	SD	AVE	CR	Cronbach alpha	$_{cv}$R	$_{cv}$CT	$_{cv}$T	CC	KC	LCc	LCm	A
$_{cv}$R	-	-	-	-	-								
$_{cv}$CT	-	-	-	-	-	-0.09							
$_{cv}$T	-	-	-	-	-	-0.04	0.504						
CC	3.68	1.94	0.57	0.72	.83	-0.04	0.636	0.671	**0.754**				
KC	4.23	1.07	0.71	0.88	.88	0.083	0.425	0.499	0.593	**0.845**			
LCc	3.73	1.04	0.60	0.82	.82	-0.005	0.529	0.571	0.809	0.689	**0.777**		
LCm	3.16	1.80	0.61	0.93	.93	-0.031	0.410	0.430	0.641	0.397	0.593	**0.964**	
A	3.64	1.15	0.59	0.82	.85	-0.129	0.621	0.617	0.750	0.533	0.693	0.592	**0.905**

Note: n=640 KC-knowledge culture, LCc-learning culture climate component, LCm-Learning culture mistakes acceptance component, CC-collaborative culture, A-organizational agility; control variables: $_{cv}$T-Trust, $_{cv}$CT-Critical thinking, $_{cv}$R– Risk-taking attitude; squared root of AVE is bolded

Table 1 shows a high correlation between CC and LCc, which exceeds the squared root of AVE. Since Common method bias exposes an acceptable level, it suggests that CC supercharge LCc.

4. Results

Control variables imputation requires first running and comparing empirical models with and without control variables (CV), and if the model with CVs is better fitted to the data, then the CVs imputation is justified, and the model results can be analyzed (Becker et al., 2016; Carlson and Wu, 2012). The results (Table 2) showed that the model with CVs indeed fits the data better than the model without them. So, the model with CVs is further discussed and analyzed in this paper. Most of the hypotheses formulated were confirmed; the exceptions are H2, H3, and **$H_{cv}3$**. These exceptions are discussed more in-depth in the next section. The general results show that the KLC culture synergy supports organizational agility. The mistakes acceptance component of learning culture and collaborative culture support it directly, whereas knowledge culture and learning climate component of learning culture indirectly. Moreover, all inputted control variables are significant for organizational agility: trust among employees and critical thinking attitude support organizational agility positively, whereas risk-taking attitude – negatively. Figure 2 and Table 2 expose hypotheses verification details.

Table 2: Hypotheses verification

Model A with CVs; RMSEA=.055(.049-.061) χ2=264.42(116) Cmin/df=2.93 CFI=.962 TLI=.952			Model B without CVs; RMSEA=.059(.052-.066) χ2=353.31(109) Cmin/df=3.21 CFI=.965 TLI=.956		
Hypothesis	**significance**	**verification**	**Hypothesis**	**significance**	**verification**
H1a	.26***	*sustained*	**H1a**	.28***	*sustained*

Model A with CVs; RMSEA=.055(.049-.061) χ2=264.42(116) Cmin/df=2.93 CFI=.962 TLI=.952			Model B without CVs; RMSEA=.059(.052-.066) χ2=353.31(109) Cmin/df=3.21 CFI=.965 TLI=.956		
H1b	-.11*	*sustained*	**H1b**	-.11*	*sustained*
H1c	.24*	*sustained*	**H1c**	.28**	*sustained*
H1d	.66***	*sustained*	**H1d**	.63***	*sustained*
H1e	.52***	*sustained*	**H1e**	.48***	*sustained*
H1f	.66***	*sustained*	**H1f**	.66***	*sustained*
H2	ns	*rejected*	**H2**	ns	*rejected*
H3	ns	*rejected*	**H3**	.17*	*sustained*
H4	.15***	*sustained*	**H4**	.15***	*sustained*
H5	.35**	*sustained*	**H5**	.54***	*sustained*
$H_{cv}1$	.13**	*sustained*			
$H_{cv}2$	.17***	*sustained*			
$H_{cv}3$	-.09**	*rejected*			

Note: n=640, ML- maximum likelihood

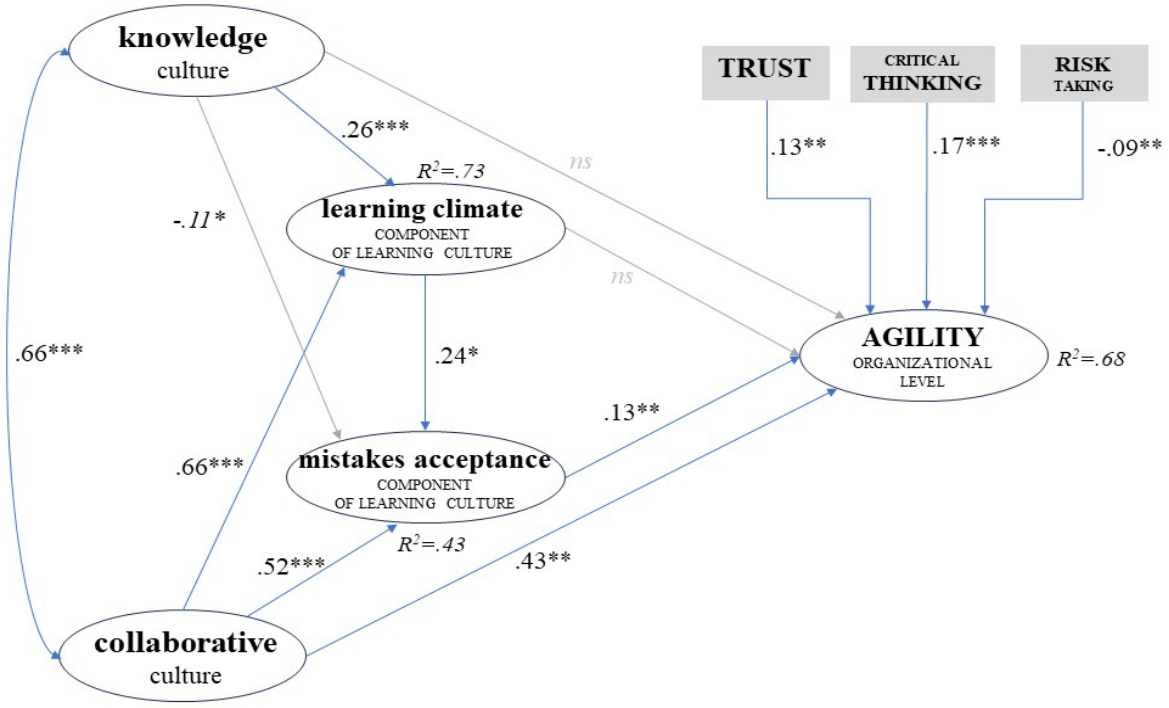


Figure 2: Empirical results

Note: n=640, ML- maximum likelihood; χ2=443.01(151) Cmin/df=2.93; CFI=.962 TLI=.952 RMSEA=.055; p<.05 **p<.01 ***p<.001 ns-not significant result

5. Discussion

Results requiring discussion concern those hypotheses that were not confirmed: H2, H3, and $H_{cv}2$. Regarding the lack of sustention of H2, which assumed the positive influence of knowledge culture on organizational agility, it can be clarified by the definitions of knowledge culture and learning culture as well as by previous findings of Kucharska and Bedford's (2023a-b) studies. Knowledge culture itself creates a passive consumption of existing knowledge, but it creates the motivation to learn. Learning culture creates new knowledge absorption and production that leads to dynamic development. It is why H2 is not sustained, whereas H1a, about the positive influence of knowledge culture on the learning culture component – climate (LCc), is significant.

Following knowledge culture - learning culture relations, the H1b about the negative influence of knowledge culture on the mistakes acceptance component of learning culture (LCm) is confirmed. As was expected, knowledge culture itself creates a passive consumption of existing knowledge and, by nature, does not accept mistakes in any form, so it is also a potential source of learning. However, the fact that H3 about the positive influence of LCc on agility was not sustained, whereas H4 about the positive influence of LCm on agility was found to be significant, suggesting that active trial-error learning is fundamental for agility. This conclusion is confirmed critical for active trial-error learning. Without them, LCc is significantly important for agility, but if CVs imputation transforms learning climate into favorable conditions to dynamic trial-error learning through acceptance of mistakes as a potential source of learning that directly supports organizational agility.

Regarding control variables, the hypothesis about the positive influence of the risk-taking attitude of organization members on organizational agility ($H_{cv}3$=-.09**) was not confirmed. Precisely, the opposite - negative influence was observed; the risk-avoidance attitude supports agility. So, it aligns with the findings of Zanjirchi et al. (2017), who claimed that supply chain risk factors could be considered drivers of organizational agility. This is because agility, understood as smooth adaptability, is often the effect of efficient risk management. Thanks to this efficient risk management and critical thinking, the negative impact of inaction risks can often be seen as higher than the risks of very innovative actions, or in other words, very innovative actions are worth risk-taking to avoid risks caused if these innovative actions remain untaken. This is why the impact of critical thinking ($H_{cv}2$=.17***) on organizational agility is so evident. Trust ($H_{cv}1$=.14**), as claimed before by Kucharska and Bedford (2023, a-b) as vital for strengthening the KLC cultural approach benefits. One of the most desired benefits of the KLC approach is organizational agility. So, all the imputed into the model CVs are critical and support agility building.

6. Practical Implications

The key contribution of the presented findings to the practice was exposed through the negative influence of a risk-taking attitude (uncertainty acceptance) on agility. Precisely, the lack of risk acceptance or, reversely, the risk-avoidance attitude supports agility. This is because agility, understood as smooth adaptability, is the effect of efficient risk management. Thanks to risk management and critical thinking, the negative impact of inaction risks can often be seen as higher than the risks of very innovative actions. From a practical perspective, we conclude that sometimes very innovative actions are worth taking to avoid the negative consequences if these innovative and risky actions remain untaken. Risk is inevitable in business. So, from this perspective, the essence of agility is smooth risk management that creates the organizational ability to select risks taken or avoided wisely.

Regarding the KLC approach, as Kucharska and Bedford (2023b) suggested, those leaders who do not expose the KLC approach should not be leaders at any level. This study's findings enable us to add that this rule is particularly significant for those organizations that aim to be agile.

7. Limitations and Scientific Implications

The key limitation of this research is that it is based on data collected in only one country. The second important limitation is the identified strong interdependency between collaborative culture and the learning climate component of learning culture in Poland. This interdependency may cause slight bias, but at the same time, it might expose how focal collaborative culture is for motivation to learn in organizations. Moreover, the results presented reveal direct relations. No mediated or moderated effects are included. So, further studies can explore these relations more in-depth. Furthermore, the analyzed model (Figure 2) explains the studied phenomenon in 68%. It means, that other factors important for understanding the KLC approach's impact on organizational agility that are not included in the analyzed model should be identified and studied more in-depth. The critical limitation of this research is that the organizational adaptability scale was adapted here as a proxy for organizational agility. Precisely, the adapted scale omits the factor of organizational ability to respond timely, accurately, and creatively to changes. So, further studies with developed scales for organizational agility are needed to confirm the given findings and conclusions.

8. Conclusions

Trust, risk-taking attitude, and critical thinking are tremendous for organizational agility building. Moreover, the findings exposed that the KLC culture synergy supports organizational agility mainly through collaboration culture and the mediating power of mistakes acceptance component of a learning culture. Moreover, all the inputted to the model control variables significantly support this relation. The given results proved that the risk-avoidance attitude positively supports agility. This is because agility, understood as smooth adaptability, is the effect of

efficient risk management. Thanks to risk management and critical thinking, the negative impact of inaction risks can often be seen as higher than the risks of very innovative actions, or in other words, very innovative actions are worth risk-taking to avoid risks occurring if these innovative actions remain untaken. So, from this perspective, the essence of agility is smooth risk management that creates the organizational ability to select risks taken or avoided wisely. The KLC approach, critical thinking, and trust among workmates support the smooth selection of risks that must be taken.

Acknowledgement

The presented research is a result of the project Agile learning culture influence on dynamic capabilities of knowledge-based organizations: Polish-Finnish cross-country analysis No. UMO-2022/47/B/HS4/00597 financed by the funds of the National Science Center (NCN) Poland.

References

Alshwayat, D., MacVaugh, J.A. and Akbar, H. (2021), "A multi-level perspective on trust, collaboration and knowledge sharing cultures in a highly formalized organization", *Journal of Knowledge Management*, Vol.25 No.9, pp. 2220-2244. https://doi.org/10.1108/JKM-05-2020-0354

Al-Omoush, K.S., Simon-Moya, V. and Sendra-Garcia, J. (2020), "The impact of social capital and collaborative knowledge creation on e-business proactiveness and organisational agility in responding to the COVID-19 crisis", *Journal of Innovation and Knowledge*, Vol.5 No.4, pp. 279-288.

Becker, T.E., G. Atnic, G., Breaugh, J.A., Carlson, K.D., Edwards, J.R. and Spector, P.E. (2016), „Statistical control in correlational studies: 10 essential recommendations for organizational researchers," *Journal of Organizational Behavior*, Vol.37, pp. 157–167.

Brown, J.L. and Agnew, N.M. (1982), "Corporate agility", *Business Horizons*, Vol.25 No.2, pp. 29-33.

Byrne, B.M. (2016), *Structural Equation Modeling with Amos*. Routledge, Abingdon.

Carlson, K.D. and Wu, J. (2012), „The illusion of statistical control: control variable practice in management research," *Organizational Research Methods*, Vol.15 No.3, pp. 413-435.

Cegarra-Navarro, J.-G., Soto-Acosta, P. and Wensley, A.K.P. (2016), "Structured knowledge processes and firm performance: The role of organizational agility", *Journal of Business Research*, Vol.69, pp. 1544–1549. https://doi.org/10.1016/j.jbusres.2015.10.014

Conboy, K., Coyle, S., Xiaofeng, W. and Pikkarainen, M. (2011), "People over process: key challenges in agile development", *IEEE Software*, Vol.28 No.4, pp. 48-57.

Cyfert, S., Szumowski, W., Dyduch, W., Zastempowski, M. and Chudzinski, P. (2022), „The power of moving fast: responsible leadership, psychological empowerment, and workforce agility in energy sector firms", *Heylon*, Vol.8 No.10, e11188. https://doi.org/10.1016/j.heliyon.2022.e11188

Erickson, G.S. and Rothberg, H. (2012), *Intelligence in action: Strategically managing knowledge assets*, Springer.

Franco, M., Guimarães, J. and Rodrigues, M. (2023), "Organisational agility: systematic literature review and future research agenda", *Knowledge Management Research & Practice*, Vol.21, No.6, pp. 1021–1038 https://doi.org/10.1080/14778238.2022.2103048

Funston, F. and Wagner, S. (2010), *Surviving and thriving in uncertainty: Creating the risk intelligent enterprise*. John Wiley & Sons.

Galli, B.J. and Lopez, P.A.H. (2018), Risks management in agile new product development project environments: A review of literature. *International Journal of Risk and Contingency Management*, Vol.7 No.4, pp. 37-67.

Garvin, D.A. (1993), „Building a Learning Organization", *Harvard Business Review*, Vol.71, pp. 78-91.

Goncalves, D., Bergquist, M., Bunk, R. and Alänge, S. (2019), "The influence of cultural values on organizational agility", AMCIS 2019 Proceedings, pp. 1-10.

Harsch, K. and Festing, M. (2020), "Dynamic talent management capabilities and organizational agility—a qualitative exploration", *Human Resource Management*, Vol.59 No.1, pp. 43-61.

Kucharska, W. (2024), "Self-Perceived Personal Brand Equity of Knowledge Workers by Gender in Light of Knowledge-Driven Organizational Culture: Evidence From Poland and the United States", *SAGE Open*, Vol.14 No.1. https://doi.org/10.1177/21582440241227280

Kucharska, W. (2021), "Do mistakes acceptance foster innovation? Polish and US cross-country study of tacit knowledge sharing in IT", *Journal of Knowledge Managemen*t, Vol.25 No.11, pp. 105-128. https://doi.org/10.1108/JKM-12-2020-0922

Kucharska, W. and Bedford, D.A.D. (2023a), *The Cultures of Knowledge Organizations: Knowledge, Learning, Collaboration (KLC)*, Emerald.

Kucharska, W. and Bedford, D.A.D. (2023b), „The KLC Cultures, Tacit Knowledge, and Trust Contribution to Organizational Intelligence Activation", In Proceedings of the 24th European Conference on Knowledge Management, September, Lisbon, ECKM23. https://doi.org/10.34190/eckm.24.1.1248

Kucharska, W. and Erickson, G.S. (2023), "Tacit knowledge acquisition & sharing, and its influence on innovations: A Polish/US cross-country study", *International Journal of Information Management*, Vol.71, 102647. https://doi.org/10.1016/j.ijinfomgt.2023.102647

Kucharska, W., and Bedford, D.A.D. (2020), „Love your mistakes! – They help you adapt to change. How do knowledge, collaboration and learning cultures foster organizational intelligence?," *Journal of Organizational Change Management*, Vol.33 No.7, pp. 1329–1354. https://doi.org/ 10.1108/JOCM-02-2020-0052.

Kucharska, W., Kowalczyk, R. and Kucharski, M. (2017), Trust, tacit knowledge sharing, project performance, and their managerial implications. Proceedings of the 18th European Conference on Knowledge Management, Vol.1, pp. 532-539.

Kucharska, W. and Kucharski, M. (2023), Technological vs. Non-Technological Mindsets: Learning From Mistakes, and Organizational Change Adaptability to Remote Work. Proceedings of the 19th European Conference on Management Leadership and Governance, ECMLG 2023, pp. 205-214. https://doi.org/10.34190/ecmlg.19.1.1902

Liu, H.M. (2021), "Effect of partnership quality on SMEs success: mediating role of coordination capability and organisational agility", *Total Quality Management and Business Excellence*, Vol.32 No.15-16, pp. 1786-1802.

Maes, G. and Van Hootegem, G. (2019), „A systems model of organizational change," *Journal of Organizational Change Management*, Vol.32 No.7, pp. 725-738. https://doi.org/10.1108/JOCM-07-2017-0268

Martin, A.J., Nejad, H., Colmar, S. and Liem, G.A.D. (2013), „Adaptability: How students' responses to uncertainty and novelty predict their academic and non-academic outcomes," *Journal of Educational Psychology*, Vol.105 No.3, pp. 728–746. https://doi.org/10.1037/a0032794

Moran, A. and Moran, A. (2014), *Agile risk management,* Springer International Publishing, (pp. 33-60).

Nugroho, M.A. (2018), „The effects of collaborative cultures and knowledge sharing on organizational learning," *Journal of Organizational Change Management*, Vol.31 No.5, pp. 1138-1152. https://doi.org/10.1108/JOCM-10-2017-0385

Orłowski, C., Deręgowski, T., Kurzawski, M. and Ziółkowski, A. (2017), "Evaluation of readiness of IT organizations to agile transformation based on case-based reasoning", ACIIDS 2017: Intelligent Information and Database Systems, Vol. 10192, pp. 787-797.

Oswald, A.J. and Mascarenhas, S.J. (2019), "The ethics of corporate critical thinking", in: Oswald, A.J. and Mascarenhas, S.J.(Eds), *Executive Response to Market Challenges*, Emerald Publishing Limited.

Rael, R. (2017), *Smart Risk Management: A guide to identifying and calibrating business risks*. John Wiley & Sons.

Rass, L., Treur, J., Kucharska, W. and Wiewiora, A. (2023), „Adaptive dynamical systems modelling of transformational organizational change with a focus on organizational culture and organizational learning," *Cognitive Systems Research*, Vol.79, pp. 85-108. https://doi.org/10.1016/j.cogsys.2023.01.004

Rebelo, T. and Gomes, A.D. (2011), "Conditioning factors of an organizational learning culture", *Journal of Workplace Learning*, Vol.23 No.3, pp. 173-194. https://doi.org/10.1108/13665621111117215.

Reupert, A. (2020), „Change and (the need for) adaptability: The new normal," *Advances in Mental Health*, Vol.18 No.2, pp. 91–93. https://doi.org/10.1080/18387357.2020.1792633

Senge, P.M. (2006), *The Fifth Discipline: The Art & Practice of the Learning Organization*, Crown Business, New York, NY.

Spector, P.E. and Brannick, M.T. (2011), "Methodological urban legends: the misuse of statistical control variables", *Organizational Research Methods*, Vol.14 No.2, pp. 287-305. https://doi.org/ 1094428110369842.

van Wijk, R., Jansen, J.J.P., Van Den Bosch, F.A.J. and Volberda, H.W. (2012), "How firms shape knowledge to explore and exploit: a study of knowledge flows, knowledge stocks and innovative performance across units", *Technology Analysis & Strategic Management*, Vol.24 No.9, pp. 929-950. https://doi.org/10.1080/09537325.2012.718666

Webster, J. and Pearce, G. (2008), „Crossfire: knowledge sharing should focus on learning culture, rather than the generation of knowledge," *Waterlines*, Vol.27 No.2, pp. 97-103. https://doi.org/10.3362/1756-3488.2008.012

Zanjirchi, S.M., Jalilian, N. and Mirhoseini, A. (2017), "Risk-agility interactive model: a new look at agility drivers", *Journal of Modelling in Management*, Vol.12 No.4, pp. 690-711.

Zastempowski, M. and Cyfert, S. (2023), "A new angle on SMEs' competitiveness. How do agility capabilities affect a firm's competitive position?", *Journal of Organizational Change Management*, Vol.36 No.4, pp. 635-662. https://doi.org/10.1108/JOCM-09-2022-0255

Zinn, J.O. (2020), *Understanding Risk-Taking: Critical Studies in Risk and Uncertainty*, Palgrave Macmillan, Cham.

Appendix 1: Scales and their sources

Knowledge culture (Kucharska and Bedford, 2020)	• All employees perceive knowledge as a valuable resource. • We have a common language to support knowledge exchange. • We are encouraged to share knowledge, ideas, and thoughts. • We care about the quality of knowledge that we share.
Learning culture (Kucharska and Bedford, 2020)	Learning climate component • All staff demonstrate a high learning disposition. • We are encouraged to engage in personal development. • We are encouraged to implement new ideas every day. • We are encouraged to engage in seeking new solutions. Mistakes acceptance component • People know that mistakes are a learning consequence and tolerate it up to a certain limit. • Most people freely declare mistakes. • We discuss problems openly without blaming others.

	• Mistakes are tolerated and treated as learning opportunities.
Collaborative culture (Kucharska and Bedford, 2020)	• My company supports cooperation between workers. • Cooperation among the different duties, teams, and departments was encouraged. • Co-workers volunteer their support even without being asked • People support each other.
Organizational agility proxy bases on Change adaptability scale (Kucharska and Bedford, 2020)	•We are flexible to changes. • We can adjust ourselves to changes. • We adapt to changes easily. • We used changes.
TRUST (Kucharska and Bedford, 2023b)	• I trust people at work. • People in my team trust one another. • People in my division trust one another. • People in my entire organization trust one another.
CRITICAL THINKING (Kucharska and Erickson, 2023)	• Making sense of things is important to me. • I learn from constructive questioning. • I like to evaluate my work and find out better solutions on my own.
RISK-TAKING ATTITUDE (Kucharska, 2021 based on Zinn, 2020)	•I have a risk-taking attitude. •My boss exposes a risk-taking attitude. •My workmates have a risk-taking attitude.

Cultural Determinants of Sharing High-quality Knowledge: A Case Study of Wikipedia's Featured Articles

Katarzyna Kukowska
Czestochowa University of Technology, Poland

katarzyna.kukowska@pcz.pl

Abstract: Wikipedia is the largest encyclopedia in the world. It works by involving users in sharing knowledge, systematising it and correcting the content of encyclopedia entries. The range of features that involve users in the process of creating the encyclopedia and its derivative projects is much wider. From a research perspective, the socio-cultural foundations of this encyclopedia are the most interesting. The aim of this study was to present the ways in which users are involved in creating articles referred to as featured. Respondents participating in the study were asked this question: does the structure and the way authors and editors of high-quality articles are involved in the project remain dependent on the Hofstede Individualism Index (IDV)? The method used in the study was an analysis of user activity and ways in which users were involved. The author obtained the data using the xTools tool available on Wikipedia. When selecting the language versions for the analysis, criteria were used: 1) their cultural homogeneity, 2) extreme IDV values – individualism versus collectivism, in order to obtain a clear contrast, and 3) a large number of featured articles. For this sample, in cultures with high IDV rates, users were involved in creating and modifying featured articles in significantly greater numbers. However, the smallest share of featured articles concerns the language versions with the highest IDV. Statistically, the study showed significant differences in the form of author and editor engagement in creating high-quality articles. The results obtained do provide grounds for concluding that the quality of content depends on Hofstede's cultural indicators. In continuing the study, it is worth considering making a comparison of the number of featured articles of different language versions in particular fields of knowledge.

Keywords: Activity in Virtual Communities, Cultural Dimensions, Sharing Knowledge, Wikipedia Users

1. Introduction

The prospect of creating a sustainable, evolving and effective organisation based on motivated, active and unpaid activists is very attractive cognitively. The Wikipedia project proves the scale on which the cooperation of a huge number of individuals can be organised. Wikipedia does not rely on traditional forms of governance that require hierarchical leadership. The individual's contribution is fully autonomous, based on intrinsic motivation. The absence of user declarations as to the degree of commitment or tools to coerce a formal agreement has not stopped the organisation from working continuously for over 20 years.

Each language version is an autonomous community under the supervision of the Wikimedia Foundation, with Meta-Wiki coordination. Therefore, the socio-cultural determinants of the activity of Wikipedia editors are of interest to the study. The aim of this study was to present the ways in which users were involved in creating articles referred to as featured. Featured articles are a high-quality body of knowledge, created using a process of collective commitment to knowledge sharing. Wikipedians are guided by the following criteria to qualify an article as featured: a comprehensive description of the topic; a text that covers the main aspects of the topic without going into unnecessary details; neutrality; An exhaustively illustrated topic and an exhaustive overview of sources relevant to the topic is used (https://en.wikipedia.org/wiki/Wikipedia:Compare_criteria...). The high quality of the article is confirmed by the award of a symbolic medal or barnstar. Table 1 presents the symbols used to mark featured articles in the language versions selected for the study.

Table 1: Symbols of Featured Articles of Selected Language Versions in Wikipedia

Indonesian	Dutch Thai	Swedish	Georgian Norwegian Slovenian	Persian Vietnamese	German	Czech	Polish
							

Wikipedia exemplifies new patterns of cooperation and new models of information, revision and distribution that are shaping the modern model of authorship (Alonso and Robinson, 2016). The article is a contribution to a study of the determinants of high-quality knowledge sharing. The main question is: does the structure and the way authors and editors of high-quality articles are involved in the project remain dependent on the Hofstede Individualism Index (IDV)?

The article is of exploratory nature. In order to answer the research question the paper consists of sections and namely: section 2 presents a literature review, pointing out Wikipedia's lack of cultural neutrality, section 3 presents description of the research process, section 4 presents study results (hypotheses are verified in the subsections), section 5 provides a discussion and identifies the limitations of the study. The article ends with conclusions.

2. Wikipedia and Cultural Neutrality

Since the inception of Wikipedia, the issue of the quality of content created by Wikipedians has been raised. This is despite the fact that, after only a few years of Wikipedia, Giles (2005) suggested that scholarly articles on Wikipedia had reached a level of quality similar to that of the Encyclopædia Britannica. Nevertheless, Mesgari et al (2015), when identifying Wikipedia-related scholarly publications, showed that about 80% of research queries focused on quality issues. Konieczny (2021) notes that advanced review processes, particularly "Recommended Article Review", provide good protection and oversight over the quality of content. In the case of featured articles, research is largely focused on processes that monitor the quality of content. One factor influencing the quality of articles is the attributes, roles, and experiences of editors (Ren et al, 2016). Articles edited mainly by "versatile" editors, which occur in various Wikipedia activities, tend to be of high quality. In addition, research has linked the quality of articles to the experience of the main co-author (Kane, 2011), the knowledge of editors, and affiliation with WikiProjects (Kittur et al, 2009). Iba et al (2010) have developed a tool that transforms the flow of edits between contributors into a temporary social network. They analysed 2580 articles from English Wikipedia and identified a key category of coolfarmers, authors who start and create new high-quality articles best suited to enforce behaviours consistent with Wikipedia's culture. The quality of Wikipedia is deteriorated by egoboosters, people who use Wikipedia mainly to present themselves by fuelling discussions on controversial topics. Finding indicators to identify Wikipedia's most valuable contributors can be used for alternative article quality ranking systems based on author quality. Zhang et al (2020) analysed archival data of 6057 articles, examining the evolution of the quality of articles on Wikipedia. Some of the articles will never exceed the low or moderate level. Most articles achieve high quality through years of continuous efforts. In addition, the development of the article is influenced by the time the article was created, its popularity and relevance. Based on the results of the quality assessment of more than 39 million articles in 55 languages, Lewoniewski et al (2019) investigated which topics were best represented in different language versions of Wikipedia. It was confirmed that the popularity of an article could be a factor relevant to assessing quality. Articles on topics popular in a given language are of relatively high quality. One important condition is that a small group of editors contributing a disproportionately high percentage of edits remains in order for the text to achieve the status of featured articles. Lewoniewski et al (2016) proposed models to assess the relative content of the entire article and the quality of the data contained in its structural elements. For each language version of Wikipedia, parameters are selected to enable automatic evaluation. Links between articles in different languages provide opportunities to compare and verify the quality of information in different language versions. On the basis of the various characteristics of featured articles, other articles can be evaluated. Lewoniewski et al (2023) also conducted an analysis of Wikipedia references in 310 languages. Additionally, they classified Wikipedia articles according to different topics. This made it possible to find differences in the range of scholarly sources between the language versions of Wikipedia.

Wikipedia is not culturally neutral. Wikipedia editors reflect their own cultural norms by referring to the process of creating Wikipedia articles and different patterns of collaboration. A high IDV stands for individual identity, dominant over group identity. Self-actualisation and a firm private opinion are valued. Collectivism is concerned with building harmony and consensus within a group, avoiding confrontation (Hofstede et al, 2010, pp 89-134). Cultural differences in Wikipedia language versions based on Hofstede dimensions have been identified by Pfeil et al (2006) etc. The authors found that the likelihood of editors performing different types of actions on Wikipedia was correlated with differences in cultural dimensions. Pfeil et al argued that a greater number of activities would be associated with the linguistic version identified with collectivist cultures. A total of 952 changes to the selected entry of the four versions of Wikipedia were analysed. The higher the IDV of a given country, the more entries members of that Wikipedia page contributed in remedial categories. Stvilia et al (2009) measured the cultural similarity between the three Wikipedias using Hofstede's typology. In the study, the authors analysed quality understanding and value structure by tracking voting and decision-making behaviour on featured articles. In the sample, the number of editors and the number of edits made by registered users were negatively related to quality. The relationship between the degree of similarity of cultural traits and the degree of similarity of quality models in Wikipedias was not conclusive. Nemoto and Gloor (2011) analysed the

process of creating articles and social interactions in five language versions of Wikipedia. The authors found differences in communication behaviour between egalitarian and hierarchical cultures.

Despite extensive research, the debate on the quality of content and the resulting quality of knowledge popularised by Wikipedia will continue. As Jemielniak (2019) notes, Wikipedia will remain in the space of social life, providing free encyclopedic knowledge for the good of the public. Therefore, the motivation to study the behaviour of Wikipedia editors in the light of cultural conditions is justified.

3. Methodology

The article presents the next stage of a cyclical stud y on the socio-cultural determinants of the Wikipedia project, which has been in progress since 2021. So far, the author's study has shown, differences in the cooperation structures of the studied language versions of Wikipedia, in relation to selected cultural indicators by Hofstede (Kukowska, 2023; Kukowska, 2022; Skolik, Kukowska, 2021). The starting point for the current research was the involvement of users of selected language versions of Wikipedia in creating and sharing of high-quality knowledge. Co-authorship in featured articles was taken as an indicator of high quality. The level of involvement of featured article creators in various forms of activity is reflected in the individual namespaces. Namespaces are the types of web pages that make up Wikipedia content, and articles are only part of the namespace. Technically, namespaces are a collection of pages whose names begin with a prefix recognised by MediaWiki software (https://en.wikipedia.org/wiki/Wikipedia:Namespace). The study assumes that there is some correlation between the creation of high-quality knowledge by the most active users in this area and cultural conditions. The Individualism index (IDV) in Hofstede's typology was considered as the basis for differences in the cultural dimension. It was assumed that this differentiation is reflected in the form of activities reported in the statistics of the users represented. The following hypotheses were adopted:

H1 – According to the preferred models of work (collective versus individualistic), the featured articles of language versions with high IDV are created by a small group of people, as opposed to cultures with low IDV.

H2 – The index of individualism in a given culture (reflecting the attitude towards cooperation) translates into a higher or lower share of featured articles in particular language versions.

H3 – The distribution of activity of high-quality content creators in namespaces is clearly different for each language version, in view of the IDV value.

A number of steps were taken to carry out the analysis. First of all, from the https://meta.wikimedia.org/wiki/Wikipedia_featured_articles website, language versions with at least 50 featured entries were selected. The IDV indicator was used to qualify the language versions for data analysis. It was assumed that in the process of creating common content by often very many users, it is this cultural dimension that remains crucial to such a working model. The selection of language versions took into account their cultural homogeneity and extreme IDV values, i.e. above 70 or below 30 on a scale from 0 to 100. The analysis was limited to 12 language versions. The exception was the Polish (IDV47) version, which in the process of data analysis in the files was assigned to the version with low IDV. Some language versions of Wikipedia were not examined - those of the most widely used languages in the world (e.g. English, Spanish, French). They were rejected due to differences in the cultures from which their creators came. This applies especially to English, which is widely recognized as an international language. Using the same language does not always mean cultural closeness, so there was a risk of distorting the study results taking into account the level of IDV.

In the second step, 50 featured articles were randomly selected to analyse their statistics, from each of these versions. Contributors were selected from the history of the articles. Out of 600 featured articles, 2904 authors/editors were selected according to the following measures: 1) the highest percentage contribution to the article, up to the tenth position from the list of editors of a given article, 2) exclusion of bots, and 3) contributors of at least 3 featured articles from the pool drawn. 192 users from language versions with low IDV and 179 users with high IDV were deemed characteristic of user activity. The study analysed user activity by obtaining data from Wikipedia using the xTools tool. Data for the study was collected from January to March 2024.

4. Study Results

4.1 Co-Authorship Structure for Featured Articles – Collectivism Versus Individualism (Verifying H1)

To verify H1, it was necessary to answer the question of what is the structure of co-authorship of high-quality articles. The main axis representing the differences in cultural determinants for creating high-quality content was the division of the language versions of Wikipedia into a set of cultures with a high level of collectivism as opposed to individualistic cultures. After creating two sets of selected language versions overall, the statistics showed a significant difference in the number of total users. Language versions with a low IDV were created by 16,124 active users, and versions with a high IDV had 12,702 more active users (the big difference is due to the very large German version). The total number of editors creating the selected featured articles (before the selection) was adequate to the number of active users. In the language versions of collectivist cultures, 300 articles were produced by 18051 users (median: 2827.5). In individualistic cultures, it was 30,843 users (median: 4,643) per 300 articles. For this sample, in cultures with high IDV rates, users were involved in creating and modifying featured articles in significantly greater numbers. H1 received a negative assessment during verification.

4.2 Contribution of Featured Articles to Encyclopedia Entries (Verifying H2)

The answer to the question of what part of all articles are featured articles in the analyzed language versions of Wikipedia made it possible to verify H2. In the analysed language versions, featured articles account for between 1.7% and 22.1% of all articles in total. Therefore, there is a great discrepancy. The smallest share of featured articles concerns the language versions with the highest IDV: Swedish (IDV87) – 1.4% and Dutch (IDV100) – 1.7%. At the same time, Slovenian (IDV81) has the largest share of featured articles – 22.1%. The set with a lower IDV includes Georgian (IDV15) – 14.4% and Thai (IDV19) – 12.5%. The above discrepancy in the collections accepted leads to the idea that the sheer number of featured articles does not have to be represented in terms of a given cultural dimension. Moreover, the average share of featured articles in total articles for language versions with low IDV is 7.35%, and for language versions with high IDV it is 7.48%. Although this is a small sample, this very small difference in the averages is surprising. In the examples studied, the least numerous language versions of Wikipedia have the largest percentage of featured articles in their encyclopedia entries: Georgian – 284 active users (14.4%), Thai – 1169 (12.5%), Slovenian – 389 (22.1%). H2 has not been confirmed.

4.3 Activities of High-Quality Content Contributors and IDV (verifying H3)

The verification of H3 required an answer to the question of what forms of activity the contributors of high-quality content engage in the most. The Wikipedia statistic describes the characteristics of a Wikipedian's activity by counting the number of edits in a set of MediaWiki pages collectively named namespace (https://en.wikipedia.org/wiki/Wikipedia: Namespace). Namespaces are numerous, and their use varies from language to language. In order to represent user activity, namespaces were grouped according to their functions into the following areas: substantive, technical, interaction (social), content promotion, and working (organisational).

1. Substantive spaces: Main/Article, Category, File and Timedtext are types of namespaces containing content created for readers (recipients). From the encyclopedia's point of view, Mains are the most important. Managing the content of articles (this is the constantly negotiated taxonomy of encyclopedia knowledge) is enabled by Categories. The File namespace contains mainly photos but also other graphic and multimedia forms, and a number of different files that are attachments placed in articles. TimedText, on the other hand, is a multimedia file space that enables the user to add text to video recordings.

2. Technical spaces: Template, Module and MediaWiki contain mainly complex code that enables the user to handle other namespaces. Templates can be more or less complex; they contain rather simple content placed on many pages. One example is the Infobox, which is usually placed in the upper right-hand part of the article; it is technically advanced and can be filled in by entering a small amount of data. A module is a more advanced type of page that some templates use. MediaWiki, on the other hand, is the core software architecture of the Wikimedia projects.

3. Interaction/social spaces: User talk, Wikipedia, Wikipedia talk, Help and Help talk are spaces primarily used for communication between Wikipedians and to inform users about the rules of contributing to an encyclopedia. Originally, this was the purpose of the User talk space. However, such communication was not public, which is why the Wikipedia namespace was created. Common rules were also established in this space, and once

established, the Wikipedia talk space enabled them to be criticised or renegotiated. Help and Help talk have been separated for the benefit of how-to websites.

4. Content promotion spaces: Portal, Book and Story are the types of pages that allow Wikipedians to present content from specific subject areas. Portals are used for internal promotion of certain categories of entries and created according to the model of the main page, introducing the reader to a given topic area. Book and Story, on the other hand, enable individual users to choose content that is interesting to them and promote it outside Wikipedia.

5. Workspaces/Organisational Spaces are any pages where various preparatory work is done, cooperation with other users is undertaken, content is reviewed in detail, and articles are drafted. Dedicated spaces for these purposes are: Wikiproject, Wikiproject talk, Draft and Draft talk. In the case of other spaces, they are also used for the same purpose, although their purpose was different. The User space is used for self-presentation, but often users use it (or rather its subspaces) to create a number of drafts. Talk is a space for evaluating an article, and comments on how to improve an encyclopedia entry are often exchanged here. Talk spaces assigned to other namespaces are treated similarly.

In order to represent the forms of activity in which co-creators of high-quality content engage the most, the Mann-Whitney U test was conducted (Szajt, 2014). The test results are shown in Tables 2-6. Statistically significant differences for the given language versions are marked with an arrow symbol. The direction of the arrow indicates the language version in which users are more active. For the remaining cases, no statistically significant differences were confirmed.

In the case of activity in substantive spaces, the test only showed statistically significant differences in the comparison of language versions with a high IDV index, even in relation to each other. The dominant figures in this system are German and Norwegian, in which only in 3 cases were statistically significant differences not confirmed (for Persian, Thai and Dutch). In substantive areas, it is the co-authors of culturally individualistically conditioned language versions that show dominant activity in relation to collectively conditioned language versions. The only exception is the Czech version, which is inferior to the other versions from its pool (Table 2).

Table 2: Mann-Whitney U test for Author and Editor Activity in Content Spaces

LANGUAGE VERSIONS	IDV	id	ka	th	fa	vi	pl	cs	de	no	sl	sv	nl
id-Indonesian	5												
ka-Georgian	15	-											
th-Thai	19	-	-										
fa-Persian	23	-	-	-									
vi-Vietnamese	30	-	-	-	-								
pl-Polish	47	-	-	-	-	-							
cs-Czech	70	-	-	-	-	-	-						
de-German	79	←	←	-	-	←	←	←					
no-Norwegian	81	←	←	-	-	←	←	←	-				
sl-Slovenian	81	-	-	-	-	-	-	-	-	-			
sv-Swedish	87	←	-	-	-	←	-	-	-	-	-		
nl- Dutch	100	←	←	-	-	←	-	←	-	-	-	-	

In technical areas, all language versions selected for the study showed statistically significant differences in distribution levels in the test in at least 2 cases (e.g. Indonesian with German and Polish). In technical spaces, their users are more active. In this group, the Thai version is predominant in 9 cases, 5 of which refer to individualistic cultures. The trend is offset by the Polish language version, which shows statistically significant differences with all language versions from its set (low IDV) and with half of the language versions with high IDV. At the same time, in every case the Polish language version shows lower user activity in technical spaces. However, this version is an exception that does not show extreme values for the indicator (IDV47) in relation to the others. Cases of language versions with high IDV, in which users are more active (Norwegian, Slovenian and Swedish) are still distributed along with the German language version belonging to their set (Table 3).

Table 3: Mann-Whitney U Test for Author and Editor Activity in Technical Spaces

LANGUAGE VERSIONS	IDV	id	ka	th	fa	vi	pl	cs	de	no	sl	sv	nl
id-Indonesian	5												
ka-Georgian	15	-											
th-Thai	19	←	←										
fa-Persian	23	-	-	-									
vi-Vietnamese	30	-	-	↑	-								
pl-Polish	47	↑	↑	↑	↑	↑							
cs-Czech	70	-	↑	↑	↑	↑	-						
de-German	79	↑	↑	↑	↑	↑	-	-					
no-Norwegian	81	-	-	↑	↑	-	←	-	←				
sl-Slovenian	81	-	-	-	-	-	←	-	←	-			
sv-Swedish	87	-	-	↑	↑	-	←	-	←	-	-		
nl- Dutch	100	-	↑	↑	↑	↑	-	-	-	-	-	-	

User activity in interaction spaces did not show such clear tendencies of dominance of one of the sets as in the case of substantive or technical spaces. In the interaction spaces, no statistically significant differences were confirmed for the Swedish language version. In view of the test results, the Swedish version can be treated as a "typical" version. On one hand, in terms of activity it constitutes the threshold to be reached for collectivist cultures and the lower limit for individualistic cultures. For Norwegian and Vietnamese, one case was shown each. On the other hand both versions give way to the more active Persian version which belongs to a collectivist culture. Compared to users representing different Persian cultures, the language version definitely stood out. For the Persians, 8 advantages were shown: over all versions from their own pool (low IDV) and half of the versions assigned to the individualistic culture (Czech, Norwegian, Slovenian). The Persian version is counterbalanced by the Dutch and German versions with 6 and 5 advantages, respectively, but in their own cultural group (Table 4).

Table 4: Mann-Whitney U Test for Authors and Editor Activity in Interaction Spaces

LANGUAGE VERSIONS	IDV	id	ka	th	fa	vi	pl	cs	de	no	sl	sv	nl
id-Indonesian	5												
ka-Georgian	15	-											
th-Thai	19	-	-										
fa-Persian	23	←	←	←									
vi-Vietnamese	30	-	-	-	↑								
pl-Polish	47	-	-	-	↑	-							
cs-Czech	70	-	←	-	↑	-	-						
de-German	79	←	←	←	-	-	←	-					
no-Norwegian	81	-	-	-	↑	-	-	-	-				
sl-Slovenian	81	-	-	-	↑	-	-	-	↑	-			
sv-Swedish	87	-	-	-	-	-	-	-	-	-	-		
nl- Dutch	100	←	←	←	-	-	←	←	-	-	←	-	

A clear advantage of the activity of authors and editors in the promotion spaces was recorded by the Czech and German versions, defeating in 4 cases representatives of collectivist cultures (Indonesian, Georgian, Vietnamese, Polish) and in 2 cases representatives of their own pool (Norwegian, Slovenian). The versions with the highest IDVs (Swedish and Dutch) dominated the Norwegian and Slovenian versions with slightly lower IDVs. The Polish version of 9 statistically significant differences in no case achieved superiority. Only two versions (Thai and Persian) representing collectivist cultures gained an advantage over the individualist versions: Norwegian and Slovenian (Table 5).

Table 5: Mann-Whitney U Test for Authors' and Editors' Activity in Content Promotion Spaces

LANGUAGE VERSIONS	IDV	id	ka	th	fa	vi	pl	cs	de	no	sl	sv	nl
id-Indonesian	5												
ka-Georgian	15	-											
th-Thai	19	-	-										
fa-Persian	23	-	-	-									
vi-Vietnamese	30	-	-	-	-								
pl-Polish	47	↑	↑	↑	↑	↑							
cs-Czech	70	←	←	-	-	←	←						
de-German	79	←	←	-	-	←	←	-					
no-Norwegian	81	-	-	↑	↑	-	-	↑	↑				
sl-Slovenian	81	-	-	↑	↑	-	-	↑	↑	-			
sv-Swedish	87	-	-	-	-	-	←	-	-	←	←		
nl- Dutch	100	-	-	-	-	-	←	-	-	←	←	-	

The test showed predominant user activity in workspaces for individualistic cultures. Statistically significant differences predicted the favourites of users of two language versions: Dutch and German. Users of the Dutch language version had an advantage over collectivist cultures in 2 cases: Georgian and Indonesian. Other cases of predominance of the Dutch version applied to cultures with high IDV: Czech and Slovenian. The German version had the advantage of greater user activity over 3 versions of its own collection (Slovenian, Norwegian and Czech) and 5 from collectivist cultures (Georgian, Indonesian, Vietnamese, Persian, Thai). As an exception, for the Indonesian version, the test showed a statistically significant difference in distributions compared to all studied language versions except Slovenian. At the same time, the Indonesian version did not gain an advantage in any case (Table 6).

Table 6: Mann-Whitney U Test for Author and Editor Activity in Workspaces

LANGUAGE VERSIONS	IDV	id	ka	th	fa	vi	pl	cs	de	no	sl	sv	nl
id-Indonesian	5												
ka-Georgian	15	←											
th-Thai	19	←	-										
fa-Persian	23	←	-	-									
vi-Vietnamese	30	←	-	-	-								
pl-Polish	47	←	-	-	-	-							
cs-Czech	70	←	-	-	-	-	↑						
de-German	79	←	←	←	←	←	-	←					
no-Norwegian	81	←	-	-	-	-	-	-	↑				
sl-Slovenian	81	-	-	-	-	-	-	-	↑	-			
sv-Swedish	87	←	-	-	-	-	-	-	-	-	-		
nl- Dutch	100	←	←	-	-	-		←	-	-	←	-	

The Mann-Whitney U test confirmed H3, the idea that the distribution of high-quality content creator activity in namespaces was markedly different for each language version in view of the IDV value. In addition, the characteristics of contributors according to categorised forms of activity selected the most and least active among the users of the surveyed language versions of Wikipedia. In the case of the Indonesian version, only once did users gain an advantage, in the technical space (the domain of collectivist cultures) over the German version. The Polish version performed less well against 9 out of 11 language versions, only gaining an advantage over Indonesian and Czech in workspaces. The undeniable favourite in this list is the version of the German Wikipedia, which has only been off the podium podium of the greatest activity in technical spaces. The German version has an overwhelming advantage in the number of active users compared to the other language versions, which suggests that the number of users is a strong indicator. However, in the present study, the characteristics of individual user statistics were used. The overall size of a given version was much less significant. The number of users whose activity was recorded was determined by the frequency of co-authorship in the articles selected.

Therefore, the number of respondents for the 12 language versions varied for each of them, ranging from 23 to 41 users.

5. Discussion and Limitations

It seemed reasonable to assume that high quality was produced primarily by a small group of experts. It did not work for the form of work characteristic of creating the content of Wikipedia articles. The higher number of featured article editors in individualistic cultures may obviously be due to the much higher number of active users overall. However, it should be taken into account that editors of an equal number of articles were compared. Perhaps the reason for such a large difference in the number of editors lies in the greater need to assert one's own individual position in the Wikipedian community, which is attributed to individualistic cultures.

A low or high IDV does not give unambiguous results in relation to the share of featured articles in individual language versions.

The substantive space showed the greatest polarisation of the language versions of Wikipedia in terms of the cultural dimension of individualism vs. collectivism. Activity in substantive spaces is the domain of individualistic cultures. Collections of language versions with high and low IDV in technical spaces, unlike those studied in the case of substantive spaces, are the domain of collectivist cultures. Content promotion spaces remain dominated by individualistic cultures. The results of hypotheses verification are presented in table 7.

Table 7: Results of hypotheses verification

H1 – According to the preferred models of work, the featured articles of language versions with high IDV are created by a small group of people, as opposed to cultures with low IDV.	not confirmed
H2 – The index of individualism in a given culture translates into a higher or lower share of featured articles in particular language versions.	not confirmed
H3 – The distribution of activity of high-quality content creators in namespaces is clearly different for each language version, in view of the IDV value.	confirmed

A characteristic feature of all featured articles, regardless of language version, is the disproportionately large share of individual people in their creation. This study confirms the earlier results of Feldstein (2011), among others. Feldstein pointed out that at the article level, creating a text is more like the traditional creative process of an individual author. Previously, Kittur and Kraut (2008) showed that the quality of an article was positively influenced by the cooperation of a small group of editors, who create an article which is subsequently joined by a larger group. In the present study, the contribution of an outstanding editor for 10 language versions averaged 70-80% of the text. For Indonesian and Norwegian, the figure was over 80%. In the Polish version, on average, 90% of the contribution to the content of the article was made by one user. Therefore, the bottleneck in creating high-quality content in the different language versions of Wikipedia is the involvement of experts. The number of featured articles on a given topic can be a clear indicator of the presence of experts among Wikipedia users.

In the analysis of user activity in individual namespaces, there are individual exceptions to the rule of "superactive" people. Out of nearly 400 cases, 3 "superactive" users were found. If a given user has too many edits (maximum 650,000), the counter is simplified, and there is no preview of activity in individual namespaces.

Creating Wikipedia articles can take a long time. The ability to make changes to articles makes it an ongoing process, although many entries remain unchanged for years. In the case of featured articles, we are dealing with content that can be considered highly comprehensive. The primary difficulty that applies to all people exploring Wikipedia statistics is the collection of data at any given point in time. The data is becoming less relevant day by day. If these are small changes, e.g. in the number of editors of a given article or their contributions, the differences will not be significant. However, when more general data is updated every few months, and in some cases once a year or even at longer intervals, it can have an adverse effect on the reality of the analysis. It is therefore advisable to check the validity of the overall data not only at the beginning but also at the end of the study.

Language versions of Wikipedia sometimes use namespaces in individual ways, for activities that are assigned to other spaces. In addition, each language version can define its own namespaces with no equivalents in other language versions. Of the 12 versions of Wikipedia studied, the Indonesian version is example of this. Indonesian has a Story in its namespaces, which contains catalogues of photos from the phone. Such differences in namespaces require a qualitative study.

6. Conclusions

Statistically, the study showed significant differences in the form of author and editor engagement in creating high-quality articles. One should be cautious about generalising conclusions to cover other versions of Wikipedia. However, the results obtained do provide grounds for concluding that the quality of content depends on Hofstede's cultural indicators. In future research, one may assume that representatives of individualistic cultures are superior to representatives of collectivist cultures in the creating high-quality knowledge.

This paper is an extension of the research on the community involved in the sharing of knowledge on the Internet. The determinants of user activity, resulting in the creation of high-quality content, are presented. It would be advisable to include a qualitative analysis in the quantitative study presented, to highlight the differences in the use of namespaces by individual language versions. Qualitative data would give a more precise definition of the cultural space of representatives of different language versions. This could result in the emergence of a new cultural dimension that would more accurately describe the social reality on the Internet.

References

Alonso, E. and Robinson, B.J. (2016) "Exploring Translators' Expectations of Wikipedia: A Qualitative Review", *Procedia - Social and Behavioral Sciences*, No. 231, pp 114-121.

Feldstein, A. (2011) "Deconstructing Wikipedia: Collaborative Content Creation in an Open Process Platform", *Procedia - Social and Behavioral Sciences*, No. 26, pp 76-84.

Giles, J. (2005) "Internet encyclopaedias go head to head", *Nature*, Vol 438, No. 15, pp 900-901.

Hofstede, G., Hofstede, G.J. and Minkov, M. (2010) *Cultures and Organizations. Software of the Mind. Intercultural Cooperation and Its Importance for Survival*, McGraw-Hill Professional.

https://en.wikipedia.org/wiki/List%5fof%5fWikipedias

https://en.wikipedia.org/wiki/Wikipedia:Compare_criteria_Good_v._Featured_article

https://meta.wikimedia.org/wiki/Wikipedia_featured_articles

Iba, T., Nemoto, K., Peters, B. and Gloor, P.A. (2010) "Analyzing the Creative Editing Behavior of Wikipedia Editors Through Dynamic Social Network Analysis", *Procedia Social and Behavioral Sciences*, No. 2, pp 6441-6456.

Jemielniak, D. (2019) "Wikipedia: Why Is the Common Knowledge Resource Still Neglected by Academics?", *GigaScience*, Vol 8, No. 12, giz139.

Kane, G.C. (2011) "A Multimethod Study of Information Quality in Wiki Collaboration", *ACM Transactions on Management Information Systems* (TMIS), Vol 2, No. 1, pp 1-16.

Kittur, A. and Kraut R.E. (2008) "Harnessing the wisdom of crowds in wikipedia: Quality through coordination", ACM Conference on Computer Supported Cooperative Work, (San Diego), pp 37-46.

Kittur, A., Pendleton, B., and Kraut, R.E. (2009) "Herding the cats: the influence of groups in coordinating peer production", Proceedings of the 5th international Symposium on Wikis and Open Collaboration, pp 1-9.

Konieczny, P. (2021) "The Case for Institutional Support: It's High Time for Governments and University Administration to Actively Support Wikipedia", *The Journal of Design, Economics, and Innovation*, Vol 7, No. 2, pp 187-196.

Kukowska, K. (2022) "Knowledge Sharing Co-operative Structures – The Case of WikiProjects", Proceedings of the 23 nd European Conference on Knowledge Management, Naples, Italy, pp 696-704.

Kukowska, K. (2023) "Collaborative Structures in WikiProjects. Wikipedia Users' Activity Case Study", Matos, F., Rosa A. (eds.), Proceedings of the 24th European Conference on Knowledge Management, Vol 24 No. 1, pp 760-768.

Kukowska, K. and Skolik, S. (2021) "Wikipedia as a Space for Collective and Individualistic Knowledge Sharing", Proceedings of the 22nd European Conference on Knowledge Management, Coventry, United Kingdom, pp 459-466.

Lewoniewski, W., Węcel, K. and Abramowicz, W. (2016) "Quality and Importance of Wikipedia Articles in Different Languages", Proceedings: Information and Software Technologies: 22nd International Conference, Druskininkai, Lithuania, pp 613-624.

Lewoniewski, W., Węcel, K. and Abramowicz, W. (2019) "Multilingual Ranking of Wikipedia Articles with Quality and Popularity Assessment in Different Topics", *Computers*, 8, 60, pp 1-31

Lewoniewski, W., Węcel, K. and Abramowicz, W. (2023) "Understanding the Use of Scientific References in Multilingual Wikipedia across Various Topics", *Procedia Computer Science*, 225, pp 3977-3986.

Mesgari, M., Okoli, Ch., Mehdi, M., Nielsen, F.Å. and Lanamäki, A. (2015) "'The Sum of All Human Knowledge': A Systematic Review of Scholarly Research on the Content of Wikipedia", *Journal of the Association for Information Science and Technology*, Vol 66, No. 2, pp 219-245.

Nemoto, K. and Gloor, P.A. (2011) "Analyzing Cultural Differences in Collaborative Innovation Networks by Analyzing Editing Behavior in Different-Language Wikipedias", *Procedia - Social and Behavioral Sciences*, 26, pp 180-190.

Pfeil, U., Zaphiris, P. and Ang, C. (2006) "Cultural Differences in Collaborative Authoring of Wikipedia", *Journal of Computer-Mediated Communication*, 12, pp 88-113.

Ren, Y., Chen J. and Riedl J. (2016) "The impact and evolution of group diversity in online open collaboration", *Management Science*, Vol 62, No. 6, pp 1668-1686.

Stvilia, B., Al-Faraj A., and Yi, Y. J. (2009) "Issues of cross-contextual information quality evaluation – The case of Arabic, English, and Korean Wikipedias", *Library & Information Science Research*, Vol 31, No. 4, pp 232-239.

Szajt, M. (2014) *Przestrzeń w badaniach ekonomicznych*, SWWZPCz, Częstochowa.

Zhang, H., Ren, Y. and Kraut R.E. (2020) "Mining and Predicting Temporal Patterns in the Quality Evolution of Wikipedia Articles", Proceedings of the 53rd Hawaii International Conference on System Sciences, pp 3971- 3980.

Fostering Innovation Through Technology-Enhanced Learning Spaces: A Multiple Case Study

Rosaria Lagrutta[1], Daniela Carlucci[1], Francesco Santarsiero[1], Giovanni Schiuma[2] and Antonio Lerro[1]

[1]University of Basilicata, Potenza, Italy

[2]LUM University, Casamassima (BA), Italy

Rosaria.lagrutta@unibas.it
Daniela.carlucci@unibas.it
Francesco.santarsiero@unibas.it
Schiuma@lum.it
Antonio.Lerro@unibas.it

Abstract: The current business landscape is characterised by complexity and uncertainty, provoked by rapid technological advancements and interconnected macro trends that pose challenges and opportunities for organisations. In this scenario, spaces for learning and knowledge exchange, enhanced by advanced technologies, emerged as pivotal settings to foster innovation dynamics. Specifically, technology-enhanced learning spaces (TELS) are considered physical, virtual, or hybrid settings that support learning and knowledge processes. However, despite the growing interest, there is still a need for a broader understanding of how to effectively design and manage these spaces to maximise their potential in driving organisational innovation capacity. Accordingly, this study aims to address the aforementioned gap by conducting a comprehensive examination of TELS, focusing on their design, management, and influence on innovation dynamics. To achieve this purpose, the study adopts a multi-case study approach and analyses some TELSs across different organisational settings, such as public institutions, business accelerators and private organisations. Data triangulation of theoretical and empirical investigations are employed to derive key patterns and management phases. The findings reveal that TELS are crucial in promoting innovation and knowledge exchange within organisations. They foster collaboration, experiential learning, and personalized exploration, empowering organisations to generate innovative solutions, driving progress. However, several barriers hinder their optimal utilization, including technological limitations and a lack of effective management strategies. Accordingly, this paper proposes a technology-enhanced learning space management framework that distinguishes key phases for managing those spaces, with the aim of enhancing innovation capacity. Theoretical implications include validating and refining existing conceptual and theoretical frameworks related to TELS, testing them in real life settings. Practically, the study offers a framework and insights for managers to enhance the design and management of these spaces, addressing critical issues and maximizing their impact on organizational innovation and performance.

Keywords: Technology-Enhanced Learning Spaces, Management Framework, Advanced Technologies, Innovation, Multiple Case Study.

1. Introduction

In today's dynamic business landscape, organisations are confronted with a multitude of challenges driven by rapid technological advancements and intertwined macro trends. This has created an environment characterised by complexity and uncertainty. In response, organisations increasingly recognise the need to support and strengthen their learning capacity as a strategic imperative. At the heart of this imperative is the drive to innovate, a vital force that underpins organisational survival, competitiveness, and sustained growth (Hamidi et al., 2019). The ability to innovate, which involves generating and implementing novel ideas, products, or processes, is then intricately linked to learning and knowledge processes (Nonaka & Takeuchi, 2019; Hamidi et al., 2019). Learning and knowledge processes and dynamics form the foundation for cultivating capabilities that are essential for navigating the contemporary business landscape (Yildiz et al., 2021). In this vein, learning spaces, encompassing physical, virtual, social, and cultural dimensions, serve as fertile ground for nurturing innovation and driving organisational success (Morris, 2020; Hamidi et al., 2019). However, the evolution of these spaces has been significantly influenced by various factors, including a shift towards learner-centric approaches and the integration of innovative digital tools (Karam et al., 2021). The COVID-19 pandemic, for instance, has acted as a catalyst, accelerating the transformation of learning spaces into technology-enhanced learning spaces (TELS) to meet new challenges and fully leverage digital technologies for learning and knowledge exchange and dissemination (Lagrutta, 2023; Krishnamurthy, 2020).

This transformation, while challenging, holds the potential to inspire innovation and drive organisational success.

A deep understanding of TELS' diverse applications and contextualisation necessitates delineating the tangible and intangible dimensions that impact learning and knowledge dynamics. As a result, the literature review has generated a working definition of technology-enhanced learning spaces (TELS) and a conceptual framework summarising critical dimensions for design and functionality (Lagrutta et al., 2023). Yet, the management processes deserve deeper analysis to define and distinguish the management phases. While recent contributions have predominantly focused on specific management tools, software, or underlying logic unique to distinct learning spaces, the need persists for generalisable and distinctive phases (Al-Khanjari, 2021; Schobel & Scholey, 2012). Nonetheless, heightened attention towards the topic and its associated issues is evident because modern configurations of TELS, necessitating a comprehensive approach to management that necessitates consideration of all structural and dynamic dimensions, understanding their interplay, and their influence on the inclusion and utilisation of both basic and advanced technologies (Lagrutta et al., 2023).

In line with this research's objectives, it is essential to gain a deep understanding of the managerial phases of TELS that aim to drive innovation dynamics.

This study aims to fill this gap by answering to the following research question: "How can organisations effectively design and manage TELS to foster innovation?" This question holds theoretical and practical implications for organisations seeking to enhance their learning capacity and innovation potential.

To comprehensively address this question, the study aims to enrich insights from the literature and develop a management framework through an empirical approach that can serve as a valuable resource for academics and practitioners in creating and effectively managing such spaces. Given the novelty and the fragmented literature results in the management field, a shift towards empirical research is not only warranted but also crucial (Lagrutta et al., 2023). This approach will facilitate a clearer understanding of the phenomenon within the management context, contributing to the existing body of knowledge (Reyes-Mercado, 2022; Pawlowsky et al., 2020).

To achieve this, the analysis first validates theoretical patterns and insights derived from the literature before adopting an inductive approach to develop a managerial framework.

In this vein, the study adopts a multi-case study approach, focusing on TELS developed across diverse organisational settings in Finland and Italy, all aimed at fostering innovation pathways in alignment with the research. Through a rigorous examination of these cases, the research aims to unearth the dimensions and management phases that differentiate effective TELS in nurturing innovation capacity.

The structure of this paper is as follows: after this introduction, the paper provides a comprehensive theoretical background on the concept of TELS and its evolution, particularly in management literature, derived from an extensive literature review. The methodology section outlines the multiple case study approach employed in this research. Then, the findings of the multiple case study are presented.

Finally, the paper concludes with a discussion of the theoretical and practical implications of the findings, highlighting the unique contribution of this research to the field of TELS management and offering directions for future research.

2. Theoretical Background

Organisations must embrace innovation as a fundamental driver of survival, growth and success to thrive in today's rapidly changing business landscape. However, in this digital Era, innovation takes on a broader perspective, fueled by advanced technologies of Industry 4.0 and 5.0. However, the innovation process goes beyond merely adopting advanced technologies but it encompasses embracing digital transformation and organisational change, fueling mindsets and approaches that foster creativity, adaptability, and dynamic problem-solving. Essentially, it is about continuously seeking new ways to add value to products, services, and processes (Scuotto et al., 2023; Hamidi et al., 2019). In a world where disruptive technologies and market forces constantly reshape industries, organisations that fail to innovate risk falling behind their competitors and becoming obsolete.

This requires agility and adaptability to keep pace with rapid change and emerging trends. Here, knowledge plays a pivotal role. It is not just a byproduct of innovation; it is a catalyst. In fact, effective knowledge management is essential for any organization to adapt to changing market dynamics, drive long-term growth, and maintain a competitive edge in today's digital Era. By implementing systematic efforts to expand personal knowledge and facilitating the creation, dissemination, transfer, and storage of knowledge within and outside

the organization, businesses can foster a culture of innovation and enhance their innovation capacity. This, in turn, promotes an environment that stimulates innovativeness and innovation climate within the organization, ultimately leading to successful innovation (Yildiz et al., 2021; Nonaka & Takeuchi, 2019).

Consequently, to support innovation processes in the digital age, organisations must focus on enhancing knowledge management, fostering a learning culture, and creating spaces that enable innovation and knowledge sharing.

In this scenario, learning spaces have emerged as crucial environments for fostering knowledge dynamics and promoting innovation within organisations, both in the public and private sectors (Csizmadia et al., 2022).

The evolution of learning spaces is a transformative journey influenced by technological advancements, pedagogical theories, and societal needs. Traditionally, learning spaces were confined to physical classrooms with rows of desks facing the teacher, fostering a passive learning environment. However, with the emergence of digital technologies and evolving educational philosophies, the concept of learning spaces has undergone a profound transformation.

Flexible learning spaces (e.g. maker spaces and innovation labs), for example, provide learners with opportunities for hands-on experimentation, creativity, and interdisciplinary collaboration (Lee and Tan, 2022)

Moreover, the proliferation of basic and advanced digital technologies profoundly changes learning spaces' design, functioning and management. In this vein, the technological revolution paved the way for the creation of technology-enhanced learning space (TELS), where learners could engage with content and interact with peers and instructors in virtual or physical spaces, supported by basic and advanced technologies.

It follows that a TELS is *"the physical, virtual and hybrid space, of formal or informal nature, characterised by action and interactions among different actors and their capabilities, which promotes cognitive processes and influences knowledge and learning dynamics, through its tangible and intangible components and with a strong technological component"* (Lagrutta et al., 2023).

Against this backdrop of evolution and transformation TELS have emerged as dynamic and multifaceted environments that integrate physical, virtual, social, and organisational dimensions. By understanding and managing the various dimensions of learning spaces, organisations can create innovative environments that support continuous learning and adaptation. TELS encompasses tangible and intangible dimensions facilitating knowledge creation and learning dynamics (Delgado et al., 2020). A critical analysis of the literature reveals several distinguishing dimensions of learning spaces, including actors, settings, technologies, relationships, and organisational culture (Khandelwal et al., 2022; Illeris, 2004). These dimensions are interrelated and complement each other, contributing to the overall effectiveness of the learning environment (Mulligan, S. 2016). These dimensions are presented in Fig. 1 and discussed in the following. Each dimension offers unique insights into learning spaces' design, implementation, and functioning, reflecting the interconnectedness of diverse dimensions.

2.1 Actors

At the heart of TELS are those who participate in the learning process, including learners, instructors, facilitators, mentors, administrators, and other stakeholders. The diverse roles and perspectives of these actors contribute to the richness and complexity of the learning environment, shaping interactions, collaboration, and knowledge exchange (Lee and Tan, 2023; Lancaster and Milia, 2015).

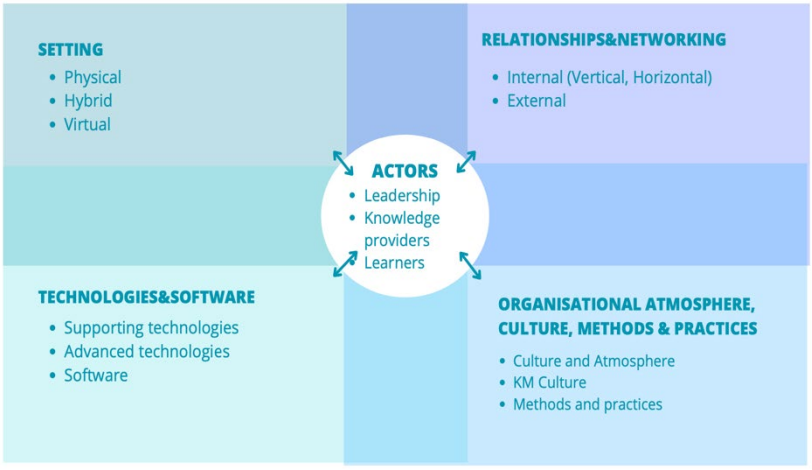


Figure 1: TELS Conceptual framework

2.2 Setting

A TELS's setting encompasses physical and virtual elements that provide the context for learning activities. Physical settings include classrooms, laboratories, workplaces and collaborative spaces designed to facilitate face-to-face interactions and hands-on experiences. Virtual settings encompass online platforms, digital resources, and interactive tools that support remote learning, collaboration, and access to information (Jens and Gregg, 2022).

2.3 Technologies and Software

Technology is central to TELS, enabling access to contents and resources, facilitating communication and collaboration, and enhancing the learning experience. Basic technologies such as computers, tablets, and projectors provide essential content delivery and interaction tools. Advanced technologies, including artificial intelligence, augmented reality, and simulation tools, offer innovative approaches to personalised learning, adaptive feedback, and immersive experiences (Lee and Tan, 2022; Reyes-Mercado et al., 2022)

2.4 Relationships and Networking

Learning is inherently social, and relationships between learners, instructors, and peers play a crucial role in shaping the learning experience. Positive relationships foster collaboration, knowledge sharing, and a sense of community within TELS (Abuhassna et al., 2022). Networking extends beyond immediate interactions to include broader connections and collaborations that enable access to diverse perspectives, expertise, and resources (Ching Lee and Yian Tan, 2022; Müller and Wulf, 2022).

2.5 Organisational Atmosphere, Culture, Methods and Practices

The organisational context significantly influences TELS's design, implementation, and outcomes. Atmosphere refers to the learning space's overall climate and culture which can impact motivation, engagement, and satisfaction. Organisational culture encompasses shared values, beliefs, and norms that shape behaviours and interactions within the organisation. Methods and practices encompass instructional strategies, pedagogical approaches, and assessment methods that guide teaching and learning activities within TELS (Lee and Tan, 2023; Lazzari, 2023)

3. Research Methodology

From a methodological point of view, according to the aim of the study, a multiple case study approach (Yin, 2009) has been rigorously elaborated and developed to provide empirical insights supporting the evidence emerging from the above proposed conceptual model.

Generally, a qualitative management research allows to capture intangible factors that create higher value for the literature. Furthermore, according to Yin (2009; 2013), the conducted case studies aim to gather valuable insights, through literal replication of real-life situations and allow cross-comparisons between different realities

by identifying and defining critical learning points related to the fields of analysis that will result in helpful empirical guidelines for both scholars and practitioners. At its core, the multiple case study approach is a qualitative research methodology aimed at generating and testing theory, particularly in management, when dealing with broad, undefined concepts. It allows for the exploration of complex phenomena within their natural contexts and facilitates the discovery of new variables and insights (Yin, 2009; 2013).

To develop the study, careful consideration was given to ensuring a diverse and representative sample of cases encompassing various geographical locations, organizational settings, and types of TELS.

Then, data collection involved a multifaceted and iterative approach, incorporating both primary and secondary sources to ensure the findings' reliability, validity, and comprehensiveness. Document analysis, participant observation, and in-depth semi-structured interviews with key stakeholders, such as space managers, practitioners, and users, were conducted over an extended research period.

All the interviews were recorded and transcribed. This allowed to have a reliable information base that perfectly reflected the interviewees' thoughts and follows requirements to ensure rigour and validity

The data analysis process was rigorous and systematic, involving the identification of emerging patterns, themes, and relationships within each case. Data were organised, coded, and analysed using qualitative analysis software (e.g., NVivo), allowing for efficient management and synthesis of large volumes of data.

The findings derived from the data analysis were used to validate, refine, and extend existing conceptual framework (figure 1) and develop new insights and conceptual models' specific to the management of TELS for innovation. The study's outcomes aim to contribute to both academic knowledge and practical applications in innovation management, organisational development, and learning.

The selection of nine TELS for innovation, spanning across Finland and Italy, was strategically chosen and each learning space, denoted as Tx, Hx, Dx, Kx, Ax, Cx, Digx, Dihx, and Ox (names changed for confidentiality reasons), was carefully curated to represent diverse perspectives and approaches to fostering innovation dynamics and capacity. The choice of this sample is indeed focused on TELS, which aims to promote innovation dynamics and capacity, providing different perspectives of innovation that are stressed in the following. Moreover, the selection of the cases aims to provide insights into different organisational contexts and approaches to innovation management. This diversity ensures a comprehensive analysis and a nuanced understanding of the processes and dimensions characterising real learning spaces for innovation.

Some of the learning spaces in this multiple case study, in particular, aim to support the development of new ideas and solutions, and thus are involved with startup and entrepreneurial ecosystems; others aim to support individuals and organisations on the path of digital innovation, while others aim to strengthen networking and social innovation. In consequence, these TELS serve various purposes, ranging from digital literacy and social innovation to supporting organisations' digital transformation journey. Despite the diversity in their objectives, these learning spaces share a common goal: to facilitate innovation, knowledge exchange, and collaboration within their respective ecosystems. They act as facilitators, offering a range of initiatives, courses, activities, and consultancy services to guide individuals and companies along their innovation journeys.
Overall, the chosen cases offer a rich and diverse dataset, allowing for cross-comparison and in-depth exploration of the design, functioning, and management aspects of learning spaces for innovation. While existing literature has made some attempts to address this issue, much of it is focused on educational learning environments geared towards facilitating the acquisition of knowledge and skills by students. In contrast, this study seeks to delve into the specific management dynamics of TELS aimed at fostering innovation.

The comparative analysis supports the identification of distinct phases in the management process of TELS for innovation, ultimately leading to the development of a management framework.

4. Findings

The study investigates various TELS for innovation across different contexts, outlining their management strategies, activities, and impacts. Here is a summary of the key findings from each case:

Table 1: Summary of key findings of each case

Tx	It is a community space supported by public financing that aims to connect actors in the startup and innovation ecosystem. It organises events, courses, and networking opportunities. Challenges include assessing long-term impacts and effectiveness, and plans are in place to develop better assessment metrics.
Hx	Situated within a university, Hx fosters entrepreneurial expertise through tailored methodologies like Innovation Challenges and Sprint Innovation Festival. Communication, community development, and continuous feedback are prioritised, alongside integrating technology into the learning process.
Dx	A leading co-creation space focusing on transformative dynamics, Dx brings together professionals, researchers, and facilitators to address high-risk challenges. Their strategy involves understanding diverse motivations, implementing digital technologies, and lean management practices, emphasising co-creation and partnerships.
Kx	This space facilitates collaboration and networking between industries and universities, offering innovative workplaces and co-working labs. It emphasises concrete outcomes, such as new projects and collaborations, and utilises technology to support communication and project organisation.
Ax	Originating from a regional grant, Ax is a diffused learning space for digital innovation, offering courses, seminars, and co-working spaces. Their management approach involves bottom-up and top-down planning, continuous adaptation, and collaboration with associations and local businesses.
Cx	A multi-functional learning space, Cx focuses on sustainable entrepreneurship and offers events, workshops, and creative labs. They sustain their initiatives through a mix of private funding and public calls, engaging learners through tailored events and technology-driven initiatives.
Digx	Dedicated to disseminating digital culture and innovation, Digx operates across small towns, fostering social innovation through activities like hackathons and workshops. Their management approach emphasises joint planning, engagement with young people, and collaboration with local associations.
Dihx	Dihx supports SMEs in digital transformation and offers consultancy, training, and prototyping services. Its management practices involve lean and agile methodologies, community development, and integrating advanced technologies like AI and big data.
Ox	A public-driven space for innovation, Ox focuses on community engagement and developing digital and entrepreneurial skills. It emphasises interaction with the territory, offering diverse activities like training paths, hackathons, and co-creation projects. Ox plans to assess long-term impacts more comprehensively.

Overall, these cases demonstrate diverse approaches to managing TELS for innovation, highlighting the importance of community engagement, strategic planning, continuous feedback, and leveraging technology to drive impactful outcomes.

One pivotal finding of this study emphasises the multifaceted nature of TELS management, which extends far beyond the confines of educational pedagogy. It was revealed that effective TELS management necessitates navigating through a myriad of contextual landscapes, considering legal, institutional, political, economic, and social dimensions, both at local and global scales. This contextual analysis serves as the foundation upon which strategic decision-making is built, empowering TELS leaders to identify and face challenges and barriers while capitalising on emerging opportunities. Moreover, the study revealed a diverse spectrum of financing models employed by TELS, ranging from profit-driven private initiatives to collaborative ventures with public entities and academic institutions. This diversity accentuates the adaptive nature of TELS management, which is finely attuned to each space's unique needs and aspirations.

Community engagement emerged as a pivotal phase in the management of TELS, serving as a conduit for co-creating value propositions intricately aligned with learners' evolving needs and the broader societal landscape. Whether driven by specific demands articulated by learners or broader imperatives identified within the community, TELS leaders engage in co-creation and co-design activities to define strategic intentions and chart a course of action. This bottom-up approach ensures a degree of flexibility and adaptability essential for TELS to evolve in tandem with the dynamic demands of the innovation ecosystem, allowing them to remain relevant and impactful. Consequently, by adapting to local needs and involving community members in the decision-making process, TELS adopt collaborative and inclusive approach to innovation fosters a dynamic environment where continuous learning and adaptation drive sustained development and success. Central to TELS operations and to their continuous connections and interactions with the surrounding territories, lays the concept of open innovation, which emphasizes the integration of manifold perspectives. In this context, the creation and development of communities is critical and necessary. Initial actions, in fact, aim to engage individuals, considering inputs from various stakeholders to shape the definition of the value proposition, through open innovation principles.

The planning phase of TELS management revolves around the formation of strategic partnerships, judicious allocation of resources, and integration of cutting-edge technologies. Despite the transformative potential of

advanced technologies in enriching learning processes, challenges persist in their effective implementation and in assessing their tangible impact. Nevertheless, TELS leaders remain buoyantly optimistic about integrating these technologies into their spaces, particularly in light of the seismic shifts precipitated by the global pandemic, which prompted an accelerated adoption of hybrid learning models.

TELS foster innovation-friendly environments by adopting active methodologies and knowledge-sharing initiatives to nurture a culture of creativity and collaboration. Community development emerges as a transversal activity, facilitating continuous engagement and collaboration among internal stakeholders as well as external partners. Moreover, TELS prioritise the principles of privacy, accessibility, and inclusivity, particularly in the context of leveraging emerging technologies, to ensure a safe, equitable, and empowering learning environment for all participants.

Continuous monitoring and evaluation emerged as the basis of effective TELS management, allowing iterative improvements and data-driven decision-making. response, a proposed management model distilled recurring processes into distinctive phases, offering a comprehensive framework for planning and managing TELS effectively.

5. Discussion: TELS Management Framework

Following the comparative analysis of the case studies, a framework to manage TELS for innovation is presented (figure 2) The management framework for TELS for innovation, presented in figure 2, consists of three sequential phases: Define, Cultivate, and Collect, along with two transversal phases: Analyse and Involve, and include.

5.1 Define Phase

In this phase, the value proposition and objectives are defined based on a shared vision. Planning includes top-down or bottom-up approaches to goal-setting, defining core activities, strategic resources (primarily technological), and budget planning.

5.2 Cultivate Phase

Once optimal conditions and objectives are set, this phase focuses on executing core activities tailored to the goals, target audience, and available resources. Knowledge and learning dynamics are activated through specific methodologies and activities, facilitated by knowledge providers. The space should support innovation dynamics through adaptable settings, stable technology infrastructure, and activities fostering high-quality relationships and innovation.

5.3 Collect Phase

This phase involves gathering reflections and assessing outcomes and impacts achieved. Activity results are compared with initial aims to identify insights for learning and developing innovation activities and strategies. This phase initiates continuous improvement cycles, guiding organisations in ongoing innovation processes to remain competitive in an evolving environment.

Additionally, two transversal phases run through the framework:

5.4 Analyse Phase

This phase addresses social, legal, and political barriers, seeks economic opportunities, and identifies territorial needs through context analysis and continuous monitoring activities.

5.5 Involve & Include Phase

This phase focuses on communication activities and dynamics to facilitate the development of quality relationships and the creation of an innovative community, in line with the principles of open innovation. It emphasises overcoming privacy, accessibility, and inclusivity concerns and building valuable external partnerships with stakeholders.

Figure 2: TELS Management Framework

Overall, this framework provides a structured approach for managing technology-enhanced learning spaces for innovation, guiding organisations through goal-setting, execution, assessment, and continuous improvement processes.

6. Conclusion

Today's business landscape is complex and uncertain due to rapid technological advancements and interconnected macro trends and continuous innovation is the key to organizational survival, competitiveness, and sustained growth (Hamidi et al., 2019). The ability to innovate is intricately linked to learning and knowledge processes (Nonaka & Takeuchi, 2019; Hamidi et al., 2019). Learning and knowledge processes and dynamics form the foundation for cultivating capabilities that are essential for navigating the contemporary business landscape (Yildiz et al., 2021). Therefore, TELS play a crucial role in driving innovation within organisations in the contemporary business landscape. The evolution of learning spaces has been significantly influenced by various factors, including a shift towards learner-centric approaches and the integration of innovative digital tools. The COVID-19 pandemic has also acted as a catalyst, accelerating the transformation of learning spaces into technology-enhanced learning spaces (TELS) to meet new challenges and leverage digital technologies for learning and knowledge exchange and dissemination.

Following these trends, a working definition of TELS and a conceptual framework summarising critical dimensions for design and functionality has been presented. However, the management and assessment processes require deeper analysis to define and distinguish the management phases. In consequence, the RQ driving this study is: "*How can organisations effectively design and manage TELS to foster innovation?*"

To answer this RQ, a management framework for TELS for innovation has been developed through an empirical approach (i.e. multiple case studies).

Overall, the study highlights the importance of effective TELS design and management to foster innovation and enhance an organisation's learning capacity. The multiple case study approach provides insights into the dimensions and features that differentiate effective TELS in nurturing innovation capacity, which can have practical implications for organisations seeking to drive innovation and remain competitive in the contemporary business landscape.

The research provides both theoretical and practical implications. In terms of theoretical implications, the paper provides findings that enrich the existing knowledge concerning TELS in management literature and allows the development of effective and impactful guidelines for management and decision-making and to support the continuous improvement of the specific spaces. Theoretical implications include also validation and refinement of existing conceptual and theoretical frameworks related to TELS, testing them in real life settings.

On the other hand, in terms of managerial and policy implications, the management framework can be helpful to different actors aimed at developing effective TELS to foster the innovation capacity of public and private organizations. Specifically, the analysis empirically investigates the management aspects of TELS designed to promote innovation. The framework may serve as a valuable resource for academics and practitioners in creating and effectively managing TELSs.

The study's main limitation is the lack of a deep analysis of the TELS's impacts on short— and long-run outcomes. Specifically, the analysis highlights the lack of effective assessment methodologies, prompting a need to develop

more robust evaluation frameworks capable of capturing the long-term impacts of innovation.

The limitations represent opportunities for future research in order to reinforce the conceptual framework, the findings' generalizability as well as to collect more pieces of evidence and further rigorous and valid insights to derive guidelines from assessing effective TELS for innovation capacity.

Acknowledgment

This work was granted by Next Generation UE - PNRR Tech4You Project fundsassigned to Basilicata University (PP4.2.2 -SDI for Tourism ecosystems innovation and development based on cultural heritage. Scientific Coordinator prof. Daniela Carlucci; Innovation Lab; Responsible: prof. Antonio Lerro)

References

Abdalina, L., Bulatova, E., Gosteva, S., Kunakovskaya, L., & Frolova, O. (2022). Professional development of teachers in the context of the lifelong learning model: The role of modern technologies. *World Journal on Educational Technology: Current Issues*, Vol. *14* No. 1, pp. 117 – 134.

Abuhassna, H., Busalim, A. H., Mamman, B., Yahaya, N., Za. aria, M. A. Z. M., Al-Maatouk, Q., & Awae, F. (2022). From Student's Experience: Does E-learning Course Structure Influenced by learner's Prior Experience, Background Knowledge, Autonomy, and Dialogue. *Contemporary Educational Technology*, Vol. *14* No. 1.

Al-Khanjari, Z., & Al-Kindi, I. (2021). Proposing A Systematic Framework for SQU-Smart Learning Management System (SQU-SLMS). International Journal of Computing and Digital Systems, Vol. 10, pp. 1-13.

Csizmadia, P., Csillag, S., Szászvári, K. Á., & Bácsi, K. (2022). To learn and let learn? Characteristics of the learning environment in knowledge-intensive medium-sized enterprises. *Journal of Workplace Learning*, Vol. *34* No.7, pp. 661 – 674.

Delgado, L., Galvez, D., Hassan, A., Palominos, P., & Morel, L. (2020). Innovation spaces in universities: Support for collaborative learning. *Journal of Innovation Economics Management*, Vol. 1, pp. 123-153.

Diaz Tito, L. P., Tito Cárdenas, J. V., Garcia Curo, G., & Boy Barreto, A. M. (2021). Artificial intelligence applied to the education sector | Inteligencia artificial aplicada al sector educativo. *Revista Venezolana de Gerencia*, Vol. *26* No.96, pp. 1189–1200.

Hamidi, S., Zandiatashbar, A., & Bonakdar, A. (2019). The relationship between regional compactness and regional innovation capacity (RIC): Empirical evidence from a national study. *Technological Forecasting and Social Change*, Vol. *142*, pp. 394-402.

Jens, K., & Gregg, J. S. (2022). Building performances in open and enclosed spaces: a method for balancing operational costs and space utilization with a focus on user needs and satisfaction. Architectural Engineering and Design Management, 18(2), 149 – 164.

Karam, M., Fares, H., and Al-Majeed, S. (2021). "Quality Assurance Framework for the Design and Delivery of Virtual Real-Time Courses", Information, Vol. 12, No. 2.

Krishnamurthy, S. (2020). The future of business education: A commentary in the shadow of the Covid-19 pandemic. *Journal of business research*, *117*, 1-5.

Lagrutta, R., Carlucci, D., Santarsiero, F., Schiuma, G., & Lerro, A. (2023, September). Distinguishing the Dimensions of Learning Spaces: A Systematic Literature Review. In European Conference on Knowledge Management (Vol. 24, No. 1, pp. 769-778).

Lancaster, S., & Di Milia, L. (2015). Developing a supportive learning environment in a newly formed organisation. *Journal of Workplace Learning*, *27*(6), 442-456.

Lazzari, E. (2023). Flipped learning and affect in mathematics: Results of an initial narrative analysis. European Journal of Science and Mathematics Education, 11(1), 77 – 88.

Lee, W. C., & Tan, B. C. Y. (2023). "Workplace learning strategies, enablers, and challenges in the context of digital innovation." Journal of Workplace Learning, Vol. 35, No. 2, pp. 192-209.

Morris, T. H. (2020). "Experiential learning–a systematic review and revision of Kolb's model.", Interactive Learning Environments, Vol. 28, No. 8, pp. 1064-1077.

Nonaka, I., & Takeuchi, H. (2019). *The wise company: How companies create continuous innovation*. Oxford University Press.

Pawlowsky, Peter, Nina S. Pflugfelder, and Maik H. Wagner. (2021). "The ISO 30401 knowledge management systems standard–a new framework for value creation and research?" *Journal of Intellectual Capital*.

Reyes-Mercado, P., Barajas-Portas, K., Kasuma, J., Almonacid-Duran, M., & Zamacona-Aboumrad, G. A. (2022). Adoption of digital learning environments during the COVID-19 pandemic: merging technology readiness index and UTAUT model. *Journal of International Education in Business*, *16*(1), 91-114.

Sankari, I., Peltokorpi, A. Nenonen, S. (2018), "A call for co-working - users' expectations regarding learning spaces in higher education", Journal of Corporate Real Estate

Sasson, I., Yehuda, I., & Miedijensky, S. (2021). "Innovative learning spaces: class management and universal design for learning" in *Learning Environments Research*, pp. 1-15.

Schobel, K., & Scholey, C. (2012). Balanced Scorecards in education: Focusing on financial strategies. *Measuring Business Excellence*, Vol. *16* No.3, pp. 17 – 28.

Yildiz, H. E., Murtic, A., Klofsten, M., Zander, U., & Richtner, A. (2021). Individual and contextual determinants of innovation performance: A micro-foundations perspective. *Technovation*, Vol. *99*, pp. 102130.

Capturing and Transferring Lessons Learned for Risk Reduction: NASA's Phase 1 Program

David M. Lengyel
The George Washington University Washington, DC, USA

dmlengyel@icloud.com

Abstract: The National Aeronautics and Space Administration (NASA) and the Russian Space Agency (RSA) conducted the Phase 1 (Shuttle-Mir) Program from 1993 through 1998. The joint manifest of this cooperative effort consisted of Russian Soyuz (crew) flights, Progress (cargo) flights, Russian science module flights (Spektr and Priroda), U.S. space shuttle docking missions, and nine long duration missions aboard Russia's Mir space station by U.S. astronauts. The purpose of the program was to establish and create a cooperative technical, operational and managerial experience base between Russia and the United States to reduce risks associated with the assembly, operations, science and logistical support of the International Space Station (ISS). In this paper we take a retrospective look at the extensive capture of lessons learned—gained from Phase 1 and transferred to the ISS program (ISSP)—and how this effort served to mitigate risk.

Key Words: Lessons Learned, Risk Reduction, Knowledge Capture and Transfer

1. The Past is Prologue

The Phase 1Program was rooted in the history of U.S. and Soviet human spaceflight collaboration. While the 1960s were a largely a period of a superpower competition, détente arguably began with the Nuclear Non-Proliferation Treaty (1968) and continued throughout the 1970s. In 1972, discussions began between the two parties on in-space rescue modalities and the docking interfaces required to accomplish such a mission. Uri (2022) notes that the 1972 Agreement Concerning Cooperation in the Exploration and Use of Outer Space for Peaceful Purposes between President Nixon and Premier Kosygin laid the groundwork for what would become the Apollo-Soyuz Test Project (ASTP) in 1975. In the aftermath of ASTP, joint discussions were held regarding "the objectives, feasibility, and means of carrying out a joint experimental program using the Soyuz/Salyut [space station] and Shuttle [still in development] spacecraft" to take place in the 1981 timeframe (OTA, 1985). However, several geopolitical and military events, including the Soviet invasion of Afghanistan in 1979, terminated these plans. It would be almost two decades before the subject would be revisited. Fortunately, the institutional memory as well as the means of organizing joint spaceflight operations between the U.S. and Russia was still available in both countries in the early 1990s.

2. Phase 1 Background

In early 1993, Vice President Al Gore and Russian Prime Minister Viktor Chernomyrdin signed the *Gore-Chernomyrdin Commission* agreement. One of the elements of this agreement envisioned a single long-duration mission aboard Mir by a NASA astronaut, along with a single docking mission by the space shuttle to Mir. Beyond that, NASA, the Russian Space Agency (RSA) and Rocket and Space Corporation Energia (RSC-E) were in early discussions to use the Soyuz-T spacecraft as an assured crew return vehicle (ACRV) for the ISS. The reliable Soyuz had been used as a crew transportation system since 1977 to Russia's six Salyut space stations, as well as the Mir (Portree 1993).

These cooperative activities proceeded with the Clinton administration's Office of Science and Technology Policy (OSTP) in full support. NASA and RSA signed a contract for $400M: $335M for additional NASA astronaut long duration flights to Mir and $65M for early ISS hardware (Phase 2). As Cline (2002) notes, "Russia's motivations to join the program are perhaps the most complex of all the [international] partners...the station could bring Russia into the "free world" and at the same time help the partners with its years of experience in space." This rapprochement was reminiscent of the diplomatic efforts leading to the Apollo-Soyuz Test Project (ASTP) some 23 years earlier at the height of the Cold War. Through Viet Nam, Bosnia-Kosovo, Gulf Wars I and II, and the Ukraine-Russia conflict, cooperation in space seemingly transcends diplomatic relations on Earth.

In June of 1995, space shuttle Atlantis, on mission STS-71 (the 69th shuttle flight), docked with the Mir space station for the first time. Two cosmonauts were ferried to Mir while NASA astronaut Norm Thagard was returned to Earth on the shuttle. At the time, NASA had 14 years of operational space shuttle experience and only 24 weeks of operational space station (Skylab) experience. In 1994-1995, NASA ISS personnel were reflecting on lessons from space station analogs (e.g., nuclear ballistic missile submarines, Antarctic scientific expeditions, etc.) in an effort to glean engineering design, human factors, and operational lessons for application to the ISS.

From 1995 to 1998, NASA had use of the Mir, an actual working laboratory in space, as well as a cadre of Russian managers, engineers, scientists, flight and ground operations personnel, cosmonauts, and physicians to learn from.

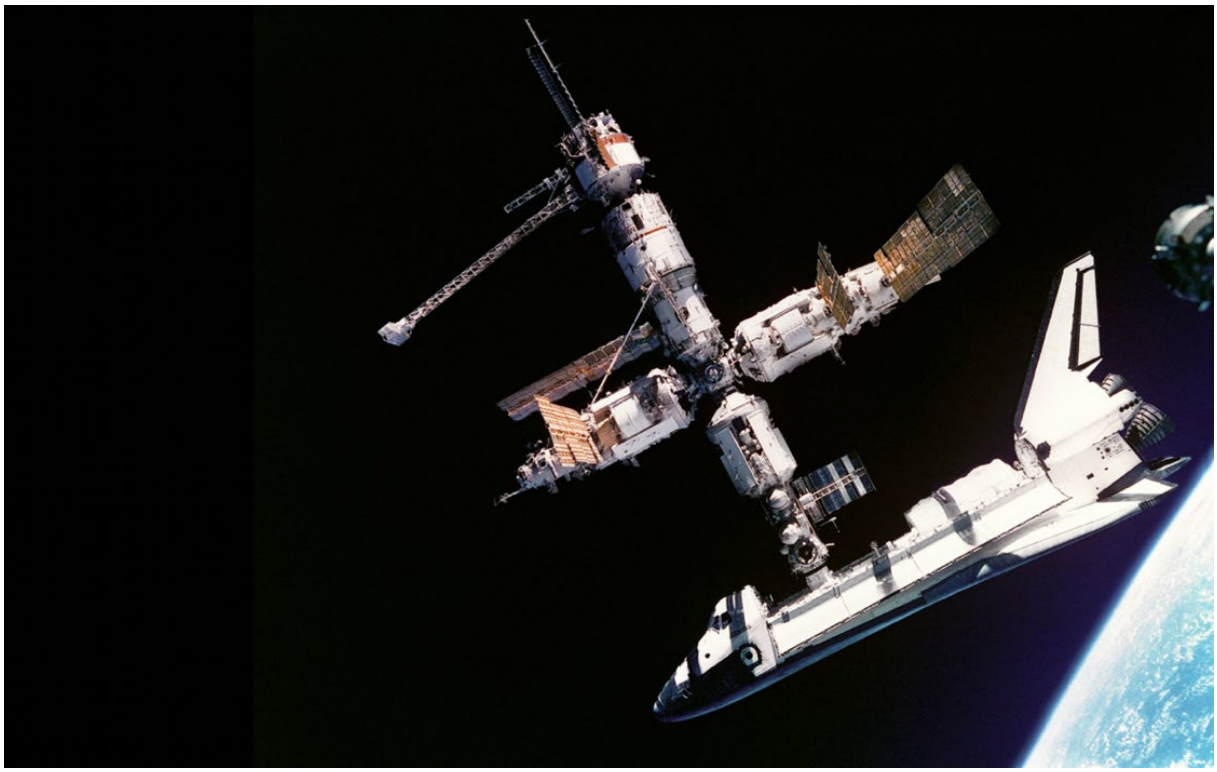


Figure 1: Space Shuttle Atlantis Shuttle Docked to Mir (Credit: NASA)

3. Risk Reduction

As the first phase of the ISS, the Shuttle-Mir Program was a risk reduction effort between NASA and RSA designed to increase the likelihood for safe and reliable operations of the future ISS. Risk reduction generally involves identifying known risks, then developing and executing mitigation plans to reduce the likelihood or consequence of the risks. Learning is generated from the difference between carefully planned activities, expected versus real outcomes, as well as from risk mitigation efforts. Major categories of risks, which may also be referred to as critical knowledge areas, included but were not limited to:

- Developing U.S. and Russian collaborative relationships;
- Refining Space shuttle proximity, rendezvous, and docking operations;
- Developing mission control center integration and joint operations;
- Performing long-duration mission increment planning and execution;
- Integrating crew training (Houston and Star City) and;
- Discovering other knowledge gaps in long-duration spaceflight.

However, not all risks can be effectively identified before flight. In some cases, unforeseen circumstances occur. During Phase 1 an onboard fire caused by a faulty oxygen generator cannister and a collision and depressurization mishap between Mir and a Progress cargo vehicle both occurred. These incidents generated many lessons which were then applied to future ISS emergency procedures (Thieme, 2003). Reflecting on these events, Jim van Laak, Phase 1 Deputy Program Manager stated that, “the relationship we developed with the Russians as a result of these near catastrophes is what enabled ISS to be successful (Van Laak, 2024).”

4. Knowledge Capture / Transfer (KC/T) Modalities

In risk management parlance, the purpose of a mitigation plan is to change the relationship between the existing condition and the potential consequence. Risk statements are therefore carefully written as: Given [condition

X]; there is a possibility that [consequence Y] may occur. Exploration of the relationship between the condition and consequence allows the risk owning organization to develop an effective mitigation plan.

Many ISS risks were unknown and/or undocumented when the Phase 1 Program began due to the ISS nascent risk management processes. As a result, the identification of risks of related to the planning and execution of long duration missions aboard Mir were more a matter of discovery than an intellectual effort of foresight. This was a missed opportunity for the two programs to collaborate and use ISS risk issues to cue KC/T activities in Phase 1, i.e., to capture lessons most useful to buy down risk for the ISS. Despite this, there were several traditional means of KC/T employed during the Shuttle-Mir Program which included:

- Long-Duration Mir Crew Mission Debriefs;
- Space Shuttle Crew Mission Debriefs;
- Mission Operations Directorate Flight Control Team Debriefs and;
- NASA Lessons Learned Capture Activities and Reports (See Para. 4 below).

After the close of the program, knowledge capture involved the following KC/T modalities:

- Technical/Engineering Papers (NASA Technical Reports Server);
- Human Spaceflight Conference Papers;
- Academic Journal Articles;
- Oral History Project Interviews (e.g., Johnson Space Center) and;
- NASA History Office Narrative Reports.

Other sources of lessons learned documented outside of NASA efforts included:

- U.S. Government Accountability Office (U.S. GAO) reports;
- Aerospace Industry Press Articles (e.g., Aviation Week and Space Technology, etc.);
- Non-Fiction Historical Books (e.g., *Dragonfly, Star-Crossed Orbits*) and;
- Congressional Hearing Testimony (Written Submissions and Transcripts).

Had the Shuttle-Mir Program been conducted today, several other means of KC/T activity may have included information technology (IT) aids:

- Collaborative online meetings tools such as MS Teams, Zoom, or MeetingSphere to capture knowledge in real-time and;
- Collaborative team-oriented tools such as wikis, particularly blogs and discussion boards to capture knowledge asynchronously.

One should note that tacit knowledge, the knowledge, skills, and abilities an individual gains through experience, also played an important role in both knowledge capture and transfer. The personnel who worked in NASA functional organizations, such as engineering, space and life sciences, mission operations, flight crew, payload integration and operations, ground systems and operations, all built a knowledge base which was directly applied to the ISS Program. This also includes NASA contractors such as Boeing, United Space Alliance, and Lockheed-Martin. Some senior managers were transferred into leadership positions in the ISS Program, where their management experience and relationships with their Russian colleagues was highly beneficial.

5. The Lessons Learned Architecture

Abiding by the dictum that a little structure goes a long way, particularly when it comes to KC/T activities, two significant and complementary efforts occurred at the end of Phase 1 which merit a more detailed discussion. The first involved the documenting of over 500 individual lessons from each of the Phase 1 working groups, followed by peer-to-peer exchanges with ISS personnel to ensure that each lesson found a home in the Station Program Integration Plans (SPIPs). SPIPS were the backbone of the document/information architecture to guide NASA management of ISS activities. The goal of this approach was to ensure that the ISSP accommodated both positive and negative lessons; the latter included risk issues including the previously mentioned experiences of the onboard fire and depressurization. In addition to SPIPS, there was also transfer of Shuttle-Mir lessons to the ISS vehicle engineering documents, the medical operations requirements document, and standard operating procedures for public affairs activities. Oberg (1998) observed that the lesson insights “dealt less with hardware design than with operational philosophies and that ninety percent of these lessons were process oriented." Many lessons dealt with cross-cultural issues in addition to operational processes.

Table 1 below outlines both the Phase 1 management structure versus the ISS SPIPs:

Table 1: Phase 1 Working Groups and ISSP Integration Plans

Phase 1 **Management Structure:**	**Station Program Integration Plans (SPIPs)**
Team 0 Senior Management	Program Management (SPIP Vol. 1)
WG-1 Public Relations	Manifesting and Schedules (SPIP Vol. 2)
WG-2 Safety and Mission Assurance	Cargo Integration (SPIP Vol. 3)
WG-3 Flight Operations and Systems Integration	Payload Integration (SPIP Vol. 4)
WG-4 Mission Science	Logistics and Maintenance (SPIP Vol. 5)
WG-5 Crew Training and Exchange	Launch Site Processing (SPIP Vol. 6)
WG-6 Mir Operations and Integration	Training (SPIP Vol. 7)
WG-7 Extravehicular Activity	Increment Execution Preparation (SPIP Vol. 8)
WG-8 Medical Operations	Real-Time Operations (SPIP Vol. 9)
WG-9 Institutional Communications	Sustaining Engineering (SPIP Vol. 10)

Another lessons learned effort involved the joint NASA-Russian technical teams producing the Phase 1 Program Joint Report. For this heavily researched narrative report, "the Working Groups were tasked to describe the organizational structure and work processes that they used during the program, joint accomplishments, lessons learned, and applications to the International Space Station Program (Nield and Vorobiev, Eds. 1999)." As a joint report, it helped define a path forward for working with the Russians and was a critical part of the KC/T effort.

6. How to Operate a Space Station

Although transferring Phase 1 knowledge to the ISS Program was a collegial exercise, there were a number of issues raised by Phase 1 personnel early on which were ignored or shrugged off as being artifacts of NASA's "customer" role onboard a Russian space station. For example, ISSP operations managers pushed back on the Phase 1 conclusion that ISS operations would most likely be dual-language (Russian and English) and not English-only. Over time that risk was realized by the ISSP and a great deal of resources had to be spent on interpreter and translator services, flight crew language training, dual-language procedures development, as well as a requirement for NASA and Russian support group flight controllers and planners to be stationed in Houston and Korolev.

The language issue was likely due to a cognitive bias exhibited by many ISS Program personnel. Hence, the belief early on that Phase 1 lessons were not necessarily applicable to the multi-international partnership that defined the ISSP. In Russia however, many of the personnel involved in Phase 1 believed that the ISS was simply an extension of the Mir operational philosophy. Unlike NASA personnel, the assumption on the Russian side was that most management, engineering, systems integration, crew training, medical support, etc., would remain the same or very similar. To some extent that was true during early ISS operations but there is no argument that the risks associated with rendezvous and docking, planning and execution, and, perhaps most importantly, crew training and bridging the cultural gaps, had been mitigated to very low risks levels by the Phase 1 Program.

Aside from three missions to NASA's Skylab in 1973 and 1974 for a total of eight months, NASA philosophy was focused on turning space shuttles around for six-to-sixteen-day flights. Reflecting on the Phase 1 program, NASA Flight Director Paul Dye noted that; "I think everybody knew all along that flying a Space Station is different than flying a Shuttle, and we probably would have come to the answers that they [Russians] have, sooner or later, too, but by sitting and watching how they do business, and looking at it, I think we probably shortcut some of the mistakes that we might have made (Dye, 1998)."

7. Conclusions

Measuring the value of the knowledge gained from Phase 1 in terms of the risks mitigated in the early operational years of the ISSP in an economic sense is a difficult endeavor. However, it could be inferred that the success of ISS assembly missions, on-orbit flight crew operations, ground operations, and increment and real-

time planning operations can be attributed in part to what both space agencies and their contractors learned in Phase 1. As astronaut and Phase 1 Program Manager Frank Culbertson explained; "the expense of flying the Shuttle is there, whatever the mission happens to be. I think that flying to Mir is one of the most productive ways to fly the Shuttle in terms of what we learned and what we accomplished...the cost of the contract with the Russians is about the same, rough order of magnitude, as one shuttle flight. And for the cost of one shuttle flight, we've flown to the Mir ten times and brought back innumerable lessons learned and probably saved unsuccessful shuttle flights in the future because of knowing something that we now know from Phase1. I believe it has been a very cost-effective insurance policy for the future (Oberg, 1998)."

In capturing and transferring knowledge, it is beneficial to consider a combination of techniques to ensure a comprehensive and accessible knowledge base, both tacit and written. Some of the positive aspects of the Phase 1 KC/T were that it was well documented, well communicated, and contextual. Having said that, the process was sub-optimal and could have been improved with a more disciplined planning process upfront. I offer the following KC/T planning checklist for those looking to reduce future risks through KC/T activities:

> Start with a **Systems Analysis** to ensure that problem definition, requirements, goals, and objectives are clearly defined. The analysis should ensure that all "systems" associated with the program (organizations, hardware, software, infrastructure, etc.) are properly incorporated, as well as interfaces between systems, to include international partners.
>
> Identify **Critical Knowledge** needed using a risk-based approach. The risk register, problem reporting systems, system safety analyses, mishap and close call systems, etc. can provide a valuable cueing system pointing to value-added information.
>
> A **Knowledge Architecture or Taxonomy,** whether it be an organizational breakdown, work breakdown, or engineering and science disciplines, is useful in organizing the information for later discovery and reuse. Within the architecture, key word **Tagging** of all products will aid in online search discovery.
>
> Clearly defined **KC/T Management Roles and Responsibilities** are required to ensure accountability, **Appropriate Resource Allocation,** and decision-making authority. In many cases, a KC/T effort is task organized and will therefore require coordination across multiple operational and institutional organizations (e.g., IT department, history office, public affairs and media), making an **Integrated Product Team Charter** a useful coordinating tool.
>
> Development of a **KC/T Schedule** allows more efficient resource allocation, progress tracking, alignment, and coordination among the stakeholders in the KC/T effort. Obviously, sufficient time should be allocated to the KC/T effort so as not to shortchange the quality of the knowledge products or formal transfer processes.
>
> Development of a **KC/T Communications Plan** will ensure the objectives of the capture and transfer effort are clearly defined, both internally and externally. When combined with the KC/T schedule, the communications plan should inform stakeholders of the key activities, milestones, and flow of information between all parties. The plan should identify opportunities to engage the public in the output of KC/T products via social media channels.
>
> Lessons learned are often best learned when they are codified in **Programmatic, Design, Operational and Training Documentation.** They become the standard for future efforts by identifying the documentation as targets for key **Validated Practices.**
>
> Execution of **Knowledge Capture / Transfer Activities** can include interviews, videography, writing assignments, creation of a **Narrative Report**, media preparation, training products development**,** population of a **Knowledge Portal** (if required), conduct of **Lessons Learned Forums,** establishment of **Mentoring Programs,** development of an **Expertise Locator,** and so on.
>
> **Encourage and Reward Personnel** participating in the KC/T process. This includes encouraging the writing of academic journal and conference papers. Obvious benefits include improving the morale, motivation, and retention of employees. As new programs ultimately replace programs that are completed or cancelled, the problem of **Knowledge Retention** may become acute if personnel are not transferred to the new program(s). To the extent possible, consideration should be given to retaining experienced personnel in their functional areas on new programs.

8. Epilogue

Established in 1996, the goal of the NASA Johnson Space Center Oral History Project (JSC OHP) is to capture history from the individuals who first provided the country and the world with an avenue to space and the moon. Participants include managers, engineers, technicians, doctors, astronauts, and other employees of NASA and aerospace contractors who served in key roles during the Mercury, Gemini, Apollo, Skylab, and Shuttle programs.

These oral histories ensure that the words of these space pioneers live on to tell future generations about the excitement and lessons of space exploration (JSC OHP, 2024). The following two interview segments provide a good synopsis of the knowledge gained from the Phase 1 Program which ultimately benefitted the ISS Program.

Andy Thomas, NASA Astronaut: "Throughout the course of the Phase 1 Program we've learned the mechanics of how you service and operate a space station; how you arrange and load a vehicle, launch it, rendezvous and dock to the space station, transfer goods, transfer crews, which we wouldn't have otherwise. It shouldn't be underestimated how to work collaboratively with the Russians because we have different cultures, different languages and that itself is a big accomplishment…it's inconceivable to do the International Space Station without first taking these steps in the Phase 1 Program (Thomas, 1998)."

General Yuri Nikolayevich Glazkov, Deputy Director of the Gagarin Cosmonaut Training Center: "I think the main result of Phase 1, which is coming to an end, is our successful transition to the International Space Station. Of course, everything that is ending now is not really an end; it is flowing into the building, assembling of the future Space Station and its future operation. I heard President Bill Clinton a few times calling the future International Space Station "the bridge into the future," and I do believe that it is the transfer of our achievements of the twentieth century into the twenty-first century, especially for our kids. That's why I'm preparing my daughter to become a cosmonaut (Glazkov,1998)."

Figure 2: Phase 1 Astronauts (1st Row L-R: Norm Thagard, John Blaha, Jerry Linenger, David Wolf, 2nd Row, L-R: Andrew Thomas, Shannon Lucid, Michael Foale. Credit: NASA)

References

Castle, R. (1998). **Interview conducted by Rebecca Wright, Houston, Texas, 24 June 1998,** NASA Shuttle-Mir Oral History Project, Edited Oral History Transcript.
https://historycollection.jsc.nasa.gov/JSCHistoryPortal/history/oral_histories/Shuttle-Mir/CastleRE/CastleRE_6-24-98.htm

Cline, L. et al. (2002). Beyond the ISS: The Future of Human Spaceflight, Proceedings of an International Symposium, 4–7 June 2002, Strasbourg, France.

Dye P. (1998). **Interview conducted by Rebecca Wright, Houston, Texas, 16 June 1998,** NASA Shuttle-Mir Oral History Project, Edited Oral History Transcript.
https://historycollection.jsc.nasa.gov/JSCHistoryPortal/history/oral_histories/Shuttle-Mir/DyePF/DyePF_5-27-98.htm

Glazkov, Y. (1998). Yuri Nikolayevich Glazkov Edited Oral History Transcript, Interviewed by Mark Davison, Cape Canaveral, Florida, 31 May 1998, NASA Shuttle-Mir Oral History Project. Found online at: https://historycollection.jsc.nasa.gov/JSCHistoryPortal/history/oral_histories/Shuttle-Mir/GlazkovYN/GlazkovYN_5-31-98.htm

Hale, W., Lane, H., Chapline, G., and Lulla, K. (Eds.) (2010). Wings in orbit: Scientific and Engineering Legacies of the Space Shuttle 1971-2010, NASA/SP-2010, https://www.nasa.gov/centers/johnson/wingsinorbit/

JSC Oral History Project. Found online at: https://historycollection.jsc.nasa.gov/JSCHistoryPortal/history/oral_histories/oral_histories.htm

Nield, G. and Vorobiev, P. Eds. (1999). Phase 1 Program Joint Report. NASA-SP-1999-6108,

Thieme, T. (2003). ISS learns from Mir's flame-up, Popular Science. 24 Jan. 2003. https://www.popsci.com/military-aviation-space/article/2003-01/iss-learns-mirs-flame/

Oberg, J. (1998). Shuttle-Mir's lessons for the international space station, IEEE Spectrum, June 1998, 28-37.

OTA, Office of Technology Assessment (1985). U.S.-Soviet cooperation in space, OTA-TM-STI-27, U.S. Government Printing Office, Washington, DC.

Thomas, A. (1998). Andrew Thomas Edited Oral History Transcript, Interviewed by Rebecca Wright, Carol Butler, and Summer Bergen, 22 July 1998. Found online at: https://historycollection.jsc.nasa.gov/JSCHistoryPortal/history/oral_histories/Shuttle-Mir/ThomasASW/thomas.pdf

Uri, J. (2022). 50 Years Ago: The United States and the Soviet Union Sign a Space Cooperation Agreement, Johnson Space Center, 23 May 2022. Found online at: https://www.nasa.gov/history/50-years-ago-the-united-states-and-the-soviet-union-sign-a-space-cooperation-agreement/

Van Laak, J. (2024). Interview conducted by D.M. Lengyel on 29 Nov. 2024.

Text Laundering: Concealing the Use of Generative AI in Text

Aline Lima de Souza[1], Matheus Argôlo[1], Carlos Eduardo Barbosa[1,2], Yuri Oliveira de Lima[1], Herbert dos Santos[1], Alan Lyra[1] and Jano de Souza[1]

[1]Programa de Engenharia de Sistemas e Computação do Instituto Alberto Luiz Coimbra de Pós-Graduação e Pesquisa em Engenharia, Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil
[2]Centro de Análises de Sistemas Navais, Marinha do Brasil, Rio de Janeiro, Brazil

limaals@cos.ufrj.br
matheusargolo@cos.ufrj.br
eduardo@cos.ufrj.br
yuriodelima@cos.ufrj.br
herbertsds@cos.ufrj.br
alanlyra@cos.ufrj.br
jano@cos.ufrj.br

Abstract: In recent years, we have witnessed a growing increase in applications involving some form of Artificial Intelligence (AI). Conversational AI has gained considerable prominence among the various types of AI applications. Classified as a type of generative AI, chatbot applications such asOpenAI's ChatGPT or Google's Bard are now utilized by multiple authors as tools. Despite its many advantages, the indiscriminate use of this type of generative AI in texts can raise ethical questions about who owns authorship of a particular work, as a human author may have contributed very little to the production of certain content. The concern about authorship is paramount in producing scientific publications, such as articles, dissertations, or theses. To avoid such questioning, some authors may develop strategies to conceal the use of generative AI in their productions. This work aims to introduce the concept of Text Laundering (TL), which we name as such due to its similarity to the practice of money laundering — applying various consecutive alterations to AI-generated text to make its origin indeterminate. This work will also develop the concept by examining examples of similar practices in the literature employing an ad hoc search. A method for applying TL to mask the origin of a text will be proposed, and the results obtained in a simple test will be presented to determine the success of our strategy. We hope this work can contribute to discussions on preventing the fraudulent use of generative AI. Discussing TL methods does not imply endorsing them but rather exploring potential mechanisms that can be maliciously utilized to gain advantages through generative AI, identifying them, and preventing their use. AI-generated texts can harm knowledge management systems, and we highlight the need to include AI-verification tools in such systems. Such tools can enhance the trustworthiness of information in knowledge management systems, improving knowledge externalization and sharing processes. Finally, we expect to promote future research on TL techniques and the proposition of new strategies to combat fraudulent practices in scientific research.

Keywords: Text Laundering, Artificial Intelligence, Generative AI, Conversational AI, AI-generated Text

1. Introduction

Artificial intelligence (AI) has brought forth the capability to generate texts that mimic the style and content of those produced by humans (Kreps, McCain and Brundage, 2022; Barbosa, 2023). Conversational AI has gained considerable prominence in the last few years among the various types of AI applications developed. Chatbot applications such as OpenAI's ChatGPT (Generative Pre-trained Transformer) or Google's Bard focus on creating human-like interactions and responses in a conversation and are now utilized as tools by many authors as they can help facilitate natural and engaging text-based interactions, providing assistance, generating creative content, and supporting various language-related tasks.

While the use of chatbots can be beneficial in empowering humans to develop new products, exploring a wide range of problems and solutions, and consequently increasing innovation performance (Bouschery, Blazevic and Piller, 2023), it is necessary to consider the ethical implications when it comes to their employment even when classified as potential transformative agents in different domains that require textual production (Stokel-Walker and Van Noorden, 2023). In particular, ethical concerns associated with preventing the reproduction of plagiarized texts or the dissemination of erroneous information must be addressed (Pavlik, 2023). An important question regarding the creation of texts through generative AI systems, i.e., systems capable of generating new content, such as text, images, or music, based on patterns learned from large datasets, is to recognize whether a particular text is or is not the result of AI. A possible benefit of concealing generative AI would be that using more humanized AI-generated texts can enhance user interaction, promoting a better understanding and acceptance of conveyed information, as it resembles natural writing (Bozkurt *et al.*, 2021). Nevertheless, the use of this type of technology is not always beneficial.

In the context of higher education, the integration of generative AI within Higher Education Institutions (HEIs) introduces some ethical considerations. While these tools hold promise in enhancing research processes and knowledge dissemination within academia, their implementation raises concerns regarding academic integrity and undergraduates' skills building and evaluation (Chan and Hu, 2023; Michel-Villarreal *et al.*, 2023; Wang, 2023).

Generative AI technologies offer unprecedented capabilities in content creation, aiding researchers and educators in generating diverse materials for study and publication. In an era where the labour market evolves rapidly, HEIs face the imperative to adapt their curricula to meet industry demands (Dos Santos *et al.*, 2023). This pressure often leads to the integration of cutting-edge technologies like generative AI into educational practices. However, their introduction forces HEIs to reassess their educational curricula (Dai, Liu and Lim, 2023), as generative models could potentially overshadow critical thinking and originality in students and researchers work (Spector and Ma, 2019).

The rapid adoption of such tools underscores the importance of fostering skills in prompt engineering among undergraduate students (Dai, Liu and Lim, 2023). As generative AI systems may produce erroneous or misleading outputs (Fui-Hoon Nah *et al.*, 2023), individuals must possess the theoretical knowledge to identify and correct these inaccuracies effectively. Moreover, the rapid advance of generative AI adoption forces a shift in educational focus towards equipping learners with the competencies to engage with AI technologies critically (Dai, Liu and Lim, 2023).

In this rapidly evolving landscape of generative AI adoption, this work aims to introduce the concept of Text Laundering (TL), which we define as such due to its similarity to the practice of money laundering — applying various consecutive alterations to AI-generated text to make its origin indeterminate. This concept not only sheds light on the potential vulnerabilities of AI-generated content detection tools but also underscores the inadequacy of relying solely on such tools to deter the fraudulent use of generative AI by undergraduate students or researchers. We hope to present some preliminary thoughts on this novel concept, develop it, and discuss how to determine whether a text was produced by humans or by AI and subsequently laundered to create ways for discovering AI-generated laundered texts. We expect this work can serve as a foundation for future discussions on preventing the fraudulent use of generative AI in HEIs context, raising the discussion whether identifying fraudulent use of AI should focus on identifying AI-generated texts or on discerning whether the guiding intelligence behind the AI-generated text is human or artificial. Discussing TL methods doesn't mean supporting them. Instead, we explore how the utilization of text laundering methods demonstrates the inefficacy of current AI-generated text identification techniques in detecting the malicious use of the tool for undergraduates and researchers to gaining unfair advantages in their work.

The text laundering of an AI-generated text employs techniques – often automated – to make it more challenging to identify the text's AI origin. How to generate texts more similar to those produced by a human author is already a highly debated and intriguing topic in natural language processing (Camacho-Collados and Pilehvar, 2020). Therefore, there is a need to develop literature for a practice that has been taking place and to assist in improving the detection of the artificial origin as AI systems improve and texts generated by humans and AI tend to look more alike.

Including AI-generated laundered texts in corporate knowledge management systems can have detrimental consequences. For example, it may lead to challenges in accurately externalizing tacit knowledge and documenting lessons learned. Therefore, AI-generated data could result in the loss of nuance or context, leading to less effective knowledge-sharing and decision-making within the organization. Additionally, reliance on AI may introduce biases or errors into the knowledge management system, compromising its effectiveness and reliability.

This work shows how to develop a concealment method for the artificial origin of a text produced by generative AI tools against AI detection tools. We will then discuss ethical questions regarding this process, particularly concerning fraudulent scientific research practices. This topic is of significant educational, academic, and social relevance, as these tools and their growing interest are essential in all these areas. We also hope this work can encourage future research on TL techniques and that researchers can propose new strategies to combat fraudulent practices in scientific research.

2. Theoretical Background

This section explores the theoretical foundations necessary to understand generative AI methodologies used to generate text and Stylometry, which analyze linguistic patterns and determine authorship. Next, we discuss the ethical concerns associated with AI applications, particularly plagiarism and the proliferation of false or misleading information. Finally, we present applications for detecting AI-generated content.

2.1 Generative AI

Generative AI refers to a class of artificial intelligence systems designed to create or generate new content, such as images, text, audio, or even video, that is convincingly similar to the data it has been trained on. Unlike traditional AI models for classification or prediction tasks, generative AI models focus on creating new content. These models typically utilize techniques like deep learning, particularly Generative Adversarial Networks (Creswell *et al.*, 2018) and Variational Autoencoders (Doersch, 2021), to produce output that exhibits characteristics similar to the training data. Generative AI has applications in various fields, including art, design, entertainment, and even scientific research, where it can be used to generate synthetic data for experimentation or to assist in creative endeavors. These systems can also employ techniques such as natural language processing when dealing with text generation (Mou, 2022). The impact of AI on copyright and related rights is also a topic of discussion, particularly regarding the recognition of authorship and responsibility for copyright infringement (Bysaga, Byelov and Zaborovskyi, 2023).

In the academic field, researchers can use generative AI for the automated production of academic texts, such as abstracts, essays, and even dissertations and theses. Additionally, these systems can deliver adaptive learning content by interacting with students through text and voice (Barbosa, 2023). However, generative AI tools are most commonly employed to produce and modify texts. Their ability to generate original and contextually relevant content from a given dataset has significantly advanced natural language processing. Generative text AI tools become widely used as they can produce fluent and contextually relevant texts in just a few seconds, allowing users to generate new content or make their writing process more efficient and agile.

To give some examples of tools, we here will focus on OpenAI's. One of the various generative AI models used to create or edit texts is the GPT-3.5, a transformer-based language model capable of generating coherent and context-relevant texts. GPT-3.5 is trained using a large amount of textual data for translation, text summarization, and dialog generation, among other applications. ChatGPT is a specific implementation of the GPT-3.5 model focused on conversation. It can answer questions, provide information, assist with problem-solving, and engage in natural language dialogues. Another example is OpenAI Codex (OpenAI, 2024). The Codex is a language model trained on programming code and can generate code from natural language descriptions. It can assist developers in writing code by providing suggestions and auto-completing code snippets. Yet another example is TextGPT, a variation of GPT-3.5 specifically designed to work with natural language text that can generate stories, essays, articles, and poems, among others. All these tools can create and modify texts, exemplifying how AI can assist in text creation and editing across various domains.

2.2 Stylometry

A possible method to detect AI-generated content is Stylometry. Stylometry is the field of study that analyzes text's linguistic and stylistic characteristics. Stylometry gained strength by developing computational tools designed explicitly for this purpose (Boto Bravo, 2018), and the possible applications are many: plagiarism detection, countering identity deception, email impersonation detection, authorship detection in SMS messages, identifying speech writers, multi-modal authentication on mobile devices, among others (Neal *et al.*, 2018). Tools such as Stylo R have been used to analyze and classify literary works based on their typological and stylistic characteristics (Boto Bravo, 2018).

Furthermore, computational statistical tools such as ContaWords have also been used to identify stylistic elements in literary texts (Ferreira Barrocal, 2021). Machine learning techniques can also be used for authorship attribution and characterization (Deutsch, 2020). In addition, critical editions of literary works have been produced to examine their plot, attribution, and historical context (Ferreira Barrocal, 2022). In digital humanities, data mining techniques can visualize concepts, author constellations, and indexed citations of digital collections (Rota, 2022). Recurrent neural networks generate obfuscated texts, preserving their original semantics (Franco and Oliveira, 2019). Finally, the automatic detection of fake news was explored (Santos, 2022). These studies

demonstrated applying computational and statistical methods to analyze and comprehend texts. Researchers can use stylometric analysis methods to investigate the possible artificial origin of a text.

There are still challenges in authorship analysis using stylometry techniques, such as a lack of sufficient data or inconsistencies in text samples (Neal *et al.*, 2018). Achieving high accuracy in stylometric analysis, especially with large and diverse datasets, remains a significant challenge. Still, some studies report accuracy rates ranging from 53.8% to 98.312% for tasks like authorship attribution and verification (Neal *et al.*, 2018). The accuracy of stylometric analysis can vary depending on various factors such as the specific task being performed (e.g., authorship attribution, verification, profiling), the size and quality of the dataset, the features and algorithms used, and the complexity of the writing style being analyzed (Neal *et al.*, 2018).

2.3 Ethical Issues

Among the many issues concerning generative AI applications is the issue of plagiarism. If an AI system generates a text that is similar or identical to a pre-existing text, will it be considered a misappropriation of someone else's work? Chatbots frequently do not mention who published it or even from what source (website, book, magazine, etc.) the information came. Still, the model training may use data from specific sources without acknowledging the original authors.

Generative AI also presents ethical challenges regarding its dual modes of operation: autonomously generating content and synthesizing user input. In the former, the AI may inadvertently produce text resembling existing works, raising concerns of plagiarism. In the latter, the AI acts as a facilitator, crafting text based on user input, blurring lines of authorship and authenticity. As such technologies become more widespread, addressing these dilemmas and establishing guidelines for responsible use and content attribution becomes increasingly urgent.

Another issue is the authenticity and authorship of a text. AI-generated texts often present themselves as though a human wrote them, potentially resulting in a lack of authenticity. The authorship of the texts generated by the AI must be appropriately attributed and disclosed to avoid deception or manipulation (Rossetti and Angeluci, 2021).

Regarding the manipulation of information, AI has the potential to create texts similar to authentic and reliable texts. However, they can also increase the proliferation of false or misleading information. This AI capability can lead to the spread of misinformation and undermine public trust in AI-produced texts.

Another important point is responsibility and supervision, as the production of texts by AI also raises questions about who will be responsible for the generated content. Who would be responsible for ensuring the accuracy, integrity, and ethics of texts produced by AI? Careful monitoring and oversight are required to ensure that the texts generated meet ethical and quality standards.

Finally, there is still the possibility of ideological or discriminatory biases in the text. Even today, AIs are trained on large datasets, which may contain built-in biases and biases. These biases can be reflected in texts generated by AI, reproducing or expanding inequalities, discrimination, or societal stereotypes.

2.4 AI-Generated Content Detection

An AI detection tool is software capable of identifying, recognizing, or classifying specific objects, patterns, behaviors, or information in data or images. Some of these tools may use AI to perform stylometric text analysis.

As generative AI tools become more accessible to the public, AI-generated content becomes more common. To be able to determine if AI produced an article or content is something fundamental to content marketers. Fortunately, some methods exist to assess and determine if the content is AI-generated.

One way to identify this AI-generated content is to look for repetitive or unusual patterns in the text. AI text generation is imperfect, i.e., it may not look human in a human or automated analysis. Sometimes, texts tend to repeat sentences or structures. This repetition may indicate that the content was generated by AI rather than a human author. AI content detection tools may also use machine learning and natural language processing techniques to determine whether the content was created by a human or not in an AI versus AI clash. Machine learning techniques can make computer systems more efficient with every text analyzed. AI applications designed to detect the use of AI in texts can also analyze large amounts of information available on the web about a specific content topic in seconds. This analysis can potentially make the detection of AI-generated content more precise. Several free AI content detection tools are available to help identify whether certain content was generated by AI or by a human author; one example is GPTZero.

GPTZero (GPTZero, 2024) is a tool designed to identify text generated by artificial intelligence, specifically by large language models like ChatGPT. It is helpful when understanding the source of a piece of writing is important, such as academic integrity and content authenticity. GPTZero analyzes the statistical properties of text and its Stylometry, such as how random or predictable it is. Based on this analysis, it can tell with some accuracy whether the text was written by a human or generated by a large language model. It's important to note that GPTZero detection is not perfect. As AI language models continue to develop, GPTZero's ability to detect them might require updates.

AI Detector (Corrector App, 2024) is an application designed to scan and analyze texts to identify the use of AI technology. The tool analyzes words like *the*, *it*, and *is,* which tend to be often used by AI text generators. They claim to search for unnatural transitions and errors in the text and the lack of the author's personal opinions since AI-generated texts often present heavy facts in their contents.

3. Methodology

The proposed methodology aims to create techniques that modify an AI-generated text to hide its origin as artificial text. The approach combines four main stages: the setup stage, the text generation stage, the text laundering stage, and the AI-detection & analysis stage.

In the setup stage, we define the tools used in the process. We need to select three types of tools: the generative AI used to produce the text, the tools responsible for altering the generated text, and finally, the tools used to validate if the modified text is detectable as human-made or AI-generated.

In the text generation stage, we use the generative AI (selected in the setup stage) to create a Corpus of text. The AI employed in this stage is supposed to generate coherent and relevant content, but it is also expected to be detected by AI-generated text detection tools.

In the text laundering stage, the text is processed through single or multiple tools (also selected in the setup stage) to resemble a human writing style. We denominate the tools used to alter the AI-generated text to achieve this goal as *text laundering tools*. The idea behind this stage is that sequential laundering processes like translation and paraphrasing will introduce nuances and subtleties often found in human-written texts while removing evidence from known biases derived from AI-generated text. Therefore, we expect to trick the detection tool and statistical analysis.

In the AI-detection & analysis stage, we use the altered text as an input to AI-generated text detection tools (also selected in the setup stage) to assess the success of the laundering. At the end of this stage, we analyze if the results show consistent difficulty in identifying the text as AI-generated. If the results are unsatisfying, we can return to the setup step to modify the tools used in the text laundering process to improve the results. We summarize the described process in Figure 1.

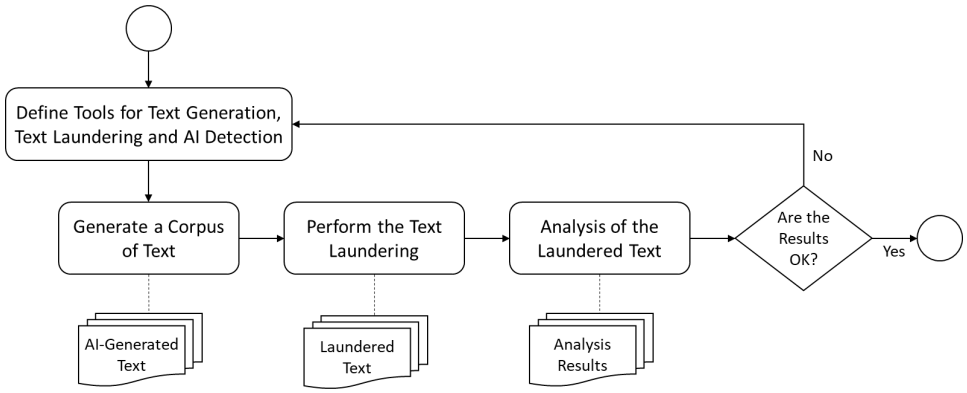


Figure 1: The proposed methodology for the development of Text Laundering techniques.

4. Experiment

In this section, we conduct an experiment on text laundering using the proposed methodology. In the setup stage, we chose ChatGPT as generative AI used to produce the text, Google Translate and Scite as text laundering tools, and GPTZero and AI Detector to validate if the altered text is detectable as human-made or AI-generated. We selected ChatGPT for its popularity and ability to generate quality content in its free version. Google Translate

and Scite were chosen to show that several types of applications can be used for text laundering. Finally, we selected GPTZero and AI Detector because they can detect ChatGPT-produced text.

In the text generation stage, we give ChatGPT the following prompt: "I need you to generate ten topics from different Knowledge Areas and, for each Knowledge Area, a famous and complex topic. I just want the topics; I don't need to generate any text about them." The response was (1) Quantum Physics -Schrödinger's Cat Paradox, (2) Philosophy - JohnRawls's theory of justice, (3) Biology - CharlesDarwin's Theory of Evolution, (4) Mathematics -Fermat's Last Theorem, (5) History - The Cold War and the nuclear arms race, (6) Psychology - SigmundFreud's theory of personality, (7) Sociology - The concept of consumer society, (8) Law - The ethical dilemma of using torture to obtain information, (9) Medicine - The discovery and development of vaccines, and (10) Computer science - The P versus NP hypothesis in computational complexity theory. We then asked ChatGPT to generate a text of approximately 300 words about each topic, one at a time. These texts served as the corpus of text for this experiment.

In the text laundering stage, we use the Google Translate and Scite tools to modify the original text to make it more human-like. In this process, we used Google Translate to perform a double translation (change the text to another language and then back to English). We use Scite to paraphrase and rewrite the text. We end up with three versions of each text: the original version (before the laundering process), the Google Translation laundered text, and the Scite laundered text. We highlight that we can use any tool to create any post-processing workflow to disguise the text, including AI-generating tools (such as ChatGPT) to perform the laundering. We also highlight that we can achieve better results using multiple laundering tools in sequence.

In the AI-detection & analysis stage, we sent each text to the GPTZero and AI Detector to analyze their performance. These tools analyze and identify language patterns generated by AI models, allowing us to confirm the authorship of the texts. The results of the detection experiment are shown in Table 1. We now decide if the results are good *enough* to achieve our goals. If we find the results unsatisfactory, we can revisit the setup stage to adjust the tools utilized in the process or the workflow of laundering tools employed.

Table 1: Results of the experiment.

Text ID	Original Text		Laundered (Google Translate)		Laundered (Scite)	
	GPTZero [AI/Human]	AI Detector [% fake]	GPTZero [AI/Human]	AI Detector [% fake]	GPTZero [AI/Human]	AI Detector [% fake]
Text 1	AI	18.82%	Human	19.94%	AI	8.82%
Text 2	AI	49.97%	AI	57.23%	AI	9.97%
Text 3	AI	49.97%	AI	37.37%	AI	9.97%
Text 4	Human	0.08%	Human	7.38%	Human	0.08%
Text 5	AI	34.67%	AI	65.36%	AI	4.67%
Text 6	AI	1.55%	AI	9.97%	AI	0.55%
Text 7	AI	0%	Human	9.97%	AI	0%
Text 8	AI	0.02%	AI	0.02%	Human	0.02%
Text 9	Human	0.41%	Human	0.03%	Human	0.41%
Text 10	Human	46.70%	Human	41.52%	AI	6.70%

Analyzing the results, we observe that the original AI-generated texts vary in human-likelihood. The original ChatGPT text passes as human in 3 of 10 texts in GPTZero without changes. Similarly, the original text is below *10% fake* in 5 of 10 texts. Regarding the text laundered with Google Translate, we see improvement in the GPTZero assessment, with 5 of 10 texts labeled as human-generated. Meanwhile, in most cases, the AI Detector considered the Google Translate results worse than the original text. Regarding the text laundered with Scite, we see a significant improvement in the AI Detector assessment, with all texts below *10% fake*. However, in the GPTZero results, the Scite laundering kept the 3 of 10 texts labeled as human-generated.

5. Discussion

Our results showed that text laundering can help make texts less artificial and more authentic in the eyes of AI detection systems like the AI Detector. However, we highlight that the effectiveness of this laundering can vary depending on the chosen tool. Our experiment involving the analysis of 10 texts found that four were considered less artificial by the AI Detector after undergoing text laundering. This result indicates that the appropriate choice of laundering tool impacts text detection, making them more genuine and less susceptible to being labeled as artificial.

However, we highlight that the detection methods used by AI Detector systems can vary. Some may be more sensitive to specific laundering techniques, while others may have different rules and algorithms. Therefore, no universally effective method of text laundering works equally well for all cases. Each text and context requires careful analysis to determine the appropriate choice of laundering. We should consider factors such as the type of text, the target audience, the communication objective, and the specificities of the detection system used. For example, in some cases, removing specific language patterns or adding contextual elements may be necessary to decrease the text's authenticity.

We recognize that there is no universally effective approach. Each case requires an individualized analysis, considering specific detection methods and the characteristics of the text in question. The discussion about the ethical implications related to the choice of text laundering tool and its influence on text detection is of utmost importance. Several ethical issues in this context deserve consideration (Bysaga, Byelov and Zaborovskyi, 2023).

One key point is using text laundering to deceive or manipulate artificial intelligence detection systems. Using a text laundering tool to circumvent these systems and provide misleading or false information can produce severe ethical consequences. For example, the spread of misinformation undermines the reliability of information and compromises informed decision-making. Furthermore, the choice of text laundering tool can also raise ethical concerns about privacy and consent. If text laundering involves manipulating or altering other people's texts without their knowledge or consent, it can violate privacy and copyright rights. It is essential to respect individual rights and ensure that any text laundering process is carried out ethically and transparently (Rossetti and Angeluci, 2021). Another important ethical implication is the possibility of bias and discrimination. If specific text laundering tools are more effective in reducing the detection of artificial texts produced by specific groups or communities, it can lead to unfair discrimination. It is crucial to ensure that the choice of laundering tool is unbiased and does not perpetuate or amplify existing prejudices (Temsah *et al.*, 2023). Additionally, we highlight ethical implications related to the reliability and transparency of artificial intelligence detection systems. If the systems cannot identify laundered texts effectively, it can undermine trust in AI technologies and create an environment conducive to spreading false information (Rossetti and Angeluci, 2021).

Although, concerns regarding the detection and prevention of AI-generated content emerge. While these measures can preserve academic integrity, they may inadvertently suppress the creative potential of Generative AI within educational contexts. Rather than solely relying on detecting AI-generated content, HEIs should prioritize educating students on responsible AI usage and encourage the ethical application of Generative AI as a supplemental tool in their learning journey. Therefore, the use of text laundering techniques and tools can serve to demonstrate that alternative methods of detecting fraudulent use of Generative AI should be employed, focusing more on evaluating the ability of undergraduate students to be the guiding minds behind AI-generated texts rather than whether the texts were generated by AI.

Finally, we highlight the necessity of carefully examining the ethical implications of using a text laundering tool. It is necessary to consider the impact on information reliability, privacy, consent, discrimination, and transparency of AI systems. Ensuring that text laundering is conducted ethically and responsibly is essential to promote integrity and trust in AI technologies. The discussion between assistance and complete substitution in the context of AI technologies raises essential questions about acceptable limits and the ethical implications involved. On one hand, AI assistance can bring significant benefits in various areas, such as healthcare, education, and work. The ability of AI technologies to assist humans in complex tasks, provide valuable insights, and enhance efficiency is undeniable. Assistance can involve automating repetitive tasks, analyzing large datasets, and even assisting in decision-making.

6. Conclusions

AI can create texts that closely mimic human writing. However, there's ongoing debate regarding the credibility and impact of AI-generated texts in foreign policy. Platforms like ChatGPT are being investigated for their

potential to produce written content across various fields. However, identifying AI-generated texts and dealing with the ethical considerations they raise pose significant challenges.

This work proposes a methodological approach to develop methods to mask the artificial origin of AI-generated texts, contribute to the development of more effective verification tools, present text laundering techniques, and address associated ethical issues, particularly within the context of HEIs.

Based on the results obtained, we can conclude that the choice of text laundering tool significantly impacts the detection of texts generated by artificial intelligence. Of the ten texts analyzed, we found that four were considered less artificial by the AI Detector after the laundering process. This result indicates that adequate laundering can positively affect detection.

This work contributes significantly to Knowledge Management by developing methods to mask the artificial origin of AI-generated texts, and the approach shows an open issue that must be solved with the development of more effective AI-verification tools, prioritizing the evaluation of the intelligence behind the generated text over the evaluation of AI-generated text. We expect such verification to enhance the trustworthiness and authenticity of information within Knowledge Management Systems and improve the knowledge externalization and sharing processes.

However, we highlight that detection methods vary and require a case-by-case analysis to determine the most appropriate wash. No universally effective method works in all situations. Therefore, it is critical to carefully consider the different laundering methods available and adapt them according to the study's specific needs.

This study has limitations worthy of mentioning. First, we use only a single text-laundering step, which can limit the effectiveness of the process. Furthermore, we analyzed only ten texts, which may not represent all possible variations and results. We also considered only one text generation tool, two laundering tools, and two detection tools, which may restrict the scope of the results.

Future research can explore multiple laundering steps, increase the number of analyzed texts, and include various generation, laundering, and detection tools. This research will help to gain a more complete and accurate understanding of the effects of these processes on detecting AI-generated text. Furthermore, conducting tests on several detection tools would be important to assess their effectiveness in detecting false or misleading information. Automating the laundering process would be crucial to increase efficiency and scalability. Finally, knowledge management systems can integrate AI-detection tools to improve their knowledge externalization and sharing processes.

References

Barbosa, C.R.D.A.C. (2023) 'Transformações no Ensino-Aprendizagem com o Uso da Inteligência Artificial: Revisão Sistemática da Literatura', *RECIMA21 - Revista Científica Multidisciplinar - ISSN 2675-6218*, 4(5), p. e453103. Available at: https://doi.org/10.47820/recima21.v4i5.3103.

Boto Bravo, M.A. (2018) 'Mapa estilométrico de la narrativa de Eduardo Mendoza: aproximación a un análisis estilistico computacional de textos literarios', *Epos : Revista de filología*, (33), p. 99. Available at: https://doi.org/10.5944/epos.33.2017.18281.

Bouschery, S.G., Blazevic, V. and Piller, F.T. (2023) 'Augmenting human innovation teams with artificial intelligence: Exploring transformer-based language models', *Journal of Product Innovation Management*, 40(2), pp. 139–153. Available at: https://doi.org/10.1111/jpim.12656.

Bozkurt, A. *et al.* (2021) 'Artificial Intelligence and Reflections from Educational Landscape: A Review of AI Studies in Half a Century', *Sustainability*, 13(2), p. 800. Available at: https://doi.org/10.3390/su13020800.

Bysaga, Y.M., Byelov, D.M. and Zaborovskyi, V.V. (2023) 'Artificial intelligence and copyright and related rights', *Uzhhorod National University Herald. Series: Law*, 2(76), pp. 299–304. Available at: https://doi.org/10.24144/2307-3322.2022.76.2.47.

Camacho-Collados, J. and Pilehvar, M.T. (2020) 'Embeddings in Natural Language Processing', in *Proceedings of the 28th International Conference on Computational Linguistics: Tutorial Abstracts*. *Proceedings of the 28th International Conference on Computational Linguistics: Tutorial Abstracts*, Barcelona, Spain (Online): International Committee for Computational Linguistics, pp. 10–15. Available at: https://doi.org/10.18653/v1/2020.coling-tutorials.2.

Chan, C.K.Y. and Hu, W. (2023) 'Students' voices on generative AI: perceptions, benefits, and challenges in higher education', *International Journal of Educational Technology in Higher Education*, 20(1), p. 43. Available at: https://doi.org/10.1186/s41239-023-00411-8.

Corrector App (2024) *AI Checker Free*. Available at: https://corrector.app/ai-content-detector/ (Accessed: 30 March 2024).

Creswell, A. *et al.* (2018) 'Generative Adversarial Networks: An Overview', *IEEE Signal Processing Magazine*, 35(1), pp. 53–65. Available at: https://doi.org/10.1109/MSP.2017.2765202.

Dai, Y., Liu, A. and Lim, C.P. (2023) 'Reconceptualizing ChatGPT and generative AI as a student-driven innovation in higher education', *Procedia CIRP*, 119, pp. 84–90. Available at: https://doi.org/10.1016/j.procir.2023.05.002.

Deutsch, C. (2020) *Atribuição autoral com uso de classificadores de perfis*. Mestrado em Sistemas de Informação. Universidade de São Paulo. Available at: https://doi.org/10.11606/D.100.2020.tde-04112020-152132.

Doersch, C. (2021) 'Tutorial on Variational Autoencoders'. arXiv. Available at: https://doi.org/10.48550/arXiv.1606.05908.

Dos Santos, H.S. *et al.* (2023) 'A Framework for Assessing Higher Education Courses Employability', *IEEE Access*, pp. 1–1. Available at: https://doi.org/10.1109/ACCESS.2023.3256722.

Ferreira Barrocal, J. (2021) 'Petrarquismo en «Los amores de Marte y Venus», una fábula mitológica del siglo XVI', *Hipogrifo. Revista de literatura y cultura del Siglo de Oro*, 9(2), pp. 823–841. Available at: https://doi.org/10.13035/H.2021.09.02.58.

Ferreira Barrocal, J. (2022) 'Edición crítica de la «Loa con que empezó Escamilla», atribuida a Calderón', *Hipogrifo. Revista de literatura y cultura del Siglo de Oro*, 10(2), pp. 735–757. Available at: https://doi.org/10.13035/H.2022.10.02.45.

Franco, A. and Oliveira, L. (2019) 'Avaliação de Modelos de Redes Neurais Recorrentes para Anonimização de Textos em Português', in *Anais do XIX Simpósio Brasileiro de Segurança da Informação e de Sistemas Computacionais (SBSeg 2019)*. *Simpósio Brasileiro de Segurança da Informação e de Sistemas Computacionais*, Brasil: Sociedade Brasileira de Computação, pp. 421–426. Available at: https://doi.org/10.5753/sbseg.2019.13992.

Fui-Hoon Nah, F. *et al.* (2023) 'Generative AI and ChatGPT: Applications, challenges, and AI-human collaboration', *Journal of Information Technology Case and Application Research*, 25(3), pp. 277–304. Available at: https://doi.org/10.1080/15228053.2023.2233814.

GPTZero (2024) *GPTZero*, *GPTZero*. Available at: https://gptzero.me/ (Accessed: 30 March 2024).

Kreps, S., McCain, R.M. and Brundage, M. (2022) 'All the News That's Fit to Fabricate: AI-Generated Text as a Tool of Media Misinformation', *Journal of Experimental Political Science*, 9(1), pp. 104–117. Available at: https://doi.org/10.1017/XPS.2020.37.

Michel-Villarreal, R. *et al.* (2023) 'Challenges and Opportunities of Generative AI for Higher Education as Explained by ChatGPT', *Education Sciences*, 13(9), p. 856. Available at: https://doi.org/10.3390/educsci13090856.

Mou, L. (2022) 'Search and learning for unsupervised text generation', *AI Magazine*, 43(4), pp. 344–352. Available at: https://doi.org/10.1002/aaai.12068.

Neal, T. *et al.* (2018) 'Surveying Stylometry Techniques and Applications', *ACM Computing Surveys*, 50(6), pp. 1–36. Available at: https://doi.org/10.1145/3132039.

OpenAI (2024) *OpenAI Codex*. Available at: https://openai.com/blog/openai-codex (Accessed: 30 March 2024).

Pavlik, J.V. (2023) 'Collaborating With ChatGPT: Considering the Implications of Generative Artificial Intelligence for Journalism and Media Education', *Journalism & Mass Communication Educator*, 78(1), pp. 84–93. Available at: https://doi.org/10.1177/10776958221149577.

Rossetti, R. and Angeluci, A. (2021) 'Ética Algorítmica: questões e desafios éticos do avanço tecnológico da sociedade da informação', *Galáxia (São Paulo)*, (46), p. e50301. Available at: https://doi.org/10.1590/1982-2553202150301.

Rota, A.R. (2022) 'El uso de la minería de datos como heurística para la teoría de la historia y la historia de la historiografía', *Amoxtli* [Preprint], (7). Available at: https://doi.org/10.38123/amox7.205.

Santos, R.L.D.S. (2022) *Detecção automática de notícias falsas em português*. Doutorado em Ciências de Computação e Matemática Computacional. Universidade de São Paulo. Available at: https://doi.org/10.11606/T.55.2022.tde-14072022-165613.

Spector, J.M. and Ma, S. (2019) 'Inquiry and critical thinking skills for the next generation: from artificial intelligence back to human intelligence', *Smart Learning Environments*, 6(1), pp. 8, s40561-019-0088-z. Available at: https://doi.org/10.1186/s40561-019-0088-z.

Stokel-Walker, C. and Van Noorden, R. (2023) 'What ChatGPT and generative AI mean for science', *Nature*, 614(7947), pp. 214–216. Available at: https://doi.org/10.1038/d41586-023-00340-6.

Temsah, O. *et al.* (2023) 'Overview of Early ChatGPT's Presence in Medical Literature: Insights From a Hybrid Literature Review by ChatGPT and Human Experts', *Cureus* [Preprint]. Available at: https://doi.org/10.7759/cureus.37281.

Wang, T. (2023) 'Navigating Generative AI (ChatGPT) in Higher Education: Opportunities and Challenges', in C. Anutariya et al. (eds) *Smart Learning for A Sustainable Society*. Singapore: Springer Nature Singapore (Lecture Notes in Educational Technology), pp. 215–225. Available at: https://doi.org/10.1007/978-981-99-5961-7_28.

Community-Led Innovation: Lessons from VEB2023, European Capital of Culture Programme

Katalin Lőrincz[1] and Judit Hargitai[2]
[1]University of Pannonia, Department of Tourism, Veszprém, Hungary
[2]Public Foundation for the Culture of the Veszprém-Balaton Region, Veszprém, Hungary

lorincz.katalin@gtk.uni-pannon.hu
judit.t.hargitai@gmail.com

Abstract: The "Microgrant" funding scheme launched under the Veszprém-Balaton2023 aimed to ignite creativity and innovation within local communities, businesses, and organizations in Veszprém and the Balaton region, as part of the European Capital of Culture initiative. Facilitated by the Veszprém-Balaton Region Public Foundation for Culture 2022-2023, this initiative utilized a unique four-round framework wherein community-driven projects ranging from community gardens to cultural exhibitions were presented and evaluated through a community decision-making process. Utilizing a cooperative board game format, the community decision-making process ensured diverse perspectives were considered, fostering consensus among jury members. The Microgrant project, with a funding pool of HUF 350,000 (approx. EUR 915), sought to empower local communities by supporting small-scaled projects all year round. These projects not only enriched the local cultural landscape but also fostered community cohesion and engagement. The research methodology approached the issue of social innovation from several angles. Structured interviews were conducted with VEB2023 staff (7 people) to map the application process and the community decision-making process, a questionnaire survey measured the opinions of jury members involved in community decision-making (64 people), and spatial and thematic characteristics were used to examine the 241 winning mini-proposals. The paper delves into the practical implementation of community decision-making process, focusing on innovation, sustainability and adaptability. Beyond economic considerations, these initiatives have indirectly contributed to enhancing the subjective quality of life, diversifying the cultural offerings of the Lake Balaton region, and shaping the attitudes of residents towards community involvement and cultural preservation. Based on the outcomes, new inquiries arise: How can we leverage community decision-making, a methodology closely intertwined with the social dimension of sustainability, in forthcoming initiatives? How might this approach be flexibly adapted to various settlement and spatial development blueprints? And what are the key attributes that describe the potential of small-scaled communities?

Keywords: Microgrants, VEB2023, Spatial and Thematic Characteristics, Community Decision-Making, Social Innovation

1. Introduction

Community decisions are often based on the assumption that groups usually make better decisions than individuals. In other words, more eyes see more of the important information; open discussion helps to consider aspects correctly; members of the group feel the decisions made together more their own, and those in charge are also more motivated to implement them (Waldmüller, 2010). At the same time, several authors (Arrow, 1951; Weber, 1978; Czibor, 2014) emphasize that (average) persons, as members of the community, use the information available to them in distinct ways, and in decision-making situations their rational behaviour is also different. Many varying points of view can be discovered regarding the nature of community decisions. According to Arrow's (1951) "Impossibility Theorem" community decisions are never coherent and they are inconsistent. Community decisions are not made in a vacuum: they are influenced by the previous decisions, the practical issues of the given moment, the abundance or lack of information, as well as the credibility, reliability of information, and the low level of time investment and "attention" (Johnson, 1999; Szántó, 1999).

What does community involvement, or in a narrower sense community decision-making mean in practice and how can this be applied in projects that strengthen cultural and social sustainability? What experiences can be drawn from the endeavours of European Capital of Culture (hereafter ECOC) projects in this direction, and how can the methodology of community decision-making be further developed? In this study, after a brief summary of the theoretical background of the concept, the authors present specific ECOC solutions (Wroclaw, Rijeka).

In 2023, in the Veszprém-Balaton region of Hungary, the microgrants served as a functional and applicable good practice. During the primary research, structured interviews were conducted with the grant experts, while the local actors, involved in the jury evaluating the applications, took part in an online satisfaction survey. The study presents the spatial and thematic characteristics of the implemented microgrants, as well as the opinions of the applicants, based on the microgrant reports and a questionnaire survey.

2. Theoretical Background

2.1 The Scientific Background of Community Decision-Making

Community decision-making goes back thousands of years, since it has always been typical in small communities to decide together on matters affecting everyone. With the development of modern societies and the population growth, this form of decision-making has been pushed into the background in most places (Barr-Hashagen, 2000). We had to wait until the end of the 20th century for the big political and economic institutions to rediscover the power inherent in community decision-making – of course, this also required that it has become easier than before to reach and organize people with the development of information and communication technology.

The theory of community decisions (public choice theory) is basically a scientific field at the border between political science and economics. The subject of its interest is similar to that of political science, but its methodology differs from that: it uses the well-known and proven tools of economics concerning the study of human behaviour (Szabó et al., 2020). Its fundamental finding is that actors in the government sector behave similarly to market actors and pursue their own individual goals in their actions and decisions, striving for individual profit maximization.

The theory and practice of community involvement (the following terms are also used: participatory decision-making; participatory budgeting; social participation in planning, design; public support for participation in local development) are among today's prominent social issues. In a broader sense, community decision-making is part of the so-called community development, which can also be interpreted as an activity open to interdisciplinarity (Vercseg, 2020). This process can apply to changes in any area of life, and its basic purpose is to involve those concerned in community action, in becoming more active citizens. According to Henderson (2005, 2006), the concept of community development is increasingly being replaced by the terminology of community involvement (community engagement), which assumes social justice, participation, equality, learning and cooperation in the selection of values.

Community decision-making (citizen decision, participatory decision-making) can also be understood as a kind of social participation, where local actors are informed and consulted, but at the same time a more active participation and involvement (cooperation, empowerment, transfer of power, delegated decision-making) is realized from the community's side. In relation to local governments social participation is an active learning process that "provides the opportunity to express various points of view and ideas. Another advantage is that information that was previously not known to everyone is often published, points of view generally converge, and solutions can be outlined that serve to satisfy more and more actors" (Pallai, 2010:11).

The participatory (or participation) decision-making process, which is closely related to the topic, primarily means a freely chosen decision-making method that the manager chooses for the tasks to be solved in a given project. This choice applies to a specific project, so the leader's freedom is not impaired, but strengthened by this option, and the leader's solution toolkit is expanded, which can be used for the benefit of the given community. In his study, Németh (2021) presents the applicability of the method in connection with case studies in Esztergom and Nagymányok.

Dobay-Tzadok (2006) examine the dilemmas of community decision-making in practice in the case of a settlement (Modi'in, Israel) where, as a result of modernization, a difference of interests is formed within the community. In connection with the specific international case study and research results the authors state that human rationality is limited, the expertise and receptiveness of the participants in community decisions is finite, so the experts supporting the decision-making processes must adapt to this.

Examining new forms of cooperation and studying urban development based on social innovation (URBACT programme) experts emphasize active, participatory initiatives (Veresné Somosi – Sikos, 2023). According to their opinion, in a new local government model – in relation to the factors of operation – the acting and cooperating task of local government, the function supporting citizen decision should be emphasized (URBACT II Capitalisation, 2015).

2.2 The Role of ECOC Programs in Community Building and Community Decision-Making (International Examples)

The European Capital of Culture project can be considered one of the most successful initiatives of the European Union: in recent decades it has been proven that, in addition to stimulating cultural life, moreover economic, community and urban development, the event can also play a significant role in tourism in the participating cities (Lőrincz, 2017). Based on experience winning the title improves the international visibility of the cities and a significant tourism activity starts in the towns, moreover the local communities also benefit from the renewed cultural offer, thus the image of their place of residence improves in their eyes as well (Richards, 2020). Since the mid-1990s, and especially in the last decade, many ECOC programs have placed special emphasis on audience development and cultural engagement, which affect both the balance of their cultural programs and the design of specific projects and events aimed at involving local communities (Tommarchi et al., 2018; Demartini et al,. 2020).

Recently several ECOC programs have successfully implemented the microgrants scheme, among which the good practices of Wroclaw and Rijeka inspired the staff of VEB2023:

- Thanks to the "microGRANTS ECoC 2016" program in the European Capital of Culture Wroclaw 2016 project, city dwellers and local communities were able to realize their ideas related to community, cultural and educational initiatives (https://www.wroclaw.pl/rozmawia/mikrogranty). In Poland, the slogan "Spaces for beauty" of the microgrant program was the same as the title of the successful ECOC application. In this scheme each winning project could receive financial support of up to 5,000 zlotys (approx. 457,000 forints or 1,170 euros in April 2024). In the ECOC program of Wroclaw the range of applicants was extremely wide: private individuals (adults), informal groups with adult representatives, non-governmental organizations, home owners' associations, social cooperatives, church institutions and religious organizations could apply. Applications submitted online were evaluated by an external, independent jury based on a predetermined point system. The microGrants program is successful and continues to this day: from 1 to 15 May 2024 individuals, civil communities and young people can apply with initiatives related to animation, recreation, education or art.
- The Rijeka2020 European Capital of Culture programme also encouraged community participation. The aim of the project running under the slogan "Port of Diversity" was to create the city of culture and creativity for Europe and the future. On the one hand the organizers invited the Rijeka population and civil organizations to propose minor greening projects and to organize cultural and artistic events in the city districts. The invitations also included applications for the "Civil Council", in which members of the local population evaluated the quality of the submitted applications and selected the best ideas deemed worthy of funding. In the framework of the ECOC programme many individuals and civil groups responded to the call, submitting a total of 141 projects. 155 local residents applied to participate in the "Civil Council" (Partner project • Rijeka 2020). The initiative is still alive today under the name of "active citizenship" (Active citizenship – City of Rijeka), leading to the participation of the local population in budget planning and adoption of the budget. "Proračun(ajme)" is a budget education game in which the citizens of Rijeka, in addition to learning about the actual budget items, can choose the projects they want to implement that are not included in the existing budget.

3. Case Study of the Veszprém-Balaton 2023 Ecoc Project: Microgrants Programme

3.1 Good Practice of Microgrants in the VEB2023 ECOC Project

The spirit of the Microgrants Program, the objective of supporting communities, was already included in the first application document of the VEB2023 project, the Veszprém2023 Bidbook, under the working title "White Spots Program" (Veszprém2023 BidBook, second round application material, 2018). During the preparatory years (2019-2022) the VEB2023 management consulted several times with representatives of European Capital of Culture programmes and experts, as a result of which the idea of a smaller grant (microgrant) scheme and the decision-making methodology involving local population were further strengthened.

At the end of 2022 the "Small-Scale Community Grants Program" (hereinafter referred to as microgrants) initiative was launched within the VEB2023 program. The microgrants scheme set three priority goals, namely education, simplified support system and practical application of community decision-making.

- Education meant that anyone who had not applied before – be it a non-governmental organization, municipality or economic operator – could try themselves in a simple scheme and achieve a sense of success. This helped these actors to apply for larger sums later and to confidently participate in more complicated procedures.
- The simplified procedure and the standard subsidy (HUF 350,000, approx. EUR 915) made it possible to apply for events and tools that were not possible to get from other sources – due to the scale –, therefore the organizers of the program considered this type of scheme as filling a gap.
- For the sake of more transparent, more diverse and more effective evaluation VEB2023 experts developed and tested the community decision-making process. The practical utilisation of the method, the eight application rounds proved its effectiveness.

The city of Veszprém won in December 2018, together with the Balaton-Bakony region, the title of European Capital of Culture of 2023. The settlements of the region could join from three counties (Somogy, Veszprém, Zala). The intention was confirmed by signing a cooperation agreement, which involved the payment of membership fees. The Microgrants Program was opened exclusively for settlements having ECOC cooperation agreements. In connection with this, the staff of the Public Foundation for the Culture of the Veszprém-Balaton Region, in close cooperation with the ECOC program, held application briefings at nine locations, preparing and informing potential applicants from the local communities. The goal was to support community events and activities with artistic-cultural or local historical values, which responded to real, local needs with a fresh approach in the fields of theatre, music, fine arts, applied arts, movement arts, dance, architecture, cultural history, local history, folk art, landscape culture and ecology.

The preparation and implementation of community decision-making, the operation of the grant scheme, and the realisation of applications mobilized enormous forces. In numbers this meant that in the four application rounds a total of 600 bids were received, and these were evaluated by a total of 64 jury members in four community decision-making rounds for the city of Veszprém and four additional rounds for the region. Taking into account the judging criteria and the application fund of HUF 84 million (approx. EUR 220,000) the jury members supported 240 winning applications. In 2023, in the Veszprém-Balaton area the programs featuring diverse themes (the most popular being music, knowledge dissemination and folk art/tradition) had an impact on the lives of more than 100,000 people, one third of whom were local residents, and 61% of whom were visitors to the settlement or tourists.

3.2 Practical Implementation of Community Decision-Making

Decisions regarding the microgrants were made based on a new kind of methodology, involving the local population. Although community decision-making (citizen decision, participatory decision-making) is not a complete peculiarity in domestic settlement development, as far as we know, no one has used it yet for application judging. Lukácsházi Gergely sociologist and Bogáti Réka lawyer from the PartLab team helped the program owners in developing this innovative form (helloveb.hu, 2023).

The volunteering jury members involved in community decision-making were selected according to demographic factors (age, gender, place of residence) and interests. The decision process itself was assisted by a moderator, furthermore a game table and tokens represented the applications. In the first step the jury members got to know the applications with the help of the presentation put together by the moderator. For each application the jurors received a short summary, a voting aid and a paper notebook, where they could write their thoughts as they proceeded. During the judging they had opportunity to ask questions about the applications and discuss them. The main task of the moderator was managing time and ensuring a tight session.

Jury members representing the population of Veszprém and the region made supportive decisions based on their own value judgments, with the help of tokens, jointly. In this process they had to convince each other, argue, and clash different points of view. At the same time the organizers of the grant scheme asked the public representatives also to rank the applications according to the four parameters of involvement, creativity, community impact and quality project planning, as well as to take into account the objective aspects included in the call for applications. With objectivity in mind jurors had to try to support programs that

- are unfeasible or difficult to implement on a business basis;
- speak to local people about passing on local traditions;
- are created with a lasting community-building intention;
- can possibly have a lasting, tangible end result;

- do not finance daily operating expenses, but use the funds for the benefit of a community.

3.3 The Process of Community Decision-Making – Experts' Point of View

Regarding the community decision-making process itself structured interviews were conducted with several VEB203 employees and experts involved in the application process, as well as with Lukácsházi Gergely (PartLab), the developer of the methodology based on playful elements. The expert discussions (involving 7 persons) touched on

- the main principles of conducting the Microgrants Program;
- the innovative elements and novelty value of community decision-making;
- application criteria (amount, location, purpose);
- the methodology of community decision-making (selection of jury members, location, moderator, playful elements), its advantages and disadvantages;
- proposals and future plans for community decision-making.

The sociologist expert emphasized that during each round of decision-making people unknown to each other sat together, and at the end of the process they achieved the final result by choosing values and in the framework of cooperation. "Judging is a great experience... we didn't know what the actual result of the decision-making would be, it was decided there on the spot." Lukácsházi Gergely emphasized. During the community decision-making techniques used in coaching and board games were used, i.e. the civilian jury members had to choose values, cooperate and then decide next to a game table, with the help of tokens. Conversation, debate, persuasion and argument appeared as key elements, and group decisions were made at the end.

Figure 1: The picture of the board game table used in the jury sessions

Source: VEB2023

The experts working in the framework of the Veszprém-Balaton 2023 programme and conducting the microgrants highlighted both the advantages and disadvantages of the community decision-making methodology (Table 1).

Table 1: Experts' perception of conducting the microgrants and the community decision-making method

Advantage	Disadvantage
close to people, humane way of working	there is not necessarily an insight into the (application) interests when selecting the jury members
impartiality, independence	registration process for jurors: the sample could not always be taken from the region
makes decision-making transparent	jurors' sensitivity to social problems – this often diverted the decision in a different direction
diversity prevails	in terms of jury members there were 1-2 repetitions, i.e.: some jury members were called for evaluation more than once.
strong community-building role	question of professionalism and competence – civilians decide
people unknown to each other sit to a table	the decision-makers do not know the applicants / the background of previously awarded amounts, they decide based on the title and content of the micro-application
jury members feel the program their own	time- and resource-demanding process
the active jury member is usually an "influencer", opinion-leader in his or her own environment	
togetherness	
the opinion must be assumed	
local patriotic spirit	
small communities see that it makes sense to get started – we pay attention to the MATTER	
the application procedure is simple and non-administrative	

Source: Own editing based on structured interviews, 2023

3.4 Thematic and Spatial Analysis of the Microgrants

The winning microgrants were analysed based on the data of simplified application accounting (data received by the Public Foundation: implementers of winning applications, locations, themes, timing, type of program, target group's size, age and locality). In this study, we present the thematic and spatial pattern.

During the year 2023 – in quarterly cycles – 240 winning applications were implemented in the settlements of VEB2023. The impact of winning applications is diverse, but focused basically on the smaller communities operating in the given municipality. Based on the professional reports received it was confirmed that the microgrant applications conveyed meaningful recreation, positive experiences and new knowledge, while the sense of identity and the local community strengthened within the settlement, the relationship among generations and between new settlers and deep-rooted residents developed in a positive direction; the passing on of traditions, the revival of forgotten habits was realized. The awareness-raising programs were characterized by joint design-creative work, and they were implemented in good, familial-friendly atmosphere. Several participants reported that they were planning to continue.

The microgrant winners (N=43 persons) named the three most characteristic terms related to the application scheme. Based on the answers, a visual word cloud can be drawn, where the expressions "simple, fast, community, creative, useful" are the most typical ones (Figure 1).

Figure 2: "What comes to mind when you think of the term 'microgrant'?" – the most typical answers of the winners (N=43)

Source: Public Foundation for the Culture of the Veszprém-Balaton Region, 2023

About the spatial distribution of microgrants it can be said that most of the programs (58) were implemented in Veszprém, followed by Balatonfüred (17) and Várpalota (10). In terms of population-application ratio we can highlight Vászoly (283 people) with 7, Balatonudvari (350 people) with 6 and Balatoncsicsó (261 people) with 5 winning applications (Figure 2). Out of the 116 settlements (approx. 300,000 residents altogether) that joined the programme, 63, i.e. 54% of the municipalities, received support from the microgrants scheme.

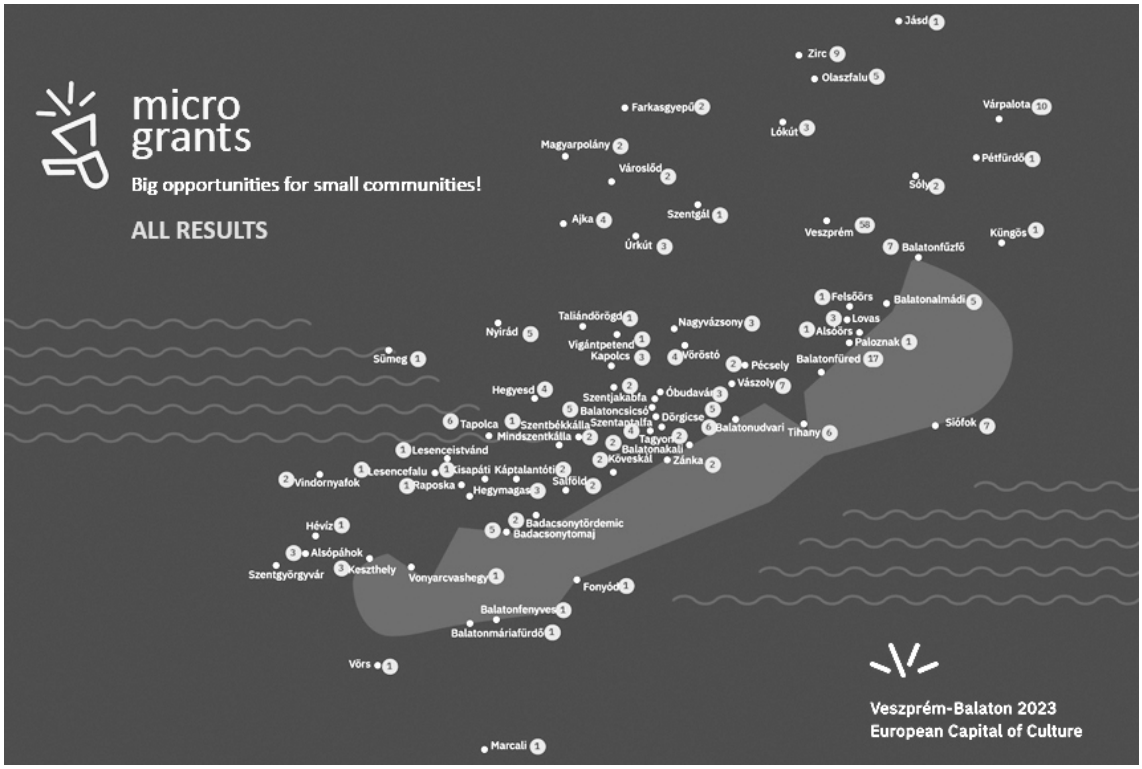


Figure 3: Spatial distribution of the microgrants

Source: VEB2023

3.5 The Opinion of Jury Members Involved in Community Decision-Making

Based on the sent invitations and contact information, each jury member was given the opportunity to evaluate the process of community decision-making and to express his or her opinion anonymously. After the judging the questionnaire sent out by the moderator concerned mainly the assessment process (fun, exciting; easy to understand, to follow; transparent; efficient and smooth), the final result of the judging work (satisfaction with the selected applications), as well as the evaluation of their own role and of the community participation experience (team spirit; moderator's work; organization; proposals for the future). Respondents rated each statement on a scale of 1 to 5, and sent their suggestions and criticism replying to open questions.

Based on 64 responses the jury members rated the jury day a total of 4.91 points on a scale of 1 to 5, which clearly shows the positive assessment. Those participating in decision-making were most satisfied with the quality of preparation, organization and execution, and least satisfied with the selection of location, the services provided on site and the "tiring" aspect of the judging process. In general it can be said that the respondents from Veszprém spoke more critically than the residents of the regional settlements (Figure 3). From another point of view, 67 jurors would gladly participate in a similar event in the future as well or recommend it to a friend or acquaintance.

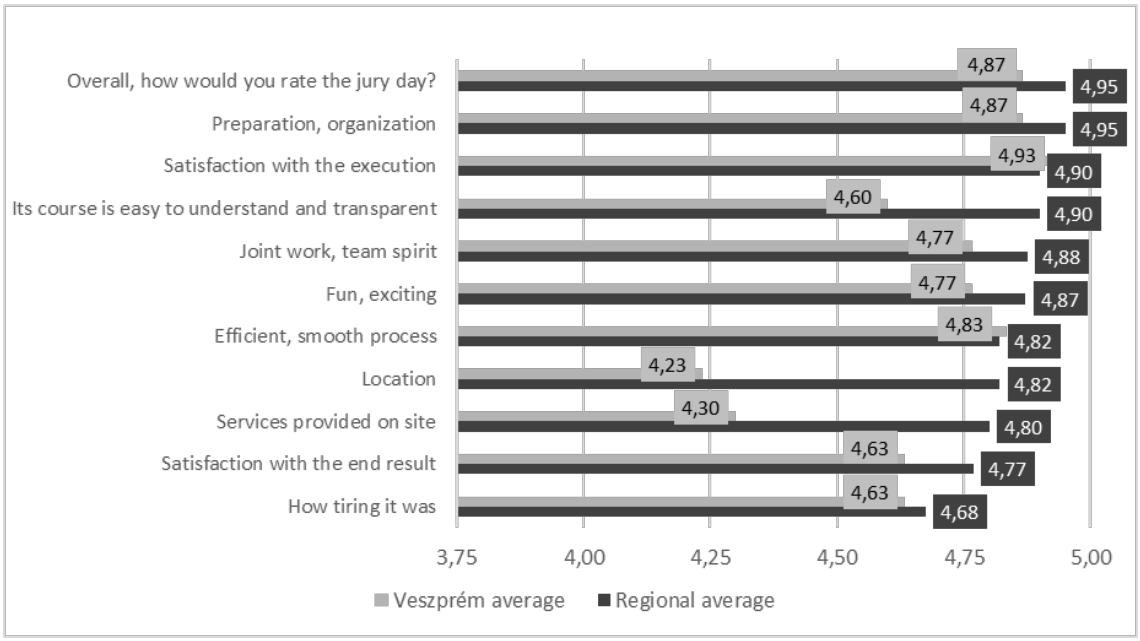


Figure 4: Judges' satisfaction with different features of the jury day, by area (N=64)

Source: Own editing based on Part Lab, 2023

4. Summary, Conclusions

Based on the results it can be said that the implemented Microgrants Program contributed to the expansion of event offerings of the European Capital of Culture thematic year, to the involvement of people living in the area of Lake Balaton, as well as to community building and awareness raising. Despite the fact that the HUF 350,000 (approx. EUR 915) standard subsidy can be considered low, 15% of the winning applicants were businesses. Starting with the second round of applications identical programs implemented in several settlements appeared, with the cooperation of municipalities. The target groups were coloured by the disadvantaged, by those who "newly settled in", as well as by the different generations. Some of the programs dealt specifically with environmental awareness (planting trees, building bird feeders, manufacturing briquette bricks, etc.), but sustainability elements (recyclable cups, plates, selective waste collection) were also often emphasized during implementation. The continuation of the realized events and making them a tradition were expressed many times as a demand.

The opinion of experts participating in the process of community decision-making and in the execution of the microgrants is unanimous regarding the continuation. In their view the methodology and approach tested also in practice can be extended and adapted to the community development activities of Hungarian settlements. In relation to the application conditions specific proposals were formulated, affecting the following criteria:

- Grant amount: a minor (inflation-adjusted) increase of the eligible grant amount, namely to HUF 500,000 (approx. EUR 1,275) for 2024.
- Time schedule: quarterly periods, a schedule adapted to seasons and special holidays as well is recommended.
- Regional distribution of the application framework, mitigation of regional disparities: if the program continues in the VEB2023 region, the proportion of the application fund between Veszprém and the settlements in the region should be one-third to two-thirds. Encouraging application activity and increasing initiative is specifically recommended for the settlements of Bakony hills and of the southern shores of Balaton.
- Application topic: the current goal – community building, development of creativity – can be extended to other areas, for example to support civil associations. The priority task of the future is to separate the goal and the means (what result the community expects and through which type of activity or program it is effectively achieved) during the presentation and development of the application idea.

- The jury involved in community decision-making: the composition of the jury, which should consist of persons selected from the community given on the basis of socio-demographic aspects, is still a determining factor for success. It is worth giving priority to diversity and the different interests of jury members, therefore a larger campaign and effective communication are recommended in connection with the recruitment of jury members.

The closing of the VEB2023 program provides an opportunity for a kind of knowledge sharing, the transfer of experiences and good practices. The experts of the microgrants plan to publish the entire methodology of participatory community decision-making (from the call to the end of applications) in a detailed guide. According to the plans the eBook format document will be delivered to as many municipalities, non-governmental organizations and grant scheme decision-makers as possible, with the intention that they will also benefit from the advantages of community decision-making. The primary academic and practical contribution of this endeavor will be the decision-making guide upon its release.

Acknowledgment

The study was carried out as a cooperation of Veszprém-Balaton 2023 JSC. and the University of Pannonia, Veszprém.

References

Arrow, Kenneth J. (1951) *Social Choice and Individual Values,* John Wiley & Sons, Hoboken, New Jersey, United States.

Barr, A. and Hashagen, S. (2000) *Achieving Better Community Development (ABCD Handbook)*, Community Development Foundation Publications, London, United Kingdom.

Czibor, A. (2014) *Döntések társas dilemmahelyzetekben: személyiségjellemzők és szituációs faktorok hatása* (*Decisions in Social Dilemma Situations: the Influence of Personality Characteristics and Situational Factors)*, PhD thesis, Pécs, Hungary https://pea.lib.pte.hu/bitstream/handle/pea/15180/czibor-andrea-phd-2014.pdf?sequence=4&isAllowed=y (downloaded: 7 March 2024).

Demartini, P., Marchegiani, L. and Marchiori, M. (2020) *Culture Invites Participation. An Inquiry on Matera as European Capital of Culture 2019,* in: Piber, M. (ed.): Management, Participation and Entrepreneurship in the Cultural and Creative Sector, ISBN: 978-3-030-46795-1.

Dobay P. and Tzadok, Y. (2006) *„Not In My Back Yard" – közösségi döntések, technológia, városfejlődés* (*"Not In My Back Yard" – Community Decisions, Technology, Urban Development)*, Tér és Társadalom 20(3), 2006, pp 1–17, Pécs, Hungary, https://doi.org/10.17649/TET.20.3.1063.

Henderson, P. (2005) *Including the Excluded*, Policy Press, Bristol, United Kingdom.

Henderson, P. (2006) *A közösségfejlesztés alapelvei és gyakorlata (Principles and Practice of Community Development),* Parola periodical, Budapest, Hungary.

Johnson, D. B. (1999) *A közösségi döntések elmélete (The Theory of Community Decisions),* Osiris Kiadó, Budapest, Hungary.

Lőrincz, K. (2017) *A fenntarthatóság társadalmi vetületei az Európai Kulturális Főváros projektben (Social aspects of sustainability in the European Capital of Culture project),* in: Comitatus különszám, 2017, pp 64–72, Győr, Hungary.

Németh, V (2021) *Magyarországi szervezeti participációs döntéshozatali jó gyakorlatok az integritásmenedzsment területén (Hungarian Organizational Participatory Decision-making Good Practices in the Field of Integrity Management)*, Belügyi Szemle, 69(3), 2021, pp 447–468, Remeteszőlős, Hungary, https://doi.org/10.38146/BSZ.2021.3.6.

Pallai, K. (2010) *Társadalmi részvétel: Bevezetés a helyi önkormányzati képviselők számára*, POLGÁRMESTER AKADÉMIA 7. *(Social Participation: Introduction for Local Government Representatives,* MAYOR ACADEMY 7*),* Budapest, Hungary, TÖOSZ, https://www.pallai.hu/wp-content/uploads/2010/11/toosz-ctp-tarsadalami_reszvetel_last.pdf.

Richards, G. (2000) *The European cultural capital event: Strategic weapon in the cultural arms race?,* International Journal of Cultural Policy, 6 (2), 2000, pp 159–181, https://doi.org/10.1080/10286630009358119.

Szabó, K., Bara, Z. and Hámori, B. (eds. 2020): *Intézményi közgazdaságtan (Institutional Economics)*, Akadémiai Kiadó, Budapest, Hungary, https://mersz.hu/szabo-bara-hamori-intezmenyi-kozgazdasagtan (downloaded: 6 March 2024, https://mersz.hu/hivatkozas/m704ik_172_p1/#m704ik_172_p1).

Szántó, Z. (1999) *A társadalmi cselekvés mechanizmusai (Mechanisms of Social Action),* Aula Kiadó, Budapest, Hungary.

Tommarchi, E., Ejgod Hansen, L. and Bianchini, F. (2018) *ECoC cities: Problematising the question of participation in Capitals of Culture,* Participations https://www.participations.org/15-02-10-tommarchi.pdf.

URBACT II Capitalisation (2015): *Social Innovation in Cities* https://urbact.eu/sites/default/files/03_socialinn-web.pdf (downloaded: 7 March 2024).

Vercseg, I. (2020) *KÖZÖSSÉG ÉS RÉSZVÉTEL. A közösségfejlesztés és a közösségi munka gyakorlatának elmélete (COMMUNITY AND PARTICIPATION. The Theory of Community Development and the Practice of Community Work)*, ELTE Társadalomtudományi Kar, Közösségi és civil tanulmányok mesterszak, Budapest, Hungary,

https://tatk.elte.hu/dstore/document/1564/Vercseg_K%C3%B6z%C3%B6ss%C3%A9g%20%C3%A9s%20r%C3%A9szv%C3%A9tel.pdf.

Veszprém2023 BidBook (2018) http://2023veszprem.hu/app/uploads/2017/09/Bid_book_2018_HU-1.pdf (downloaded: 1 February 2019), version 2 (winning application material): https://veszprembalaton2023.hu/blob/bid-book-2018-hu-1.pdf (downloaded: 7 March 2024).

Waldmüller, B. (2010) *A közösségi döntés (The Community Decision)* (translated by Németh Attila SP), L'Harmattan-Sapientia, Budapest, Hungary.

Weber, M. (1978) *Selections in translation,* Cambridge University Press, United Kingdom.

Examining the Impact of Local Developments and Effective Governance to Foster Social Innovation Practices

Tivadar Máhr and Eszter Júlia Németh
University of Pannonia, Faculty of Business and Economics, Innovation-management Department, Veszprém, Hungary

mahr.tivadar@gtk.uni-pannon.hu
nemeth.eszter.julia@gtk.uni-pannon.hu

Abstract: Social innovation grassroots initiatives play a pivotal role in addressing locally occurring problems - such as aging population, high unemployment, and inequality of disadvantaged groups - by recognizing them and responding with adequate answers that are in harmony with the needs of the local community. Therefore, focusing on the even more urgent difficulties of sustainable, bottom-up initiatives of social innovation, the balance of effective governance and locals has an enormous role in fostering real solutions. However, the process to solve these challenges is multifaceted, based on the renewal capacity of the local community that is rooted in the volume of involvement, effort and willingness to adapt and learn, including on the one hand the local inhabitants, and on the other hand the decision-makers, politicians and administrations. By examining the impacts of local developments and effective governance in the context of social innovation the authors seek answers how local developments and effective governance can contribute to enhance social innovation and what are the biggest challenges of local communities they are facing? What kind of instruments can contribute to create a positive change? With respect to the research question, the methodology contains qualitative focus group discussions, where professionals from business, academia, government, and civil organizations were asked. In conclusion, the results and novelty of the research show that local developments supporting the partnerships between the stakeholders, have a massive goal to jointly support the progress of public goods and life-quality, sustain and increase local wealth, knowledge transfer, strengthen the cohesion among locals, and support prosperity in a determined local territory. By drawing attention into real cases the authors introduce how to support social innovation in diverse areas of life through effective governance and local developments. The research emphasizes the importance of modern forms of local governance to establish an ecosystem that supports the processes of social innovation with appropriate instruments, including the capability, attitude, talent, and commitment of local governance leaders, role of cooperation culture among quadruple helix members and the necessity of knowledge transfer and adaptation between stakeholders.

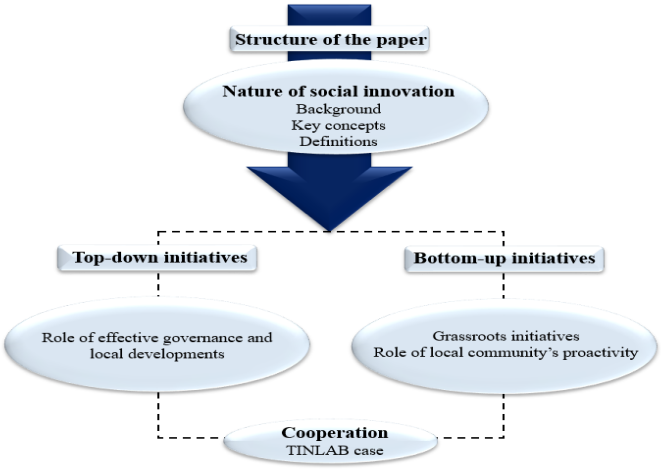
Keywords: Social Innovation, Local Developments, Grassroots Innovation, Effective Governance, Public Good, Knowledge Transfer

1. Introduction

Examining the entire nature of innovation, more specifically focusing on ***social innovation*** is a challenging, but an increasingly urgent task, due the widespread societal issues, such as aging society, gender inequality, climate change, self-evaluation problems, youths' life starting crisis or new labor necessities due digitalization (Rodek, Bogdány, Máhr, & Rentz, 2024). Of course, the list of social problems is much longer and dynamically expanding. First and foremost, approaching the term of social innovation, there is no universal consensus in its definition (Varga, 2017), however it composes many building blocks. The concept was used already by Joseph Schumpeter that serves as a worth by facilitating structural transformation in society. However it came to the mainstream in the 1990s and has been a popular topic ever since (Baker, & Mehmood, 2013). According to the Oslo manual, social innovation is a kind of innovation, characterized by "*social objectives*" aiming to increase the well-being of people or collective groups (Oslo manual, 2018, p. 252). Social innovation can arise everywhere, however areas with frequent social and environmental challenges boost its appearance (Bogdány, Varga, & Veresné Somosi, 2021). The rise of new societal needs such as modern labour perspectives, different approaches among generations, changing social relations are driving the evolution of social innovation practices and implementation of new ideas (Rodek, Bogdány, Máhr, & Rentz, 2024). Just as the basic definition of innovation implies, social innovation is characterized also as a non-linear process, wherein diverse actors come together and take joint actions, mutually put their efforts into the processes and share their knowledge to call advantageous results for life (OECD, 2021, p.12).

The necessity of social innovation practices is significant, which can emerge from ***top-down initiatives***, such as through the activities of the local governing authority or institutions, by introducing modern policies or new strategies, or from a ***bottom-up approach*** based on the proactivity of a local community. However, it is significant to understand, social innovation is a complex phenomenon, which requires comprehensive

management to understand the cause-effect relationships and to deliver proper answers for the arising necessities.



Source 1: Visual introduction

Source: own edition

Therefore the authors are focusing on how ***local developments*** and ***effective governance*** can contribute to enhancing social innovation and what are the biggest challenges of local communities they are facing? What kind of instruments can contribute to creating a positive change? With respect to the research question, the methodology contains qualitative focus group discussions in order to gain deep understanding of the topic. Among the objectives of the qualitative methodology were to gain information about aspirations and driving factors of social innovation, grassroots practices and connections of local government. The focus group discussions involved professionals from diverse areas such as from the sphere of business, academia, government, as well as locals and civil organizations were asked.

The paper has several contributions. Firstly, the research provides a comprehensive analysis about the nature of social innovation and role of grassroots initiatives, highlighting the connection to effective governance practices. Secondly, the paper identifies the significance of modern governance practices that can serve as a driving force in social innovation practices and supporting the social collaborations. By analysing the qualitative insights of the diverse stakeholders, the findings have practical implications and suggest the importance of implementing modern governance perspectives into the daily life of local governments. Overall, these contributions provide a starting point for supporting a transformation in the establishment of modern government approaches, which are beneficial for strengthening the role and impact of social innovation's grassroots initiatives.

The study is structured as follows; in the following section the article summarizes the findings of a literature review by showcasing the entire definition framework and nature of social innovation, the next section introduces the role of grassroots initiatives and role of local governments and finally the study introduces the qualitative focus group discussion results with conclusions.

1.1 Taking a Look at Social Innovation

Social innovation is not merely a by-product, it is a significant type of innovation viable on its own, and created by organization of social associations, knowledge unions to solve locally occurring societal needs, however previously it was often mentioned next to technological innovations as an integral part (Rodek, Bogdány, Máhr, & Rentz, 2024). Furthermore, the white paper of social innovation states, social innovation can strongly connect to the innovation in technology, encompasses those technological renewals that are accepted by the community (Bogdány, Varga, & Veresné Somosi, 2021). Due to the Covid-19 pandemic, the importance of social innovations has been amplified to generate adequate solutions to the diverse societal and environmental issues (OECD, 2021, p.1). However, taking a look to an earlier period, already the 2008 financial crisis contributed to recognizing the role and potency of social innovation in the level of policy generation (OECD, 2021, p.4). As Rodek, Bogdány, Máhr, and Rentz mentioned in their work, social innovation is generated to satisfy the human

needs, bring a change, broaden the capacities and allocation of resources, as well as to support the creation of new practices and ideas (2024). Therefore it is clearly visible that social innovation is multifaceted and means a process from the ideation till the realization of solutions to the locally occurring challenges. It can focus on the enhancement of social objectives, can provide new processes, methods, models or integrate diverse competencies. According to the OECD "*social innovation is generally a product of collaboration between several actors, either directly or through a trusted intermediary, which results in collective knowledge building*" (2021, p.11). The authors agree with this formulation, as well as with those who mention both collaboration and its effect on knowledge creation. Collaboration fosters knowledge transfer, the birth of new ideas, at the same time it can deliver new perspectives to the members through interaction, and finally it leads to new, creative solutions. In conclusion, the process of collective knowledge building can contribute to develop and share new practices that can ultimately support the evolution of social innovation. By taking another definition about social innovation, Mulgan's perspective states "*it refers to innovative activities and services that are motivated by the goal of meeting a social need and that are predominantly diffused through organizations whose primary purposes are social*" (2006). In this statement, it is important to highlight the dual focus of social innovation, that is on the one hand seeks to realize innovative outcomes and on the other hand aims to implement social impacts. Moreover, referring to the views of Varga, there are diverse factors that foster social innovation practices. Among these, it is useful to note the aim to identify new, effective and sustainable solutions to locally occurring barriers and needs, while also fostering cooperation and interaction among locals (Varga, 2022). By examining the complex nature of social innovation, multifaceted components and intricate interplay can be seen between the actors. This is clearly visible in the work of who mentions the differences between the basic type of innovation and social innovation. In the social type, the action goes beyond the individual level, and demands interaction that has a societal impact. "*The reconfiguring of social practices, in response to societal challenges, which seeks to enhance outcomes on societal well-being and necessarily includes the engagement of civil society actors*'' (Polman, Slee, Kluvánková, Dijkshoorn, Nijnik, Gezik, & Soma, 2017, p.4). Phills and colleagues' mentioned the financial aspects of the innovation process that is used to gain social value and benefits so in line with the statements social innovation can be defined as a "*novel solution to a social problem that is more effective, efficient, sustainable, or just than existing solutions and for which the value created accrues primarily to society as a whole rather than private individuals*" (Phills Deiglmeier, & Miller, 2008). Taking conclusions about the definitions, existing studies concentrate on the diverse background of social innovation, whereas it is clearly visible that the driving force of social innovation is the increase of social well-being, to foster social change and positive development by taking into consideration the local circumstances. In addition, these definitions deliver broader connotations, in which the role of collaboration is meaningful, due to knowledge transfer and creation activities that can support the progress of social innovation.

Many elements encompass the initiation or hindrance of the movement of social innovation. As in a basic form of innovation, so in social innovation creativity plays a huge role to find renewed practices to local problems. Additionally, worth remembering, it is a demand driven procedure, which requires specialized solutions to the local circumstances, needs and obstacles (Bogdány, Varga, Veresné, 2021). These currently occurring local challenges make it necessary to establish new ways of collaborations among locals, different institutions like the government, industry or academia, to identify and realize the stakeholders and create a live cooperation by calling them (Varga, 2022). Therefore, joint cooperation of the heterogeneous stakeholders supports the evolution of the processes. At the same time, by involving and engaging the heterogeneous actors an open knowledge flow is characterizing the complex framework of social innovation. Consequently, the holistic approach of social innovation demands expertise, willingness, trust and involvement of locals into the decision making (Varga, 2022). Taking an example, many times there is a lack of knowledge on local levels therefore the benefits of social innovation cannot be fully exploited (OECD, 2021, p.4).

In conclusion, as the definition of social innovation suggests, the concept is multifaceted, encompassing several fundamental elements. Focusing on the origin of social innovation, it is driven by collective actions of the heterogeneous stakeholders aiming to address locally occurring societal challenges. The interacting community, the engaged people serves as a supporting source of its progress. Based on the statements, there is a prevailing consensus that social collaboration plays a major role in order to effectively contribute to a positive change in the well-being of a local community. To explore the broad context of social innovation, the next section seeks to explore the role and possibilities of grassroots initiatives in social innovation practices.

1.2 Grassroots Innovation

There is a prevailing consensus, that social innovation has a growing importance and a significant task for the future to minimize the current locally occurring problems (Rodek, Bogdány, Máhr, & Rentz, 2024). A considerable amount of literature has been published, initiating social innovation practices can come from two main directions. On the one hand, it can begin as a "*top-down*" action -originating from the local government - or on the other hand it can emerge as a "*bottom-up*" or "*grassroots*" proposal – driven by the local proactive community (OECD, 2021, p.12). Other voices concern three different social innovation sources, the grassroots innovations of civils, responses to local needs and thirdly as a renewal and transformation process (Nemes, & Varga, 2021 as cited in Rodek, Bogdány, Máhr, & Rentz, 2024).

Notably, bottom-up initiatives have a major role in the development of social structures and community competencies. These initiatives arise locally, seeking to find answers for the urgent, uncomfortable local problems or needs. This requires the local stakeholders to discuss all approaches as well as to support the initiatives (OECD, 2021, p.12). By accepting the statement, grassroots activists can generate sustainable solutions for local situations by approaching the local interests, framework and value system. According to the research of Bogdány et al., grassroots innovation can deliver several advantages for a community. First of all, there is a community level advantage, which means new work possibilities or community services. On the other hand, the change of ideology can be mentioned among the advantages that can be gained by grassroots innovations (2021). Many studies have concerned the impact of grassroots innovation and naming as a community innovation. Recent evidence suggests it is a great source of renewal within the local community. Moreover, going beyond the source and output of grassroots innovation, education and community learning are inseparably connected to it. Approaching beyond the process, among the stakeholders there is a knowledge sharing, therefore an open innovation is characterizing the process (Rodek, Bogdány, Máhr, & Rentz, 2024).

Throughout the examination of the non-linear social innovation bottom up initiatives, diverse actors - including the members of the public-, private- organizations, NGOs, the civil society, governmental actors, or academia - are cooperating (OECD, 2021, p.14). Therefore social innovations are characterized by even bigger complexity, which requires a strong collaboration, proactive engagement from the heterogeneous actors and agility (OECD, 2021, p.17). Additionally, the supporting environment is a powerful factor in the process and contributes to the successful end result. So, managing and mentoring the entire process is a significant task (Katonáné Kovács, Varga, & Nemes, 2017) and not just the locals should understand its importance, but the local government should realize the power of it.

1.3 Effective Governance and Local Developments

According to the white book of Social Innovation National Laboratory (TINLAB), social innovation requires both top-down, government driven and bottom-up, citizen led engagements in which territorial networking has a great role to be effectively coordinated by the actual social needs (Bogdány et al., 2021). TINLAB came to life in 2020 in a partnership of four consortium members, namely with three universities and one foundation. The consortium is led by the Eötvös Lóránd University, joint partners are the University of Pannonia, University of Miskolc and Hárfa Foundation. The objective of the consortium is to support social innovation initiatives and practices and to create a knowledge pool due the diverse network of the Quadruple helix members. Therefore TINLAB identified significant focus areas like digitalization, future of labor, climate protection and determined clear activities to support social innovation practices such as through thematic forums, social innovation trainings for mentors and managers or by the support of pilot projects in social innovation initiatives. Recognizing these social dynamics, political structures should adapt to better address the local needs. Modern perspectives in effective government are vital in order to provide adequate answers for the locally emerging social needs. In line with the above mentioned, collective actions and co-production with the locals are essential in this regard. Networks among heterogeneous actors are playing pivotal roles. Strong social ties are connected to effective networks and can help to overcome cultural obstacles. This can also promote synergy, as well as foster inclusiveness especially in vulnerable communities. Furthermore a socio-political transformation is essential, necessitating new perspectives in governance which emphasize the role of grassroots initiatives, prioritize the importance of involvement of locals in the decision-making processes and at the same time to hear the voices of the citizens (Galego, Moulaert, Brans, & Santinha, 2022).

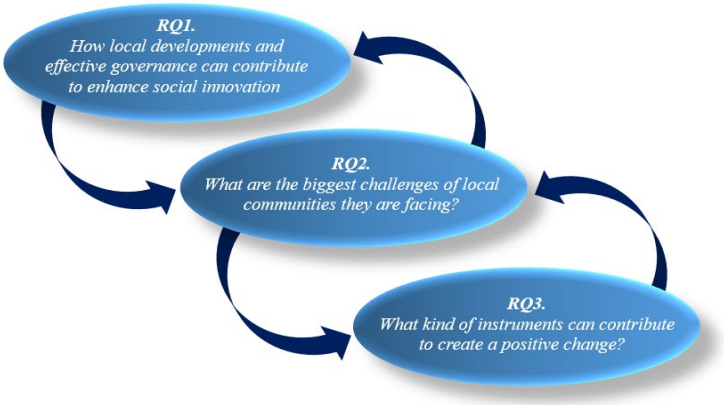
Effective local governance relies on good management practices and proper skills. In the case of social innovation, urgent local problems should be effectively realized, evaluated and on the long run properly solved in line with the local value of the community. Therefore, knowing the local circumstances serves as a baseline in the decision making processes (TINLAB, 2021, p.5). According to the work of Pálné Kovács, a good local governance is characterized by the capability to provide locally good solutions. Furthermore, good governance is democratic, efficiently manages the duties, transparent for everyone, legal, thinks and acts in a future oriented manner, behaves ethically and as a service provider. Also important to be open and supportive for the initiatives. An effective local governance based on local knowledge, that is a great resource for effective developments. Last but not least, it is important to mention the leader, who has a vital role therefore a great leadership and adequate style is necessary. In conclusion, city mayors should connect to both local and global knowledge, should build networks and mobilize them (Pálné Kovács, 2015) to foster developments. As an example of the URBAN program's town level social innovation, the role of effective governance is visible. In line with the previous authors, local areas have a vast duty to realize their characteristics and values. By knowing them, they can exploit their collaboration in which social innovation is a tool to support the processes. As a task for the local government, to work together with the locals, involve and empower them, while they cannot act as isolated actors. In conclusion, a holistic perspective is needed from the local government to be able to act effectively (Varga, 2017).

Social innovation is a great catalyst of sustainable development. Effective governance can foster sustainable social and environmental interactions. The governance has the power to create a bridge among the actors and with the tool of social innovation traditional rules can be challenged and exchange mechanisms can be established among the diverse actors, by at the same time responsively creating modern governance structures (Baker, & Mehmood, 2013). Moreover, social innovation impacts the development of a region, however as noted by Katonáné Kovács, Varga, and Nemes, the contribution cannot come to life without a supporting environment, engaged and empowered mentors (2017). Therefore, within the process of social innovation, highlighting the role of grassroots initiatives is vital, that can address locally occurring necessities to find proper solutions in balance with the needs of the local community (Katonáné Kovács, Varga, & Nemes, 2017). Bottom up initiatives are increasingly valuable, local governments should realize their power, and promote them. To properly foster social innovation practices new governing approaches are needed. Local governments should understand its entire nature, empower and involve locals into the real decision making processes by listening to their voices (Varga, 2017).

Local governments have a great responsibility in social innovation practices and play crucial role in fostering local developments in the horizontally and vertically wide area of social innovation. The relevance of the topic is based on the growing demand for effective solutions, due the local demands (Rodek, Bogdány, Máhr, & Rentz, 2024), therefore collaboration of local governments with social innovators is vital. This requires an open working manner to establish development plans and ideas based on local needs, and support the engagement of heterogeneous members, namely the Quadruple helix members. This joint engagement and strong participation serves as a significant basis to reach common goals in local developments by improving the quality of life, leveraging local assets, and strengthening social cohesion. In conclusion, local developments encompass a wide range of activities with the objective to support social and economic progress through joint participation (Bogdány et al., 2021).

2. Methodology

By examining the impacts of local developments and effective governance in the context of social innovation the authors seek answers for the following research questions:



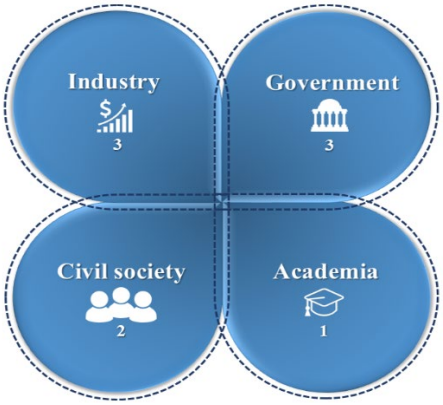
Source 2: Research questions

Source own edition

To shed light on the above concerns, qualitative focus group discussion was used to analyze the situation deeply. According to the research objectives, a qualitative focus group methodology is a great tool to capture diverse viewpoints and gain insights about real life experiences (O. Nyumba, Wilson Derrick, & Mukherjee, 2018). However this methodology is only one small part of the TINLAB project in which all of the pre-defined research areas of social innovation were examined and asked through focus group discussions (FGD).

The methodology enables to collect attitudes and aspirations on the topic of local developments, effective governance in line with social innovation practices. The focus group interviews were conducted with participants from the academia-government (local)-enterprise-civil networks. They represent the large urban and rural areas, but also the developed capital and West-Hungarian region and the less developed East-Hungarian region. Participants have at least 10 years of experience in their field and an extensive personal network of contacts, giving them a broad perspective on local development and governance. Participants were selected based on personal approaches, with the main criteria being their role in the four-helix model, their professional experience and their network of contacts. The expertise of the interviewees invited was the primary factor in the selection process, while their other (e.g. political) views and motivations were not explored and thus not taken into account. A further criteria was that participants should be territorially representative of both metropolitan and rural areas, and geographically representative of both developed and less developed rural areas.

The FGD were conducted online. Based on the guideline of a pre-defined focus group guide, in approximately 110 minutes, 4 blocks were asked. These sections contained the challenges, innovative solutions, sources of involvement of the local community and networking platforms. The trained moderator guided the discussion. The article synthesizes the results of 2 focus groups, altogether the answers of 9 participants.



Source 3: Participants of the focus group discussion

Source own edition

3. Results

By summarizing the main findings of the DGD in the topic of effective governance and local developments, several meaningful challenges have been identified. First of all, **attitude and abilities towards social innovation practices and local developments.** Questions are arising often whether the local government is capable of supporting social innovation practices and capable of creating a supporting environment, while very often the abilities are lacking. Also a problem can arise when the leadership cannot demonstrate that it has power in its hand and cannot effectively manage the local challenges. Therefore talent and attitude are important factors especially in smaller communities in case of the developments. Local governments do not always realize its role in the local developments, especially in the case of the establishment of economic development strategies, however that would be useful.

"...I think one of the most important factors, whether your leadership can demonstrate to the local community that you have some tools in your hands to solve problems effectively."

Secondly, **resources and cooperation can challenge the effectiveness of local governance.** Very often, local resources like human, expert, economical ones are underutilized due strict rules and tight perspectives of the local governance.The local government suffers from the lack of resources, especially human resources which limit the openness towards social and economical innovations. There is a low level of cooperation among the local actors that serves as a barrier. On the contrary, a competing behavior is characterizing the interaction of the governmental, civil and industrial sectors. Even in the age of globalization, digitalization, and industry 4.0. there is a low level of interaction in the local governmental sector. Communication with the diverse stakeholders is also on an improper level and the local leadership has not followed the speed of the expected development.

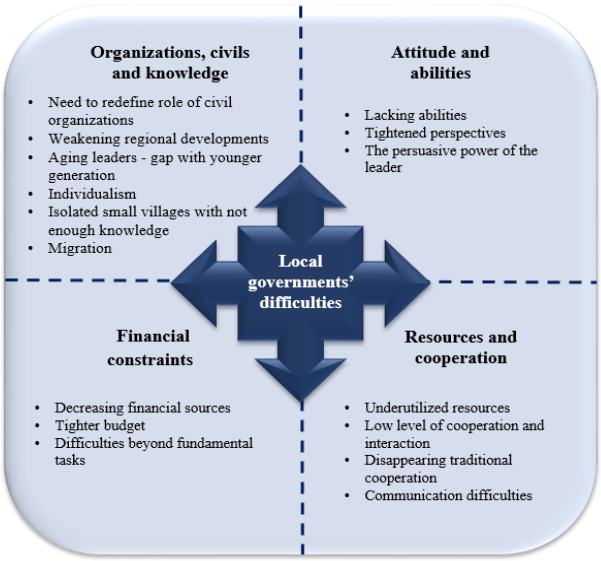
"...The existing attitude system is a challenge. For example, when two local markets organise, they immediately see themselves as competitors to each other, rather than saying that they align their calendars and one operates on Wednesday and the other on Saturday, in effect living better together, working together. Without coordination at the municipal level, it doesn't work. In a good case, it's done by a mayor or someone who is a pretty strong public figure in the city. In the absence of such people, there is no central coordinating force to drive good will towards cooperation. They cancel each other out as competitors…"

Thirdly, **different organizations, civils and knowledge impact evolution.** There would be a need to redefine the role of civil organizations, while they can support the social innovation practices. The Middle level of regional development has been weakened. The aging leaders of these organizations could not provide a renewal and there is a gap with the younger generation, who live in their online environment. An increasing individualism describes the current environment in the local communities. Traditional cooperation disappeared and was replaced by new online ones. There are several difficulties in isolated small villages where there is not enough knowledge, however at the same time there is a great need for innovations and solutions. Furthermore, migration is a significant issue. Visible the fact that big cities from smaller towns and foreign possibilities from big cities absorb the people with more education and work possibilities.

"The issue of emigration and how to deal with it is a significant one. Large cities absorb the adult population, thanks to educational institutions and job opportunities."

Finally, financial constraints characterize the situation. The **financing sources are decreasing**. Local governments are facing difficulties. Beyond the fundamental task there is a lack of financial sources.

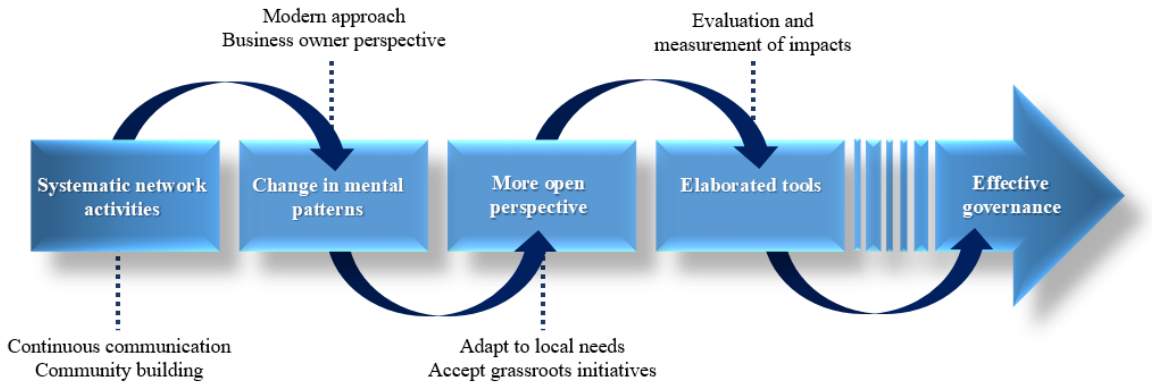
"There is no social innovation without the economy - it will finance it later. The two cannot be separated, social innovation itself has to figure out how it fits into the economy."



Source 4: Difficulties of local governments

Source own edition

In order to solve the challenges there is a need for the establishment of a local ecosystem in which the heterogeneous actors can collaborate and act for a common social goal to increase the well-being of the local community. According to Rodek, Bogdány, Máhr, and Rentz's work, the ecosystem is a network of actors whose both individually and collectively contribute to the knowledge creation, development of new solutions in a loose or tight cooperation form. Innovation ecosystem is a dynamically changing collaboration of the heterogeneous actors, who has a common specific objective that is carried out within the framework of innovation ecosystem (2024).



Source 5: Building components of effective governance

Source own edition

Based on the opinion of the FGDs' participants, not just cooperation but the process should be supported by a **more systematic networking activity**, which serves as a tool for supporting communication and community building, contributes to creativity, knowledge exchange and idea generation for local problems. This can support the evolution of the local ecosystem that serves as a framework for the local developments. As for the **local government, a change in the existing mental patterns** are needed. The old working manners should be replaced by a new, business owner perspective, in which they realize their power to facilitate real solutions and to support the other helix actors. There is a need for the **open perspective** from the centralized governance to adapt to the local needs and to accept the community innovations. Finally, **elaborated tools** should be generated for evaluation and measurements of the impacts. These can serve as a useful guide in the process of effective governance and can support the grassroots initiatives.

4. Discussion

Summarizing the literature, social innovation gains vast importance nowadays, due to the dynamically changing circumstances that are challenging local communities (Rodek, Bogdány, Máhr, & Rentz, 2024). As the definition itself suggested, social innovation provides a solution for locally occurring necessities, trying to raise living conditions (Oslo manual, 2018, p. 252) by actively involving and engaging heterogeneous actors. At the same time, the concept draws the attention to the importance of collaboration whereby difficulties could be effectively solved (OECD, 2021, p.11). Therefore the mutual participation of both top down approaches from the governing authorities' side and local communities' grassroots initiatives are equally important for the long term success (Bogdány et al., 2021). Exploring deeper into the research topic vertically, local governments have significant importance and contribute to the local developments. This requires a modern, adaptive and open perspective and a supportive yet powerful leadership (Varga, 2017). Through qualitative research, the authors examined the topic and found answers regarding RQ1, how local developments and effective governance can contribute to enhance social innovation. By looking for answers, the participants highlighted the importance of major areas. Proper attitude and abilities are necessary for effective governance. These can significantly encourage social innovation practices, foster cooperation and diverse partnership due to an open and flexible attitude. At the same time the establishment of a supportive environment is vital to assist grassroots initiatives, to understand the local needs yet to know the local possibilities and circumstances. However this requires adequate skills, to be able to create a collaboration with the Quadruple helix members, involve and engage the civil society as well as to mobilize human and financial resources. Furthermore, the RQ2 focused on challenges faced by local communities and suggested that there are often issues with the outlook of local governments. It highlighted the necessity that local governments need to adapt to the current local demands by presenting a modern perspective in order to properly arrange social innovation initiatives and support the flow of local developments. Local communities often feel the lack of a supportive environment due to the old mental patterns, budget constraints, low level of cooperation, aging local governmental leaders, tight perspectives, changing cooperation forms, isolation among groups and low level of communication. The listed barriers require adaptive, flexible and open behaviour from all of the Quadruple helix members to find solutions and eliminate the challenges faced by local communities.

In search of solutions the study draws attention to the instruments that can contribute to positive change. As it was mentioned previously, collaboration among the diverse actors, involvement of the local communities, openness from the side of local governance to the grassroots initiatives are building components of the solution. So this requires a well-defined concept or in other words an itinerary that supports the local governments. Therefore, as a suggestion of the authors, local governments should establish a systematic network activity in which proper and continuous internal and communication as well as networking have a necessary role to strengthen the local ecosystem. Secondly, there is an urgent need to transform the existing mental patterns by replacing modern, collaborative, involving, encouraging and business owner perspectives. Thirdly, mentality should be changed. Local governments should be open and curious to the local challenges, needs and possibilities to support the grassroots initiatives by understanding the local environment. That is a challenge however a must in the long run. Last but not least, as in all project, the evaluation of the processes and measurement of the impacts should be part of the local governments' transformation to evolve continuously with the local needs. Consequently, these results provide an important insight into the importance of modern governance perspectives that should be realized by the local governments in order to exploit the possibilities of local circumstances and be able to manage the complexity of social innovation practices to the locally occurring urgent challenges.

5. Limitations

To enhance the rigor and transparency of the study, it is necessary to address the limitations of the study comprehensively. The objective of the small number of focus group discussions was to start a vast research by gaining insight about the both horizontally and vertically broad topic and to monitor the significant elements by important members of the social innovation. However, the current research contains limitations and bias concerning the qualitative methodology due to the reached target groups and the small sample size. First and foremost, the methodology of the research relies only on a focus group discussion conducted online in Veszprém, Hungary. The way supported the communication, made it possible for the researchers to depict the topic with the help of analysing verbal communication elements, however as for the potential bias, the focus

group discussion's online form and the role of the moderator may influenced the perspectives and the interaction of the participants. The online form restricted to analyse nonverbal communication elements. While the research addressed at least one of the representatives of the quadruple helix based on the 3-pillar selection criteria that was necessary to find diverse perspectives from actors, on the other hand the size of focus group discussion was limited. Only 2 rounds of focus group discussions were implemented with a total of 9 people, who may not fully capture all of the perspectives. Therefore the reliance of the focus group discussion is not relevant and only a snapshot can be seen. However, in line with the previously highlighted limitations, further elaboration of both quantitative questionnaire and qualitative structured expert interview research is needed to gain a more specific and detailed insight about the nature of social innovation, impacts of local developments and effective governance from the bottom and top sides of the actors. The authors acknowledge the importance of the topic and recognize the necessity for comprehensive research methodologies, therefore with the help of mixed methodology, the research will be continued. This future direction support on the one hand the quantification of the data, by reaching the quadruple helix members and on the other hand a deeper understanding of the current results.

References

Baker, S., & Mehmood, A., (2013). Social innovation and the governance of sustainable places. *Local Environment,* http://dx.doi.org/10.1080/13549839.2013.842964

Bogdány, E., Varga, K., Veresné, S. M. (szerk.) (2021): *Társadalmi innovációs fehér könyv.* Miskolci Egyetem.

Elte.hu (n.d.) NATIONAL LABORATORY FOR SOCIAL INNOVATION (TINLAB) Together for an innovative society Retrieved on 2024.03.21., from https://www.elte.hu/dstore/document/11130/tinlab_szorolap_a5_online_angol.pdf

Galego, D., Moulaert, F., Brans, M., & Santinha, G. (2022). Social innovation & governance: a scoping review. *Innovation: The European Journal of Social Science Research,* 35(2), 265-290.

Rodek, N., Bogdány, E., Máhr, T., & Rentz, T. (2024). *Bevezetés a társadalmi innovációba.* Akadémiai Kiadó

Katonáné Kovács, J., Varga, E., & Nemes, G. (2017). Fókuszban a társadalmi innováció folyamata a magyar vidéken. *Észak-magyarországi Stratégiai Füzetek*, 14(1), 6-19.

Mulgan, G. (2006). *The process of social innovation.*

Nico Polman, Bill Slee, Tatiana Kluvánková, Marijke Dijkshoorn, Maria Nijnik, Veronika Gezik, Katrine Soma, (2017). Social Innovation in Marginalised Rural Areas Call: H2020-ISIB-2015-2 Innovative, Sustainable and Inclusive Bioeconomy. Report D2.1 Classification of Social Innovations for Marginalized Rural Areas, SIMRA, London

OECD (2021), "Building local ecosystems for social innovation: A methodological framework*", OECD Local Economic and Employment Development (LEED) Papers,* No. 2021/06, OECD Publishing, Paris, https://doi.org/10.1787/bef867cd-en.

OECD/Eurostat (2018), *Oslo Manual 2018: Guidelines for Collecting, Reporting and Using Data on Innovation, 4th Edition,* The Measurement of Scientific, Technological and Innovation Activities, OECD Publishing, Paris/Eurostat, Luxembourg. https://doi.org/10.1787/9789264304604-en

O. Nyumba, T., Wilson, K., Derrick, C. J., & Mukherjee, N. (2018). The use of focus group discussion methodology: Insights from two decades of application in conservation. *Methods in Ecology and evolution,* 9(1), 20-32.

Pálné Kovács, I. (2015). Helyi tudás, helyi kormányzás, helyi fejlesztés. *Magyar Tudomány,* 176(2), 150-158.

Phills Jr, J.A., Deiglmeier, K., and Miller, D.T., 2008. Rediscovering social innovation. *Stanford Social Innovation Review,* 6 (4), 34–44.

TINLAB (2021. július 13.) Társadalmi Innovációs Nemzeti Laboratórium társadalmi innováció fókuszterületei - Előzetes kutatási jelentés

Varga, K. (2017). A regionális társadalmi innováció kérdései. *International Journal of Engineering and Management Sciences*, 2(4), 602-616.

Varga, K. (2022). Részvételen alapuló társadalmi innováció Encs városban. *ÉSZAK-MAGYARORSZÁGI STRATÉGIAI FÜZETEK,* 19(3), 70-83.

The Role of Stakeholders in Crowdfunding Success: Insights From a Systematic Literature Review

Maurizio Maraglino Misciagna
Dipartimento Jonico in Diritti Economie e culture del Mediterraneo, Università degli studi di Bari Aldo Moro, Taranto I Italia

maurizio.maraglino@uniba.it

Abstract: In the last decade, crowdfunding has emerged as a pivotal innovation in financial and entrepreneurial ecosystems, reshaping how projects are funded and how investors interact with emerging ventures. This paper conducts a systematic review of crowdfunding literature from 2010 to 2020 using the PRISMA method, focusing on the roles and interactions of diverse stakeholders within the crowdfunding framework. By integrating stakeholder theory, the study examines how alignment of stakeholders' interests—ranging from founders and backers to crowdfunding platforms and regulatory bodies—contributes to the success of crowdfunding initiatives. The review highlights the evolution of crowdfunding, not only as a funding tool but also as a community-building platform that leverages Web 2.0 technologies to foster interactive engagement. Findings suggest that successful crowdfunding requires more than financial transactions; it necessitates a robust ecosystem where stakeholders' expectations and contributions are clearly understood and managed. The study contributes to academic and practical understandings of crowdfunding by delineating the dynamics between various stakeholders and providing insights into how these relationships influence the outcomes of crowdfunding campaigns. Future research directions are suggested, including deeper exploration of the regulatory impacts and the long-term sustainability of crowdfunding as a finance model.

Keywords: Crowdfunding Models, Stakeholders Theory, Literature Review, Web 2.0 Technologies, Financial Innovation, Entrepreneurial Ecosystems

1. Introduction

Over recent decades, technological innovations have dramatically transformed the realms of communication and finance, fundamentally altering how individuals interact and conduct business. Among the most notable shifts is the rise of crowdfunding, which has quickly ascended to prominence as a modern financial innovation. This funding model democratizes investment, enabling thousands to participate interactively via the Web 2.0 network, thereby becoming an essential tool for SMEs and startups (Belleflamme et al., 2010). Crowdfunding allows these entities to source capital directly from the "crowd," with each contributor offering small amounts that collectively support various projects (Belleflamme et al., 2013). This method not only facilitates job creation and economic growth but also empowers ordinary individuals to influence the market by opening up new funding avenues (Sigar, 2012). As crowdfunding continues to surpass expectations, its strategic importance escalates, especially for startups that leverage innovative technologies to obtain significant financial resources. This study aims to dissect the structure of crowdfunding, focusing on the contributions and interactions of various stakeholders within this ecosystem. Employing stakeholder theory, the research seeks to elucidate the roles and impacts of the different parties involved, evaluating why crowdfunding campaigns succeed when the interests of all stakeholders align (Harrison et al., 2013; Burtch et al., 2013).

2. Theoretical Framework: The Crowdfunding

Research on crowdfunding has undergone substantial growth over the last decade. Before 2006, the literature on this subject was relatively scarce, with interest beginning to surge particularly in the United States around this time, marking it as a novel solution to the funding challenges faced by new ventures (Röthler et al., 2011). In contrast to traditional funding sources such as venture capitalists and banks—which typically invest at later, more mature stages of business development—crowdfunding provides early-stage funding directly from a diverse pool of individual backers, including friends and family (Robb et al., 2014). Initially discussed under various terms such as "social lending" and "peer-to-peer lending," crowdfunding has since emerged as a distinct and widely adopted method of financing (Hulme et al., 2006; Klafft, 2008). Belleflamme et al. (2013) identify several key motivations for choosing crowdfunding, including financial support, increased public exposure, and valuable feedback on products or services. Subsequent studies have demonstrated that successful crowdfunding campaigns not only establish market legitimacy but also significantly enhance the customer base and visibility of products (Martin, 2012; Burtch et al., 2013). Moreover, theoretical models have shown that reward-based crowdfunding can facilitate price discrimination, enabling companies to identify and target customers willing to pay premiums for early access to products (Belleflamme et al., 2010; Hu et al., 2014). This section of the literature illustrates how

crowdfunding has evolved from niche financing options into a critical tool for market access and business growth, reflecting its increasing adoption and sophistication in the global financial landscape.

2.1 The Evolution of Crowdfunding in a Digital Era

Crowdfunding epitomizes the contemporary challenge of steering global progress towards a more digital and interconnected society. Over the past decade, the evolution of Web 2.0 technologies has catalyzed the emergence of innovative business models that place the digital user at the center of consumption and production processes (Brenner et al., 2014). This paradigm shift has transformed users from mere endpoints in the value chain into integral participants and co-decision makers, compelling industries to reconfigure and embrace digital business models. Among the various forms of crowdsourcing—such as crowdvoting, crowdcreation, and crowdfunding—crowdfunding distinctively operates as an open call, primarily online, soliciting financial contributions from individuals rather than professionals. These contributions come in various forms including donations, exchanges for future products, or rewards (Howe, 2006; Belleflamme et al., 2014). While not a new concept, with historical precedents such as the funding of the Statue of Liberty's pedestal in 1885 through small donations orchestrated by Joseph Pulitzer (Harris, 1986), crowdfunding has gained substantial prominence in recent times. Notable examples include Barack Obama's 2008 election campaign, which raised $800 million, with a significant portion coming from small donors (Kappel, 2009), and its surge during the 2008-2009 financial crises as a vital funding avenue for startups facing credit access challenges. Today, crowdfunding is not only celebrated as a financial innovation but also hailed as a democratizing force in finance and knowledge dissemination, albeit not without risks of misuse, necessitating continuous vigilance (Shiller, 2013). The essence of crowdfunding lies in leveraging technology, capital financing, and the power of the crowd, which collectively enable the accumulation of significant financial resources through small individual contributions (Beaulieu et al., 2015). Its participatory nature, which enhances its effectiveness through group involvement, contrasts sharply with venture capital's selective focus. Analysis of data from successful Kickstarter campaigns and venture capital investments in the US between 2009 and 2015 illustrates how crowdfunding has served as an alternative funding channel during periods of venture capital scarcity, overcoming the geographical limitations inherent in traditional venture financing (Sorenson et al., 2016). Unlike venture capital, crowdfunding's democratic nature allows for broad participation with minimal capital, though it typically affords backers less control over funded enterprises (Mollick, 2013). As a result, crowdfunding has emerged as a versatile and influential term that encompasses various digital fundraising strategies, fundamentally reshaping the landscape of entrepreneurial finance (De Crescenzo et al., 2020).

3. The Ecosystem of Crowdfunding Stakeholders

Crowdfunding is distinguished by a diverse array of actors, each crucial to its success. For newcomers, crowdfunding might appear as an expansive network of individuals, often referred to as the "crowd" or "community," where anyone can financially support an idea or a startup. However, the reality reveals a more sophisticated stakeholder approach, where aligning the interests of all parties is essential to enhance the overall well-being of those involved in the crowdfunding process (Peda, 2012; Sen, 2012). This modern phenomenon's success is predicated on the effective alignment of stakeholder interests as posited by stakeholder theory. An initial step in analyzing crowdfunding from this perspective involves identifying the needs it fulfills and how various parties contribute to and benefit from the process (Valančienė et al, 2014). The crowdfunding operation varies significantly based on how intermediaries perceive and organize campaigns (Belleflamme et al, 2013). Rather than allocating all R&D resources to internal teams, a company might invest in emerging ventures, thereby controlling their development of new solutions without direct acquisition. This arrangement allows for a broader range of minority investments and gives small entrepreneurs the freedom to innovate under the guidance of a larger firm's management, with the potential for the firm to acquire a majority stake under favorable terms as the startup matures. Intermediaries play a crucial role as they influence numerous aspects of a campaign's execution. Crowdfunding excels in mobilizing people and generating innovative ideas, surpassing other funding mechanisms. The involvement of intermediaries is pivotal, encompassing various agents such as the crowd, campaign initiators, platforms, consultancies, and regulators. The "crowd" typically includes the founder's family and friends, who are key supporters or "crowd investors," especially in equity crowdfunding projects (Agrawal et al., 2010). Freeman (1984) provides a seminal definition of a stakeholder as "any group or individual who can affect or is affected by the achievement of the organization's objectives." This study aims to elucidate how entities interact within the crowdfunding ecosystem using stakeholder theory and emphasizes the importance of aligning towards shared objectives for value creation. Beyond profit, key participants in crowdfunding are

driven by motives including communication, branding, networking, and technology. The literature review has identified major stakeholder groups and outlined their roles and influence within the crowdfunding framework. Crowdfunding has evolved significantly over the past five years, gaining wider recognition and utilization. The technology underpinning it has also advanced, leading to the evolution of stakeholder roles during this period. The subsequent sections will delve deeper into the major players in crowdfunding and their development. Belleflamme et al. (2012) categorize crowdfunding into two primary types based on the involved actors: one where the goal is to gather sufficient funds with crowdfunding acting as a pre-sale mechanism, and another motivated by potential financial returns, with actors assuming the roles of investors. Ordiani et al. (2011) identify three categories of crowdfunding actors: those proposing ideas or projects for funding, the "crowd" that backs selected projects expecting a profit, and crowdfunding platforms that facilitate connections between those seeking and providing funding for new ventures. Emerging prominently yet underrepresented in scholarly discussions are crowdfunding associations. These associations have gained significant relevance by facilitating the exchange of knowledge and experiences, investing in the value creation process for the benefit of all involved parties (Quero, 2018). With increasing interest in crowdfunding, governments have begun to implement new regulations to govern the process, enhancing the importance of crowdfunding associations in their advocacy role to preserve and enhance the benefits of crowdfunding for all participants. Table 1 below outlines the recognized actors in the crowdfunding context, detailing their actions and intentions as depicted in existing literature.

Table 1: Actors in the Crowdfunding Context

Actor	Literature References	Reasons for Inclusion	Reference Years
The Founders	Ordiani et al. (2011), Belleflamme et al. (2012), Burtch et al. (2013), Valancienė (2014), Beaulieu (2015)	Central to initiating and driving crowdfunding campaigns.	2011-2015
The Crowdfunding Platforms	Beugré (2013), Ramos (2014), Valancienė (2014), Beaulieu (2015)	Facilitate the interaction between funders and receivers, essential infrastructure.	2013-2015
The Backers	Ordiani et al. (2011), Belleflamme et al. (2012), Beaulieu (2015), Quero and Ventura (2018)	Provide the necessary capital for projects, key to crowdfunding success.	2011-2018
The Consultants	Ralcheva (2016), Valancienė (2014)	Offer expertise in campaign strategy and market positioning.	2014-2016
The Professional Investors	Belleflamme et al. (2012), Valancienė (2014), Beaulieu (2015)	Bring substantial financial investment and professional oversight.	2012-2015
The Supervisory Bodies	Gelfond (2012), Valancienė (2014), Beaulieu (2015)	Regulate and ensure the legality and ethical adherence of campaigns.	2012-2015
Crowdfunding Associations	Quero et al. (2018), Silver et al. (2020)	Advocate for the interests of the crowdfunding community, policy influence.	2018-2020

3.1 The Role of Founders in Crowdfunding

The founder, whether an individual or a legal entity such as a company, foundation, or association, plays a pivotal role in initiating a crowdfunding campaign to support their idea or project. Literature has referred to these individuals with various terms such as "creator," "borrower," "entrepreneur," "company," "founder," "owner," and "startup." Beaulieu et al. (2015) note that while these labels are diverse, many are too narrow and fail to capture the broader scope of involvement within crowdfunding contexts. For example, on a rewards-based crowdfunding platform, the person launching a campaign might not necessarily be an entrepreneur in the traditional sense, thus not required to establish a startup. Founders are central to the crowdfunding ecosystem; their primary role is to conceptualize a product or project and articulate their ideas compellingly and clearly to potential backers through a crowdfunding website. However, their involvement extends beyond merely seeking financial support. According to Dingman (2014), founders also engage in crowdfunding to gain visibility for future funding opportunities, test market receptivity to an idea (Helmer, 2014), and foster relationships by promoting open communication and collaboration with backers (Gerber, 2012). Launching a crowdfunding campaign involves significant responsibility and requires meticulous preparation and strategic planning. Without these, the risk of project failure increases substantially. Founders must understand that initiating a crowdfunding campaign without a well-thought-out strategy can lead to inadequate funding, thus jeopardizing the project's success. This

aspect underscores the substantial responsibility that founders bear, as underestimating the importance of a strategic approach can have dire consequences for their projects.

3.2 The Central Role of Technology in Crowdfunding

Technology is an indispensable element in the structure of crowdfunding. It facilitates the aggregation of funds, interaction within support communities, presentation of projects by founders, and connections with institutional investors like venture capital, banks, and business angels. Crowdfunding platforms, therefore, act as a crucial hub for all stakeholders within the ecosystem. The technology underpinning these platforms has advanced significantly in recent years, enhancing their capacity to serve as effective intermediaries between founders and the financial community.These web platforms bridge the gap between founders, investors, and supporters, allowing founders to showcase their ideas and projects to a broad audience. This facilitates the submission of funding applications and creates investment opportunities for backers or professional investors who might not otherwise have access to such ventures through traditional financing channels (Beugré et al., 2013; Valančienė et al., 2014). Furthermore, the integration with social media platforms like Facebook and Twitter boosts the visibility of projects, enabling backers and founders to promote their initiatives effortlessly within their social networks, thereby attracting a larger pool of potential supporters (Beaulieu, 2015). The critical role of these platforms is highlighted by their function as intermediaries, with the success of the crowdfunding process heavily reliant on their effective perception and organization (Valančienė et al., 2014). Ramos (2014) identifies four distinct types of crowdfunding platforms based on the nature of the financial transaction involved:

- **Equity-based platforms**, which focus on projects offering investors tangible returns in the form of equity.
- **Lending-based platforms**, aimed at providing loans in exchange for interest payments, thereby appealing to those seeking financial returns.
- **Rewards-based platforms**, which offer non-monetary rewards such as DVDs or T-shirts as incentives for financial contributions, appealing to supporters interested in personal or creative rewards.
- **Donation-based platforms**, designed to gather donations for socially driven projects, where the rewards are intangible, such as a sense of solidarity or contribution to a cause.

These platforms are instrumental in shaping how crowdfunding campaigns are perceived and operated, thus playing a pivotal role in the development and success of various crowdfunding endeavors.

3.3 The Role of Backers in Crowdfunding

In the crowdfunding ecosystem, backers play a crucial role in enabling projects to reach their funding goals. Through web platforms, these individuals—ranging from small donors to major investors—provide the capital necessary for founders to transform their ideas into viable projects or to address specific needs. The contribution of backers is vital not only for financial support but also for validating the market potential and assessing the investment worthiness of the projects (Beaulieu, 2015). To describe the role of an individual who supports a crowdfunding campaign both financially and communicatively, the term "supporter" is used consistently. However, the nomenclature may vary, including terms such as 'supporters', 'suppliers', or 'lenders', depending on the platform and the specific model of crowdfunding employed (Gerber and Hui, 2014). Supporters' involvement extends beyond mere financial contributions; they often actively participate in market testing and provide feedback that is crucial for the iterative development of the project. The motivations driving individuals to become backers are diverse. One significant category includes altruists, often friends and relatives of the founder, who contribute without any expectation of tangible returns. Their support is driven by personal connections and a desire to help someone they care about succeed (Gerber et al., 2012). Another group consists of motivated supporters, those who engage because they want to be part of the project's journey and its potential impact. This includes enthusiasts passionate about a project’s theme or mission, and investors looking for early opportunities in promising ventures. Each backer's contribution, whether small or significant, combines to form a collective effort that supports the crowdfunding campaign's success. This communal support not only provides the necessary funding but also creates a network of advocates who share and promote the project, further enhancing its visibility and likelihood of success.

3.4 The Role of Consultants in Crowdfunding

The consultancy segment within the crowdfunding ecosystem has seen notable growth in recent years, emerging as a crucial category of stakeholders. This group consists of advisors who guide founders through the

crowdfunding campaign, often in return for compensation. These professionals provide essential expertise that helps founders craft and launch effective online campaigns. Consultants in the crowdfunding context can be categorized into two distinct groups: traditional and modern. Traditional consultants generally align with professions such as lawyers, accountants, and notaries, offering services that ensure compliance with legal standards and financial scrutiny. On the other hand, modern consultants specialize in the digital and web marketing sphere, focusing primarily on managing communication and enhancing the visibility of online crowdfunding campaigns. Their role is increasingly vital as the complexity of digital interaction grows. Research by Ralcheva and Roosenboom (2016) highlights the critical role of these advisors in providing consultancy services that are prominently featured on campaign pages of crowdfunding platforms. The involvement of professional advisors not only lends credibility to the projects but also boosts investor confidence by validating the project's potential and the team's commitment to success (Mejia et al., 2019). This nuanced differentiation between types of consultants underscores the evolving landscape of crowdfunding, where the integration of digital expertise is increasingly recognized as pivotal. The ability of modern consultants to navigate the complexities of online fundraising is crucial for the success of campaigns, especially in an era where digital presence significantly influences public perception and funding outcomes.

3.5 The Role of Professional Investors in Crowdfunding

Professional investors, encompassing entities like banks, venture capital firms, and business angels, play a traditional and foundational role in the financial landscape (Beaulieu et al., 2015). They differ from typical backers in crowdfunding due to their structured investment approaches and their focus on substantial financial returns. However, the emergence of equity crowdfunding—where supporters directly invest into a company's equity—has positioned crowdfunding as a viable alternative to these conventional financial channels, attracting a broader and more varied base of supporters. According to Beaulieu (2015), traditional financing sources view crowdfunding as a complementary phase that aids in market validation for a product or service. This perspective is particularly evident in how venture capital firms approach companies that have successfully undertaken crowdfunding campaigns. For instance, a venture capital firm may be more inclined to invest in a company post-crowdfunding, seeing the successful campaign as evidence of market demand and reduced risk (Burns, 2014). This approach benefits from the crowdfunding process, which not only tests the market's receptiveness to the product but also demonstrates the entrepreneur's capability to attract funding from a broad audience. Business angels and venture capitalists often prefer observing an entrepreneur’s ability to secure crowd-based funding before committing their investments. This strategy is predicated on the notion that success in crowdfunding can significantly mitigate the risks associated with new ventures, as it proves the concept's validity and market appeal (Valančienė et al., 2014). This evolving dynamic between traditional investors and crowdfunding platforms highlights a shift in how projects are funded and ventures are evaluated. Professional investors are increasingly recognizing the value of crowdfunding not just as a funding mechanism, but as a critical tool for gauging market interest and potential success.

3.6 The Role of Regulatory Bodies in Crowdfunding

This category encompasses entities that, in accordance with the laws of each country, oversee particular sectors. Specifically for crowdfunding, Italy entrusts oversight to Consob (National Commission for Companies and the Stock Exchange) and the Banca d'Italia (Bank of Italy). Conversely, in the United States, the SEC (Securities and Exchange Commission) assumes regulatory responsibility. These institutions play a crucial role in drafting and implementing regulations governing crowdfunding to ensure a secure and equitable environment for all involved parties (Beaulieu et al., 2015). In addition to federal legislation, crowdfunding activities may also be subject to state-specific laws and licensing requirements, further shaping the regulatory landscape (Gelfond et al., 2012).

4. Value Creation through Stakeholder Interaction in Crowdfunding

This document delves into the actors involved in the crowdfunding process through the lens of stakeholder theory, aiming to understand how interactions within the crowdfunding phenomenon can create substantial value.

As illustrated in Figure 1, the interconnectedness of all actors is crucial; the satisfaction of the objectives of all actors in the process is essential for the creation of value and the success of crowdfunding initiatives.

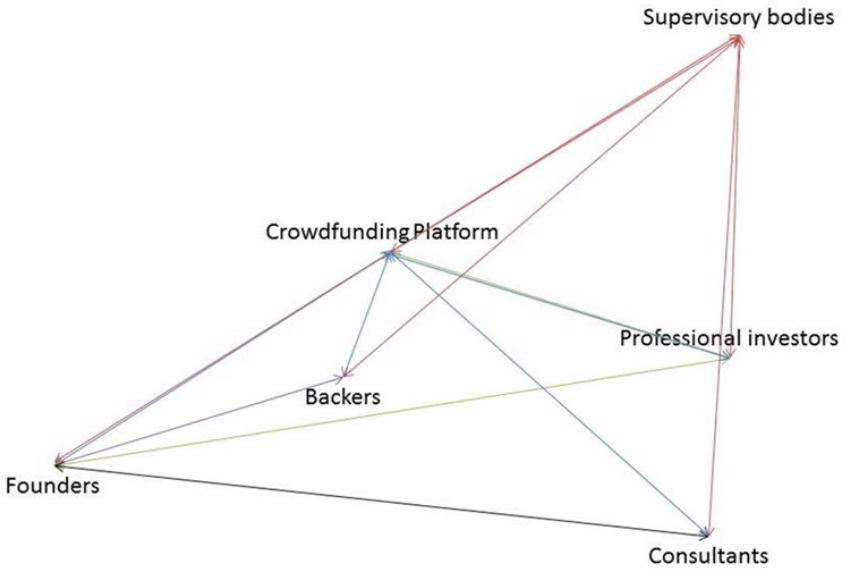


Figure 1

The scientific literature extensively recognizes the importance of the relationship between stakeholders and companies, a bond characterized not only by a convergence of interests but also by increasingly active stakeholder participation in decision-making processes. Despite its relative novelty, the crowdfunding phenomenon is highly dynamic and continually evolving, influenced by both internal and external management that generates value within the crowdfunding process. Success in crowdfunding is contingent upon meeting the common goals of all stakeholders. This analysis delineates various stakeholder classes within the crowdfunding process, considering the presence of one, two, or all three of the following attributes:

- The stakeholder's power to influence the crowdfunding process;
- The legitimacy of the stakeholder's relationship with crowdfunding;
- The urgency of the stakeholder's expectations regarding entrepreneurial projects.

For example, founders possess all three attributes, having the power to shape the process, legitimacy through relationships, and a direct link to the urgency of expectations: without the support of backers, a campaign cannot succeed. However, customers and suppliers must also be integrated and transformed into users, encompassing both investors and startups. Crowdfunding platforms are legitimized by their relationships between founders and supporters or professional investors and have the power to influence fundraising. The varying technological networks and media visibility of web platforms can influence a founder's choice of platform. Backers also embody the three attributes of legitimacy, power, and urgency, acting alongside professional investors as intermediaries between web platforms and founders. Consultants possess two attributes: the urgency of expectations in bridging the founder's project with the crowd, and legitimacy through their relationships with the web platform and project founder. Both founder and consultant share the goal of achieving crowdfunding success, albeit for different reasons: the founder needs funding and visibility for their product or service, whereas the consultant seeks to validate their strategic contribution to the campaign's success. Moreover, supervisory bodies hold the power to regulate and legitimize relations among the various actors, especially within the equity crowdfunding market, through adherence to regulations. Understanding these dynamics is crucial, as value creation is only possible when the interests of all stakeholders are satisfied, leading to a deeper comprehension of the actors' interests, needs, and expectations. Analyzing the crowdfunding process as an effective means allows companies to build trust with their stakeholders, enhance their reputation, contribute to equitable and sustainable social development, and improve processes and products. Hence, stakeholder involvement is essential for enhancing actions that impact society and companies alike. While the crowdfunding process might initially seem to hinge solely on backers or investors and founders, it actually encompasses a broader range of stakeholders whose interests must be considered. Crowdfunding stakeholders constitute a global community, with some governments recognizing its potential to create jobs and foster economic recovery, thereby investing significant efforts in regulating the discipline, particularly in the equity-based model (Valančienė, 2014). This research lays the groundwork for future studies to more deeply explore the types of value created in crowdfunding, the practices of value creation, and the growing interconnectivity among stakeholders that supports the development and sustenance of crowdfunding ecosystems. Future research could also delve into the

demographic analysis of stakeholders across different countries engaging with web platforms, shedding light on how demographic culture influences the crowdfunding value creation process. Future studies might consider an international comparative analysis to understand how crowdfunding varies across cultural and regulatory contexts. Long-term impacts of crowdfunding on business success, including the survivability and growth of startups, warrant deeper investigation. The advent of emerging technologies, such as artificial intelligence and blockchain, offers new avenues for enhancing crowdfunding campaigns and their security and efficiency.

References

Abu Amuna, Y. M. (2019). Crowdfunding Financing Model effect on Entrepreneurship Aspirations. *International Journal of Academic Accounting, Finance & Management Research* (IJAAFMR).

Agrawal, A., Catalini, C., & Goldfarb, A. (2010). The Geography of Crowdfunding. *NET Institute Working Paper No. 10-08*.

Beaulieu, T., Sarker, S., & Sarker, S. (2015). A conceptual framework for understanding crowdfunding. *Communications of the Association for Information Systems*, January 2015.

Belleflamme, P., Lambert, T., & Schwienbacher, A. (2010). Crowdfunding: An Industrial Organization Perspective. Prepared for the workshop *Digital Business Models: Understanding Strategies*, held in Paris.

Belleflamme, P., Lambert, T., & Schwienbacher, A. (2012). Individual Crowdfunding Practices. *Venture Capital*.

Belleflamme, P., Lambert, T., & Schwienbacher, A. (2013). Crowdfunding: Tapping the Right Crowd. *Journal of Business Venturing*.

Belleflamme, P., Lambert, T., & Schwienbacher, A. (2014). Crowdfunding: Tapping the right Crowd. Manuscript submitted for publication.

Beugré, C. D., & Das, N. (2013). Limited Capital and New Venture Creation in Emerging Economies: A Model of Crowd-Capitalism. *SAM Advanced Management Journal — Summer 2013*.

Blohm, I., Leimeister, J. M., & Krcmar, H. (2013). Crowdsourcing: How to benefit from (too) many great ideas. *Books*.

Brenner, W., Karagiannis, D., Kolbe, L., Krüger, J., Leifer, L., & Lamberti, H. J. (2014). User, use & utility research. *WIRTSCHAFTSINFORMATIK*, 56(1), 65–72. doi:10.1007/s11576-013-0394-y.

Burns, M. (2014). Pebble nabs $15M in funding, outs Pebblekit SDK and Pebble Sports API to spur smart watch app development. Retrieved May 15, 2014.

Burtch, G., Ghose, A., & Wattal, S. (2013). An Empirical Examination of the Antecedents and Consequences of Contribution Patterns in Crowd-Funded Markets. *Information Systems Research*.

De Crescenzo, V., Ribeiro-Soriano, D. E., & Covin, J. G. (2020). Exploring the viability of equity crowdfunding as a fundraising instrument: A configurational analysis of contingency factors that lead to crowdfunding success and failure. *Journal of Business Research*, 115, 348–356.

Dingman, S. (2014). Canadian's smartwatch startup matches record $15-million in VC funding. *The Globe and Mail*. Retrieved October 5.

Freeman, R. E. (1984). Strategic Management: A Stakeholder Approach. Boston: Pitman.

Gelfond, S. H., & Foti, A. D. (2012). US $500 and a click: Investing the crowdfunding way. *Journal of Investment Compliance*, 13(4), 9-13.

Gerber, E. M., & Hui, J. (2014). Crowdfunding: Motivations and Deterrents for Participation. *ACM Transactions on Computer-Human Interaction*, 20(6):34-32.

Gerber, E. M., Hui, J. S., & Kuo, P. Y. (2012). Crowdfunding: Why people are motivated to post and fund projects on crowdfunding platforms. In Proceedings of the International Workshop on Design, Influence, and Social Technologies: Techniques, Impacts, and Ethics.

Harris, J. (1986). A statue for America: The first 100 years of the Statue of Liberty. New York: Simon & Schuster.

Helmer, J. (2014). 8 ways to cut through the crowdfunding clutter. *Entrepreneur*, 42(6), 86-90.

Howe, J. (2006). The rise of crowdsourcing. Retrieved from http://archive.wired.com/wired/archive/14.06/crowds.html.

Hu, M., Li, X., & Shi, M. (2014). Product and Pricing Decisions in Crowdfunding. *SSRN Working Paper No 2405552*.

Hulme, M., & Wright, C. (2006). Internet based social lending: Past, present and future. *Social Futures Observatory*, October(2006).

Kappel, T. (2009). Ex ante crowdfunding and the recording industry: A model for the U.S. *Loyola of Los Angeles Entertainment Law Review*, 29(3), 375–385.

Klafft, M. (2008). Online Peer-to-Peer Lending: A Lenders' Perspective. In *International Conference on E-Learning, E-Business, Enterprise Information Systems, and E-Government, 2008*.

Leimeister, J. M. (2012). Crowdsourcing: Crowdfunding, Crowdvoting, Crowdcreation. *Zeitschrift für Controlling und Management (ZFCM)*, 56, 388–392. doi:10.1365/s12176-012-0662-5.

Martin, T. (2012). The Jobs Act of 2012: Balancing Fundamental Securities Law Principals with the Demands of the Crowd. *SSRN Working Paper No 2040953*.

Mejia, J., Urrea, G., & Pedraza-Martinez, A. J. (2019). Operational transparency on crowdfunding platforms: effect on donations for emergency response. *Production and Operations Management*, 28(7), 1773-1791.

Mollick, E. R. (2013). Swept Away by the Crowd? Crowdfunding, Venture Capital, and the Selection of Entrepreneurs. *Working Paper*.

Ordiani, A., Miceli, L., Pizzetti, M., et al. (2011). Crowd-funding: Transforming Customers into Investors Through innovative Service Platforms. *Journal of Service Management*, 22(4), 443–470.

Peda, P. (2012). The Relationship between Governance and Performance in Water Services Provision in Estonian Municipalities. *Doctoral dissertation: Tartu University Press*.

Quero, J. M., & Ventura, R. (2018). Value proposition as a framework for value cocreation in crowdfunding ecosystems. *Marketing Theory*, 19(3), 14705931187221.

Ralcheva, A., & Roosenboom, P. (2016). On the Road to Success in Equity Crowdfunding. Available at: https://ssrn.com/abstract=2727742.

Ramos, J. (2014). Crowdfunding and the Role of Managers in Ensuring the Sustainability of Crowdfunding Platforms. *European Union: Institute for Prospective Technological Studies*.

Robb, A., & Robinson, D. (2014). The Capital Structure Decisions of New Firms. *The Review of Financial Studies*.

Röthler, D., & Wenzlaff, K. (2011). Crowdfunding Schemes in Europe. *EENC Report*, September 2011.

Sen, S., & Cowley, J. (2012). The Relevance of Stakeholder Theory and Social Capital Theory in the Context of CSR in SMEs: An Australian Perspective. *Journal of Business Ethics*, 118, 413-427.

Shiller, R. J. (2013). Capitalism and Financial Innovation. *Financial Analysts Journal*, 69(1), 21-25.

Sigar, K. (2012). Fret no more: inapplicability of crowdfunding concerns in the internet age and the JOBS Act's safeguards. *Administrative Law Review*, 2, 474-505.

Sorenson, O., Assenova, V., Cheng Li, G., Boada, J., & Fleming, L. (2016). Expand innovation finance via crowdfunding. *Science*, Vol. 354, Issue 6319, pp. 1526-1528.

Surowiecki, J. (2004). The wisdom of crowds: Why the many are smarter than the few and how collective wisdom shapes business, economies, societies, and nations. New York: Doubleday.

Valančienė, L., & Jegelevičiūtė, S. (2014). Crowdfunding for creating value: stakeholder approach. *19th International Scientific Conference; Economics and Management*, ICEM 2014, 23-25 April 2014, Riga, Latvia.

Intellectual Capital Management in Performing Arts: A Case Study

Florinda Matos[1] and Nuno Matos[2]
[1] Instituto Universitário de Lisboa (ISCTE-IUL), Centro de Estudos sobre a Mudança Socioeconómica e o Território (DINÂMIA'CET), Lisboa, Portugal
[2] ICAA – Intellectual Capital Association, ICLab, Santarém, Portugal

florinda.matos@iscte-iul.pt
nuno.matos@icaa.pt

Abstract: The permanent search for organizational competitiveness in a context marked by sustainability objectives and digital transformation leads companies to develop management tools and models that guarantee them a high level of competition. Understanding intellectual capital management (ICM) processes in the different areas of business activity is, therefore, a priority for creating value. This research aims to analyse ICM through an audit of its main dimensions and try to understand its relationship with knowledge management processes, namely the retention and transfer of knowledge in an area that still needs to be explored: the performing arts industry. The performing arts, also known as 'creative experience providers', are professional areas based on arts and culture, which are based on selling cultural shows (e.g., theatres, ballet companies, orchestras) and whose professional activity is acting for audiences. The research methodology is based on a case study carried out in a Portuguese performing arts organization. The theoretical support model was an intellectual capital management model previously tested in companies with a different profile than these organizations. The main findings point out that intellectual capital management in the performing arts industry can be audited. However, adjustments must be made to these industries' working realities. It was also concluded that intellectual capital management is a critical factor in the success and survival of these industries, so the management of this asset and its valorization is strategic. The uniqueness of this study is its contribution to stimulating data-driven discussions regarding the necessity of improving intellectual capital management practices in organizations, with particular emphasis on organizations such as those in the performing arts sector, where the most significant value is centred on the intangible assets of each worker.

Keywords: Intellectual Capital Management; Knowledge Management; Performing Arts

1. Introduction

Among the scientific and business community, it seems clear that the creation of value in a company is related to its ability to manage its intellectual capital, making retention, sharing, and transfer of core knowledge of its activity. The management of these intangible assets is even more strategic in business entities that are highly dependent on the individual knowledge of each worker and their ability to share this asset, as is the case in the Performing Arts (PA) sector.

These organizations, belonging to the creative industries sector, have a particular profile, as they cannot financially support themselves. The need to explore the way they organize themselves internally to promote shows that create a connection with their audiences and, thus, their continued sustainability through the financial assistance of their Patrons raises several questions that arise within the scope of intellectual capital management.

In many cases, these organizations are managed using State funds and can remain in business, even when there are management deficiencies, given their contribution to a country's culture.

A well-known example of this organization in Portugal is OPART, E.P.E (OPART), which is designated as a public business entity. OPART manages some of the best-known artistic houses in the country, the São Carlos National Theater (SCNT), the National Ballet Company (NBC), and also Victor Córdon Studios (VCS). As a company in the Performing Arts sector, it demonstrates its importance by managing the only opera house in Portugal.

This research chose the case study of OPART. Since it is a convenience sample, it will focus on the Teatro Nacional São Carlos and Victor Córdon Studios.

The São Carlos National Theater is an ancient house in the performing arts sector in Portugal. Opened in 1793, this theater is considered the only theater in Portugal that presents a production based on opera, choral, and symphonic music shows.

The Victor Córdon Studios correspond to an OPART project that simultaneously works in dance and music, promoting sharing activities within the artistic areas. The VCS aims to create interconnected programs between the NBC and the SCNT, allowing a more direct connection with audiences by allowing this experience and direct contact between artists (who teach) and audiences (who intend to learn).

This research aims to verify whether it is possible to audit the management of intellectual capital in Performing Arts organizations and to evaluate the performance of organizations in the Performing Arts sector by managing their intellectual capital.

2. Theoretical Considerations

Goods are mainly derived from knowledge and cannot be touched because they lack a physical form and are known as intangible assets. Sectors that utilize intellectual property rights more frequently in connection with their human capital activity tend to benefit more from these assets (EPO and EUIPO, 2016).

Intellectual capital is acknowledged as an organization's primary intangible asset. It is essential to its success and profitability since it is the foundation of all knowledge that exists and can be used to create value.

Several definitions of intellectual capital exist, and comprehensive research confirms that scientists do not universally acknowledge a single definition.

While Galbraith's 1969 publication is credited with coining the term "intellectual capital," the concept of intellectual capital management emerged from three different sources: the research conducted by Hiroyuki Itami (1980) on the impact of intangible assets on Japanese corporate management, a study conducted by a group of economists (including Penrose, Rumelt, Wemerfelt, and others) in search of a fresh perspective on business; and, lastly, the writings of Karl-Erik Sveiby in Sweden. Intellectual capital would only have become prominent with this author's contributions. His work introduced a novel perspective by emphasizing intangible assets as the primary strategic concern for enterprises.

One of the first writers in Sweden to acknowledge the need to measure intangible assets was Karl-Erik Sveiby, who is credited with founding the knowledge management and intellectual capital movements.

In June 1991, Stewart published an article titled "Brain Power - How Intellectual Capital Is Becoming America's Most Valuable Asset," which effectively introduced "intellectual capital" into the management lexicon despite Sveiby's assertiveness. In this essay, Stewart argues that various forms of knowledge, such as patents, procedures, management talents, technology, data on suppliers and consumers, and prior experience, are growing in significance for the entire firm. The collection of knowledge and expertise is referred to as intellectual capital. In other words, the company's competitive advantage arises from the combined expertise of its

whole workforce. He contributed to the rise in the significance of intellectual capital by penning the cover story "Your Company's Most Valuable Asset: Intellectual Capital" for Fortune magazine in 1994 and later publishing the book "Intellectual Capital: The New Wealth of the Organization" (Stewart, 1997).

Nonetheless, Sveiby's (1997) work inspired Leif Edvinsson, the corporate director of Skandia AFS, who was among the first to refer to intangible assets as intellectual capital. He created the idea and defined intellectual capital as the body of information, practical experience, organizational technology, professional skills, and client relationships that provide a business with a competitive edge.

Edvinsson (1997) explains intellectual capital using a metaphor. The author likens a business to a fruit tree, with financial outcomes as the fruits and intellectual capital as the roots that ensure long-term sustainability.

Edvinsson and Malone (1997) divide intellectual capital into two categories: human capital and structural capital.

These writers define human capital as the capital of the organization's human resources: talents, creativity, relationship-building ability, cumulative value of practices, and values. This capital also includes the organizational principles and culture of the business. These writers contend that this capital is the fundamental wellspring of creativity and rebirth.

The worth of databases, software, manuals, pamphlets, client lists, and other items still in the company after employees "go home" is known as structural capital. Customer and organizational capital are two categories into which this capital can be separated. Organizational capital is subdivided into innovation capital (the company's capability for innovation) and process capital (the company's value creation and non-value creation processes). Customer capital, sometimes called relational capital, is the worth of a business's connections with its clients. This perspective holds that intellectual capital, the foundation of the capacity to produce value of the highest caliber, is the total of structural and human capital.

Since Edvinsson is considered the intellectual capital theorist who contributed most to developing the notion, this study concentrates on his definition.

To enhance intellectual capital management, it was necessary to develop a variety of models so that it would be possible to determine which is the most effective and how it should be managed (Matos, 2011; Matos, 2013). Despite the emergence of various frameworks (see Edvinsson and Malone (1997); Stewart, 1997; Sveiby (1997); Kaplan and Norton, (1992, 1996) Mouritsen et al.,(2001); Andriessen & Tissen, (2000); Viedma, (2001); and Andriessen, (2004) there is currently no consensus regarding the optimal model for intellectual capital management.

This study opted to utilize the Intellectual Capital Management model (ICM), as suggested by Matos and Lopes (2009). This model is widely used in the business sector and offers a more robust capability than alternative models to address the complexity associated with the elements comprising intellectual capital and organizational knowledge (Matos, 2011).

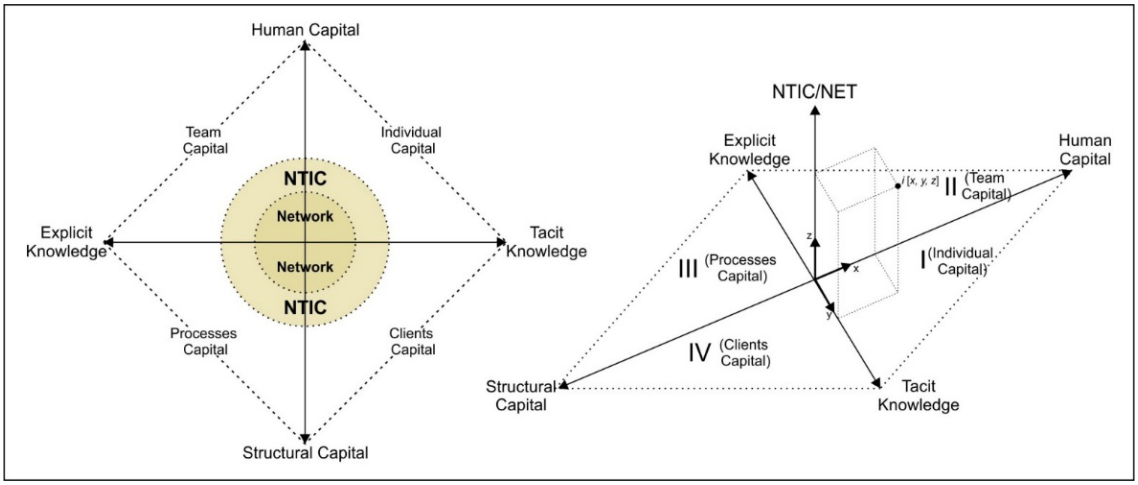


Figure 1: ICM - Intellectual Capital Model (Matos and Lopes, 2009)

According to this model, the intellectual capital assets is organized by two axes that reflect Knowledge (with Tacit Knowledge and Explicit Knowledge as opposed factors) and Organization (with Human Capital and Structural Capital as opposing factors). The four quadrants are categorized as follows: Quadrant I represents Individual Capital, Quadrant II represents Team Capital, Quadrant III represents Processes Capital, and Quadrant IV represents Clients Capital. The core component of the model illustrates the impact of New Technologies of Information and Communication (NTIC) in conjunction with Networks (NET) on all functions and tasks related to intellectual capital management (Matos et al., 2020).

3. Methodology and Data Sources

This study's target population corresponds to the workers of OPART and, more specifically, the collaborators of SCNT and VCS, a total of 262 collaborators. A convenience sample was extracted, taking into account the risk of respondents refusing to participate in the investigation or bureaucratic limitations.

As it was impossible to obtain authorization to administer a questionnaire to NCB workers, the decision was made to administer questionnaires to all workers at TNSC and VCS, regardless of their professional category, to obtain a representative sample of this universe. Responses were obtained from 39 individuals, approximately 15% of the population.

A questionnaire aimed at verifying workers' perceptions of Intellectual capital management was developed based on the questionnaire that supports the model proposed by Matos (2013).

Due to the constraints of the data frame, sample size, and response rate, the findings cannot be extrapolated to the Target Population. The current work is regarded as a preliminary study to support future research endeavors.

Following the ICM model proposed by Matos and Lopes (2009), the survey was divided into six parts: a set of questions that focus on respondents' social characterization and five sets of questions corresponding to the five dimensions of intellectual capital proposed by Matos and Lopes (2009): individual capital, team capital, processes capital, customer capital, networks, and new communication technologies.

The questionnaire has a total of 73 questions.

The same 5-point Likert scale tested by Matos (2013) was used.

4. Data Analysis

The Cronbach's Alpha Coefficient and the Pearson Correlation Coefficient were used to verify the internal consistency of the variables and the reliability of the questionnaire survey.

Given that the ICM is based on a theoretical structure, it was considered appropriate to carry out principal components analysis for exploratory analysis of adjusting data to a low-dimensional factorial structure.

This research was carried out using IBM SPSS Statistics 25 software.

4.1 Sample Characterization

The data that seems most relevant to the social characterization of the sample are presented below.

Approximately 54% are female, with the remaining 46% being male.

Regarding the level of education, it appears that most participants obtained a bachelor's degree (33.3%), and 15.4% of participants obtained a master's degree.

It can be observed that the majority of participants who were given the questionnaire indicated the NTSC as their place of work, with approximately 90% of responses, and the remaining 10% as the minority who responded that they were working at the VCS. Regarding the years of work at OPART, it was possible to verify that most participants have worked for more than ten years in the company (65.8%), and only 15.8% of participants say they have worked for OPART for between five and ten years. Only 2.6% say they have worked at OPART for less than one year.

4.2 Analysis of the Average Responses to the Quadrants of the ICM Model

To better understand how participants' opinions in this study are formed, an analysis was carried out on the response averages per Quadrant, among the four quadrants and NTIC and NET that make up the ICM model used in this investigation.

Table 1: Average responses from participants, according to ICM Quadrants.

	N	Average	Minimum	Maximum	Standard Deviation
Individual Capital Quadrant	39	2,47	1,00	5,62	,91
Team Capital Quadrant	39	3,22	1,21	5,71	1,05
Processes Capital Quadrant	39	4,10	1,31	5,69	1,28
Clients Capital Quadrant	39	3,99	1,00	5,80	1,38
NTIC + Network	39	2,52	1,29	3,57	,71

4.2.1 Individual Capital Quadrant

The proposed model analyzes a quadrant focusing on human capital with an average response level of two. It indicates that most respondents believe the situation presented is minimally relevant to their real context (M=2.47).

4.2.2 Team Capital Quadrant

The second quadrant of the team capital quadrant focuses on the collective aspect of a company's work, with a level 3 average response indicating a higher representation of the collective element. Given that the average response is at level 3 of the measurement scale (M=3.22), the collective element of the company ends up having more representation than the individual element.

4.2.3 Processes Capital Quadrant

The third quadrant of the model is associated with the formalization and development of the team's organizational memory, that is, processes that allow this formalization of a company's knowledge. Considering the average responses, most of the respondents agree that this applies very much to their professional context: the average response was centered on level 4 of the scale (M=4.10).

4.2.4 Clients Capital Quadrant

This quadrant is closely linked to the relationship that workers and the company establish with their customers and also to the way they develop services and products, taking into account their target and the concern about how they can increase the satisfaction of its customers. It can be observed, through the answers, that the respondents believe that it applies moderately to the professional reality they experience, considering that the average answer is at level three of the scale (M=3.99).

4.2.5 New Technologies and Networks

This last dimension is shared between the four main quadrants of the model, establishing a relationship between them. It is the company's added value in that it facilitates certain types of functions, such as administrative functions, so that certain functions are not time-consuming, thus enabling increased labor productivity. It can be seen that the average of this quadrant is centered on level 3 of the scale, meaning, therefore, that the working reality of the respondents differs, as the set of situations included in this last quadrant, on average, apply little to the professional context of each respondent (M=2.52).

4.3 Analysis of Correlations between Quadrants of the ICM Model

Knowing that the Pearson correlation is measured using a scale from <0.19 (very weak) to 1 (very strong), it was considered appropriate to apply this measure of association to the quadrants that form the ICM model simultaneously (see Table 2).

It is possible to observe that, in all cases, a positive correlation was identified as the following:

1) correlations were observed between the individual capital quadrant with the team capital quadrant (rs=0.587, p<0.001), the processes capital quadrant (rs=0.516, p<0.01) and the customer capital quadrant (rs=0.543, p<0.01) in which the correlations are positive and moderate, and with the new technologies and networks capital quadrant (rs=0.718, p<0.01) where the correlation is positive and strong;

2) correlations were observed between the team capital quadrant with the process capital quadrant (rs=0.539, p<0.01), the customer capital quadrant (rs=0.474, p<0.01), and the new quadrant technologies and networks (rs=0.546, p<0.05) in which, in all three cases, the correlations are positive and moderate;

3) correlations were observed between the processes capital quadrant and the customer capital quadrants (rs=0.736, p<0.001) and new technologies and networks (rs=0.516, p<0.05);

4) the last correlation to observe is between the customer capital quadrant and the new technologies and networks quadrant, and we found a positive and moderate correlation (rs=0.536, p<0.05).

Table 2: Correlations between the quadrants of ICM Model

	Quadrant TC	Quadrant PC	Quadrant CC	NTIC/NET
Quadrant IC	,587***	,516**	,543**	,718**
	(N = 37)	(N = 34)	(N = 33)	(N = 14)
Quadrant TC		,539**	,474**	,546*
		(N = 34)	(N = 33)	(N = 14)
Quadrant PC			,736***	,516*
			(N = 31)	(N = 12)
Quadrant CC				,536*
				(N = 13)
* p < 0,05 ** p < 0,01 *** p < 0,001				

4.4 Questionnaire Reliability and Validity

The purpose of carrying out Cronbach's Alpha for this part of the study was to verify the credibility of the questionnaire survey applied to the sample based on the values obtained.

Two of the questions that made up the ICM model had to be excluded after applying Cronbach's Alpha, as they contributed to reducing the reliability of the same questionnaire.

Table 3 presents the estimated value of Cronbach's Alpha (0.940), concluding that we have excellent internal consistency.

Table 3: Alfa de Cronbach

Reliability		
Cronbach Alpha	**Cronbach Alpha based on Standardized Items**	**N Items**
0,940	0,963	66

By carrying out an analysis of the Pearson Coefficient, it was possible to verify that there are correlations among the variables that make up the ICM model, which in some cases are considered significant because they are very close to (1).

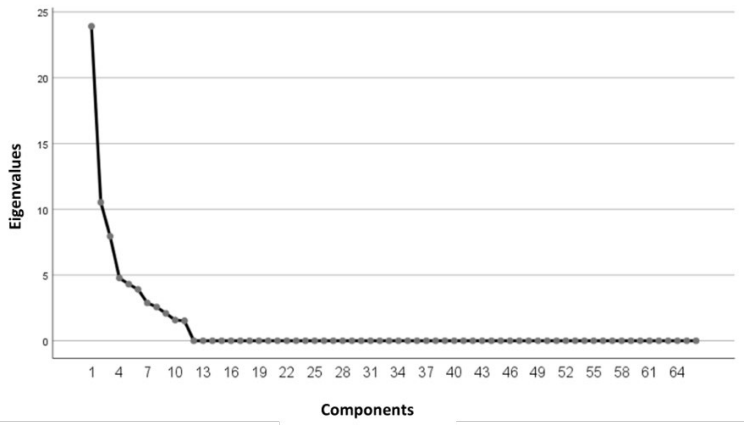
These correlations between different ICM variables allow us to conclude that the greater the concern for the satisfaction of its audiences, the better the business entity-public relationship is established, and the more easily the quality of the service is guaranteed. It can also be concluded that the new technologies depend on improving the quality of internal organization processes, and their greater use will be in recording and systematizing internal organization processes. It is also possible to understand that the greater the investment in internationalization through networks with international companies, the greater the motivation to create new internationalization strategies.

The greater the investment in innovation at the market level, the greater the investment in new services/products. It is observed that the greater the investment in the innovation of new internal organization processes, the greater the response to resolving external complaints. When new technologies are used to encourage a culture of teamwork, they are used more to record important knowledge.

It is verified that by developing partnerships to help create value and improve the company's internal functioning, greater recognition is also being given to professional training as a tool for acquiring new skills. It is also concluded that the more investment in creating events within Portugal, the greater the need to include internationalization in the business entity's ongoing strategies. Finally, by promoting new technologies to record essential knowledge, their use will be greater in recording and systematizing all internal organization processes.

In the final analysis, a principal component analysis was carried out to confirm the validity of the questionnaire. The aim is to understand whether reducing most variables that make up the ICM model of intellectual capital management to fewer factors is possible.

Following the criterion of the proportion of total variance explained, it is possible to observe the extraction of 11 possible components. If only the first three components were extracted, we would reach the desired percentage, with 64% of the variance explained by the five IC components (see Graph 1).



Graph 1: Principal Component: *Screen Plot*

5. Conclusions and Limitations

Following the objectives defined for the research, it was possible to verify that the research support model (ICM), with the necessary adaptations, allows auditing the management of intellectual capital in Performing Arts organizations. Some quadrants are more critical at OPART, such as the quadrant of team capital, client capital, and processes capital, but this does not imply that the other quadrants are not equally important. Given OPART's area of activity, it is natural that there is greater involvement in teamwork, as is the great concern for the satisfaction and pleasure of its audiences. However, it is also necessary not to forget that individual capital tends

to override team capital, requiring permanent intellectual capital management in areas where each employee can be an artist unique.

Processes capital quadrant proved to be the most relevant. Through this quadrant, it is understood that there is a promotion of the development of teamwork and, with it, the sharing of ideas and knowledge through its collaborators, which allows not only a closer relationship between people through their professional experiences but also the creating value through the sharing of different working methods, whether they are old values passed down within the company, or new ones, integrated into the company by new employees. This knowledge-sharing leads to the need to retain and systematize the same knowledge. The importance of professional training as a tool for acquiring new skills was also recognized.

Although it is not possible to prove the second objective - verifying whether it is possible to evaluate the performance of organizations in the Performing Arts sector through the management of their intellectual capital - the results indicate the existence of a relationship between the management of intellectual capital and the performance of the same organizations.

It is important to highlight some of the main limitations in the context of the research carried out. Therefore, although the results are pretty interesting and raise clues about the importance of managing intellectual capital in the performing arts, we can only analyze this case study from an exploratory perspective, and the results cannot be extrapolated to other organizations.

Another limitation resulting from OPART employees' poor adherence to this research is that it is impossible to obtain a homogeneous sample of all the entities that make up OPART since more responses were obtained from the SCNT.

References

Andriessen, D. (2004). Making Sense of Intellectual Capital. Designing a Method for the Valuation of Intangibles. Elsevier Butterworth-Heineman, Burlington (MA) and Oxford (UK).

Andriessen, D.; Tissen, R. (2000). Weightless Weight—Find Your Real Value in a Future of Intangible Assets; Pearson Education: London, UK.

Edvinsson, L.(1997). Developing Intellectual Capital at Skandia. Long Range Plan, 30, 366–373.

Edvinsson, L.; Malone, M.S. (1997). Intellectual Capital: Realizing Your Company's True Value by Finding Its Hidden Brainpower; Harper Business: New York, NY, USA.

European Patent Office (EPO). and European Union Intellectual Property Office (EUIPO) (2016). Intellectual property rights intensive industries: contribution to economic performance and employment in the European Union.

Galbraith, J.K. (1969). The New Industrial State; Houghton Miin Company: Boston, MA, USA.

Itami, H.(1980). Mobilizing Invisible Assets; Harvard University Press: Cambridge, UK.

Kaplan, R.S.; Norton, D.P. (1992). The Balanced Scorecard: Measures that Drive Performance. Harv. Bus. Rev. 70, 71–79. [PubMed]

Kaplan, R.S.; Norton, D.P.(1996). The Balanced Scorecard: Translating Strategy into Action; Harvard Business School Press: Boston, MA, USA.

Konrad Group (1990). The Invisible Balance Sheet; Sveiby, K., Ed.; Aärsvärlden Förlag: Stockholm, Sweden.

Matos F, Vairinhos V, Godina R. (2020). Reporting of Intellectual Capital Management Using a Scoring Model. Sustainability12(19):8086.

Matos F.; Lopes A. (2009). Intellectual Capital Management – SMEs Accreditation Methodology. Paper read at European Conference on Intellectual Capital 09, INHolland University of Applied Sciences, Haarlem, The Netherlands, 28-29 April.

Matos, F. e Lopes A. (2011). Intellectual Capital Management: Case Study Portugal Versus Romania, Paper read at European Conference on Intellectual Capital 11, Cyprus, Nicosia,18-19 April 2011, pp. 240-250.

Matos, Florinda (2013). A Theoretical Model for the Report of Intellectual Capital, Electronic Journal of Knowledge Management, (Online), 11 (4), pp. 339-360.

Mouritsen, J.; Larsen, H.T.; Bukh, P.N.(2001). Intellectual Capital and the 'Capable Firm': Narrating, Visualising and Numbering for Managing Knowledge. Account. Organ. Soc. 2001, 26, 735–762.

Stewart, T.A. (1991). Brainpower: How Intellectual Capital is Becoming America's Most Important Asset. Available online: https://archive.fortune.com/magazines/fortune/fortune_archive/1991/06/03/75096/index.htm (accessed on 3 May 2024).

Stewart, T.A. (1997). Intellectual Capital: The New Wealth of Organizations; Currency Doubleday: New York, NY, USA.

Sveiby, K. (1997). The New Organizational Wealth: Managing and Measuring Knowledge-Based Assets; Berrett-Koehler Publishers: San Francisco, CA, USA.

Viedma Martí, J.M. (2001). ICBS—Intellectual Capital Benchmarking System. J. Intellect. Cap., 2, 148–165.

Greening the Innovation Landscape: Leveraging Open Innovation Channels for Sustainable Technology Adoption

Marita McPhillips
Faculty of Management and Economics, Gdansk University of Technology, Gdansk, Poland

marita.mcphillips@pg.edu.pl

Abstract: Open innovation offers a great potential for accelerating sustainable technology adoption. This study presents the diverse interaction channels of open innovation and their role in facilitating the development and integration of sustainable solutions. Through an analysis of collaboration mechanisms associated with various open innovation channels in sustainable technology adoption projects, this paper offers a comprehensive framework for partnerships to strategically execute innovation strategies geared towards furthering sustainability objectives. The findings highlight the transformative potential of different open innovation interaction channels in advancing sustainability agendas. Several collaboration mechanisms support the benefits of employing the open innovation interaction channels. By categorizing and evaluating different interaction channels conducive for sustainable solutions this study explores the interplay between open innovation processes and sustainable innovation, assesses the role of different collaboration mechanisms in driving sustainable open innovation, discusses metrics to measure the effectiveness of open innovation interactions in sustainable initiatives and provides new ideas for managers to improve sustainable innovation performance.

Keywords: Open Innovation; Sustainable Open Innovation; Sustainability; Open Innovation Partnerships; Interaction Channels; Collaboration Mechanisms

1. Introduction

Open innovation (OI) and sustainability represent interconnected themes that have gained recognition within the field of innovation management. The concept of OI, characterized by engaging with external actors, is being recognized for its role in advancing sustainability-oriented innovations through the facilitation of knowledge exchange, the enhancement of creativity, and the adoption of a more inclusive stakeholder approach (Kimpimäki et al., 2022; Rauter, 2019). Empirical studies have demonstrated that the application of OI strategies can foster the development of more sustainable business models and innovation practices (Cappa et al., 2019; Franco et al., 2021). This, in turn, contributes to the enhanced performance and growth of organizations, underlining the synergistic potential between OI and sustainability efforts.

While the significance of OI and sustainability is widely acknowledged, there has been limited research on their interplay and joint impact (Cillo et al. 2019). Most studies have traditionally examined these phenomena in isolation, with only a few delving into their interconnectedness (Beck et al., 2022; Rangus et al., 2016; Slavec et al., 2019). This paper aims to bridge this gap by integrating insights from both fields to shed light on how various OI interaction channels can facilitate the achievement of sustainability objectives. There's an increasing awareness of OI's potential in tackling major societal and environmental challenges, positioning it as a catalyst for sustainable development. However, there's a need for a deeper understanding of how OI practices themselves can be rendered sustainable (Kimpimäki et al., 2022). The recent efforts to merge the concepts of openness and sustainability, such as the notion of 'sustainable open innovation' proposed by Bogers et al. (2020), remain the specific role and implications of OI interaction channels in this context underexplored. This paper seeks to shed light on the ways in which OI channels can contribute to sustainable goals within R&D oriented OI partnerships, the collaborative mechanisms that enhance the effectiveness of these channels, and the possible limitations associated with various approaches.

Considering the complex nature of our study, we employed a qualitative approach to research, as outlined by Yin (2009). Given the exploratory character of our study, our goal was to deepen the understanding of complex OI processes and their role in achieving sustainability objectives, from the viewpoint of OI partnership coordinators. Our research seeks to uncover recurring patterns and key elements, exploring the interplay between different dimensions of OI and sustainability, particularly through various forms of interaction channels. The findings of this investigation indicate that several factors facilitate OI for sustainability, such as cross-sector collaborations, knowledge sharing mechanisms and active engagement with stakeholders.

2. Open Innovation Interaction Channels Driving Sustainability

OI can be characterized as a decentralized innovation approach that involves the governance of knowledge flows across organizational lines, both inbound and outbound, for financial and non-financial gains, conforming to the

organization's commercial approach (Chesbrough et al., 2014). Comprehensive studies on OI has confirmed its significant benefits across various types of innovation (Bogers et al., 2018). However, the existing body of literature also acknowledges the presence of costs and downsides associated with OI (Dahlander et al., 2021; Stefan et al., 2022).

Within an OI ecosystem, individual actors do not operate in isolation; instead, they engage in collaborative efforts, co-creating knowledge, and continuously adapting their range of interaction channels to generate new value (Ogink et al., 2023). The growing complexity of knowledge necessitates multiple innovation partnerships and diverse interaction channels to increase the potential of addressing appropriate innovation demands (Bogers et al., 2017). Open innovation interactions encompass different inbound, outbound, and coupled processes encompass representing the diversity of functions, relations, and organizational setups (Bogers et al., 2017; Audretsch & Belitski, 2023). These interactions can take many forms, including co-creation of innovation in science-industry partnerships and user innovation, crowdsourcing, patenting and licensing, utilizing open data, among others (Beck et al., 2022) Each of interaction channels has a core purpose to establish an environment that fosters innovation success. Bogers et al. (2017) emphasize the significance of OI channels, such as platform-based systems, crowdsourcing communities, and open data, as important contexts for future research on the network level. The requirement for a specific OI interaction type depends on the industry and commercial approach (Chesbrough and Bogers, 2014). The choice of interaction channels depends on various elements, such as the nature of the partnership, and the preferences of the partners involved.

There are several types of OI interaction channels that can be used for sustainable goals (Mcphillips et al., 2024; Kimpimäki, 2022; Urbinati et al., 2022). External knowledge sourcing involves harnesses knowledge from science and non-science partners, through various means such as university-industry collaborations and inter-organizational partnerships, facilitating both knowledge sharing and acquisition (Radziwon & Bogers, 2019). These interaction type can extend beyond formal projects to include commission projects and staff exchanges, significantly impacting knowledge flow through both formal and informal channels (Hossain & Kauranen, 2016). According to Hendricks & Matthyssens, (2022), in an institutionalized business market, strategic collaborations among key market players are crucial. This study highlights the significance of intensified interactions and carefully chosen partnerships in driving sustainable innovation initiatives within such markets.

OI platforms facilitate open and distributed innovation, characterized by modularity and interoperability, but face governance issues such as intellectual property control and technology access (Gawer & Cusumano, 2014). According to (Čolić et al., 2023), collaborative platforms have the potential to enhance transformative learning beyond academia, showcasing the outcomes of transformative experiences for sustainable development. Technology transfer in OI involves mechanisms like patents and licensing, aiming to enhance innovation performance by capitalizing on knowledge assets, yet is challenged by knowledge leakages and the need for novelty in patent applications (Bogers et al., 2017). Many scholars have emphasized the importance of technology transfer in driving sustainable innovation (e.g. Fernandes et al., 2021)

User innovation, where individuals modify or create products, contributes significantly to OI by meeting unmet needs and fostering user loyalty, though organizations often underestimate its potential (Piller & West, 2014). Arancio et al. (2022) discusses the utilization of open innovation through user challenge competitions to promote sustainable development goals. Crowdsourcing, another OI interaction channel, leverages the crowd's wisdom to enhance innovation performance, requiring careful task design and participant management (Brabham, 2013). Testa et al. (2023) highlights the importance of environmentally sustainable projects in attracting funds and engaging crowd investors, emphasizing the significance of framing messages on environmental protection for crowdfunding success. Public sector partnerships in OI, involving open data from public organizations, offer new innovation opportunities but necessitate robust management and transparency (Sadiq & Indulska, 2017; Urbinati et al., 2023). Bertello et al. (2023) points out the need for exploring sustainable innovation within the realm of open data. According to Hrustek et al., (2022), the integration of open governmental and public data, along with contractual sharing, is crucial for creating sustainable value in agricultural systems.

OI interaction channels have the capacity to shape more sustainable business models and innovation practices, empowering organizations to remain competitive and aligned with the latest advancements in technology (Obradović et al., 2021). The relationship between OI and sustainability is complex and multifaceted, with implications for various industries and research areas. While the interaction channels through which open innovation promotes sustainability may vary, the evidence suggests that embracing OI practices can be instrumental in driving sustainable innovation and addressing environmental challenges (Milana & Ulrich, 2022)

As OI interaction channels serve as the infrastructure facilitating the absorption and dissemination of heterogeneous knowledge assets, the collaboration mechanisms are the orchestrated processes that govern the dynamics of interaction within these channels, ensuring the alignment of objectives, the mitigation of intellectual property risks, and the optimization of synergistic potential (Miranda et al., 2023). They refer to the processes, structures, and strategies used to coordinate and align the activities in an OI partnership. Collaboration mechanisms can include joint planning and decision-making processes, shared goals and performance metrics, division of labor and responsibilities, intellectual property agreements, and governance structures. Effective collaboration mechanisms can help to overcome challenges prevailing in some of the OI interaction channels such as misaligned incentives, conflicting priorities, and differing levels of commitment among partners.

Moreover, they can help partnerships to access new knowledge resources leading to more innovative and sustainable solutions. Reficco et al., (2018) suggest that several collaboration mechanisms positively influence innovation targeted at sustainablility, but the effectiveness of these mechanisms largely depends on the kind of partners involved. OI projects for sustainability purposes lead to increased creativity and reduced project duration. However, the potential benefits of OI projects are obstructed by the high degree of complexity that they entail. Collaboration mechanisms are mitigating those obstructions. Lappalainen et al. (2023) suggests that managing governance, control, and social relations are critical to the success of OI projects. Effective communication and knowledge flows among partners are also essential to ensure successful collaboration. Furthermore, a study by Rauter et al. (2019) uncovers the influence of diverse OI partners, including customers, universities, and broader ecosystem stakeholders like intermediaries or NGOs, on the economic and sustainability innovation performance. External actors' involvement in OI seems to be a key factor for performance. By engaging a diverse array of stakeholders, partnerships can gain access to a wealth of ideas, expertise, and resources. This multi-stakeholder engagement thus significantly contributes to overcoming the barriers associated with OI, driving forward the agenda of sustainable innovation. Kimpimäki et al., (2022) also highlight the importance of a broader stakeholder approach to sustainable innovation and emphasizes the need for a mindset shift from "inside-out" to "outside-in" to become truly sustainable. Overall, the studies suggest that effective collaboration mechanisms are essential to the success of OI projects geared towards furthering sustainability objectives.

Challenges faced in utilizing OI interactions include innovation capability, partnership expectations, and risks (Howells et al., 2012; Steinmo & Rasmussen, 2018; Radziwon & Bogers, 2019). Implementing OI for sustainable innovation presents similar challenges (Rauter et al., 2019). OI may lead to a loss of control (or perceived loss) over the innovation process, as partnerships involve collaboration with external partners and share intellectual property. Coordinating and managing a varied group of stakeholders in the sustainable context can be complex, requiring additional resources and expertise. Partnerships must carefully select partners that align with their sustainability goals and have the necessary expertise to contribute. The solutions not always can be scaled up and implemented across different operations. Measurement and assessment of the impact is also complex and multifaced. Many researchers struggle with evaluating how opening up internal innovation processes impacts innovation results and economic performance. Studies like Kratzer et al. (2017) suggest this impact might be limited, potentially leading to smaller gains in innovation over time or even negative effects, as pointed out by Greco et al. (2017). This inconsistency in findings could be because we don't yet fully understand how OI contributes to a organization's competitive edge or under what specific conditions it is most effective (Zhang et al., 2023).

3. Methods

This research focused on examining the adoption of OI interaction channels to explore their role in advancing sustainable objectives within OI partnerships. We began by identifying key attributes and roles of these channels in fostering sustainable innovation, drawing on a review of existing literature on the subject (Bogers et al., 2020). This review informed the creation of deductive codes that guided the analysis of our data. Because of the innovative and complex nature of our study, we grounded our investigation in a qualitative research methodology (Yin 2009), which allowed for a comprehensive exploration. Employing a qualitative framework was particularly pertinent for delving into the relatively underexplored domains of OI and sustainability processes (Kimpimäki et al., 2022). The exploratory angle of this study was defined by its aim and research queries, which were to enhance the comprehension of OI interaction channels and processes, along with their influence on sustainability objectives, from the individual perspectives of OI partnership managers. Theoretical

frameworks were employed not only to craft the research questions and objectives but also to outline the initial coding schema. The study was characterized by open-ended, process-focused questions.

The respondents were managers coordinating European OI partnerships, that had 7 to 11 years of experience in various OI projects and possessed significant expertise in sustainability, classifying them as elite informants. The focus was on OI partnerships engaged in R&D and technology adoption. The study involved eleven in-depth, semi-structured interviews conducted in three different countries, each lasting about 60 minutes on average. The OI partnerships were chosen using the maximum variation criterion to ensure a wide representation of the diverse OI interaction channels and the range of perceptions among respondents in varied contexts. Due to the adoption of purposive sampling, strict participation criteria were enforced (Patton 2002). Respondents were required to possess a minimum of three years' experience in managing an OI partnership. Additionally, they had been in contact with sustainability processes and presented familiarity with essential concepts and definitions pertinent to the field. These prerequisites were verified at the beginning of each interview. For the analysis of the data, MaxQDA, a software tool designed for qualitative data analysis, was used to facilitate the process.

4. Results

The most common OI interaction channels reported by respondents were sourcing of external knowledge, technology transfer, platforms and complex systems and engaging users. Utilizing open data or crowdsourcing were much less common. The effect of utilizing those channels on sustainability goals was prevalent. Despite initial hesitance among participants about how to assess the direct connection and the impact of interaction channels on sustainability, all respondents reported a beneficial influence on achieving sustainability goals.

OI interactions were perceived as a set of beneficial practices that drive the innovation processes in all areas, including sustainability. The OI partnership managers emphasized three key factors influencing sustainable outcomes in OI partnerships regardless the interaction channel in terms of collaboration mechanisms: (1) cross-sector collaborations, (2) knowledge sharing mechanisms (3) active engagement with stakeholders.

Cross-sector collaborations emerged in the study as a vital catalyst for fostering innovation and driving widespread adoption of sustainable technologies. Respondents underlined importance of combining varied expertise, which they saw as key to solving complex problems. This blending of skills not only filled technological gaps but also encouraged a culture of creative thinking. Knowledge sharing mechanisms were pointed to as playing role in leveraging collective expertise and accelerating the pace of sustainable innovation. Open communication and fair distribution of both risks and benefits, trust and clear governance were highlighted as crucial for the success of these collaborations. The use of digital tools for collaboration was another important theme. These tools were found to significantly improve the efficiency and effectiveness of projects. The results highlighted the importance of actively involving stakeholders throughout the project lifecycle. Participants from various sectors stressed the value of engaging a broad spectrum of stakeholders, including customers, suppliers, and ecosystem members, right from the early stages. This approach brought diverse perspectives into the project, making the innovations more relevant and widely accepted. Feedback loops with stakeholders were particularly noted for their role in addressing sustainability challenges effectively, allowing projects to adapt based on ongoing input.

Our study identified several metrics, used to measure the effectiveness of OI interactions in sustainable initiatives. Some implemented metrics includes: input metrics, when the resources and activities invested in OI were measured, such as the number of partners, projects, or platforms used; output metrics, connected to the results and outcomes generated from OI, such as the number of ideas, prototypes, or patents produced; as well as process metrics, measuring the efficiency and effectiveness of OI processes, such as the time and cost of innovation activities. Even though the most popular metrics for projects outside of sustainability scope is return on investment (ROI) it was not commonly used for sustainability efforts. Environmental impact metrics, including carbon footprint reduction were also rarely used, aligning the assessment with the sustainability goals of the projects.

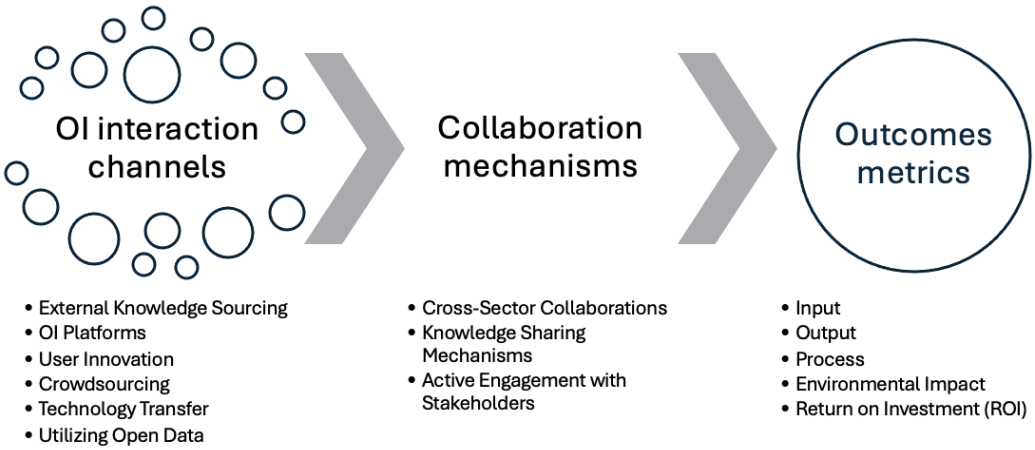


Figure 1: OI interaction channels, knowledge mechanisms and outcome metrics in OI partnerships towards sustainable objectives

Respondents pointed to several barriers that hinder the effectiveness of sustainable OI. A predominant challenge identified by participants was the misalignment of organizational goals and governance models, which often led to conflicting priorities and approaches to sustainability. Intellectual property concerns were also frequently cited, with the protection and sharing of proprietary knowledge creating tensions within collaborative frameworks. Furthermore, the complexity of coordinating across diverse stakeholder groups, each with their unique expectations and communication styles, was highlighted as a significant obstacle. These barriers, compounded by the inherent challenges of integrating sustainability into OI processes, underscore the need for indicating best practices in utilizing collaboration mechanisms targeted at OI partnerships driving sustainability projects.

5. Discussion

The research question of the role of OI interaction channels in driving the sustainability goals proved to be complex. First, the research highlighted the absence of a universally accepted framework defining sustainability within the context of OI processes. Second, the fields of OI and sustainability are characterized by a dense overlap of concepts, themes, and terminologies, leading to diverse interpretations among respondents who might use disparate terms for similar concepts. Third, different OI interactions and levels of engagement in sustainable processes produced a broad spectrum of perspectives among scholars and industry professionals (Hassan, 2022).

The respondents in this study were unable to agree on a definite description of the sustainable OI phenomenon. Nonetheless, echoing the existing literature, the results of the study indicate that sustainable OI is regarded as a process of distributed innovation that is aimed at fostering development in a manner that satisfies current requirements without hindering future generations' capacity to fulfill their own needs, aligning with the definition presented by Bogers et al. (2020). The majority of participants in this research did not mention sustainability as a priority in OI partnerships. This observation comes from the fact that OI partnerships typically do not place sustainability at the forefront of their agendas, but rather adopt sustainable practices when they coincide with, or emerge as a byproduct of, their business objectives. Even though, OI partnerships are known for having relatively modern cultures, embracing experimentation, they tend to be very cautious when it comes to financial expenditures and investments.

The existing OI literature provides frameworks of OI interaction channels (McPhillips et al.,2024). Not all of them were utilized in all of the OI partnerships. These OI channels are not easy to adopt, and sectoral preference might play a role in adoption. The extant literature frequently highlights the benefits of OI (e.g. Bogers et al., 2018). From the many advantages described in the literature, responding OI partnership managers were mostly focused on the improved process efficiency aspect, which directly contributes to reduced costs and shorter project durations. These operational improvements were mostly quantified through input and output metrics, focusing on the resources utilized and the tangible outcomes achieved.

All of the respondents declared that OI practices positively affected drive towards sustainability goals, and the unique combination of the OI interaction channels was perceived as instrumental in leveraging the effectiveness of OI, thereby facilitating significant sustainability improvement. OI managers monitor progress towards sustainability mostly by noting reductions in time and cost, which are indicative of enhanced efficiency in OI processes. Environmental impact metrics, including carbon footprint, were not used mainly due to complexity of innovation focusing of sustainability, diverse stakeholder involvement, long term impact and data availability and quality (Kemp and Pearson, 2007; Milana and Ulrich, 2022).

However, many OI partnerships do not inherently prioritize sustainability within their projects, often integrating sustainable practices only when they align with business objectives. This lack of strategic emphasis on sustainability can significantly impede progress in this area. The cautious, risk-averse culture still prevalent among many partnership members further compounds the challenge of investing in sustainable solutions. According to the data, sustainability is frequently regarded by OI managers as a context rather than a core objective, leading to a hesitancy to overhaul business models for the sake of sustainability.

6. Conclusions

Open innovation and sustainability have gained significant attention from researchers and industry professionals alike. The pressing need for collective measures to address the climate crisis underscores the growing relevance of these themes. Organizations that adopt OI are often at a competitive advantage compared to those that maintain closed innovation systems. Research and practical evidence suggest that OI contributes positively to sustainability outcomes, although with the challenge of establishing and leveraging a variety of OI interaction channels. The sustainability context imposes additional considerations on OI processes, making the adoption of OI a complex challenge with each partnership navigating its path towards sustainability in different ways (Bogers et al., 2020).

This study highlights the importance of collaboration mechanisms such as cross-sector collaborations, knowledge sharing mechanisms, and stakeholder engagement in streamlining OI processes towards sustainability. These "innovation-producing" mechanisms, as termed by Majchrzak et al. (2023), encourage the sharing of not only solutions but also essential insights into underlying problems, fostering the emergence of optimal solutions through diverse knowledge contributions within each of the OI interaction channels. Certain factors, like intellectual property issues and the complexity of governance structures, can hinder the development of sustainable OI. However, the research results suggest that successful sustainable OI emerges from the interplay of various elements (Milana & Ulrich, 2022).

The results of this paper offer valuable insights for managers in OI partnerships. A critical takeaway is the awareness of importance of different OI interaction channels. Our research demonstrates that a diverse range of OI interaction channels can markedly enhance the drive towards sustainability objectives within OI partnerships. Enhanced efficiency in OI partnerships can refine the innovation process, bringing not only financial gains but also advancing sustainability efforts. Consequently, OI partnerships that strategically embrace a variety of OI interaction channels stand a better chance of securing a competitive edge in the field of sustainability.

OI managers take on a strategic challenge to navigate the OI interaction channels within the context of sustainability dynamics. It is crucial for them to cultivate a strategic perspective of the sustainable OI process that will be deeply integrated into the fabric of the OI partnership. Such a holistic approach can facilitate the development of sustainable OI strategies that are conducive to sustainable outcomes. An essential recommendation for OI managers is to prioritize sustainability measures within the innovation process. Also, even in the face of time limitations and resource constraints, it's vital to establish sustainability objectives that also contribute to achieving financial targets, ensuring that sustainable innovation remains aligned with the overarching business strategy.

Finally, our study has uncovered that sustainable OI presents a considerable challenge for many OI managers, largely due to its complexity and unpredictability. Although OI managers are typically well-versed in OI processes, their expertise in sustainability may be lacking. It's crucial to recognize the dynamics at play, where financial gains often overshadow sustainability efforts. Consequently, sustainable OI practices may be underutilized or entirely overlooked, hindering the realization of sustainable goals. Tackling the uncertainties surrounding sustainability could empower OI managers to shift towards more structured investment risk assessments, moving away from decisions solely based on previous experiences or conventional wisdom.

While this study has provided valuable insights into the interplay between sustainability and OI interaction channels from the perspective of OI partnership managers, it's important to acknowledge its limitations, that can also pave the way for future research opportunities. The qualitative, exploratory nature of the research was designed to paint a broad picture of sustainability within the OI context as perceived by these managers. Consequently, the findings are specific to these perceptions and are not intended for broad generalizations, but rather to invite deeper examination. The study's scope did not extend to a detailed investigation of individual characteristics or the subtleties of personal experiences. Nor did it delve into the micro-level analysis concerning specific sustainability-related decisions. Essentially, while the research was centered on a meso-level analysis, it has also laid the groundwork for future studies to explore sustainability in OI at various analytical levels, thereby contributing to a more nuanced, multi-dimensional understanding of the subject.

Funding This research was supported by the Gdansk University of Technology under Grant DEC-4/2021/IDUB/II.2/Sc in the Scandium Programme within Excellence Initiative—Research University Programme.

Data availability statement Our manuscript has no associated data. The interview transcripts are available upon request.

References

Arancio, J., Velis, E., & Torres, D. (2022). Documenting and Assessing Open Innovation: Co-Creation of an Open Data Model for Surgical Training. *Fteval Journal for Research and Technology Policy Evaluation*. https://doi.org/10.22163/fteval.2022.574

Audretsch, B. D., & Belitski, M. (2023). The limits to open innovation and its impact on innovation performance. *Technovation*, *119*, 102519. https://doi.org/https://doi.org/10.1016/j.technovation.2022.102519

Beck, S., Bergenholtz, C., Bogers, M., Brasseur, T.-M., Conradsen, M. L., Di Marco, D., Distel, A. P., Dobusch, L., Dörler, D., & Effert, A. (2022). The Open Innovation in Science research field: a collaborative conceptualization approach. *Industry and Innovation*, *29*(2), 136–185.

Bogers, M., Chesbrough, H., & Strand, R. (2020). Sustainable open innovation to address a grand challenge. British Food Journal, 122(5), 1505–1517. https://doi.org/10.1108/BFJ-07-2019-0534

Bogers, M., Zobel, A.-K., Afuah, A., Almirall, E., Brunswicker, S.,Dahlander, L., Frederiksen, L., Gawer, A., Gruber, M., Haefliger, S., Hagedoorn, J., Hilgers, D., Laursen, K., Magnusson, M. G., Majchrzak, A., McCarthy, I. P., Moeslein, K. M., Nambisan, S., Piller, F. T., ... Ter Wal, A. L. J. (2017). The open innovation research land- scape: established perspectives and emerging themes across different levels of analysis. *Industry and Innovation*, 24(1), 8–40.https://doi.org/10.1080/13662716.2016.1240068

Bogers,M., Foss,N.J., & Lyngsie,J. (2018). The "Human" Side of Open Innovation: The Role of Employee Diversity in Firm-Level Open Innovation Capabilities. Journal of World Business, 53(5), 741-758.

Cappa, F., Ferrucci, E., Oriani, R., & Meliciani, V. (2019). Does institutional quality matter in open innovationn?. In *Opening Up for Managing Business and Societal Challenges* (pp. 1-18).

Chesbrough, H., Vanhaverbeke, W., & West, J. (2014). *New frontiers in open innovation*. Oxford University Press.

Cillo, V., Petruzzelli, A. M., Ardito, L., & Del Giudice, M. (2019). Understanding sustainable innovation: A systematic literature review. *Corporate Social Responsibility and Environmental Management*, *26*(5), 1012–1025.

Čolić, R., Rodić, D. M., & Fokdal, J. (2023). To What Extent Can Collaborative Platforms in Urban Planning Education Enhance Transformative Learning Outside of Academia? *International Journal of Sustainability in Higher Education*. https://doi.org/10.1108/ijshe-06-2022-0184

Dahlander, L., Gann, D. M., & Wallin, M. W. (2021). How open is innovationn? A retrospective and ideas forward. *Research Policy*, *50*(4), 104218.

Fernandes, C., Veiga, P. M., Ferreira, J. J., & Hughes, M. (2021). Green Growth Versus Economic Growth: Do Sustainable Technology Transfer and Innovationns Lead to an Imperfect Choice? *Business Strategy and the Environment*. https://doi.org/10.1002/bse.2730

Franco, S., Presenza, A., & Petruzzelli, A. M. (2021). Boosting innovative business ideas through hackathons. The "Hack for Travel" case study. *European Journal of Innovation Management*, *25*(6), 413-431. https://doi.org/10.1108/EJIM-06-2021-0300

Hassan, A. (2022). Diffusion of Innovation in Sustainable Development Projects: A Proposed Integrative Model. *Environmental Management and Sustainable Development*. https://doi.org/10.5296/emsd.v11i2.19553

Hendricks, L., & Matthyssens, P. (2022). Platform Ecosystem Development in an Institutionalized Business Market: The Case of the Asset Management Industry. *Journal of Business and Industrial Marketing*. https://doi.org/10.1108/jbim-10-2021-0484

Kemp, R., & Pearson, P. (2007). Final report MEI project about measuring eco-innovationn. UM Merit, Maastricht, 10(2), 1-120.

Kimpimäki, J.-P., Malacina, I., & Lähdeaho, O. (2022). Open and sustainable: An emerging frontier in innovation management? *Technological Forecasting and Social Change*, *174*, 121229. https://doi.org/https://doi.org/10.1016/j.techfore.2021.121229

Lappalainen, L., Aleem, M., & Sandberg, B. (2023). How to manage open innovation projects? An integrative framework. *Project Leadership and Society*, *4*, 100095. https://doi.org/https://doi.org/10.1016/j.plas.2023.100095

McPhillips, M. (2024). Going all in or spreading your bet: a configurational perspective on open innovation interaction channels in production sectors. *Production Engineering Archives,* 30(20)

Milana, E., & Ulrich, F. (2022). Do open innovation practices in firms promote sustainability? *Sustainable Development*, 30(6), 1718–1732. https://doi.org/10.1002/sd.2337

Miranda, L. F., Cruz-Cázares, C., & Saunila, M. (2023). Towards a Comprehensive Framework to Analyse the Benefits of Openness for sustainability-oriented Innovation: A Systematic Literature Review. *Sustainable Development*. https://doi.org/10.1002/sd.2581

Obradović, T., Vlačić, B., & Dabić, M. (2021). Open innovation in the manufacturing industry: A review and research agenda. *Technovation*, *102*, 102221. https://doi.org/https://doi.org/10.1016/j.technovation.2021.102221

Ogink, R. H. A. J., Goossen, M. C., Romme, A. G. L., & Akkermans, H. (2023). Mechanisms in open innovation: A review and synthesis of the literature. *Technovation*, *119*, 102621. https://doi.org/https://doi.org/10.1016/j.technovation.2022.102621

Patton M.Q. (2002) Qualitative research and evaluation methods. Sage Publications

Rangus, K., Drnovšek, M., & Di Minin, A. (2016). Proclivity for open innovation: Construct development and empirical validation. *Innovation*, *18*(2), 191–211. https://doi.org/10.1080/14479338.2016.1213136

Rauter, R., Globocnik, D., Perl-Vorbach, E., & Baumgartner, R. J. (2019). Open innovation and its effects on economic and sustainability innovation performance. *Journal of Innovation & Knowledge*, *4*(4), 226–233.

Reficco, E., Gutierrez, R., Jaen, M., & Auletta, N. (2018). Collaboration mechanisms for sustainable innovation. *Journal of Cleaner Production*, *203*, 1170–1186. https://doi.org/10.1016/j.jclepro.2018.08.043

Slavec Gomezel, A., & Rangus, K. (2019). Open innovation: it starts with the leader's openness. *Innovation*, *21*(4), 533–551. https://doi.org/10.1080/14479338.2019.1615376

Stefan, I., Hurmelinna-Laukkanen, P., Vanhaverbeke, W., & Oikarinen, E.- L. (2022). The dark side of open innovation: Individual affective re- sponses as hidden tolls of the paradox of openness. *Journal of Busi- ness Research*, 138, 360–373.https://doi.org/https://doi.org/10.1016/j.jbusres.2021.09.028

Testa, S., Troise, C., Cincotti, S., & Camilleri, M. A. (2023). The Role of Electronic Waste Management Solutions and Message Framing in Influencing Consumer Behaviours: Exploring the Crowdfunding Context. *Business Strategy and the Environment*. https://doi.org/10.1002/bse.3526

Urbinati, A., Esfandabadi, Z. S., & Petruzzelli, A. M. (2023). Yin, R. K. (2009). *Case study research: Design and methods* (Vol. 5). Sage Publications

Zhang, X., Chu, Z., Ren, L., & Xing, J. (2023). Open innovation and sustainable competitive advantage: The role of organizational learning. *Technological Forecasting and Social Change*, *186*, 122114. https://doi.org/https://doi.org/10.1016/j.techfore.2022.122114

The Future of Knowledge Management in Family firms: Factors and Barriers for AI Adoption

Anna Maria Melina[1], Walter Vesperi[2] and Raimondo Ingrassia[2]
[1] University of Messina, Italy
[2] University of Palermo, Italy

amelina@unime.it
walter.vesperi@unipa.it
raimondo.ingrassia@unipa.it

Abstract: Family businesses represent the most widespread entrepreneurial form. Within knowledge management studies, a large amount of research has focused on family businesses, highlighting the particular needs they require. At the same time, several studies have highlighted the existence of barriers and enabling factors in the adoption of new technologies within family businesses. Currently, we are seeing the spread of artificial intelligence (AI) within business organizations. On these premises, this study has a dual objective. The first objective, from a theoretical point of view, wants to trace the link between AI and knowledge management. The second objective of this study aims to identify the main barriers to the application of AI in family businesses. This study is based on a systematic literature review using the phases of data collection, bibliometric analysis and content analysis. Two international scientific databases were used: Scopus and Web of Science (Clarivate). A search string was created by identifying keywords. Subsequently, only scientific documents published in double blind review journals, in English, were selected. The sample used in this study contained about 40 scientific documents. The results of this study offer initial reflections on the adoption of artificial intelligence in family businesses. Artificial intelligence represents a new way of managing knowledge within organizations. The peculiar characteristics of family businesses impose reflections on the methods of adoption and barriers that may emerge. This study contributes to the understanding of family businesses, under the theoretical perspective of knowledge management. Family businesses represent complex but widespread organizations. For this reason, academics, entrepreneurs and practitioners must understand the obstacles that could make the adoption of AI difficult.

Keywords: Family Firm, Barriers, Knowledge Management, AI, Absorptive Capacity.

1. Introduction

Family businesses represents the most common element in the entrepreneurial system. For this reason, family business assumes a relevant role in economic and social system. This relevance has attracted the attention of management and organization theory scholars. Consequently, an intensive and active academic debate has developed around family businesses. In recent decades, scholars have focused attention on the peculiar characteristics of family businesses (Salganicoff, 1990; Sharma, et al., 1997; Ventura, et al., 2020; Daspit, et al., 2021), often, through a comparison with non-family businesses (Conz and Magnani, 2020; Rovelli, et al., 2022; Baltazar, et al., 2023). Above all, a growing research area on knowledge management studies in family business has developed. This line of studies aimed to understand the dynamics and practices of knowledge management in family businesses (Chaudhary and Batra, 2018; Pütz and Werner, 2023).

The family business, under the theoretical lens of knowledge management theories, emerges the paradox of family businesses. In fact, family businesses are organizations recognized as slow to introduce innovation and new knowledge (Nieto, et al., 2015; Soluk and Kammerlander, 2021). Innovation and technological progress represent levers for maintaining or increasing competitive advantage. For this reason, family businesses must increase their capacity to absorb new technology and knowledge. Artificial Intelligence (AI)-based systems represent the latest and greatest challenge for family businesses. Artificial intelligence (AI) is a relatively recent phenomenon, which is spreading rapidly and across various sectors.

Although the first attempts to define artificial intelligence date back to the 1950s, even today, it appears difficult to offer a complete and exhaustive definition of artificial intelligence. AI represents a complex and multidimensional phenomenon. With the aim of analyzing AI, under a theoretical perspective typical of knowledge management studies, we can preliminarily define artificial intelligence (AI). AI, and the systems connected to it, can be defined as systems capable of absorbing, creating, managing and transferring the knowledge of an organization, within it, through different combination techniques. Knowledge management (KM), therefore, is supported through AI systems.

AI systems rely on external and internal knowledge sources. External sources are represented by the ability to store, collect and use quantities of data (big data); instead, internal sources are the absorption of professional knowledge to carry out a certain task and knowledge of the organization.

With these premises, the main objective of this study is to identify the Factors and barriers for AI Adoption that can influence the adoption of AI systems in family businesses.

2. Theoretical Framework

2.1 Family Firms in Knowledge Management Studies

In recent decades, knowledge has assumed the role of a strategic resource and source of competitive advantage (Mårtensson, 2000). For knowledge to become a strategic resource, the organization's processes must be based on the creation, storage, sharing and enhancement of knowledge. Knowledge Management (KM) becomes a crucial and transversal element in all organizational processes (Martinez-Conesa et al., 2017). KM can be traced back to all activities oriented towards the acquisition, storage, sharing and application of knowledge (Alavi and Leidner, 2001; Lee, 2012). Organizations, therefore, find themselves having to develop the ability to organize their internal processes by enhancing knowledge (Durst and Edvardsson, 2012; Del Giudice and Maggioni, 2014).

In the modern debate within knowledge management studies, a growing and solid line of studies has focused on family businesses (Ventura, et al., 2020; Arzubiaga, et al., 2022; Vesperi, et al., 2023).

Despite this, knowledge management appears particularly complex. First of all, knowledge is an intangible and complex element with results that cannot be measured in the short term and, above all, cannot be defined a priori. On the other hand, family businesses are particularly complex organizations with intrinsic characteristics, equipped with a system of values dominated by opposing strategic orientations (Reid, et al., 1999; Hernández-Linares, 2020). Different analytical perspectives and facets emerge in KM studies on family businesses (Letonja and Duh, 2016; Ge and Campopiano, 2022; Ratten, 2023). More specifically, previous research on KM has mainly focused on the difference between family and non-family businesses.

Studies analyzing the multiple facets of KM have mainly focused on non-family businesses (Obeso et al., 2020), while KM research on family businesses is still at an early stage. although it is broad and offers insights for both research and management practice, there is a lack of coherent and adequate conceptualizations of KM for the development of theoretical models and the design of empirical work in the always complex area of the family. businesses. The objective of this study is to offer the theoretical basis for understanding the adoption of artificial intelligence, identifying the main barriers and enabling factors, in family businesses, under the theoretical perspective of KM.

3. Methodology

The main purpose of this study is to offer a theoretical framework on the adoption of artificial intelligence in family businesses, under the theoretical perspective of knowledge management. The academic contributions on family businesses, also from the perspective of knowledge management studies, appear substantial and in a mature phase. On the contrary, the impact of artificial intelligence on the dynamics of family businesses appears poorly studied and fragmented.

With these premises and with the aim of offering a broad picture of existing scientific contributions, a qualitative methodology was adopted (Bell, et al., 2004), of an exploratory nature (Alcácer, et al., 2016), based on the literature review. The systematic literature review also allows future research to be linked to studies conducted in the past (Vesperi and Coppolino, 2023).

The collection and analysis of scientific documents followed the following steps:

I. Source of the data. The scientific documents analyzed in this study are all the scientific documents on family firms contained in the databases (a) SCOPUS and (b) Web of Knowledge (WoS). Scientific documents were extracted and retrieved in April 2024. Only peer-reviewed journals articles published in English were considered (not considered: books, chapters/book reviews, professional articles, conference proceedings, working papers, reports, unpublished works; see on this point Tranfield et al., 2003). We selected only scientific papers with the following keywords in article titles, abstracts and keywords: “knowledge”, “family firm*” OR “family business*”, “Artificial Intelligence*” OR “AI”, “barrier*”, “enabl*”.

Only scientific documents were considered in the areas "*Business, Management and Accounting*" and "*Social Science*". No time limitation criteria has been inserted.

Finally, 178 records were produced from the sources.

II. File format and database preparation. All bibliographic data have been saved in CSV (Comma Separated Values) format, sorted in alphabetical order by title. In addition, other entries not considered useful or duplicate entries have been removed from the file. (Karamali, et al., 2020).

III. Visualization of keywords. The database was exported and analyzed using the VOSviewer software (see van Eck and Waltman, 2007; 2010; 2014) with the aim of identifying the link between the keywords used by the authors of the scientific documents identified.

IV. Selection of scientific documents. The implementation of qualitative methodological processes could generate "non-transparent areas". According to Yin (2012), to solve this limit the authors must analytically describe all the steps taken for the selection of scientific documents. To overcome this limit, the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyzes) guidelines have been adopted. The selected scientific papers will be analyzed to define the theoretical framework on the topics under study.

The PRISMA guidelines guarantee transparency in the systemic literature review process (Liberati, et al., 2009).

In the study, attention had to be paid to duplicates that were removed from the databases. The final database is made up of n. 41 relevant documents of which 10 open access. The remaining papers were read to ensure their alignment with the research objective according to the theoretical quality and methodology/robustness of the data.

4. Main Results and Discussion

From the analysis of the scientific documents identified, numerous contributions emerge which deal with understanding the enabling factors and barriers to the adoption of new technologies and knowledge. The literature on the topic, therefore, is rich in theoretical and empirical analysis perspectives. With the aim of offering the most complete academic debate, the graphic representation of the scientific panorama was created. The scientific panorama was created by highlighting the relationships between the keywords that scholars have used to analyze the phenomenon of enabling factors and barriers.

Figure 1 shows the representation of the scientific panorama based on the intensity of use of keywords.

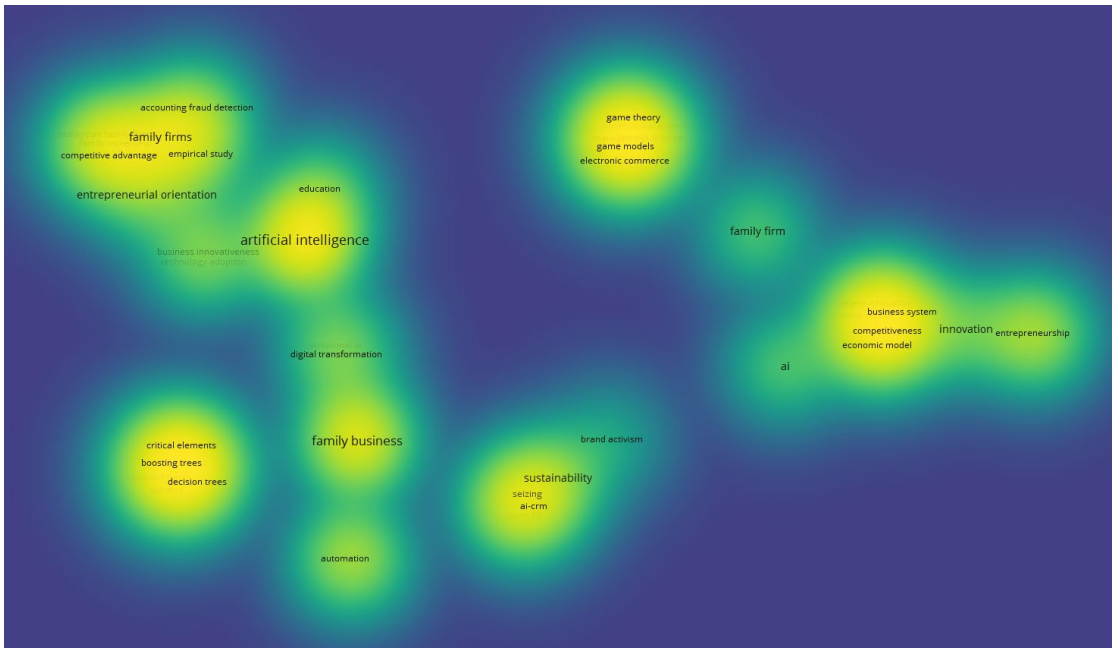


Figure 1: Scientific landscape

Source: Vosviewer software

Figure 1 shows the scientific landscape, highlighting the density (i.e. numerousness) of the words. The keywords that are at the center of larger circles define a greater number of uses than that keyword. The scientific landscape is characterized by the presence of various centers that focus the attention of scholars. In fact, we can identify the main centers around the keywords "family firms", "family business", "competitiveness", "sustainability" and "critical elements". Although the first two centers are representations of the same phenomenon but with different terminology, the other centers of the scientific landscape determine different analysis perspectives of the scholars.

First of all, it is possible to identify the historical evolution of the number of manuscripts published over time. The first paper published on the topic dates back to 2010. Since 2019, there has been an increase in published articles. In fact, over 50% of the selected papers were published from 2019 to 2023.

This allows us to draw the conclusion that the topic of the adoption of AI systems represents an emerging topic in the field of knowledge management studies, linked to family businesses.

A further consideration, under the temporal perspective, that emerges is linked to the focus on AI systems. In fact, the less recent selected articles adopt an analysis perspective focused mainly on the theoretical definition of artificial intelligence and the impacts of new technologies.

The most recent articles, on the other hand, focus on a hybrid perspective, that is, the selected papers begin to offer some empirical reflections.

A further element of preliminary analysis is linked to the countries from which the greatest number of contributions come.

The country from which the greatest number of contributions come is the United States with 13 contributions. Subsequently, the major countries that have contributed are Australia (with 10 contributions) and Germany (with 7 contributions). Finally, there are Italy and the United Kingdom (with the same number of contributions, that is 5) and Spain (with 1 contribution).

Finally, the last data is the number of papers published in open access. Of the 41 selected articles, 10 articles were published in open access. Open access articles represent easily consultable articles that can influence the scientific community and practitioners more quickly.

From reading the abstracts and selected articles, it emerges that introducing an AI system within a complex organization such as a family has a profound impact on internal processes.

Several authors have highlighted that the introduction of new technologies.

By focusing attention on enabling factors and barriers, numerous contributions emerge. Although it is possible to identify different taxonomies of enabling factors and barriers, the most recent and modern literature focuses on the presence or absence of some factors that could Favor or hinder the adoption of new technology, particularly in family businesses.

By analyzing the selected scientific documents, 9 factors capable of influencing (positively or negatively) the adoption of artificial intelligence (AI) in family businesses were identified.

Subsequently the factors were divided based on a micro or macro dimension. Table 1 reports the factors identified.

Table 1: Dimension Factors

Micro Dimension Factors	Macro dimension Factors
Know-how or new knowledge needed	Compagny Dimension
Perceived ease of AI System	IT system diffusion
Human Capital	HRM and Organizational Culture
Use of team work	Organizational Structure
	External economic and fiscal incentives

Source: our elaboration

Table 1 breaks down the factors based on their direct impact. Two dimensions have been identified: micro and macro dimensions. All the factors that are directly influenced by individuals have been grouped in the micro

dimension. Micro factors are internal factors and are unique to each organization. For this reason, it is included i) Know-how or new knowledge needed; ii) Perceived ease of AI System; iii) Human Capital and iv) diffusion of teamwork.

The first micro dimension is know-how or new knowledge needed. In fact, the selected papers highlight that it is necessary to understand the organizational needs that AI systems must respond to. In fact, it is necessary to create a map of the knowledge present within the organization and understand which knowledge needs the AI system must respond to. The second element is the way in which the AI system is perceived. Some articles have highlighted that there is often a wrong perception of the AI system and its functioning. Human capital is a further micro dimension factor. Finally, the diffusion of culture and the diffusion of teamwork becomes a crucial element.

Instead, all factors connected to a dimension of organizational structure or external to the organization have been identified as macro dimension factors. They are micro dimension factors: i) Company Dimension; ii) IT system diffusion; iii) HRM and Organizational Culture; iv) Organizational Structure and v) Economic and fiscal incentives.

5. Limits and Future Research Directions

This study can represent a first element of reflection in the debate on the adoption of artificial intelligence in family businesses. Understanding the enabling factors or barriers that can favor or hinder the introduction of AI systems in family businesses takes on an important economic and social value, especially considering the role that family businesses play in economic and social systems. Helping entrepreneurs and professionals of family businesses can promote the value of a local socioeconomic system. Family businesses are very complex socio-economic systems. In fact, the presence of two systems (family and business) often determines tensions in the adoption of new innovations. In fact, from the selected articles a consolidated line of studies emerged focused on the causes that determine the failure of the adoption of new technologies by companies. This line, which also characterizes the studies on the adoption of AI systems in family businesses. In fact, several studies have used this theoretical framework. This aspect therefore determines a starting point for scholars of family businesses and AI systems who want to understand the barriers and enabling factors of AI systems.

In assumption, this study, although analyzing a recent topic such as the adoption of AI systems in family businesses, benefits from a consolidated reference literature. In fact, to understand this very specific phenomenon, it is necessary to resort to the consolidated literature on the socio-economic characteristics of family businesses, with reference to internal innovation processes and the enabling factors and obstacles to the adoption of new technologies. At the same time, AI systems have been considered in this study as a tool for knowledge transfer within the family business. For this reason, it is also necessary to resort to the theoretical framework on knowledge transfer and KT tools. These considerations therefore determine a very high complexity for scholars who approach this study.

The study is not without limitations. The first is related to the methodology used. The analysis was based on a limited number of scientific papers, selected through a keyword search string. Further future studies should expand the number of keywords and scientific papers analyzed. Another limitation of this study is related to this aspect. Changing the keywords could reveal additional barriers and enablers that have not yet emerged.

Further research steps could highlight other factors that are not yet present. In fact, the study analyzed a limited number of scientific papers. In fact, the results of this study could be integrated, identifying a larger number of scientific papers. Finally, the study analyzed the relationship between family business and AI, with the sole purpose of identifying barriers and enablers. Many aspects require further investigation.

Future studies should focus on the empirical investigation of AI barriers and enablers in family businesses. Future studies could investigate barriers and enablers in a variety of contexts in terms of geographical location, sector, size, level of family involvement. A further step could be represented by using a methodology based on empirical observation. Future studies in this sense could validate the factors identified through interviews or case study analysis.

This study contributes to the academic debate on knowledge management studies, offering a first element of reflection on artificial intelligence and family businesses. In particular, the results of this study can help to understand how to promote the introduction of artificial intelligence systems in knowledge management in family businesses.

References

Alavi, M., & Leidner, D. E. (2001). Knowledge management and knowledge management systems: Conceptual foundations and research issues. *MIS quarterly*, 107-136.

Alcácer, J., Cantwell, J., & Piscitello, L. (2016). Internationalization in the information age: A new era for places, firms, and international business networks?. *Journal of international business studies*, *47*, 499-512.

Arzubiaga, U., De Massis, A., Kammerlander, N., & Hoy, F. (2022). Knowledge management in family firms: opening the black box and suggestions for future research. *Journal of Knowledge Management*, *26*(2), 269-290.

Baltazar, J. R., Fernandes, C. I., Ramadani, V., & Hughes, M. (2023). Family business succession and innovation: a systematic literature review. *Review of Managerial Science*, *17*(8), 2897-2920.

Bell, J., Crick, D. and Young, S. (2004), "Small firm internationalization and business strategy: an exploratory study of 'knowledge-intensive'and 'traditional'manufacturing firms in the UK", International Small Business Journal, Vol. 22 No. 1, pp. 23-56.

Chaudhary, S., & Batra, S. (2018). Absorptive capacity and small family firm performance: exploring the mediation processes. *Journal of knowledge management*, *22*(6), 1201-1216.

Chikweche, T., & Bressan, A. (2018). A systematic review of future research challenges and prospects of organizational learning research in small medium size enterprises. *Journal of Small Business & Entrepreneurship*, *30*(2), 175-191.

Conz, E., & Magnani, G. (2020). A dynamic perspective on the resilience of firms: A systematic literature review and a framework for future research. *European Management Journal*, *38*(3), 400-412.

Csaszar, F. A., & Steinberger, T. (2022). Organizations as artificial intelligences: The use of artificial intelligence analogies in organization theory. *Academy of Management Annals*, *16*(1), 1-37.

Dabić, M., Vlačić, B., & Kovač, I. (2023). Guest editorial: The future of family business: Marketing challenges in times of crisis. *Journal of Family Business Management*, *13*(1), 1-6.

Daspit, J. J., Chrisman, J. J., Ashton, T., & Evangelopoulos, N. (2021). Family firm heterogeneity: A definition, common themes, scholarly progress, and directions forward. *Family Business Review*, *34*(3), 296-322.

Durst, S., & Runar Edvardsson, I. (2012). Knowledge management in SMEs: a literature review. *Journal of knowledge management*, *16*(6), 879-903.

Ge, B., & Campopiano, G. (2022). Knowledge management in family business succession: Current trends and future directions. *Journal of Knowledge Management*, *26*(2), 326-349.

Hernández-Linares, R., Kellermanns, F. W., López-Fernández, M. C., & Sarkar, S. (2020). The effect of socioemotional wealth on the relationship between entrepreneurial orientation and family business performance. *BRQ Business Research Quarterly*, *23*(3), 174-192.

Lannon, F., Lyons, R., & O'Connor, C. (2023). Generation AI and family business: a perspective article. *Journal of Family Business Management*.

Lee, S., Kim, B. G., & Kim, H. (2012). An integrated view of knowledge management for performance. *Journal of Knowledge management*, *16*(2), 183-203.

Letonja, M., & Duh, M. (2016). Knowledge transfer in family businesses and its effects on the innovativeness of the next family generation. *Knowledge Management Research & Practice*, *14*(2), 213-224.

Liberati, A., Altman, D.G., Tetzlaff, J., Mulrow, C., Gøtzsche, P.C., Ioannidis, J.P. and Moher, D. (2009), "The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration", Journal of Clinical Epidemiology, Vol. 62 No. 10, pp. e1-e34

Mårtensson, M. (2000). A critical review of knowledge management as a management tool. *Journal of knowledge management*, *4*(3), 204-216.

Martinez-Conesa, I., Soto-Acosta, P., & Carayannis, E. G. (2017). On the path towards open innovation: Assessing the role of knowledge management capability and environmental dynamism in SMEs. *Journal of Knowledge Management*, *21*(3), 553-570.

Nieto, M. J., Santamaria, L., & Fernandez, Z. (2015). Understanding the innovation behavior of family firms. *Journal of Small Business Management*, *53*(2), 382-399.

Obeso, M., Hernández-Linares, R., López-Fernández, M. C., & Serrano-Bedia, A. M. (2020). Knowledge management processes and organizational performance: the mediating role of organizational learning. *Journal of Knowledge Management*, *24*(8), 1859-1880.

Pütz, L., & Werner, A. (2023). Absorptive capacity in family firms: a systematic literature review. *Review of Managerial Science*, 1-56.

Ratten, V. (2023). ChatGPT, the metaverse and artificial intelligence: implications for family business management education. *Journal of Family Business Management*, *13*(4), 821-827.

Reid, R., Dunn, B., Cromie, S., & Adams, J. (1999). Family orientation in family firms: A model and some empirical evidence. *Journal of Small Business and Enterprise Development*, *6*(1), 55-67.

Rovelli, P., Ferasso, M., De Massis, A., & Kraus, S. (2022). Thirty years of research in family business journals: Status quo and future directions. *Journal of Family Business Strategy*, *13*(3), 100422.

Salganicoff, M. (1990). Women in family businesses: Challenges and opportunities. *Family Business Review*, *3*(2), 125-137.

Sharma, P., Chrisman, J. J., & Chua, J. H. (1997). Strategic management of the family business: Past research and future challenges. *Family business review*, *10*(1), 1-35.

Soluk, J., & Kammerlander, N. (2021). Digital transformation in family-owned Mittelstand firms: A dynamic capabilities perspective. *European Journal of Information Systems*, *30*(6), 676-711.

Ulrich, P., Frank, V., & Buettner, R. (2023). Artificial intelligence in small and medium-sized family firms: An empirical study on the impact of family influence. *Corporate Governance and Organizational Behavior Review*, *7*(1), 72-80.

van Eck, N.J. and Waltman, L. (2007), "VOS: a new method for visualizing similarities between objects", Studies in Classification, Data Analysis, and Knowledge Organization, Springer Berlin Heidelberg, Berlin, Heidelberg, pp. 299-306.

van Eck, N.J. and Waltman, L. (2010), "Software survey: VOSviewer, a computer program for bibliometric mapping", Scientometrics, Vol. 84 No. 2, pp. 523-538

van Eck, N.J. and Waltman, L. (2014), "Visualizing bibliometric networks", Measuring Scholarly Impact, Springer International Publishing, Cham, pp. 285-320.

Ventura, M., Vesperi, W., Melina, A. M., & Reina, R. (2020). Resilience in family firms: a theoretical overview and proposed theory. *International Journal of Management and Enterprise Development*, *19*(2), 164-186.

Ventura, M., Vesperi, W., Melina, A. M., & Reina, R. (2020). Resilience in family firms: a theoretical overview and proposed theory. *International Journal of Management and Enterprise Development*, *19*(2), 164-186.

Vesperi, W., & Coppolino, R. (2023). Inter-organizational relationships in agri-food sector: a bibliometric review and future directions. *British Food Journal*, *125*(1), 82-95.

Vesperi, W., Melina, A.M., Cristofaro, C.L. and Ventura, M. (2023), "First (latent) generation and family business: a perspective article", Journal of Family Business Management, Vol. ahead-of-print No. ahead-of-print. https://doi.org/10.1108/JFBM-10-2023-0227

Wang, Y., & Beltagui, A. (2023). Does intergenerational leadership hinder the realization of innovation potential? A resource orchestration perspective. *Journal of Small Business Management*, *61*(4), 1704-1735.

Wong, K. Y. (2005). Critical success factors for implementing knowledge management in small and medium enterprises. *Industrial management & Data systems*, *105*(3), 261-279.

Yin, R.K. (2012), "Case study methods", APA Handbook of Research Methods in Psychology, American Psychological Association, Research designs: Quantitative, qualitative, neuropsychological, and biological, Vol. 2, pp. 141-15

Adopting a Learning Organization Philosophy to Promote Knowledge Sharing in the University

Patrick Mbongwa Mhlongo
Durban University of Technology, Durban, South Africa

patrickm@dut.ac.za

Abstract: Higher education institutions, as with organizations in other sectors, are operating in an environment characterized by rapid change, complexity, competition and stakeholder demands. Therefore, these institutions are continuously exploring and adopting effective strategic approaches to survive and remaining competitive. The Learning Organization philosophy is one of the concepts that has been predominantly adopted by organizations in the private sector in order to remain competitive. The aim of this study was to investigate the applicability of a Learning Organization philosophy as a strategy to promote knowledge-sharing across functional boundaries in a university. The study adopted a survey design underpinned by a post-positivism philosophical worldview. Hence, a cross-sectional design was adopted. Stratified simple random sampling was used to select participants from a population of employees at a University of Technology. The data collection instrument used in the study was a self-administered questionnaire. The Statistical Package for the Social Sciences (SPSS) was used to analyze the data. Overall, the findings of the study revealed that the adoption of a Learning Organization philosophy would promote knowledge-sharing beyond functional boundaries in Universities of Technology. Knowledge in an organizational context is regarded as a strategic asset and the Learning Organization is regarded as a philosophy that fosters knowledge creation and sharing. It is through learning that knowledge is created, and knowledge becomes useful when it is shared. Therefore, this study provides organizations, especially Universities of Technology, with necessary insights into the adoption of a Learning Organization philosophy as a strategy to promote knowledge-sharing beyond functional boundaries.

Keywords: Learning Organization, Knowledge-Sharing, Knowledge Management, Continuous Improvement, Higher Education. University of Technology

1. Introduction

To compete and remain relevant in today's turbulent and competitive environment, higher education institutions need to explore effective strategic approaches (Wang and Rashid 2022). Given this context, the aim of this study was to investigate the applicability of a Learning Organization philosophy as a strategy to promote knowledge-sharing across functional boundaries in the University of Technology. Previous researchers have investigated the knowledge-sharing concept from different perspectives (Santhose and Lawrence 2023). This study focuses on knowledge-sharing from a Learning Organization perspective in a university context. In addition, Yoon and Park (2022) argue that few studies have empirically examined individual and organizational factors together in relation to knowledge-sharing. Knowledge -sharing is the fundamental activity that facilitates learning through sharing knowledge to improve organizational processes and products (Chua, Thinakaran and Vasudevan 2023). Furthermore, Igbal and Ahmad (2020) eloquently stated that a Learning Organization has the ability to learn, adapt and outperform competitors. It is therefore critical to have a conducive environment that fosters knowledge-sharing in an organization, hence exploring effective knowledge-sharing strategies becomes critical. Consequently, the focus of the study was to explore the applicability of a Learning Organization philosophy to foster a knowledge-sharing culture in the University of Technology because institutions of higher learning are under pressure to continuously improve their offerings in line with the needs of relevant stakeholders (Jhaj 2019).

1.1 Problem Statement

The lack of an overarching philosophy that is internalized and institutionalized to foster knowledge-sharing within and beyond functional boundaries in a university encumbers knowledge -sharing. Moreover, the prevalence of silo practices in the university is also a challenge, where the focus is more on departmental or faculty goals than broader institutional goals. This is posited by Annansingh et al. (2017), who refer to this problem as knowledge silos in higher education institutions. Proponents of a Learning Organization philosophy, Robbins and Judge (2013) identify the Learning Organization philosophy as a remedy for fragmentation, competition and reactiveness in an organization. Bento, Taliabue and Lorenzo (2020) alluded to the fact that a silo mentality creates a problem, with a reluctance to share knowledge across university departments. Furthermore, Yoon and Park (2022) state that there are many barriers to knowledge-sharing in an organizational context.

2. Literature Review

The environment in which universities operate is characterized by globalization, the new economy and a number of other factors (Austin and Jones 2016). Hence, Elenezi (2021) describes the higher education environment as becoming increasingly more competitive. Universities have a role to play, not only in teaching and learning, but also in generating new knowledge to benefit society (Rossouw and Goldman 2023). Therefore, remaining relevant and to survive in such an environment requires adaptive capabilities. This highlights the importance of an overarching philosophy that will encourage the learning and sharing of knowledge in the university. Learning at an individual and collective level has been identified as key to gaining competitiveness (Sarder 2016). In addition, knowledge must be shared within and beyond functional boundaries for universities to respond to the needs of their stakeholders. Rossouw and Goldman (2023) alluded to a need for higher education institutions to continuously review their operations as they advance society in general.

Kinicki and Fugate (2018) describe a Learning Organization as an organization that has the ability to create, acquire and transfer knowledge, and as a result its behavior changes on the bases of new knowledge and insights. Learning in an organization is critical for continuous improvement purposes (Kinicki and Fugate 2016). Moreover, learning in an organization is associated with competitive advantage and innovation. Marquis and Huston (2021) succinctly state that the concept of a Learning Organization was introduced and popularized by Peter Senge. This is also espoused by Ortenblad (2018), who explains that the term 'Learning Organization' was coined by Peter Senge. A Learning Organization has the ability to operate effectively by responding to a rapidly changing business environment (Sarder 2016). Central to the Learning Organization philosophy is the understanding that business models and strategies that were previously effective, have become obsolete and no longer effective to respond to the global economy, as well as changing customer preferences. Watkins and Marsick's (1993) theory underpins this study from a Learning Organization perspective. This theory emphasizes promotion of learning and the effective management of knowledge at all levels of the organization (Nakaziba and Ngulube 2023).

2.1 Continuous Improvement of University Operations

Continuous improvement is generally viewed as a learnt and interiorized capacity that is demonstrated through a set of organizational daily routines (Jurburg et al., 2018). In other words, continuous improvement is an internalized and institutionalized philosophy to inspire a continuous improvement culture across the organization which is necessary to achieve excellence and competitiveness in an environment that is continuously changing (Juburg et al., 2018). Given the importance of continuous improvement, Singh and Singh 2015) have described it as a world-class approach to improving organizational effectiveness. Organizational members at different levels of the organization are encouraged to play their part to improve organizational processes and practices. Therefore, it becomes necessary that a conducive environment is created in an organization to encourage employees to embrace continuous improvement through learning and knowledge-sharing. According to Gasper and Mwenda (2023), the Continuous Improvement concept is receiving attention from all sectors of the economy due to increasing global competition and stakeholder demands. Hence knowledge -sharing plays a central role in continuously improving university operations to meet stakeholder needs.

2.2 Knowledge-Sharing in the University

The knowledge-sharing concept is a knowledge management technique, and it is viewed as the key to gaining competitiveness in an organizational context (Santhose and Lawrence 2023). From a theoretical perspective, the Social Exchange Theory underpins knowledge sharing. According to Tsai and Cheng (2012), the Social Exchange Theory covers knowledge-sharing robustly and it is widely used to study knowledge sharing behavior. Yoon and Park (2022) emphasize the importance of having effective systems and a culture that will promote knowledge creation and dissemination in an organization. Universities are competing in a global environment and are thus under constant pressure to continuously improve their services to respond to the needs of their stakeholders (Garcia-Sanchez 2019). The Learning Organization philosophy promotes a strong learning culture across the organization, which fosters the sharing of knowledge. As a result, productivity improves. Chua, Thinakaran and Vasudevan (2023) emphasize that in an organization where knowledge is effectively shared, such a practice leads to organizational effectiveness. Santhose and Lawrence (2023) state that in a conducive environment where there is trust and a sense of shared values, it becomes possible for members of the organization to share their knowledge.

2.3 The Learning Organization as a Strategic Choice to Achieve Organizational Effectiveness

Organizational effectiveness is the organization's ability to operate effectively, to remain competitive and to respond to the needs of its stakeholders (Ofor-Douglas 2022). Learning therefore becomes key in this context. Through learning, the organization develops its capacity to adapt in a rapidly changing environment. Ofor-Douglas (2022) further opines that organizational effectiveness is about the effective use and management of the organization's resources to achieve its strategic goals. Defined in simple terms by Ofor-Douglas (2021), organizational effectiveness refers to an organization's ability to achieve its strategic goals. In essence, organizational effectiveness is about the ability to adapt and the continuous improvement of the organization's process and practices. According to Ahmad et al. (2020), organizational effectiveness is key to responding effectively to the needs of the stakeholders. The Learning Organization philosophy creates a conducive environment for knowledge -sharing, which leads to organizational effectiveness. Yoon and Park (2022) concur that organizations need relevant competencies to adapt to a rapidly changing environment.

3. Research Methodology

The study adopted a survey design, underpinned by a post-positivism philosophical worldview. Hence, a cross-sectional design was used. The study was quantitative in nature as quantitative data was collected to achieve the objectives of the research. Leavy (2017) describes quantitative research as research characterized by measuring and testing relationships between variables to identify patterns and correlations. This point is posited by Leedy and Ormrod (2019) as well, that quantitative researchers focus on identifying relationships between variables. A sample of 291 participants was selected from a population of 1213 employees of a selected University of Technology. Staff from both the academic and academic support sectors of the university participated in the study. A response rate of 70% was achieved. Cronbach's Alpha was used to determine the reliability of the measuring instrument with an overall reliability score of 0.912.

3.1 Sampling

A stratified simple random sampling technique was used to select the sample from the population. This sampling technique has the advantage of guaranteeing the equal representation of each strata (Leedy and Ormrod 2019). Stratified random sampling is further defined by Trochim, Donnelly and Arora (2016) as a sampling method whereby the population is divided into homogenous sub-groups, then using a simple random sampling in each group to select participants.

3.2 Data Collection Method

Data collection in a research project relates to the technique used to gather a specific type of data (Spickard 2017). A self-administered questionnaire was used as the data collection instrument for this study. The questionnaire contained Likert scale statements. Leedy and Ormrod (2019) mention that questionnaires are popular for quantitative researchers because they can be distributed to a large number of participants.

3.3 Data Analysis

The Statistical Package for the Social Sciences (SPSS) version 20.0 was used to analyze data. This computer software is regarded as a user-friendly and effective statistical computer program for quantitative data analysis (Gaur and Gaur 2009).

3.4 Profile of Participants

This section presents descriptive statistics based on the biographical information of the participants of the study. Information solicited was in relation to whether participants were part of the academic or administration sector in the university.

3.5 Sector in the University of Technology

The sample constituted participants from two different sectors (academic and administration), as presented in Figure 1 below.

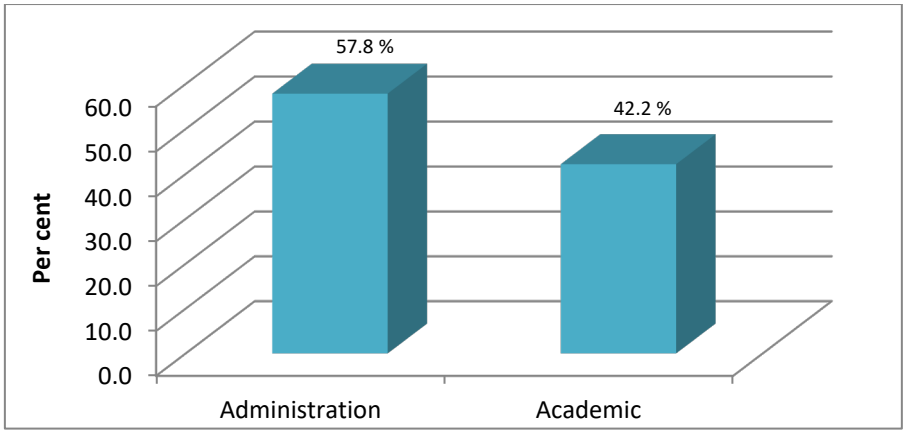


Figure 1: Sector in the University of Technology

The results show that 57.8% of the participants were from the administration sector, and 42.2% from the academic sector. It was found that the number of respondents was almost in the ratio of 6:4 for the administrative and academic sectors. This revealed that the university had more employees in administration than in the academic sector.

3.6 Opportunities for the application of a Learning Organisation philosophy in the University of Technology

This section examined opportunities for the application of a Learning Organisation philosophy at the University of Technology. Figure 2 below presents participants' responses on opportunities for the application of a Learning Organisation philosophy at the university.

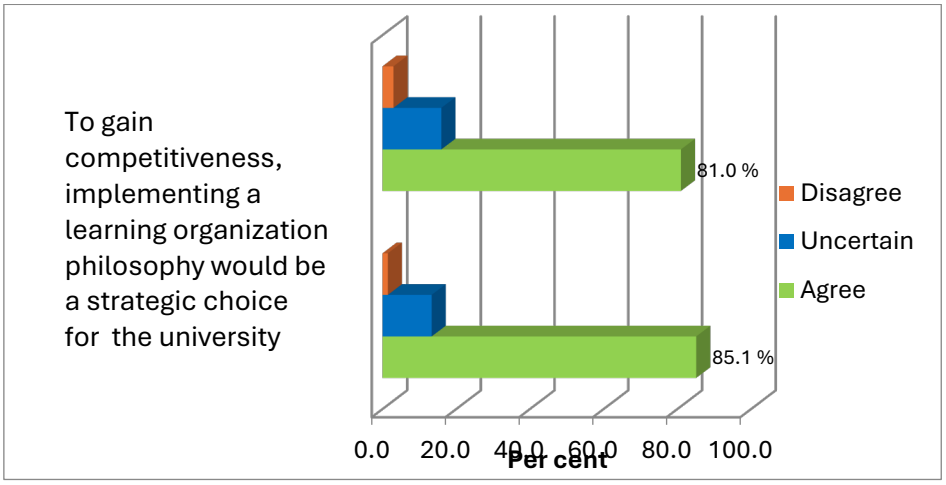


Figure 2: Opportunities for the implementation of a Learning Organisation philosophy

The majority of participants were optimistic that the application of a Learning Organisation philosophy would improve processes and practices in the university. Approximately 85% were of the view that the university would be able to respond effectively to the needs of its stakeholders through the implementation a Learning Organisation philosophy. The results further revealed that 81% of the participants felt that the adoption of a Learning Organization philosophy would be a strategic choice for the university. Lin, Eichelberger and Leong (2020) state that the rapidly changing environment in which universities operate requires new approaches with new perspectives.

3.7 Challenges with the Application of a Learning Organisation Philosophy in the University

Information is presented in Table 1 below on the possible challenges with the application of a Learning Organisation philosophy in the university.

Table 1: Challenges with the application of a learning organisation philosophy

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	Lack of staff motivation	72	35.3	39.1	39.1
	Lack of support systems	66	32.4	35.9	75.0
	Lack of a shared vision	40	19.6	21.7	96.7
	Other	6	2.9	3.3	100.0
	Total	184	90.2	100.0	
Missing	System	20	9.8		
Total		204	100.0		

Almost 39.1% of the participants highlighted the lack of staff motivation and 36% identified the lack of support systems. In addition, 22% of the participants felt that the lack of a shared vision might also be a problem for the implementation of a Learning Organization philosophy in the University of Technology. Overall, these are the key challenges identified by participants. Besides these challenges, Wang and Rashid (2022) argue that transforming an organization into a Learning Organization has a number of benefits, mainly the ability to compete.

3.8 University Governance and Institutional Culture From Employees' Perspective

Figure 3 below provides a summary of the responses illustrating the views of participants on university governance and institutional culture.

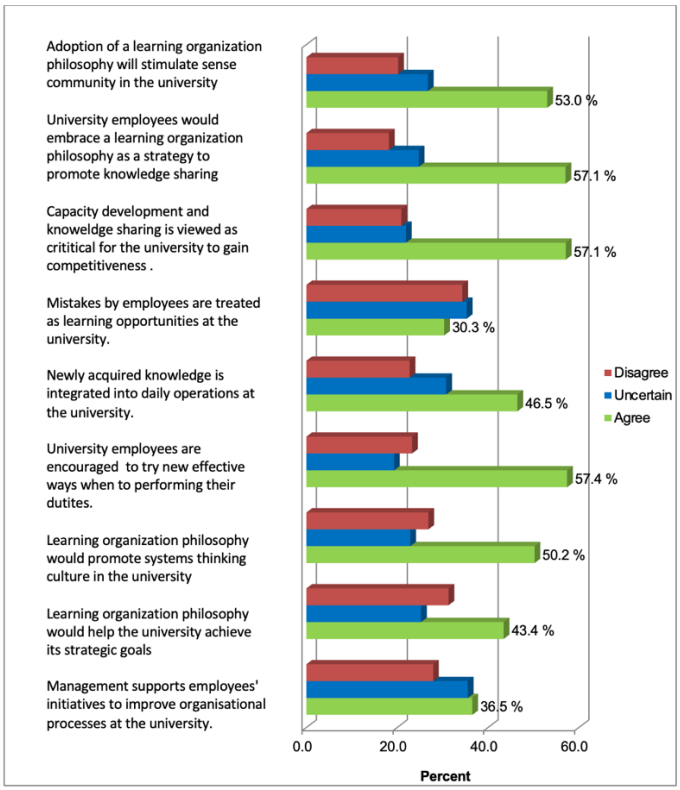


Figure 3: University governance and institutional culture

Overall, the responses show higher levels of agreement for most statements. Comparatively, the findings indicated low levels of agreement on just two statements, namely mistakes by employees are treated as learning opportunities and management supports employees' initiatives to improve organisational processes in the university. Agreement levels on both variables were at 30.3% and 36.5% respectively. The majority of participants indicated that the university is an organisation where employees strive for excellence, at 57.1%; they are encouraged to be innovative, at 57.4%; and capacity development and knowledge sharing is viewed as a priority, at 57.1%. Furthermore, there was a high level of agreement that adopting a Learning Organization

philosophy would stimulate a sense of community, and employees are willing continuously to improve on what they do, at 53.0%. The Learning Organisation philosophy places strong emphasis on the importance of a sense of community within an organisation. Matic (2022) posits that a Learning Organization philosophy has been identified as a strategic option for competing in a highly demanding and rapidly changing environment.

3.9 ANOVA Test Results on University Governance and Institutional Culture

Table 2 below presents ANOVA test output in relation to university governance and institutional culture.

Table 2: ANOVA : Test results on University governance and institutional culture

ANOVA : Employee Perceptions						
	ANOVA	**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Adoption of a Learning Organization philosophy will stimulate sense of community in the university.	Between Groups	.739	1	.739	.606	.437
	Within Groups	239.301	196	1.221		
	Total	**240.040**	**197**			
University employees would embrace a Learning Organization philosophy as a strategy to promote knowledge sharing.	Between Groups	1.805	1	1.805	1.599	.208 .
	Within Groups	221.371	196	1.129		
	Total	**223.177**	**197**			
Capacity development and knowledge sharing is viewed as critical for the university to gain competitiveness.	Between Groups	.209	1	.209	.171	.679
	Within Groups	236.709	194	1.220		
	Total	**236.918**	**195**			
Mistakes by employees are treated as learning opportunities at the university.	Between Groups	.792	1	.792	.723	.396
	Within Groups	217.934	199	1.095		
	Total	**218.726**	**200**			
Newly acquired knowledge is integrated into daily operations at the university.	Between Groups	1.244	1	1.244	1.214	.272
	Within Groups	200.917	196	1.025		
	Total	**202.162**	**197**			
University employees are encouraged to try new, effective ways when performing their duties.	Between Groups	1.224	1	1.224	.982	.323
	Within Groups	249.232	200	1.246		

ANOVA : Employee Perceptions						
	Total	**250.455**	**201**			
Adopting a Learning Organization philosophy would promote systems thinking culture in the university.	Between Groups	14.177	1	14.177	10.407	.001
	Within Groups	271.077	199	1.362		
	Total	**285.254**	**200**			
Learning Organization philosophy would help the university to achieve its strategic goals.	Between Groups	.269	1	.269	.220	.640
	Within Groups	239.771	196	1.223		
	Total	**240.040**	**197**			
Management supports employees' initiatives in improving organisational processes at the university.	Between Groups	6.092	1	6.092	6.016	.015
	Within Groups	197.441	195	1.013		
	Total	**203.533**	**196**			

The ANOVA test results in Table 2 reveal variables with statistically significant differences, as well as variables with no statistical significance. These variables relate to perceptions of both academic and administration sectors on university governance. Study variables with a significance difference include: Adopting a Learning Organization philosophy would promote a systems thinking culture in the university, with a p-value of **0.001;** and that university management supports employees' initiatives in improving organisational processes, with a p-value of **0.015**. However, all other variables have no statistical significance.

3.10 Chi-Square Tests Output on University Governance and Institutional Culture

Table 3 below presents Chi-square test results relating to university governance and institutional culture.

Table 3: Chi-square results on university governance and institutional culture

Pearson Chi-Square Tests			
	Sector	**Department**	
Adoption of a Learning Organization philosophy will stimulate sense community in the university.	0.515	0.134	
University employees would embrace a Learning Organization philosophy as a strategy to promote knowledge sharing.	0.486	0.022*	
Capacity development and knowledge-sharing is viewed as critical for the university to gain competitiveness.	0.287	0.189	
Mistakes by employees are treated as learning opportunities at the university.	0.082	0.006*	
Newly acquired knowledge is integrated into daily operations at the university.	0.263	0.015*	
University employees are encouraged to try new effective ways when performing their duties.	0.641	0.267	
Adopting a Learning Organization philosophy would promote systems thinking culture in the university.	0.009*	0.137	
Learning Organization philosophy would help the university to achieve its strategic goals.	0.498	0.144	
Management support employees' initiatives to improve organisational processes at the university.	0.182	0.158	

The chi-square results in Table 3 indicate a statistically significant relationship between the academic and administration sectors on the following variables:

University employees would embrace a Learning Organization philosophy as a strategy to promote knowledge-sharing,

Mistakes by employees are treated as learning opportunities at the university,

Newly acquired knowledge is integrated into daily operations at the university.

The results further indicate that with the rest of the study variables, there is no statistically significant relationship between the academic and administration sectors. Study variables with no statistically significant relationship have a **p-value** greater than **0.05**.

3.11 Adaptability and Continuous Learning in the University

This section deals with the continuous learning culture and adaptability in the university.

Figure 4 below presents a summary of the responses.

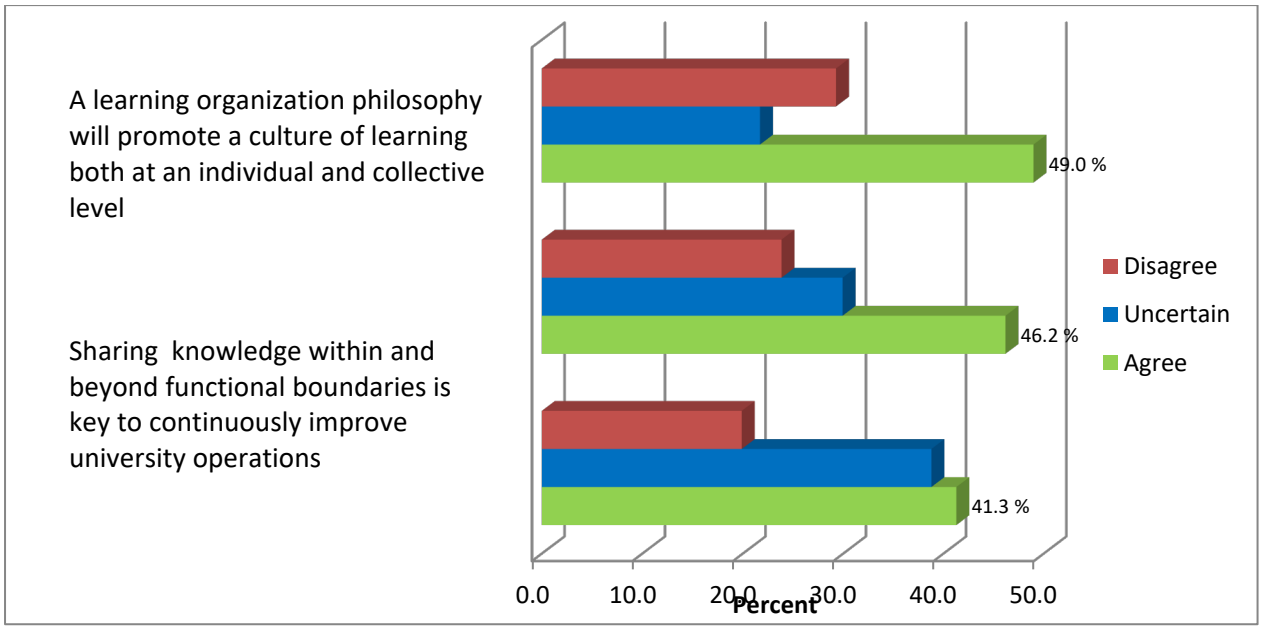


Figure 4: Adaptability and continuous learning in the university

The levels of agreement on all variables are less than 50% in this section. The findings revealed that participants at 49.0% were of the view that the implementation of a Learning Organization philosophy would promote learning at both the individual and collective levels. The results indicate that learning and sharing of knowledge was critical to responding effectively to the needs of the university's stakeholders. Although levels of agreement with statements in this section were less than 50%, the information helps to provide the perspective of participants on statements raised in this section.

4. Results and Discussions

The questionnaires were self-administered to employees of a selected University of Technology and a 70% response rate was achieved from 291 questionnaires.

Based on the findings, participants were optimistic about the implementation of a Learning Organisation philosophy in the university. The results indicate that employees at all levels would embrace the implementation of a Learning Organization philosophy in the university. Importantly, participants were of the view that the implementation of a Learning Organization philosophy would be a strategic decision to promote knowledge sharing in the university. Wang and Rashid (2022), who are proponents of a Learning Organization philosophy, accentuate that becoming a learning organization is critical in a rapidly changing environment. According to Chua, Thinakaran and Vasudevan (2023), knowledge is a key resource for solving problems, making informed

decisions, as well as improving processes and practices in an organization. The results revealed that the university environment was conducive to the implementation of a Learning Organization as a strategy to promote knowledge -sharing in the university. Overall, participants were also optimistic that adopting a Learning Organization philosophy would help the university to achieve its strategic goals, and as a result be able to respond to the needs of relevant stakeholders. Malik and Garg (2020) emphasise that continuous learning and adaptability are key characteristics of a Learning Organization. Participants raised some concerns regarding the application of a Learning Organisation philosophy at the university. However, overall, positive sentiments in the study outweigh the negative sentiments on the application of a Learning Organisation philosophy in the organisation. Hence, knowledge has been identified as a key resource for organizational success. Therefore, it is necessary to adopt, internalise and institutionalize the Learning Organization philosophy as an overarching philosophy to promote knowledge -sharing in Universities of Technology. Based on the findings, it could be concluded that a conducive environment is important to successfully implement a Learning Organisation as a strategy to promote knowledge-sharing in the university.

4.1 Research Contribution

This study has demonstrated that a Learning Organization philosophy is paramount in both creating a conducive environment and fostering a knowledge-sharing culture within and beyond functional boundaries in a university. Practically, this study provides necessary and actionable ideas on the adoption of a Learning Organization philosophy, amongst other things, to promote knowledge-sharing. This study highlights the connection between learning and knowledge. Yoon and Park (2022) argue that knowledge-sharing facilitates new ideas for innovation. Literature on the Learning Organization is copious. However, the Learning Organization has not been researched from a knowledge -sharing perspective in the context of the UoTs. The findings of the study provide necessary insights for UoTs to gain competitiveness. Furthermore, the adoption of a Learning Organization as an overarching philosophy is necessary considering the constant pressure under which UoTs operate to respond to the needs of their stakeholders. As highlighted, learning and knowledge serve as a cornerstone for organizations to compete and remaining relevant in a highly demanding global environment (Matic 2022). This study contributes to the literature by capturing knowledge-sharing from a Learning Organization perspective, in a university context.

4.2 Ethical Requirements

This research project was conducted in accordance with the ethical guidelines of the institution. The researcher obtained ethical clearance from the Research Committee at the institution. Participation in the study was on a voluntary basis and participants had to sign a consent form.

4.3 Study Limitations

One of the limitations of this study was that it focused on only one University of Technology, which was one of the two Universities of Technology in the province of KwaZulu- Natal, South Africa. This university was selected based on its historical background as it was formed after a merger of two Technikons in 2002.

5. Conclusion

The Learning Organization philosophy serves as an overarching philosophy in an organization where continuous learning and the sharing of knowledge happens beyond functional boundaries. Marquis and Huston (2021) state that knowledge developed through various initiatives in an organization should go beyond the boundaries of individual learning. In other words, acquired knowledge both at an individual or collective level should be shared within and beyond functional boundaries in an organization. It is also further emphasized by Matic (2022) that the ability to learn and effectively manage acquired knowledge is necessary to achieve organizational effectiveness and remain competitive. This study has demonstrated that a Learning Organization philosophy could be used to foster knowledge-sharing in a university.

5.1 Future Research

It is recommended that future research should be extended to include more Universities of Technology. Furthermore, future researchers should investigate or evaluate the impact of a Learning Organization philosophy in relation to the promotion of knowledge-sharing beyond functional boundaries in a university.

References

Ahmad, S, Ali, N. A, Jantan, A, Bowyer, D, Campbell, N. and Reaz, M. (2020) "Organizational Effectiveness Through Transformational Leadership and Technology Innovation: A Systematic Literature Review and Future Research Agenda", Journal of International Business and Management, Vol 3, No.4, pp1-17.

Anderson, P. (2020) How Management Works: The Concepts Visually Explained, Dorling Kindersley, London.

Annansingh, F, Howell, K.E, Liu, S. and Nunes, M. (2018) "Academics' Perception of Knowledge Sharing in Higher Education", International Journal of educational Management, Vol 32, No.6, pp1001-1015. **https//doi: 10.1108/IJEM-07-2016-0153.**

Austin, I. and Jones, G.A. (2016) Governance of Higher Education: Global perspectives, Theories and Practices. Routledge, London.

Bento, F, Taliabue, M. and Lorenzo, F. (2020) "Organizational Silos: A Scoping Review Informed by A Behavioral Perspective on Systems and Networks", Societies, Vol10, No.3, pp 1-27.

Bratianu, C. (2020) "A Knowledge Management approach to complex crises", Management Dynamics in the Knowledge Economy, Vol 8, No.4, pp 345-356. DOI10.2478/mdke-2020-0022.

Bui, H. (2020) "From the Fifth Discipline to the New Revolution: What we have Learnt from Senge's Ideas over the Last Three Decades", The Learning Organization, Vol 27, No.6, pp 495-504. https://doi.org/10.1108/TLo-04-2020-0062.

Bui, H. and Baruch, Y. (2010) "Creating a Learning Organization: A Systems Perspective", The Learning Organization, Vol 17, No.3, pp 208-227.

Chua, K, Thinakaran, R. and Vasudevan, A. (2023) "Knowledge Sharing Barriers in Organizations: A Review", TEM Journal, Vol12, no. 1, pp184-191. https://doi.org/10.18421/TEM121-24.

Douglas, S, Merritt, D, Roberts, R. and Watkins, D. (2021) "Systematic Leadership Development: Impact on Organizational Effectiveness", International Journal of Organizational Analysis, Vol 30, No.2, pp 568-588.

Elenezi, Ma. (2021) "Deep Dive into Digital Transformation in Higher education Institutions", Education Sciences, Vol 11, pp 1-13.

Garcia- Sanchez, P, Diaz-Diaz, N. and De Saa-Perez, P. (2019) "Social Capital and Knowledge sharing in Academic Research Teams" , International Review of Administrative Sciences, Vol 85, No.1, pp 191-207.

Gaur, A.S. and Gaur, S.S. (2009) Statistical Methods for Practice and Research: A Guide to Data Analysis Using SPSS, Response Books, London.

Gasper, L. and Mwennda, B. (2023) "Quantitative Analysis of Kaizen Philosophy on Productivity Improvement", International Journal of Research in Business and Social Sciences, Vol 12, No.3, pp 557-562.

Jhaj, S. (2019) "Innovation Strategies to Address Challenges Facing Higher Education", International Journal of Design in Society, Vol13, No.1, pp 22-33.

Jurburg, D, Viles, E, Tanco, M. and Matoe, R. (2018) "Continuous Improvement Leaders, Followers and Laggards: Understanding Systems Sustainability", Total Quality Management and Business excellence, Vol 29, No.7, pp 817-833. https://doi.org/doi.org/10.1080/14783363.2016.1240610.

Kinicki, A. and Fugate, M. (2018) Organizational Behavior: A practical, Problem-Solving Approach, McGraw-Hill, New York.

Kinicki, A. and Fugate, M. (2016) Organizational Behavior: A Practical, Problem-Solving Approach, McGraw-Hill, New York.

Kumari, P. and Thapliyal, S. (2017) "Studying the Impact of Organizational Citizenship Behavior and Organizational Effectiveness", International Journal Organizational Behaviour and Human Resource Management, Vol 4, No.1, pp 9-21.

Leedy, P.D. and Ormrod, J.E. (2019) Practical Research 12th ed: Planning and Design, Pearson, New York.

Lin, M, Eichelberger, A. and Leong, P. (2020) "Examining a Change Process from a Systems Thinking Perspective: A Case study from One Academic Department", Tech Trends, Vol 64, pp 751-758.

Marquis, B.L and Huston, C.J. (2021) Leadership Roles and Management Functions in Nursing: Theory and Practice, Wolters Kluwer, London.

Mas-Machuc, M, Akhmedova, A. and Marimon, F. (2021) "Quality Management: a Compulsory Requirement to Achieve effectiveness", Total Quality Management, Vol 32, No.2, pp 220-239.

Nakaziba, S. and Ngulube, P. (2023) "Academic Libraries as Learning Organizations: Enhancing CPD Activities within Selected University Libraries in Uganda", Journal of Library Administration, Vol 63, No. 8, pp 989-1013. https://doi.org/10.1080/01930826.2023.2281339.

Nieuwenhuizen, C. (2018) Business Management for Entrepreneurs 4th ed, Juta, Cape Town.

Ofor-Douglas, S. (2022) "Organizational Effectiveness: A Necessary Tool for Achieving Quality University Education in Nigeria", East African Journal of Interdisciplinary Studies, Vol 5, No.1, pp 170-181.

Ortenblad, A. (2018) "What does Learning Organization Mean?", Learning Organization, Vol 25, No.3, pp150-158. https://doi10.1108/TLO-02-2018-0016.

Robbins, S.P. and Judge, T. (2013) Organizational Behavior 15th ed, Pearson, United States.

Rossouw, D. and Goldman, G.A. (2023) "Technology and Collaboration as Strategic Drivers Shaping Higher Education", The Journal of Transdisciplinary Research in Southern Africa, Vol19, No.1, pp1-10.

Santhose, S. and Lawrence, N. (2023) "Understanding the Implementation and Limitations in Knowledge Management and Knowledge Sharing Using a Systematic Literature Review", Current Psychology, Vol 42, No.2, pp 32427-32442 https://doi.org/10.1007/s12144-022-04115-6.

Sarder, R. (2016) Building an innovative learning organization: A Framework to Build a Smarter Workforce, Adapt to Change and Drive Growth, Wiley, London.

Senge, P. (2006) The fifth discipline: The art and Practice of the learning organization, Random House, London.

Singh, J. and Singh, H. (2015) "Continuous Improvement Philosophy-Literature and Directions", Benchmarking: An International Journal, Vol 22, No.1, pp75-119.

Spickard, J.V. (2017) Research basics: Design to Data Analysis in Six Steps, Sage, London.

Trochim, W.M, Donnelly, J.P. and Arora, K. (2016) Research Methods: The Essential Knowledge base, Cengage, Boston.

Wilson, J. (2014). Essentials of Business Research: A Guide to Doing your Research Project, Sage, London.

Tuyen, B. (2021) "Building a Learning Organization in the Digital Era: A Proposed Model for Vietnamese Enterprises", International Review of Management and Marketing, Vol 11, No.3, pp 42-48.

Wang, G. and Rashid, A. M. (2022) "Job satisfaction as the mediator between a learning organization and organizational commitment among lecturers", European Journal of Educational Research, Vol 11, No.2, pp 847-858.

Yang, W. and Marsick, V.J. 2004. "The construct of the learning organization: Dimensions, measurement and validation". Human Resource Development Quarterly, Vol 15, No.1, pp 31-55.

Yoon, S.W. and Park, J.G. (2022) "Employee's Intention to Share Knowledge: The Impacts of Learning Organization Culture and Learning Goal Orientation", International Journal of Manpower, Vol.44, No.2, pp231-246.

Identifying Knowledge Flow in Complex Sociotechnical Systems to Contribute to Resilient Capacity: An Empirical Study

Jaime Miranda Junior, José Leomar Todesco, Denilson Sell, Caroline de Medeiros and Lídia Neumann Potrich
Universidade Federal de Santa Catarina, Florianópolis/SC, Brasil

jaimemjunior@gmail.com
titetodesco@gmail.com
denilsonsell@gmail.com
profcarolifsc@gmail.com
lidia.potrich@gmail.com

Abstract: Knowledge is a fundamental element to enable organizations in anticipating and responding to Operational Safety Events (OSE). The identification and analysis of knowledge flows emerge as strategies to strengthen the potential for organizational resilience, as they qualify the knowäedge necessary for risk mitigation and the strengthening of operational safety. This article presents the results of an empirical research conducted in a sanitation company, aiming to investigate critical knowledge and its flows in complex sociotechnical systems. The research involved interviews with professionals who faced OSEs in their daily activities. OSEs were defined as situations where professionals were able to prevent accidents and/or incidents, successfully dealing with potential threats. To achieve the research objectives, two sequential instruments were used. The first instrument was employed to identify critical knowledge related to OSEs, exploring those mainly related to situational awareness and the repertoire for implementing responses to an OSE. This process revealed a diversity of knowledge, much of which was tacitly present in the minds of professionals and was not formally documented in the company's standard operating procedures. The second instrument was developed to map knowledge flows associated with the identified OSEs. This mapping provided a deeper understanding of how these critical knowledge were shared and used within the organization. The research results evidenced various critical knowledge in the analyzed OSEs, going beyond the information available in tutorials, work plans, or organizations' standard operating procedures. Both instruments used in the interviews were validated and yielded positive results. As a result of this empirical research, the organization now has a valuable understanding of the critical knowledge evidenced, which has the potential to drive organizational learning and strengthen the resilient capabilities of the organization, considering that knowledge resources are a fundamental element for resilience. As a next step, it is aimed to investigate the visual representation of knowledge flows, assess their effectiveness, and provide specific guidelines to enhance knowledge management processes in organizations.

Keywords: Knowledge Flow, Resilient Capabilities, Complex Sociotechnical Systems, Knowledge Management, Resilience.

1. Introduction

In recent years, the work environment has faced a significant increase in complexity, driven by technological advancements, market digitization, and the data revolution. This increase in complexity is particularly notable in high-reliability organizations, where risks and uncertainties are paramount. To understand this evolution, the theory of complex systems has been increasingly utilized to attempt to explain why activities evolve with a high degree of uncertainty and unpredictability, as the combination of activity variability generates complex scenarios whose outcomes become difficult to predict (Oedewald & Gotcheva, 2015; Hirose & Sawaragi, 2020; Reiman et al., 2021).

The Cynefin framework, developed by Snowden and Boone (2007), offers an approach to understanding and making decisions in different operational contexts. Comprising four distinct domains - simple, complicated, complex, and chaotic - Cynefin helps categorize organizational environments and adjust strategies according to each context. Figure 1 presents the framework.

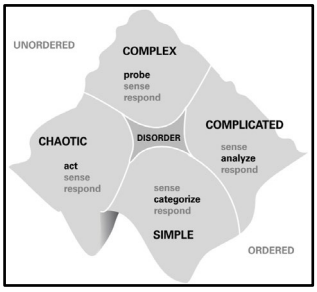


Figure 1: Framework Cynefin. Source: Snowden e Boone (2007).

Specifically in the complex quadrant of the Cynefin framework, situations and activities are characterized by high uncertainty and unpredictability. In this context, interactions between system elements are nonlinear and emergent, meaning that outcomes cannot be easily predicted based on simple cause-and-effect relationships. Instead, relationships are dynamic and may evolve in unexpected ways. As characteristics of this complex quadrant, Saurin and Sosa (2013) defined four main attributes: (i) a large number of elements that interact dynamically; (ii) a wide diversity of elements; (iii) anticipated variability; and (iv) resilience, with resilience being the primary attribute of these systems.

Given that resilience is the primary attribute of these systems, it becomes imperative for organizations to seek ways to enhance their capabilities for monitoring, anticipation, response, and learning in the face of unexpected events (Hollnagel, 2011). This article proposes the use of two guiding instruments - scripts for identifying applied knowledge in the face of OSEs, with questions - applied to professionals within an organization in the context of SSTC. The objective is to identify critical knowledge and knowledge flow in OSEs, seeking to qualify this knowledge in a way that makes it accessible and applicable within the organization. Additionally, the article also aims to verify and validate these instruments as part of its contribution to understanding and effectively managing organizational resilience in the face of the complexity of the current work environment.

The article is structured as follows: The first section contextualizes the problem in the introduction, establishing the foundation for the subsequent discussion. In the second section, theoretical foundations are provided, exploring the two main themes: knowledge flow and complex sociotechnical systems. Next, details of the knowledge flow identification process are presented, including the scenario, interview conduct, and results achieved. In the final section, concluding remarks are made, providing a conclusion on the study conducted.

2. Concepts

2.1 Knowledge Flow

The pioneering study on the construct of knowledge flow dates back to 1953, with the article titled "Planning Concepts and Regional Research," written by the American author Harvey S. Perloff. In this seminal work, Perloff investigated knowledge flow in the context of regional planning. However, until the late 1990s, publications on the topic were relatively scarce, and in several years, no publications related to knowledge flow were recorded. From 1991 onwards, a significant growth in works addressing the topic was observed, with the year 2020 standing out as the period with the highest number of publications (Miranda Junior et al., 2022b).

Despite the growing interest, there is still no consensus in the literature on a definitive definition for the concept of knowledge flow. However, the fundamental essence remains consistent, centered on the exchange, diffusion, or movement of ideas, knowledge, and concepts (An, Han & Park, 2017). In a comprehensive literature review, Bittarello (2014) identified several definitions for the term "knowledge flow," highlighting three levels of analysis: (i) team level, (ii) inter-team, and (iii) within the organization. Table 1 presents the definitions evidenced by the author, as well as others found throughout the research.

Table 1: Definition of knowledge flow

Authors	Definition
Wu, David C. Yen (2012)	The process of knowledge transfer between individuals or knowledge processing mechanisms.
Rodríguez-Elias (2008)	Transfer of knowledge from where it is created or stored to where it needs to be applied.
Nissen (2002)	It considers the flow of knowledge in terms of dynamic knowledge, where the flow engages in activities such as knowledge conversion, transfer, sharing, integration, reuse, movement, and application of that knowledge over a period of time.
Zhuge (2002)	It is a process of passing knowledge between individuals or knowledge processing mechanisms. It possesses three crucial attributes: direction, content, and carrier, which respectively determine the sender and receiver, the content of shareable knowledge, and the medium that can transmit the content.

Source: adapted of Bittarello (2014).

The definition of knowledge flow adopted in this work will be the one proposed by Zhuge (2002).

In studies on the topic of knowledge flow, three essential characteristics emerge to qualify this flow: (i) the study objective on knowledge flow; (ii) the representation of knowledge flow; and (iii) the level of analysis of knowledge flow. According to Miranda Junior, Potrich, and Todesco (2021), most research on knowledge flow is focused on three main objectives: (i) improving organizational processes, (ii) supporting senior organizational management, and (iii) stimulating organizational innovation. These objectives have been identified in various organizational contexts, from public and private organizations to research institutes, where the topic of innovation is particularly relevant.

The use of knowledge flow as a tool in knowledge engineering allows for its identification and qualification, aiming at the application of this knowledge in other related constructs, such as organizational learning and knowledge management.

In the next chapter, the second construct of this research will be presented, namely, complex sociotechnical systems.

2.2 Complex Sociotechnical Systems

Characterizing a complex sociotechnical system involves interrelations among diverse elements, including people, technology, physical environment, procedures, and regulations. In this context, activities performed are knowledge-intensive, with a strong technological presence and subject to residual risks and uncertainties. Moreover, such systems are constantly exposed to influences from the external environment (Saurin & Sosa, 2013; Schneider, 2019).

According to Saurin and Sosa (2013), four categories of characteristics define complex sociotechnical systems: a large number of elements interacting dynamically, a wide diversity of these elements, anticipated variability, and resilience.

Resilience, in particular, is a crucial attribute of these systems, denoting their ability to adjust their functioning before, during, or after changes to sustain unexpected conditions (Hollnagel, 2011; Saurin & Sosa, 2013). Woods (2015) emphasizes that resilience became a popular concept in the early 2000s due to pressure for more efficient and economical systems.

However, the popularization of resilience has also generated confusion, as the term is employed in various ways. Woods (2015) identifies four distinct approaches: resilience as recovery and return to equilibrium, as synonymous with robustness, as the opposite of fragility, and as network architectures capable of adapting to future surprises.

It is crucial to situate resilience within a specific research context. In this article, we adopt the perspective of recovery and adaptation, emphasizing the importance of a complex sociotechnical system's ability to overcome adversities and adjust to future changes, following the guidelines of Hollnagel (2011) as a central reference. Hollnagel highlights knowledge as an essential element for a system's resilience, being a fundamental component of resilient capabilities, as resilience only manifests in practice. Figure 2 presents the four capabilities described by the author.

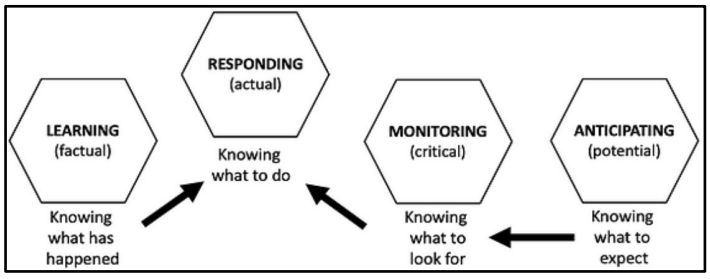


Figure 2: The capabilities of a resilient system. Source: Hollnagel, 2011.

As illustrated in Figure 2, knowledge plays a direct role in strengthening anticipation and monitoring capabilities, as well as significantly contributing to responsiveness. In this sense, knowledge is essential as a resource to guide effective action.

3. Knowledge Flow Identification Process

In this section, the process of identifying knowledge flow in a sanitation company in Brazil will be detailed. A description of the company where the research was conducted will be provided, along with details about the operational safety events that were addressed during the interviews.

3.1 Methods

The research was conducted in a public sanitation company. This organization is part of complex sociotechnical systems, characterized by dynamic interrelations among people, technology, physical environment, procedures, and regulations. In addition to its fundamental operations, the company also performs a series of other complex activities, such as water quality control and waste management. Its relevance in the context of basic sanitation and its representation as a large-scale organization make it a conducive setting for investigations into knowledge flow and resilient capabilities. The company has approximately 2.000 employees, serving around 2.7 million people across 195 municipalities within the Santa Catarina state in Brazil. For the research, two professionals from the technical department of the company were selected, who held different hierarchical levels and also had a minimum of 10 years of experience in the company. These professionals were intentionally selected due to their extensive knowledge about the operations that are the focus of this study.

Thus, the semi-structured interviews were encouraged to recall operational safety events (OSE) they witnessed during their experience in the company, events that, in some way, managed to prevent accidents and/or incidents based on their expertise. The two operational safety events (OSE) identified by the interviewees for the interviews were: (1) water reservoir rupture; (2) maintenance of pumped sewage network. To achieve the proposed objective and conduct the interviews effectively, two instruments were used. The first instrument was employed to identify the operational safety event and to highlight critical knowledge, as proposed by Miranda Junior et al. (2022a). The second instrument was sequentially used to identify the knowledge flow in the operational safety event in question, also proposed by Miranda Junior et al. (2023). Table 2 presents a synthesis of the field of study.

Table 2: Summary of aspects of the field work carried out.

Item	Description
Population	Approximately 2.000 employees, serving approximately 2.7 million people in 195 municipalities in a state in Brazil
Method used to select interviewees	Should possess varying hierarchical levels within the organization, a minimum of 10 years of experience, and extensive knowledge about the company's operations.
Type of interviews carried out	Two semi-structured interviews were conducted using instruments developed by Miranda Junior et al. (2022a) and (2023).
Analysis method used	Conducted content analysis on the responses provided by the interviewees.

Source: Authors (2024).

Tables 3 and 4 present a portion of the two instruments used to elucidate the interviews.

Table 3: Critical knowledge identification instrument.

Activity	Description
Interviewee identification	What is your name, job title, and/or role? How many years of experience do you have in this field, both at your current organization and at other companies? Could you provide a brief overview of your daily activities?
OSE identification	Could you tell me an episode where your experience helped in solving a problem?
Diagnosis	How did you realize that the event would be unusual/difficult? What were the primary pieces of information or clues available when you first realized an accident was imminent? What knowledge did you employ to interpret this information?

Activity	Description
Intervention	Considering the perception of the event, what action plan was established? What information and critical knowledge were used to develop this plan? How were the necessary skills mobilized for the implementation of the action plan?
Difficult or facilitating factors	Were there any factors that impeded the design or implementation of the action plan?

Source: Miranda Junior et. al. (2022a).

Table 4: knowledge flow identification instrument.

Activity	Description
Reaffirm the critical knowledge identified	In the previous script, critical knowledge was highlighted, enabling the detection of clues and the conception of the action plan. Would it be possible to reaffirm this knowledge? Among those related, which are the two most relevant?
Origin of the knowledge	Would it be possible to share details about the source (origin) of the knowledge in question and provide additional insights about where this knowledge emerged? Could you provide a more detailed explanation of the process of obtaining this knowledge?
Destination of the knowledge	With regard to the recipient's receptiveness to this knowledge, was it easily assimilated? Was the content presented easily understood and absorbed by the recipient, without significant difficulties or barriers to understanding?
Channel of knowledge dissemination	In what specific way was this knowledge transmitted? Which medium, media, or channel was used to convey this knowledge to the recipients, allowing them access to it?
Context of the knowledge	Can you envision that this knowledge can be applied in other contexts (ESO) beyond the current one, or is it more specific and applicable only in this particular context?
Barriers and/or facilitators for the knowledge	During the dissemination of this knowledge, was it possible to identify any barriers or facilitating elements that may influence the movement of this knowledge?

Source: Miranda Junior et. al. (2023).

Each interview was conducted with the consent of the interviewee and carried out online via the Zoom platform, with an average duration of one hour each. The interviews took place in early 2024. A summary of the research implementation is presented in Table 5.

Table 5: CDM Roadmap application scenario

Activity	Description
Complex sociotechnical system	Water supply, collection and sewage treatment company
OSE within the operation performed	Maintenance of pumped sewage network Bursting of water reservoir

Source: authors, 2024.

In the next section, the research results will be presented.

3.2 Results and Discussions

The interviews were conducted using two instruments, as previously mentioned in Tables 3 and 4. The first instrument aimed to define the operational safety event and identify the critical knowledge involved in the event. Subsequently, using the second instrument, the qualification of this knowledge was further explored through the identification of information flow. The first interview addressed the Operational Safety Event (OSE) related to Pumped Sewage Network Maintenance, while the second discussed the water reservoir rupture. Tables 6 and 7 highlight the main evidence resulting from the analysis of the first OSE.

Table 6: Main evidence of application of the critical knowledge identification instrument.

Block	Description
Interviewee identification	*The professional, referred to as interviewee 01, has thirteen years of experience in the organization, always working in the sewage operational system. He began working in a specific sewage system of a certain area, and soon after was invited to work at the central, where he oversees the sewage for the entire city.* *"On a particular day, the team had scheduled and was executing maintenance on a pumped sewage network. When I arrived at the site to oversee the operation, I immediately noticed some signs that something could go wrong. This operation posed risks of both death and environmental hazards because there was a lift station shut down, which could cause overflows."*
ESO identification	*"Maintenance of pumped sewage network"*
Diagnosis	*"The sewage network operates by gravity, meaning it has sewage pipes 4 meters, 6 meters deep. So, when excavating for sewage maintenance, one must be careful with the soil because here, the soil is very sandy and has a high water table. During excavation, if precautions are not taken, it can collapse, burying anyone present."* *"The team was conducting maintenance on a certain sewage network, and when I arrived at the site, I immediately noticed cracks in the asphalt, noticed sand around, and realized that everything was about to collapse. I halted the entire operation, asked everyone to come out of the trench, and within a minute, everything collapsed. It even caught the foot of an engineer, but thankfully it wasn't anything serious."* *"We were supposed to shore up with iron plates and lower the water table around. To avoid influencing the soil. Because here, each region has a different type of soil. When I arrived and saw that none of this was done, I immediately realized that there could be an accident."*
Intervention	*"Knowledge of technical standards and regulations."* *"Knowledge of the company's work plan and procedures."* *"Knowledge acquired through fieldwork experience, alongside more experienced professionals."* *"With this knowledge, I requested a redo of everything, including the trench that was going to be operationalized. I insisted on shoring up according to the service's depth, and only then could the work begin. Without these measures, I would not approve the start of maintenance."*
Difficult and/or facilitating factors (resources):	*"Time pressure for executing maintenance/service, as it heavily impacts city traffic."* *"Emotional control, as everyone is experiencing adrenaline at that moment."* *"Lack of knowledge among some employees regarding the proper use of PPEs for that operation."* *"Established organizational culture with entrenched habits, making it difficult to change or correct."* *"Cost can also be a barrier, as financial resources are always limited and can impact operations."*

Source: authors, 2024

The focus of the second instrument is on identifying the knowledge flow, starting with the first question that reaffirms the critical knowledge identified in the previous instrument. Table 7 highlights the knowledge related to the work plan and company procedures.

Table 7: Main evidence of application of the knowledge flow identification instrument.

Block	Description
Ratify the critical knowledge identified	1. *"Knowledge of technical standards and regulations."* 2. *"Knowledge of the company's work plan and procedures."* 3. *"Knowledge acquired through fieldwork experience, alongside more experienced professionals."*
Knowledge origin	*"Knowledge of the company's work plan and procedures."* *"Based on technical standards (NBR), Standard Operating Procedures (SOPs) are developed by the company's management and made available in a digital repository for all employees involved in those procedures. Knowledge of SOPs primarily comes from training sessions and safety management workshops. It's worth noting that accessing this knowledge is easy, as with a smartphone on-site, any SOP or other necessary information can be consulted instantly."*
Knowledge destination	*"Knowledge of the company's work plan and procedures."* *"All employees involved in those procedures."*
Knowledge movement channel	*"Knowledge of the company's work plan and procedures."* *"This knowledge moves from its source (digital repository of SOPs) to the involved employees, mainly through digital means, but also through informal conversations among workers. Evaluating this knowledge from the perspective of absorptive capacity, it can be said to have a moderate absorption rate."*
Knowledge context	*"Knowledge of the company's work plan and procedures."* *"This knowledge can be utilized in various other sectors of the company, and it should be standardized across all operations of the organization to improve service quality."*
Barriers and/or facilitators to knowledge	*"Knowledge of the company's work plan and procedures."* *The main barriers in the knowledge flow are indeed the "Time pressure for executing maintenance/service, as it heavily impacts city traffic," and the "Established organizational culture with entrenched habits, making it difficult to change or correct."*

Source: authors, 2024

With the application of the instruments in this first interview, the importance of technical and regulatory knowledge for carrying out operations was evidenced. The interviewee emphasized the importance of possessing a deep understanding of technical standards and regulations relevant to working with sewage. This knowledge not only enabled them to identify potential risks during maintenance operations but also to take corrective actions to prevent serious accidents.

The interviewee also highlighted that knowledge flow in the company is essential to ensure the safety and effectiveness of operations. Access to Standard Operating Procedures (SOPs) through a digital repository facilitates knowledge dissemination among employees. However, it was mentioned that the absorption of this knowledge may only be at a moderate level, indicating the need for improvements in the effectiveness of knowledge transfer.

Several barriers hindering knowledge movement in the company were also identified, including time pressure, established organizational culture, and cost. Time pressure may lead employees to overlook proper procedures, while entrenched organizational culture may resist necessary changes and corrections. Additionally, financial constraints may limit the resources available to implement additional safety measures.

The second interview discussed the water reservoir rupture. Tables 8 and 9 highlight the main evidence resulting from it.

Table 8: Main evidence of application of the critical knowledge identification instrument.

Block	Description
Interviewee identification	*The professional, referred to as interviewee 02, has nine years of experience in the organization and works as a leak detection technician, meaning he carries out operations to find hidden leaks in the water network, usually working at night when water pressure increases and consumption decreases. He is currently the head of the city's Water Operations Center.* *"In the second semester of 2023, there was a rupture of a water reservoir in the city, and the force of the water caused significant damage to the neighboring community. As a result, the organization's management called all department heads to assist in support. This incident occurred in the early hours of the morning, and a few hours later, my team, consisting of about eight professionals, arrived to assist in the recovery efforts."*
ESO identification	*Rompimento do reservatório de água*
Diagnosis	*"The mission given by the organization's management to my team was to clean up the affected area. At first glance, it seemed like a war zone because there was debris, cars, swimming pools, fallen walls, and poles, all out of place and piled up. There was a lot of risk involved in this activity."* *"Looking at the whole situation, I realized there was a lot of risk involved. So, I first conducted a reconnaissance of the entire area, entering houses, analyzing the terrain, and talking to residents to determine the action plan. Because I had to ensure the safety of my team."*
Intervention	*"The entire action plan for the team involved in this activity is not documented in company standards, manuals, or SOPs. It was defined through discussions and past experiences of both myself and my team."* *"Knowledge gained through fieldwork experience."* *"Leadership skills and empathy."* *"From there, we organized the team and machinery to start the work. The focus was mainly on the position and path of the machinery because it had to remove the material and dispose of it."*
Difficult and/or facilitating factors (resources):	*"As factors that hindered the operation, we faced pressure from individuals seeking to take advantage of the situation, such as those who presented themselves as community leaders and exerted pressure."* *"As facilitators, we had the support of senior management for the actions undertaken."*

Source: authors, 2024

In Table 9, knowledge through fieldwork experience is highlighted.

Table 9: Main evidence of application of the knowledge flow identification instrument.

Block	Description
Ratify the critical knowledge identified	*"Knowledge gained through fieldwork experience."* *"Leadership skills and empathy."*
Knowledge origin	*"Knowledge gained through fieldwork experience."* *"The knowledge within my team is acquired through knowledge transfer, meaning we gather every fifteen days for an informal discussion to exchange experiences from the past days."*
Knowledge destination	*"All employees of the organization."*
Knowledge movement channel	*"This knowledge moves from its source to the involved employees, primarily through in-person meetings every fifteen days.*
Knowledge context	*"This experiential knowledge can be applied in other contexts; for example, there was a 180mm reservoir rupture in another neighborhood, destroying the entire street and forming a false bottom. When the team arrived there to diagnose the situation, they already utilized the knowledge from the previous experience."*
Barriers and/or facilitators to knowledge	*"As factors that hindered the operation, we faced pressure from individuals seeking to take advantage of the situation, such as those who presented themselves as community leaders and exerted pressure."* *"As facilitators, we had the support of senior management for the actions undertaken."*

Source: authors, 2024

Considering the reports from Interviewee 02, whose experience focuses on incident management, the crucial role of knowledge acquired through fieldwork experience, as well as leadership skills and empathy in conducting emergency response operations, becomes evident. In a crisis situation such as the rupture of a water reservoir,

practical knowledge and the ability to make quick and effective decisions play a fundamental role in minimizing damage and ensuring the safety of the team involved.

Furthermore, the transfer of this knowledge among team members through regular experience-sharing meetings highlights the importance of internal communication and collaboration for disseminating best practices and strengthening the organization's capacity to respond to emergency situations.

Finally, reaffirming that knowledge is a fundamental element to support resilient capabilities, as defined by Hollnagel (2011), Table 10 synthesizes the evidence of knowledge identified in the interviews of this study, which are potential contributions to support and enhance resilient capabilities.

Table 10: Identification of knowledge to strengthen resilient capabilities in both ESOs.

Identification of critical knowledge	Knowledge qualification through knowledge flow	nputs for organizational learning
Knowledge in technical standards and company regulations.	The knowledge is explicit, acquired through training, requiring a technical background as a prerequisite. It has been internally developed by the organization itself and presents a moderate level of difficulty for absorption.	Knowledge to review access to field work plans.
Knowledge of the work plan and company procedures.	The knowledge is explicit, acquired through safety training and seminars, requiring a technical background as a prerequisite. It has been internally developed by the organization itself and has a low level of difficulty for absorption. It is mainly accessed virtually and faces challenges in field accessibility.	Knowledge to review access to field work plans.
Knowledge gained through fieldwork experiences, alongside more experienced professionals.	The knowledge is tacit, acquired through interaction with experienced professionals within the organization, presenting a high level of difficulty for absorption. One of the main barriers is communication.	Formalization of this knowledge for sharing through training.
Knowledge acquired through fieldwork experiences.	The knowledge is tacit, acquired through interaction with experienced professionals within the organization, presenting a high level of difficulty for absorption. One of the main barriers is communication, while a facilitator is the support from senior management.	Formalization of this knowledge for sharing through training.
Leadership skills and empathy.	The knowledge is tacit and explicit, acquired through interaction with experienced professionals within the organization, presenting a moderate level of difficulty for absorption.	Formalization of this knowledge for sharing through training.

Source: authors, 2024.

Following the presentation of potential contribution evidence, the conclusion of the research will be presented in the next section.

4. Conclusion

The main objective of the article was to investigate and identify critical knowledge and knowledge flows within complex sociotechnical systems, through interviews with professionals who witnessed risk situations and somehow managed to prevent a possible incident and/or accident, in order to contribute to resilient capacities.

The interviews yielded positive results, providing the organization with a valuable understanding of the critical knowledge identified, which has the potential to drive organizational learning and strengthen the resilience capabilities of the company. It is important to emphasize that knowledge is a fundamental resource for organizational resilience. According to the literature, as stated by Hollnagel (2011), knowledge is a determining factor for resilient capabilities, and through the interviews, this assumption was reaffirmed.

Based on these observations, it is possible to initiate a discussion on how the company can overcome the identified barriers and promote a culture of safety and efficiency through better transfer and utilization of available knowledge. This could involve investments in additional training, continuous review and updating of operational procedures, and a gradual change in organizational culture to prioritize safety as a fundamental priority.

The findings of this study corroborate the theories and concepts of renowned authors in the field of resilience and knowledge flow. Snowden and Boone (2007) identify the complexity of sociotechnical systems within the

complex domain of the Cynefin Framework, where resilience is essential, aligning with the operational safety events analyzed. Zhuge (2002) highlights crucial attributes of knowledge flow, reflected in the transfer of tacit and explicit knowledge observed in the study. Miranda et al. (2021) point out objectives of organizational improvement, management, and innovation, evidenced in the practical application of the critical knowledge identified. Woods (2015) discusses resilience as adaptation and recovery, exemplified by the effective crisis response documented in the study. Hollnagel (2011) emphasizes the importance of knowledge for monitoring, anticipation, response, and learning capabilities, confirming the central role of knowledge in organizational resilience found in the research.

As a next step, the aim is to investigate the visual representation of knowledge flows, evaluate its effectiveness, and provide specific guidelines to enhance knowledge management processes within organizations.

Acknowledgements

This study was conducted with the support of the Fund for Support of Higher Education Maintenance and Development (FUMDES) through the UNIEDU program.

References

An, Y., Han, M., & Park, Y. 2017, "Identifying dynamic knowledge flow patterns of business method patents with a hidden Markov model', Scientometrics, vol. 113, no. 2, pp. 783-802. Available at: https://doi.org/10.1007/s11192-017-2514-8.

Bittarello, K. P. 2014, "Knowledge flow in the environment of technological-based business networks", Master's thesis in Engineering and Knowledge Management, Federal University of Santa Catarina, Florianópolis.

Hirose, T., & Sawaragi, T. 2020, "Extended FRAM model based on cellular automation to clarify complexity of socio-technical systems and improve their safety", Safety Science, vol. 123, p. 104556.

Hollnagel, E. 2011a, "RAG: the resilience analysis grid", in Hollnagel, E. et al. (Eds.), Resilience engineering in practice: a guidebook, Farnham, UK: Ashgate.

Miranda Junior, J., Potrich, L. N., & Todesco, J. L. 2021, "Classification of knowledge flow approaches by application domain: a literature analysis", in International Congress of Knowledge and Innovation – ciKi, 11th, 2021, Maringá, PR. Proceedings [...]. Maringá, PR: ciKi.

Miranda Junior, J., et al. 2022a, "Identifying critical knowledge to strengthen resilient response capability", in International Congress of Knowledge and Innovation – ciKi, 12th, 2022, Maringá, Brazil. Proceedings [...]. Maringá, Brazil: ciKi.

Miranda Junior, J., et al. 2022b, "Mapping the scientific production on knowledge flow", in International Congress of Knowledge and Innovation – ciKi, 12th, 2022, Maringá, Brazil. Proceedings [...]. Maringá, Brazil: ciKi.

Miranda Junior, J., et al. 2023, "Identifying knowledge flow in complex sociotechnical systems to contribute to resilient capacity", in International Congress of Knowledge and Innovation – ciKi, 13th, 2023, Florianópolis, Brazil. Proceedings [...]. Florianópolis, Brazil: ciKi.

Nissen, M. E. 2002, "An extended model of knowledge-flow dynamics", Communications of the Association for Information Systems, vol. 8, no. 18. DOI: 10.17705/1CAIS.00818.

Oedewald, P., & Gotcheva, N. 2015, "Safety culture and subcontractor network governance in a complex safety critical project", Reliability Engineering and System Safety, vol. 141, pp. 106-114. DOI: 10.1016/j.ress.2015.03.016.

Reiman, A., et al. 2021, "Human factors and ergonomics in manufacturing in the industry 4.0 context: a scoping review", Technology in Society, vol. 65, p. 101572. Available at: https://doi.org/10.1016/j.techsoc.2021.101572.

Rodríguez-Elias, O. M., et al. 2008, "Applying the KoFI methodology to improve knowledge flows in a manufacturing process", in International Conference on Software and Data Technologies, 3rd. Proceedings [...], p. 309-314.

Saurin, T. A., & Sosa, S. 2013, "Assessing the compatibility of the management of standardized procedures with the complexity of a sociotechnical system: a case study of a control room in an oil refinery", Applied Ergonomics, vol. 44, no. 5, pp. 811-823.

Schneider, V. 2019, The coherence of symbols that unite agents in sociotechnical coproduction contexts, PhD thesis in Engineering and Knowledge Management, Federal University of Santa Catarina, Florianópolis. Available at: http://btd.egc.ufsc.br/wp-content/uploads/2019/05/Viviane-Schneider-Tese.pdf. Accessed on: October 10, 2022.

Snowden, D. J., & Boone, M. E. 2007, "A leader's framework for decision making", Harvard Business Review, vol. 85, no. 11, pp. 69-76.

Woods, D. D. 2011, "Resilience and the ability to anticipate", in Hollnagel, E., Pariès, J., Woods, D. D., & Wreathall, J. (Eds.), Resilience Engineering in Practice: a guidebook, Farnham, UK: Ashgate.

Zhuge, H. 2002, "A knowledge flow model for peer-to-peer team knowledge sharing and management", Expert Systems with Applications, vol. 23, pp. 23-30.

Configurations of Employee Assessments of Past Changes: Do Leadership and Learning Matter?

Irena Mladenova
Sofia University St. Kliment Ohridski, Sofia, Bulgaria

irenaml@feb.uni-sofia.bg

Abstract: Organisational change studies increasingly interpret the phenomenon as multiple change, and not a one-time occurrence. Even successful changes may have detrimental longer-term effects - change fatigue, resistance, and undermined cohesion. These might hamper the organisational capabilities needed to navigate current and future changes. Previous research highlights the importance of transformational leadership and learning culture for maintaining organisational capabilities to change sustainably. Employees' interpretations of past changes largely shape their (future) attitudes – were they involved in decision-making, were consequences personally (organisationally) beneficial, and did change break the team cohesion. This paper argues that learning organisation and transformational leadership practices are related to how employees experience and interpret past changes. A configurational approach is employed. The research aims to reveal the relationship between learning organisation (LO) and transformational leadership (TL) with three variables associated with how employees evaluate past changes – history with change (HC), valence (VA), and cohesion (CO). The study is quantitative and uses a standardised questionnaire. The level of research is individual, the sample consists of 188 respondents – managers and employees in firms in Bulgaria. Five composite variables measured by scales adapted from previous research are used. HC, VA, and CO are applied in cluster analysis which reveals three distinct clusters. Cluster 1 consistently shows the highest scores on all three variables, and Cluster 3 – the lowest. The three clusters are profiled using demographic variables, TL and LO. Of all demographic variables, only job position has a statistically significant correlation to cluster membership, suggesting that management and employees experienced past changes differently. Respondents in Cluster 1 gave the highest scores on TL and LO at their workplace, while Cluster 3 had moderate scores. The main conclusions support the argument that transformational leadership and learning organisation are related to how employees interpret past changes. There are several theoretical and practical implications. The research provides empirical evidence on the five variables' relationships thus adding to organisational change studies' advancement. The results highlight the importance of monitoring how employees internalise change consequences. Failing to do so might be detrimental to the organisational change capabilities.

Keywords: Organisational Change, Learning Organisation, Transformational Leadership, Cohesion, Valence, History With Change.

1. Introduction

Changes in organisations are the rule rather than the exceptions and require organisations to focus on building the necessary capabilities to navigate successfully change imperatives. New change initiatives are often started before previous ones are completed, putting a strain on people, processes, and resources in the organisation.

Organisations being open systems are temporary structures of relationships and interactions between individuals and the environment. Organisations are better equipped with the capabilities to change faster than individuals or societies (Laurent, 1990). It might be thus relatively easier to change structures, processes, and procedures within the organisation. When and how employees adopt the new behaviours, though, is more problematic. Heracleous and Bartunek (2021) stress that change outcomes cannot be adequately assessed from the short-term, linear time perspective, focusing on the present – which typically considers deadlines and budgets.

Narratives and sensemaking can help motivate the organisation to pursue a change and connect the past to the future. Shipp and Jansen (2021) stress the importance of accounting for subjective time – how people interpret past, present, and future changes and add meaning to what has changed and what will change. Individuals' interpretations of past changes provide the context for the way they approach current and future changes. Suddaby and Foster (2017) identify four distinct models of organisational change based on the implicit models of history involved – history as fact, as power, as sensemaking, or as rhetoric. The prevailing assumptions of history have a major impact on how change is managed, what exactly changes, and how past, current, and future changes are interpreted.

Subjective time reflects both social construction and individual perception and stresses the important role of interpretation (Shipp and Jansen, 2021). Individuals' interpretations of change (past-present-future) interact with how their group jointly co-creates the experiences and social norms, and thus impacts (individual and

shared) attitudes and behaviours. A current (or future) change is rarely evaluated on its own. It is rather interpreted based on past experiences and future expectations, individual and shared within the group.

Stepping on the concepts of subjective time and multiple change could help explore some important relationships and add to our understanding of organisational change. This study aims to reveal individual-level interpretations of organisational change and seeks answers to the following research questions:

RQ1. How do individual interpretations of past changes relate to organisational change success factors?

RQ2. Can these individual interpretations distinguish between different groups of organisational members (clusters)?

RQ3. What are the different clusters' characteristics?

The rest of this paper is organised as follows. The next section provides an overview of the theoretical background. The third section presents the methodology and sample. The fourth section describes the analysis and results. The fifth section discusses the findings and limitations of the study. The last section concludes.

2. Literature Review

2.1 Organisational-Level Factors

2.1.1 Learning Organisation

Learning has a crucial role in the adaptability of organisations to increasingly dynamic environments. The organisation seen as an open system employs learning and knowledge to interpret the internal and external environment signals, formulate (proactive or reactive) responses and implement them to ultimately improve its chances to survive (and prosper). Marsick and Watkins (1999) define the learning organisation as characterised by (1) systems-level, continuous learning (2) that is created in order to create and manage knowledge outcomes (3) which lead to improvement in the organisation's performance, and ultimately its value.

A learning approach to strategy, structure and culture enables the development of a learning organisation, and this highlights the importance of leadership (Alerasoul *et al.*, 2022). A learning organisation has an adequate climate, culture, systems, and structures that influence and create a proper environment in which individuals learn; it results in intentional improvement in knowledge performance (Marsick and Watkins, 2003).

A learning organisation builds a capacity to support, encourage, and apply knowledge on an organisational, not just an individual level. This means integrating learning into systems, structures and relevant climate and culture while considering learning on individual, team, and organisation-wide levels (Marsick and Watkins, 2003).

2.1.2 Transformational Leadership

Transformational leadership is associated with change-oriented behaviours, adaptation to external stimuli, innovation, and learning at the individual, team, and organisational levels (Mladenova and Davidkov, 2023). Many authors point to leadership as one of the key success factors of organisational change (Burke, 2011; Cameron and Quinn, 2011; Peng *et al.*, 2021). Transformational leadership is characterised by charisma-inspiration, intellectual stimulation, and individualised consideration (Bass, 1999).

Transformational leadership fosters employees' positive attitudes towards organisational change (e.g. commitment, openness, and readiness) and reduces negative reactions (e.g. resistance and cynicism) (Peng *et al.*, 2021). Transformational leadership increases employees' perceptions of attractive change consequences (valence) (Faupel and Süß, 2019) and correlates with learning on the organisational level (Lundqvist *et al.*, 2023).

2.2 Individual-Level Interpretations

2.2.1 History with Change

In this study, history with change reflects the participation in the planning and implementation of previous changes. These are often cited as key success factors in change literature. Participation is among the most prevalent change process dimensions that are found to be change antecedent (Oreg *et al.*, 2011). The way employees evaluate their experiences with previous changes may be key to the realisation of future changes (Lauzier *et al.*, 2020). Positive assessment of previous changes may help instil openness to change and reduce

change cynicism, increase self-efficacy (Lauzier *et al.*, 2020), and encourage employees to participate actively and share their opinions and concerns (Mladenova, 2022). Previous experience refers to the collectively developed change processes and perceived legitimacy of change (Klarner *et al.*, 2008) and is positively related to organisational adaptability and performance (Mladenova, 2022). The success or failure of a past change is manifested in the retrospective narratives of the organisational members and may also be controversial (Hay *et al.*, 2021). It relates to learning and suggests the active participation of employees in planning and implementing changes. Transformational leadership is expected to encourage – and correlate with – participation.

2.2.2 Valence

A key determinant of acceptance of or resistance to changes is whether these are perceived as beneficial or not (Oreg *et al.*, 2011). Personal valence in this study refers to the extent to which one feels that he or she benefitted or not from the implementation of previous changes (Holt *et al.*, 2007). Valence is one of the beliefs of change recipients that plays a key role in the success or failure of change initiatives (Armenakis *et al.*, 2007).

Armenakis et al. (2007) see valence as crucial in developing readiness for change – i.e. when the organisation plans an upcoming change initiative employees will seek a motivating answer to the question "what is in it for me?". Similarly, assessing past changes and their outcomes on a personal level might influence the open attitude to future changes. If one benefitted from previous changes, he or she would more likely expect that future changes would be also beneficial. Such a conclusion, however, is highly dependent on the scope of previous and upcoming change initiatives, and a direct relation cannot be assumed. Transformational leadership is expected to demonstrate the change benefits, work to prove its fairness, and motivate employees. If successful in past changes, transformational leadership is expected to correlate to valence.

2.2.3 Cohesion

This study borrows the definition of cohesion used by Bouckenooghe et al. (2009). It reflects the perception of togetherness and sharing, as well as the cooperation and trust in team members' competence. Trust in colleagues is one of the internal context antecedents of change (Oreg *et al.*, 2011). Cohesion is one of the climate-of-change dimensions and plays an important role in defining the background against which a change unfolds. Climate-related dimensions reflect individuals' description of their own perceptions (Koys and DeCotiis, 1991) of interconnected experiences with organisational policies, practices, and procedures, such as leadership (Schneider *et al.*, 2017) or change processes.

High levels of cohesion would mean employees would be more willing to support each other, expectedly also during challenging times such as when the organisation undergoes changes. Perceiving one's work environment as generally unsupportive, on the other hand, is more likely to lead to cynical reactions and rejection of changes (Oreg *et al.*, 2011). Climate is delicate and impacted by various organisational life events and management actions. Leadership has been widely agreed upon as a major driver of climates of all kinds (Schneider *et al.*, 2017). Transformational leadership is expected to correlate with cohesion.

2.3 Hypotheses Formulation

This study selects three dimensions of individual interpretations of past change and their effects on personal and group levels. They represent the process of change (history with change reflects whether the individual participated in the process of designing and implementing previous changes), the climate of change (cohesion reflects whether the individual trusts and cooperates with peers), and outcomes of change (valence reflects whether the individual evaluates previous changes as personally beneficial or not). Their correlation with two organisation-level success factors is assessed – transformational leadership and learning organisation. Transformational leadership is expected to largely influence employees' interpretations of changes and their results and impact. Learning organisation is expected to be influenced – and influence employees' interpretations of organisational changes.

Based on the above review, this study posits the following hypotheses:

H1: Transformational leadership correlates with individual-level interpretations (previous experience with change, valence, and cohesion).

H2: Dimensions of the learning organisation correlate with individual-level interpretations (previous experience with change, valence, and cohesion).

3. Method

3.1 Sample

This study uses data from a larger research project. The sample acquisition was conducted via an online self-administered questionnaire distributed to employees and managers in firms operating in Bulgaria. Data collection used a convenience approach in line with previous empirical research (Rahi *et al.*, 2022). This sampling approach has its limitations but can be beneficial in preliminary research (Stratton, 2021) and thus is found applicable for the purposes of this study. The inclusion criteria are ease of access and willingness to participate, as well as previous experience with organisational changes. The government sector is excluded. The level of research is individual (micro level). The demographic characteristics of the sample are presented in Table 1.

Table 1: Demographic characteristics of the sample (n=188)

Respondents profile	Number	Percentage
Age (M=34.94, SD=9.292)		
up to 30	76	40.4
31-40	64	34.0
41-50	35	18.6
51-60	10	5.3
above 60	3	1.6
Gender		
Female	109	58.0
Male	79	42.0
Education		
High school	11	5.9
Bachelor	44	23.4
Master	124	65.9
PhD	9	4.8
Tenure (M=6.85, SD=7.633)		
up to 5 years	122	64.9
6-10 years	27	14.3
11-15 years	18	9.6
16-20 years	6	3.2
above 21 years	15	8.0
Job position		
Employee	105	55.9
Middle management	69	36.7
Top management	14	7.4

The largest share of the respondents work in the Services sector (56.4%), followed by Manufacturing (28.2%). Commerce (11.7%) and Construction (3.7%) are less represented. Similarly, the largest share of the respondents work for large firms, as measured by the number of employees, i.e. 250 or above (58.6%), followed by medium-sized with 50-249 employees (20.2%), small with 10-49 employees (12.2%) and micro firms with up to 9 employees (9%).

The respondents' composition is balanced adequately according to the demographic and firm characteristics to justify their use in subsequent analyses. Some deviations from the national structure of sectors and employment should be mentioned – i.e. employees in large enterprises are overrepresented in this study sample, while micro-enterprises are underrepresented.

3.2 Composite Variables and Measures

This study uses five composite variables measured by scales adapted from previous research. All indicators were translated into Bulgarian language and transformed to a uniform 5-point Likert scale (1=completely disagree, 5=completely agree). In line with methodological recommendations (Weijters and Baumgartner, 2012) some reverse items were transformed to reduce possible issues related to psychological mechanisms employed by respondents. The final set of indicators and sources are presented in the Appendix.

4. Analytical Procedure

Data was analysed with SPSS v.25. First, the construct reliability, convergent validity and discriminant validity were examined. All constructs were found to have acceptable reliability and validity (Cronbach's alpha>0.7, item-total correlation >0.3, inter-item correlations>0.2) (Clark and Watson, 2016; Everitt, 2002; Hair *et al.*, 2010; Nunnally, 1967) (Table 2).

For the purposes of further analyses, the composite variables were calculated as mean values of their indicators.

Table 2: Composite variables - reliability and convergent validity

Composite Variable	Number of items	Corrected item-total correlation	Range of inter-item correlations	Cronbach's alpha
CO: Cohesion	4	0.720-0.808	0.582-0.794	0.895
VA: Valence	3	0.373-0.630	0.325-0.651	0.708
HC: History with Change	3	0.430-0.553	0.319-0.472	0.667
LO: Learning Organisation	7	0.354-0.716	0.200-0.643	0.848
TL: Transformational Leadership	7	0.755-0.877	0.643-0.843	0.952

Results of Kolmogorov-Smirnov and Shapiro-Wilks tests showed that data is not normally distributed. Thus, Spearman's rank-order correlation was applied. Descriptive statistics and correlations are presented in Table 3 and show that all composite variables are correlated ($p<0.01$).

Table 3: Descriptive statistics and factors correlations (n=188)

Composite variable	M	S.D.	CO	VA	HC	LO	TL
CO: Cohesion	4.4149	0.72857	1				
VA: Valence	3.0355	0.89624	.199**	1			
HC: History with Changes	3.2411	0.93953	.326**	.416**	1		
LO: Learning Organisation	3.8480	0.77188	.605**	.269**	.476**	1	
TL: Transformational Leadership	4.1223	0.93620	.473**	.283**	.392**	.658**	1

**. Correlation is significant at the 0.01 level (2-tailed).

Hierarchical and non-hierarchical cluster analyses were performed along the three individual-level composite variables (CO, VA, HC) to assess possible similarities within and dissimilarities between the groups. The other two (LO, TL) were then used to describe the clusters, and thus to verify the hypotheses.

Hierarchical cluster analysis with Ward's method was applied to assess the possible cluster solutions. The decision to proceed with a three-cluster solution was based on the assessment of the dendrogram and agglomeration schedule. The agglomeration matrix shows that a three-cluster solution is appropriate.

Then, K-means cluster analysis was performed, specifying three clusters. The resulting mean values per cluster are presented in Table 4. The F-values indicate that the means of all three variables are significantly different. The non-hierarchical cluster analysis results suggest that the three-cluster solution is adequately discriminating the observations.

Table 4: Composite variable means per cluster

Composite variable	Final Cluster Centres				
	Cluster 1	Cluster 2	Cluster 3	F	Sig.
Cohesion	4.66	4.53	3.11	134.5979	0.000
Valence	3.72	2.47	2.48	88.94436	0.000
History with Change	3.91	2.87	2.04	222.7495	0.000
Cluster size	85	80	23		
% of total	45%	43%	12%		

The three clusters' profiles are illustrated in Figure 1 and clearly point to the differences in values for each cluster. The three factors' mean values are highest in Cluster 1 and lowest in Cluster 3.

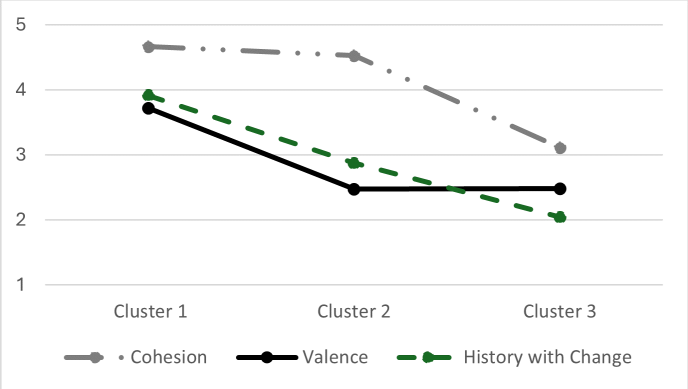


Figure 1: Clusters profiles – mean values per variable

Examining cluster stability and validity allows for further analysis and deriving conclusions of practical significance (Hair *et al.*, 2010). To assess cluster stability, data was reordered by another factor (respondent's age) and non-hierarchical analysis was performed again. The four-cluster solution is stable, with 37 of the observations (19.7%) assigned to a different cluster.

To assess predictive validity, a multivariate test was performed using three additional variables. These are three indicators of firm performance - capacity utilisation (financial performance), process improvements (market performance) and secure jobs (stakeholders). A MANOVA model was estimated where the above three variables were entered as dependent variables, and the cluster membership as an independent variable. The overall model is significant (Wilks' Lambda for cluster membership=0.814, F=6.604, Sig.=0.000). The individual F-statistics are also significant ($p<0.05$), as presented in Table 5. The results demonstrate that the cluster membership can predict other variables thus providing evidence for validity.

Table 5: Three criteria validity variables and cluster membership

Variable	Cluster number	Mean	F	Sig.
Capacity utilisation	1	4.082	9.234	0.000
	2	3.638		
	3	3.348		
Process improvements	1	4.024	18.575	0.000
	2	3.263		
	3	3.043		
Secure jobs	1	4.365	8.921	0.000
	2	3.925		
	3	3.696		

The profiles of the clusters are first assessed using the demographic variables of the respondents (age, gender, education, tenure, and job position). Then, to test the hypotheses, the additional two composite variables are used – learning organisation and transformational leadership. The relationships are tested with cross-tabulation (Table 6). Of the demographic variables, only job position has a statistically significant relationship with cluster membership. Both LO and TL show statistically significant relationships to cluster membership providing support to confirm the hypotheses. and can be used to define the clusters' profiles. The two organisation-level variables (transformational leadership and organisational learning) correlate with the individual-level interpretations (previous experience with change, valence, and cohesion).

Table 6: Cluster Profiles

		Cluster Number of Case			Total
		Cluster 1	Cluster 2	Cluster 3	
Job position	Employee	38	51	16	105
	Middle management	36	26	7	69
	Top Management	11	3	0	14
Total (χ2=11.556; df=4, Asympt. Sig.=0.021		*85*	*80*	*23*	*188*
Learning organisation	Low	0	0	2	2
	Rather low	0	0	1	1
	Average	3	13	8	24
	Rather high	32	42	10	84
	High	50	25	2	77
Total (χ2=53.049; df=8, Asympt. Sig.=0.000		*85*	*80*	*23*	*188*
Transformational leadership	Low	0	0	2	2
	Rather low	0	2	4	6
	Average	5	11	3	19
	Rather high	17	19	11	47
	High	63	48	3	114
Total (χ2=51.297; df=8, Asympt. Sig.=0.000		*85*	*80*	*23*	*188*

5. Results and Discussion

In response to the first research question, the results show that the composite variables HC, VA, and CO can be used to describe some of the individual-level interpretations of organisational changes. These variables and the organisational-level factors (LO, TL) are correlated. The cluster analyses respond to the second research question and show that these individual-level interpretations can be used and discriminate well between the groups of organisational members. Profiling of the clusters responds to the third research question and demonstrates that the three clusters have different characteristics.

Several conclusions could be made based on the analysis results. In all clusters, cohesion has the highest scores among the three composite variables. Even the lowest mean value in Cluster 3 (M=3.11) points to a rather high assessment of cohesion by the respondents. In view of the interpretations of past organisational changes and their consequences for the self and the cohesion climate, one of the possible explanations would be that past changes had positive effect on the cohesion climate, as suggested by the correlation between HC and CO. Active participation in previous change initiatives may be interpreted as a mechanism that pulls together and guides the organisation and its members; focuses their attention on the change events and the belief that they are part of something important; gives direction and enthusiasm (Bamford and Forrester, 2003). VA scores also align with such interpretation. Individuals who were actively involved in previous changes (HC) are likely to give a higher assessment of the consequences for the self (VA) and give a high assessment of the climate for cohesion in their organisation. The subjective time lens might have an impact on how respondents interpret past changes and their consequences (HC, VA) and relate to the assessment of the present climate (CO). The presence of a climate of cohesion could serve as an important ingredient for the successful implementation of upcoming changes.

Second, the composite variables used to describe two organisational-level factors (TL and LO) are correlated. The correlation between TL and LO aligns with previous research findings (Lundqvist *et al.*, 2023).

Third, this study finds evidence to support the two hypotheses raised – that the two organisational-level variables (TL and LO) correlate with the individual-level interpretations (HC, VA, CO). It suggests that the firms who worked to develop the dimensions of learning organisation and transformational leadership are characterised by more favourable individuall-level interpretations of past changes.

Fourth, this study reports a positive relationship between cluster membership and three firm performance measures – capacity utilisation, process improvements and secure jobs. This suggests that in dynamic times and environments, positive individual-level interpretations of changes might support the organisation's endeavours to improve performance. The subjective time lens could point to the relationship between the way employees internalise past changes' consequences and their interpretations of and behaviours during current and future change initiatives.

Several limitations of this study need to be mentioned. The level of analysis employed is individual. The study uses cross-sectional data. An organisation-level quantitative analysis combined with a qualitative data collection method could enrich the understanding of the studied factors and their relationships. A longitudinal study could allow for the analysis of multiple changes thus providing empirical evidence for the conclusions suggested here.

6. Conclusion

The goal of this study was to explore the relationship between two organisation-level variables (transformational leadership and learning organisation) with three individual-level variables that describe personal assessments of changes and their consequences for the self and the organisation (history with change, valence, and cohesion).

A configurational approach resulted in confirming correlations between all five composite variables (TL, LO, HC, VA, and CO). Three distinct clusters were identified, with Cluster 1 consistently scoring highest and Cluster 3 – lowest on all variables. The study finds a relation between cluster membership and three firm performance indicators – capacity utilisation, process improvements and secure jobs. The study finds evidence to support two hypotheses raised regarding correlations between two organisational-level variables (TL, LO) and three individual-level interpretations (HC, VA, CO). It thus promotes the argument that transformational leadership and learning organisation dimensions are related to the way organisational members experience and interpret past changes.

Acknowledgements

This work was financially supported by the project No. BG-RRP-2.005-0001 Twinning for scientific excellence: Stimulating sustainable energy economy and promoting research in the field of innovation management in Bulgaria (TWIN4ECO), financed by European Union – NextGeneration EU.

References

Alerasoul, S.A., Afeltra, G., Hakala, H., Minelli, E. and Strozzi, F. (2022), "Organisational learning, learning organisation, and learning orientation: An integrative review and framework", *Human Resource Management Review*, Vol. 32 No. 3, p. 100854.

Armenakis, A.A., Bernerth, J.B., Pitts, J.P. and Walker, H.J. (2007), "Organizational Change Recipients' Beliefs Scale: Development of an Assessment Instrument", *The Journal of Applied Behavioral Science*, Vol. 43 No. 4, pp. 481–505.

Bamford, D.R. and Forrester, P.L. (2003), "Managing planned and emergent change within an operations management environment", *International Journal of Operations & Production Management*, Vol. 23, pp. 546–564.

Bass, B.M. (1999), "Two Decades of Research and Development in Transformational Leadership", *European Journal of Work and Organizational Psychology*, Vol. 8 No. 1, pp. 9–32.

Bouckenooghe, D., Devos, G. and Van Den Broeck, H. (2009), "Organizational Change Questionnaire–Climate of Change, Processes, and Readiness: Development of a New Instrument", *The Journal of Psychology*, Vol. 143 No. 6, pp. 559–599.

Burke, W. (2011), *Organization Change. Theory and Practice (3rd Edition)*, SAGE Publications, Inc., Thousand Oaks, CA.

Cameron, K.S. and Quinn, R.E. (2011), *Diagnosing and Changing Organizational Culture: Based on the Competing Values Framework*, 3rd ed., John Wiley & Sons.

Carless, S.A., Wearing, A.J. and Mann, L. (2000), "A Short Measure of Transformational Leadership", *Journal of Business and Psychology*, Vol. 14, pp. 389–405.

Clark, L.A. and Watson, D. (2016), "Constructing validity: Basic issues in objective scale development.", in Kazdin, A.E. (Ed.), *Methodological Issues and Strategies in Clinical Research (4th Ed.).*, American Psychological Association, Washington, pp. 187–203.

Coyle-Shapiro, J.A.-M. (1999), "Employee Participation and Assessment of an Organizational Change Intervention: A Three-Wave Study of Total Quality Management", *The Journal of Applied Behavioral Science*, Vol. 35 No. 4, pp. 439–456.

Daly, J.P. and Geyer, P.D. (1994), "The role of fairness in implementing large-scale change: Employee evaluations of process and outcome in seven facility relocations", *Journal of Organizational Behavior*, Vol. 15 No. 7, pp. 623–638.

Everitt, B. (2002), *The Cambridge Dictionary of Statistics*, 2nd ed., Cambridge University Press, Cambridge, UK ; New York.

Faupel, S. and Süß, S. (2019), "The Effect of Transformational Leadership on Employees During Organizational Change – An Empirical Analysis", *Journal of Change Management*, Vol. 19 No. 3, pp. 145–166.

Hair, J.F., Black, W.C., Babin, B.J. and Anderson, R.E. (2010), *Multivariate Data Analysis*, 7th ed., Prentice Hall, Upper Saddle River, NJ.

Hay, G.J., Parker, S.K. and Luksyte, A. (2021), "Making sense of organisational change failure: An identity lens", *Human Relations*, Vol. 74, pp. 180–207.

Heracleous, L. and Bartunek, J. (2021), "Organization change failure, deep structures and temporality: Appreciating Wonderland", *Human Relations*, Vol. 74, pp. 208–233.

Holt, D.T., Armenakis, A.A., Feild, H.S. and Harris, S.G. (2007), "Readiness for Organizational Change: The Systematic Development of a Scale", *The Journal of Applied Behavioral Science*, Vol. 43, pp. 232–255.

Klarner, P., Probst, G. and Soparnot, R. (2008), "Organizational Change Capacity in Public Services: The Case of the World Health Organization", *Journal of Change Management*, Vol. 8, pp. 57–72.

Koys, D.J. and DeCotiis, T.A. (1991), "Inductive Measures of Psychological Climate", *Human Relations*, Vol. 44 No. 3, pp. 265–285.

Laurent, A. (1990), "A Cultural View of Organizational Change", in Evans, P., Doz, Y. and Laurent, A. (Eds.), *Human Resource Management in International Firms*, Palgrave Macmillan UK, London, pp. 83–94.

Lauzier, M., Lemieux, N., Montreuil, V.-L. and Nicolas, C. (2020), "On the transposability of change management research results: a systematic scoping review of studies published in JOCM and JCM", *Journal of Organizational Change Management*, Vol. 33 No. 5, pp. 859–881.

Lundqvist, D., Wallo, A., Coetzer, A. and Kock, H. (2023), "Leadership and Learning at Work: A Systematic Literature Review of Learning-oriented Leadership", *Journal of Leadership & Organizational Studies*, Vol. 30 No. 2, pp. 205–238.

Marsick, V.J. and Watkins, K.E. (1999), *Facilitating Learning Organizations: Making Learning Count*, Gower, Aldershot, Hampshire, England ; Brookfield, Vt., USA.

Marsick, V.J. and Watkins, K.E. (2003), "Demonstrating the Value of an Organization's Learning Culture: The Dimensions of the Learning Organization Questionnaire", *Advances in Developing Human Resources*, Vol. 5 No. 2, pp. 132–151.

Mladenova, I. (2022), "Impact Of Experience With Changes On Adaptability And Organizational Performance", *HR and Technologies*, Creative Space Association, No. 2, pp. 70–87.

Mladenova, I. and Davidkov, T. (2023), "Leadership, adaptability and performance of Bulgarian organizations - cultural reflections on empirical data", *Ikonomicheski Izsledvania*, Vol. 32 No. 7, pp. 93–113.

Nunnally, J.C. (1967), *Psychometric Theory*, 5. [print.]., McGraw-Hill, New York.

Oreg, S., Vakola, M. and Armenakis, A. (2011), "Change Recipients' Reactions to Organizational Change: A 60-Year Review of Quantitative Studies", *The Journal of Applied Behavioral Science*, Vol. 47 No. 4, pp. 461–524.

Peng, J., Li, M., Wang, Z. and Lin, Y. (2021), "Transformational Leadership and Employees' Reactions to Organizational Change: Evidence From a Meta-Analysis", *The Journal of Applied Behavioral Science*, Vol. 57 No. 3, pp. 369–397.

Rahi, S., Alghizzawi, M., Ahmad, S., Munawar Khan, M. and Ngah, A.H. (2022), "Does employee readiness to change impact organization change implementation? Empirical evidence from emerging economy", *International Journal of Ethics and Systems*, Vol. 38 No. 2, pp. 235–253.

Schneider, B., González-Romá, V., Ostroff, C. and West, M.A. (2017), "Organizational climate and culture: Reflections on the history of the constructs in the Journal of Applied Psychology.", *Journal of Applied Psychology*, Vol. 102 No. 3, pp. 468–482.

Shipp, A.J. and Jansen, K.J. (2021), "The 'Other' Time: A Review of the Subjective Experience of Time in Organizations", *Academy of Management Annals*, Vol. 15 No. 1, pp. 299–334.

Stratton, S.J. (2021), "Population Research: Convenience Sampling Strategies", *Prehospital and Disaster Medicine*, Vol. 36 No. 4, pp. 373–374.

Suddaby, R. and Foster, W.M. (2017), "History and Organizational Change", *Journal of Management*, Vol. 43 No. 1, pp. 19–38.

Weijters, B. and Baumgartner, H. (2012), "Misresponse to Reversed and Negated Items in Surveys: A Review", *Journal of Marketing Research*, Vol. 49 No. 5, pp. 737–747.

Appendix

Construct, (source)	Items used
Cohesion, (Bouckenooghe *et al.*, 2009)	When I need help, I can always ask my colleagues
	We cooperate well in my department
	My colleagues are sufficiently competent
	I have confidence in my colleagues
Learning Organisation (DLOQ), (Marsick and Watkins, 2003)	In my organisation, people are rewarded for learning
	In my organisation, people spend time building trust with each other
	In my organisation, teams/groups revise their thinking as a result of group discussions or information collected
	My organisation makes its lessons learned available to all employees
	My organisation recognises people for taking initiative
	My organisation works together with the outside community to meet mutual needs
	In my organisation, leaders continually look for opportunities to learn
Transformational Leadership, (Carless *et al.*, 2000)	My leader communicates a clear and positive vision of the future
	My leader treats staff as individuals, supports and encourages their development
	My leader gives encouragement and recognition to staff
	My leader fosters trust, involvement and cooperation among team members
	My leader encourages thinking about problems in new ways and questions assumptions
	My leader is clear about his/her values and practices what he/she preaches
	My leader instils pride and respect in others and inspires me by being highly competent
Valence, (Armenakis *et al.*, 2007)	Previous changes usually increased my feeling of accomplishment
	In general, after previous changes I earned higher pay
	As a result of previous changes, I had better opportunities for self-fulfilment
History with Change, (Coyle-Shapiro, 1999; Daly and Geyer, 1994)	People like myself had input into the decisions for previous changes
	Management did not give me a chance to express my concerns before they made the decision to move (R)
	I personally participated in the implementation of previous changes in the organisation

* (R) – reverse item

Stories as the Tool of Knowledge Sharing: How Does it Work

Ludmila Mládková
Prague University of Economics and Business, Prague, Czech Republic

mladkova@vse.cz

Abstract: Our minds use stories as an instrument of interaction with our external and internal world. Stories are essential communication and knowledge-sharing tools. They help to create trust and participate in the creation of communities. This paper aims to explain the neurobiological aspects of storytelling. It summarises the results of research on what happens in human bodies on the neural and neurochemical levels during storytelling. The theoretical part provides a theoretical background of the topic based on the keyword search. The application part discusses how neurobiological aspects of stories work on examples of two types of stories proposed by Steven Denning: the negative and the positive. The paper enriches the theory of storytelling by explaining the biological roots of storytelling and demonstrating how they impact the listener.

Keywords: Stories, Storytelling, Knowledge Sharing

1. Introduction

"For over 27,000 years, since the first cave paintings were discovered, telling stories has been one of our most fundamental communication methods. If we listen to a Powerpoint presentation with boring bullet points, certain parts in the brain get activated. Scientists call these Broca's area and Wernicke's area. Overall, it hits our language processing parts in the brain, where we decode words into meaning. And that's it, nothing else happens. When we are being told a story, though, things change dramatically. Not only are the language processing parts in our brain activated, but any other area in our brain that we would use when experiencing the events of the story are too" (Widrich 2012). Therefore, whether real or fictional, the rich and diverse experiences embedded in narratives are integral to how we learn about our environment and how we come to understand, process and memorise information (Bruner 1991; Gretter, Yadav and Gleason 2017). "By giving meaning and personal importance to narrative content, stories also allow the emergence of emotions essential in building a sense of belonging with others in the community" (Dal Pian, Dal Pian and Dal Pian 2019, p. 10073)

Stories are perceived as "key instruments of mind … with ability to disseminate knowledge about or ways of engaging with the world" (Herman 2013, p. 162). They provide "a society of mind, suprapersonal systems for sense-making" (Herman 2013, p. 192) and are "equipment for navigating the world and solving problems" (Armstrong 2019, p. 406).

Traditional ideas of a dualism of body and mind were challenged "by empirical facts and findings amassed in the last 15 years or so by cognitive science and neurobiology "(Aldama 2015, p. 91). These are based on "an ever more accurate knowledge of the anatomy and physiology of the brain and have empirically dissolved the so-called mind/body problem in favor of a monist (or materialist) approach. The brain is a very specialized organ of the body that reacts to stimuli from the body itself (internal stimuli) and from the outside world (external stimuli), and this material reaction, according to its specific origin and outcome, is termed emotion, thought, intention, planning, etc. " (Alama 2015, p. 91).

These findings change "understanding of the relation between language, cognition, and narrative, poised between formalist models of schemes, scripts, and preference rules inherited from structuralism and pragmatically oriented theories of narrative as embodied, intersubjective interaction. Understanding the neurobiological bases of narrative may help solve this problem by showing how the ability to tell and follow stories aligns with how the brain processes language" (Armstrong 2019, p. 396).

The researches show that "experiencing a story alters our neurochemical processes, and makes assertions about memory and mirror neurons (brain cells that fire not only when we perform an action, but when we observe someone else performing the same action), the brain activity of both storytellers and consumers starts to align thanks to mirror neurons" (Dal Pian, Dal Pian and Dal Pian 2019, p. 10080). "As we become involved with a story, fictional things come to seem real in our bodies" (Smith 2016, p. 3).

This paper aims to summarise some of the most important ideas on how this works and demonstrate them using the example of two types of stories. "The ability to tell and follow a story requires cognitive capacities that are basic to the neurobiology of mental functioning. Neuroscience cannot, of course, reveal everything we might want to know about stories, but it is also true that our species would probably not produce narratives so

prolifically if they weren't somehow good for our brains and our embodied interactions with the world "(Armstrong 2019, p. 395).

The research objective of the research discussed in the paper was to explain what happens in human bodies on the neural and neurochemical levels during storytelling. The research enriches the theory by explaining the biological roots of storytelling. We demonstrate the theoretical findings of what happens during storytelling in our bodies and how it impacts the listener on two types of stories: positive and negative.

2. Background - Stories, Storytelling

"Narrative is a huge territory that encompasses numerous phenomena "(Aldama 2015, p. 88). The story is a set of symbols, "a narrative that links a set of events in some kind of casual sequence" (Denning 2004, p. 2); “it is everything told or recounted in the form of a causally-linked set of events, account, tale, the telling of a happening or connected series of happenings, whether true or fictitious” (Denning 2013, Some definitions). It is "an account of events that are causally connected in some way" (Denning 2011, p.13), a sequence of interlinked events (Snowden 1999). "A story describes a sequence of actions and experiences done or undergone by a certain number of people, whether real or imaginary" (Ricoeur 1990, p. 150).

Humans are "homo narrans", (Fisher 1984, p.6), "essentially storytellers" (Fisher 1984, p.7). Stories are the key cognitive coping mechanism (Hevern 2008). They "give events meanings and significance" (Polkinghorne 1988, p. 18) and are "the preferred sense-making currency of human relationships" (Boje 1991, p. 106). Stories provide a virtual environment for knowledge sharing and identity development (Gibbons and Prusak 2020). "Storytelling gets inside the minds of the individuals who collectively make up the organisation and effects how they think, worry, wonder, agonize, and dream about themselves and in the process create - and re-create- their organization" (Denning 2012, p. xiv). It is natural for people to share their knowledge and experience through story "because the process of creating the story also creates the memory structure that will contain the gist of the story for the rest of our lives" (Shank 1990, p. 115).

As Armstrong (2019 p. 396) writes, "Stories help the brain negotiate the never-ending conflict between its need for pattern, synthesis, and constancy on the one hand and for flexibility, adaptability, and openness to change on the other".

"The story had created a context in which the message is inescapable or at least unarguable. This contrasts with most corporate communications, where the message is delivered at the start and then explained/justified. The fable structure prevents the problems associated with starting a communication with the message, where the audience makes up their mind early in the process and decide upfront whether they will accept the message "(Snowden 2001, p. 4).

3. Objective and Methodology

The objective of this paper is to explain the neurobiological aspects of storytelling, e.g. what happens in human brains on the neural and neurochemical levels during the storytelling. The brain response to storytelling is discussed from the perspective of the listener. We did not research the storytelling brain processes of the teller, though it is possible to conclude that the teller brain response is similar.

As for the methodology, the data used in this paper are secondary data from the literature. The theoretical background, e.g. the literature on neurobiological aspects of storytelling was collected by keyword search in WOS. In WOS we searched for words: story and physical aspects of storytelling, storytelling and brain endorphin system, storytelling and neurobiology showed that the topic is underdeveloped as the search led to the identification of only a few topic-relevant articles. The same happened when Google searched for the same keyword combinations. Still, these papers became the foundation for further snowball searches, which led to the identification of other materials. We also used literature (Merzenich, Zak, Doidge) previously known to the author.

To show how the neurobiological aspects of stories work, we demonstrate them using the example a negative and the positive story (Denning 2004). As for the methodology of this part of the paper, we analysed two types of stories (Denning 2004) from the perspective of neurobiological aspects of storytelling. We applied knowledge presented in the theoretical background to elements of negative (connectedness, strangeness, comprehensibility) and positive story (introduction of the problem, solution of the problem, I into we change,

repetitions). E.g., we combined two different pieces of explicit knowledge (explicit knowledge on neurobiological aspects of storytelling and knowledge on different types of stories) to explicit knowledge of higher quality.

In this paper, we use the words story and narrative as synonyms. We use the term story in the most general and broad way as a set of symbols, "a narrative that links a set of events in some kind of casual sequence" (Denning 2004, p. 2). From this perspective, stories are not only what is told but also various types of art, like pictures, pieces of music, etc. This approach allowed us to capture the ideas of authors from different fields. The literature shows that the human brain responds to stories performed in different forms in the same way.

4. Findings

4.1 How Does it Work – Brain and Body

One of the most exciting questions concerning stories and storytelling is "how is it possible that we learn from objects we know do not exist and how we can do this" (Aladama 2015, p. 82). We can explain this miracle by an explanation of neural circuits as action-perception circuit and by so-called neural synchronicity.

The neurons in the brain create new synapses and organise them into networks. This synaptogenesis develops new knowledge and is "experience dependent" (Merzenich 2015, p. 20). It is "the formation of synaptic connections in response to our experiences and environment" (Merzenich 2015, p. 20). Or, as Hebb (2005, p. 70) writes, "The general idea is an old one, that any two cells or systems of cells that are repeatedly active at the same time will tend to become associated: so that activity in one facilitates activity in the other".

The brain is plastic. New incentives create new connections, and connections (knowledge) that is not used are dying (Doidge 2007; Merzenich 2015). "The brain knows the world by forming and dissolving assemblies of neurons, establishing the patterns that through repeated firing become our habitual ways of interacting with the environment, even as ongoing fluctuations in these syntheses combat their tendency to rigidify and promote the possibility of new cortical connections. The brain's ceaseless balancing act between the formation and dissolution of patterns makes possible the exploratory play between past equilibria and the indeterminacies of the future that is essential for successful mental functioning and the survival of our species" (Armstrong 2019, p. 397).

"Contemporary neuroscience suggests that the biological basis of these connections is an action-perception circuit that makes action fundamental to many cognitive processes that might seem unrelated to the control of

various body parts by the motor cortex" (Armstrong 2019, p. 401). Various studies proved that reading or thinking about the action reveals the activity in the relevant part of the motor cortex, which coordinates body movements (Paul 2012; Doidge 2007). "Imagining a movement relies on the same mechanisms as actually performing it, (Jeannerod 2006, p. 28)" and that "imagined actions are indeed actions in their own right: they involve a kinematic content, they activate motor areas almost to the same extent as executed actions, they involve the autonomic system as if a real action was under way" (Jeannerod 2006, p. 39). "Learning a motor task by using motor imagery induces a pattern of dynamic changes in cortical activation similar to that occurring during physical practice" (Jeannerod 2006, p. 41). Armstrong (2019, p. 402) concludes, "If the motor cortex and even muscle tissue can be excited by mental rehearsal of an action, that should also be true of linguistic simulations of actions, and there is experimental evidence that this is so".

When we see somebody else perform the action or hear about the action in the story, "the brain activity of both storytellers and story listeners starts to align thanks to mirror neurons, brain cells that fire not only when we perform an action but when we observe someone else perform the same action" (Smith 2016, How stories unfold in our bodies). "The synchronization of brain waves across the cortex makes possible the formation of neuronal assemblies and coordinates the workings of different regions of the brain" (Armstrong 2019, p. 399).

This is called neural synchronicity. This neural process allows the other person to feel like the other one motoric sensation via his own kinaesthetic memory and knowledge (Bolens 2012). Therefore, the life experience transformed into the story works the same way.

"The story activates the neuronal connection in the brain of the listener and allows him to live the experience via his own memory and knowledge. "Different brain regions track different aspects of a story," Speer concludes, "such as a character's physical location or current goals," and "some of these regions mirror those involved when people perform, imagine, or observe similar real-world activities" (Speer et al 2009, p.990). As we become involved with a story, fictional things come to seem real in our bodies" (Smith 2016, How stories unfold in our

bodies). Through this mechanism, "the brains of the person telling a story and listening to it, can synchronize" (Widrich 2012; Stephens, Silbert and Hasson 2010, p. 14425).

"This process changes the patterns of listener reception and as such support cooperation among people therefore are a valuable source of collective knowledge and social cohesion "(Armstrong 2019, p. 406).

"Plots can play a central role in structuring our understanding of the world because action is thoroughly implicated in perception and cognition" (Armstrong 2019, p. 401).

Said differently, "readers' representations of word meaning are grounded in visual and motor representations. The brain regions involved in tracking different dimensions of a reader's situation model should correspond to regions that have a role in seeing and acting out similar activities in the real world." (Speer et al 2009, p. 2).

Forming and dissolving assemblies of neurons based on imagined actions and synchronicity represents just one of the processes related to storytelling. Storytelling is also related to changes in neurochemical processes responsible for emotions.

Zak (2015, p. 6-7) notes, "If you pay attention to the story and become emotionally engaged with the story's characters, then it is as if you have been transported into the story's ". Telling and listening to stories raises emotions, which are "the response of dedicated neurobiological systems to concrete experiences" (Hogan 2010, p. 255). Eslocker (2023) writes that our brains respond to different story elements by transmitting oxytocin, endorphins, cortisol, dopamine, and other neurotransmitters.

"The narrative with the dramatic arc caused an increase in cortisol and oxytocin" (Zak 2015, p. 4). "Oxytocin was associated with concern for the characters in the story "(Zak 2015, p. 6) as it increases trust (Zak 2017). As for cortisol, its release is stimulated by a hormone called ACTH. Zak (2015) found out that "the change in ACTH correlated with the amount of attention people paid to the story. If we do not attend to a story, it will not pull us into its narrative arc" (Zak 2015, p. 6). "Once we are attentive and emotionally engaged, our brains go into mimic mode and mirror the behaviors that the characters in the story are doing, or might do" (Zak 2015, p.9). Endorphins and dopamine are released as a result of resolving the problem in the story and happiness (Eslocker 2023).

Even more, Zak (2015) discovered that "emotionally engaging narratives inspire post-narrative actions" (Zak 2015, p.4). He writes, "The narrative is over, but the effects linger. It is as if the brain is lazy and is using a "monkey see, monkey do" approach to assess appropriate social behaviors. (Indeed, the brain seeks to conserve energy by using default pathways—a kind of "laziness)" (Zak 2015, p.6).

4.2 How Does it Work – Example of Negative and Positive Story

In this part of the paper, we would like to provide examples of how different types of stories work on the biological level. Even though all stories initiate knowledge sharing, "the purpose of telling a story might determine its form" (Denning 2004, p. 6). "Stories told in order to spur action need to make good on their promises and contain sufficient evidence of a positive outcome. But stories intended mainly to transfer knowledge must be more than true. Because their objective is to generate understanding and not action, they tend to highlight the pitfalls of ignorance; they are meant not to inspire people but to make them cautious" (Denning 2004, p. 6). We call the stories supporting the action the positive stories, the ones transferring knowledge the negative stories. The form of both types is different.

Negative stories are told in the form of the springboard story (Denning 2011). The negative story is built from three blocks: connectedness, strangeness and comprehensibility. The story starts with connectedness. Connectedness is the element of the story familiar to the listener. The protagonist has a typical role the listener understands and, therefore, can put himself into the shoes of the protagonist (Denning 2012). Feeling connected to the character leads to releasing oxytocin, the bonding hormone, which results in caring and increased empathy (Eslocker 2023). "The oxytocin response lags behind the attentional spike as the story begins. After about thirty seconds, vagal activity begins to increase as viewers get to know and then begin to empathize" (Zak 2015, p.8) with the protagonist. It is a factor that engages the listener's imagination and emotions (Denning 2012). From the biological point of view, connectedness is the factor that stimulates imagination. The imagination stimulates one's kinaesthetic memory and knowledge and activates the neuronal connections in the brain of the listener (Bolens 2012; Armstrong 2019), connections that represent his own experience, therefore, start the synchronicity.

Strangeness is the factor that interrupts the thought process of the listener and, therefore, violates this experience. There are two ways how to insert strangeness into the story: something expected does not happen, or something unexpected happens. It provides the shock of the unforeseen and raises fear or curiosity (Denning 2012). Getting information that violates one's own experience (the way how neurons fire) raises cortisol levels, which increases attention, focus and memory (Eslocker2023). It prepares the listener for the knowledge the story brings.

"As the cortisol that feeds attention mixes with the oxytocin of care, we experience a phenomenon called "transportation." Transportation happens when attention and anxiety join with our empathy. In other words, we're hooked" (Smith 2016, How stories unfold in our bodies).

Comprehensibility is the idea that should move the listener to a new level of understanding. Therefore, it is the knowledge embodied in the story (Denning 2012). In this type of story, comprehensibility usually provides the solution to the problem introduced by the strangeness. Recovery from solving the problem raises dopamine levels, resulting in pleasure, hope and increased focus (Eslocker 2023; Smith 2016).

Good stories release endorphins, which relieve stress, make people relaxed, and increase creativity.

Positive stories initiate action. They are objective-oriented and, as such, propose new objectives and visions. Their form can be explained by the specific examples of these stories, which are speeches that introduce vision statements. The purpose of such statements is to introduce the ideas and visions of the teller to the listener and motivate him to accept them. To do so, it is necessary to link the story with the listener's hopes, dreams, aspirations and values. The format of how to do it is the following.

The positive story (the speech) starts with an explanation of what is wrong. The storyteller (speaker) introduces the problem from his perspective as his problem. The stress from bad news releases cortisol, which increases the attention of the listener. The problem presented is usually some general problem that worries many people. This helps people to identify themselves with the teller, and as a result, the storyteller switches from I form to we form. The problem becomes the problem of listeners, too. Then, the teller offers the solution as his vision. He explains it in images and word pictures using traditional values and well-known examples in a positive and hopeful way, which raises levels of endorphins. The solution to the problem is to increase dopamine. He also uses repetitions. Repetitions help the audience have a common experience, increase the levels of oxytocin, and lead to trust and a feeling of human interconnectedness (Kouzes and Posner 2006; Eslocker 2023). As a masterpiece of positive stories may be mentioned two human rights-focused speeches, J. F. Kennedy's Address to the Greater Houston Ministerial Association ("I believe in America …", 12.9.1960, Houston) and M. L. King's "I Have a Dream" (28.8.1963, Lincoln memorial).

Telling the story (and listening to it) is the work with two stories. "This circuit entails an interaction between worlds the fictional worlds constructed by storytellers, and their re-creation in the imaginative worlds built by their recipients" (Armstrong 2019, p.219). The emotions of the listener reflect the emotions of the character, but "they are not the character's. They are our own. That's how empathy and identification work in fiction" (Oatley 2012, p. 29).

The storyteller and the listener have different experiences, e.g., different networks among neurons and these experiences may not match. "Following a story is a similarly paradoxical process, with both intersubjective and solipsistic dimensions, whereby my own resources for configuring the world are put to work to make sense of another, fictive, narrated world that may seem both familiar and strange and that may either reinforce or disrupt my sense of the world's patterns, since its figurations both are and are not analogous to mine "(Armstrong 2019, p. 404).

5. Discussion and Conclusion

In our paper, we intended to explain what happens in the brain of the listener when listening (reading, watching) to the story and demonstrate this mechanism through specific examples of two different types of stories. Our findings indicate that storytelling, the important tool of human communication, has deeper roots than generally perceived. These roots are biological and, as such, concern stories we tell in our personal lives or produce in the arts and the entertainment industry. The same rules also apply to stories shared in organisations, even though managers and employees may be sceptical about them (Snowden 2001).

Stories provide us with a virtual environment where we learn and share our knowledge (Zak 2015). "When we read or view a fictional narrative we know it is not real, yet we still experience it as if it were real. This stimulatory

approach is what allows to determine that fiction provides a place to experience emotions within a safe space. This can and does have an ameliorative effect: it helps us improve our mental models of others and ourselves" (Oatley 2012, p. 19) or as Aldama (2015, p. 82-83) notes, "we experience fleeting emotions and insights that leave residues that can over time change our selfhood."

The change of neurochemical processes that happens in our brains when we tell and listen to the story explains the emotions the story raises and their importance for the transfer of knowledge. "Emotion is a defining ingredient in narrative fiction. If we don't experience emotion we are less involved in the story" (Aldama 2015, p. 84).

On the other hand, the experience from practice and research shows that these mechanisms may fail. Stephens, Silbert and Hasson 2010 et al (2010, p. 14425) explain, "We used the speaker's spatiotemporal brain activity to model listeners' brain activity and found that the speaker's activity is spatially and temporally coupled with the listener's activity. This coupling vanishes when participants fail to communicate. Moreover, though on average the listener's brain activity mirrors the speaker's activity with a delay, we also find areas that exhibit predictive anticipatory responses. We connected the extent of neural coupling to a quantitative measure of story comprehension and find that the greater the anticipatory speaker–listener coupling, the greater the understanding."

The approach to storytelling adopted in this paper explains why people like stories regardless of their ethnicity and culture and why "recurrent configurations that develop" (Armstrong 2019, p. 218) in stories reflect "certain repeated characteristics of our species'. Shared experiences of birth and death, collaboration and competition, propagation and violence interact with biologically based cognitive proclivities to produce statistically discoverable regularities in cultural institutions, including the stories we circulate in our communities" (Armstrong 2019, p. 218). It also explains why stories can initiate profound behavioural changes, including costly acts of altruism (Smith 2016, How stories change behaviour).

Approaching storytelling from the biological perspective opens "new possibilities for addressing fundamental issues concerning the emotional, ethical, educative, and cognitive value of art" (Carroll and Gibson 2011, p. 2) and storytelling as such. These possibilities indicate potential research gaps.

References

Aldama, F. L. (2015) "The science of storytelling: Perspectives from cognitive science, neuroscience, and the humanities", Projections. Vol 9, No. 1, pp 80–95.

Armstrong, P. B. (2018) "Neuroscience and the Social Powers of Narrative: How Stories Configure Our Brains", English Language and Literature, Vol 64, No.1, pp 3-24.

Armstrong, Paul B. (2013) How Literature Plays with the Brain: The Neuroscience of Reading and Art, Baltimore: Johns Hopkins University Press.

Boje, D. M. (1991) "The storytelling organisation: A study of story performance in an office-supply firm", Administrative science quarterly, Vol 36, No.1, pp 106-126.

Bolens, G. (2012) The Style of Gestures: Embodiment and Cognition in Literary Narrative, Baltimore: Johns Hopkins University Press.

Bruner J. (1991) "The narrative construction of reality", Critical Inquiry, Vol 18., No. 1, pp 1-21.

Carroll, N. and Gibson, J. (2011) Narrative, emotion, and insight, Penn State Press.

Dal Pian, L. F., Dal Pian, M. C. and Dal Pian, M. (2019) "21st Century transmedia storytelling: experiencing narrative transportation", EDULEARN 19 Proceedings, IATED, pp. 10073-10082.

Denning, S. (2023) "What is a story. What is narrative meaning", [online], https://www.stevedenning.com/business-narrative/definitions-of-story-and-narrative.aspx.

Denning, S. (2012) The springboard, Routledge.

Denning, S. (2011) The leader's guide to storytelling: Mastering the art and discipline of business narrative, John Wiley & Sons.

Denning, S. (2004) "Telling tales", Harvard business review, Vol 82, No. 5, pp 122-129.

Doidge, N. (2007) The brain that changes itself: Stories of personal triumph from the frontiers of brain science, Penguin.

Eslocker, A. (2023) "The power of storytelling: the art, science, and philosophy of our practice", [online]. https://www.citiesthatwork.com/blog/2023/4/27/the-power-of-storytelling.

Fisher, W. R. (1984) "Narration as a human communication paradigm: The case of public moral argument", Communications Monographs, Vol 51, No.1, pp 1-22.

Gibbons, R. and Prusak, L. (2020) "Knowledge, stories, and culture in organisations", AEA Papers and Proceedings, Vol. 110, pp 187-92.

Gretter, S., Yadav, A. and Gleason, B. (2017) "Walking the Line between Reality and Fiction in Online Spaces: Understanding the Effects of Narrative Transportation", Journal of Media Literacy Education, Vol 9, No. 1, pp. 1-21.

Hebb, D. O. (2005) The organization of behavior: A neuropsychological theory, Psychology Press.
Herman, D. (2013) Storytelling and the Sciences of Mind, MIT press.
Hevern, V. W. (2008) "Why narrative psychology can't afford to ignore the body" Journal of Social, Evolutionary, and Cultural Psychology, Vol 2, No. 4, pp 217-233.
Hogan, P. C. (2010) "Literary universals", *Introduction to cognitive cultural studies,* Edited by Zunshine, Johns Hopkins University Press, pp 37–60.
Jeannerod, M. (2006) Motor cognition: What actions tell the self, OUP Oxford.
Kouzes, J. M., and Posner, B. Z. (2006) The leadership challenge, John Wiley & Sons.
Merzenich, M. (2015) "Building a Smarter Brain", [online], https://medien.umbreitkatalog.de/pdfzentrale/978/111/892/Leseprobe_l_9781118926109.pdf.
Oatley, K. (2012) The Passionate Muse: Exploring Emotion in Stories, Oxford University Press.
Paul A. M. (2012) "Your brain on fiction", [online], *The New York Times.* March 17, 2012, https://www.nytimes.com/2012/03/18/opinion/sunday/the-neuroscience-of-your-brain-on-fiction.html?pagewanted=all.
Polkinghorne, D. E. (1988) Narrative knowing and the human sciences, Suny Press.
Ricœur, P. (1990) Time and narrative, The University of Chicago Press.
Schank, R. C. (1995) Tell me a story: Narrative and intelligence, Northwestern University Press.
Smith J. A. (2016) "The science of the story". [online], Story Header, https://greatergood.berkeley.edu/article/item/science_of_the_story.
Snowden, D. (1999) "Story telling: an old skill in a new context", Business Information Review, Vol 16, No. 1, pp 30-37.
Snowden, D. (2001) "Narrative patterns: The perils and possibilities of using a story in organisations", Knowledge Management, Vol 4, No. 10, pp 1-14.
Speer, N. K., Swallow, K. M., Reynolds, J. R. and Zacks, J. M. (2009) "Reading stories activates neural representations of visual and motor experiences", Psychological science, Vol 20, No. 8, pp 989-999.
Stephens, G. J., Silbert, L. J. and Hasson, U. (2010) "Speaker–listener neural coupling underlies successful communication", Proceedings of the National Academy of Sciences, Vol. 107, No. 32, pp 14425-14430.
Widrich L. (2012) "The Science of Storytelling: What Listening to a Story Does to Our Brain"s, [online], Buffer, https://buffer.com/resources/science-of-storytelling-why-telling-a-story-is-the-most-powerful-way-to-activate-our-brains/.
Zak, P. J. (2015) "Why inspiring stories make us react: The neuroscience of narrative", Cerebrum: the Dana forum on brain science, Vol. 2015, pp 1-13.
Zak, P. J. (2017) "The neuroscience of trust", Harvard business review, Vol 95, No. 1, pp 84-90.

Corporate Taxonomy Mapping for Performance-Supporting KM

Maayan Nakash
Department of Management, Bar-Ilan University, Israel

Maayan.Nakash@biu.ac.il

Abstract: Taxonomies are controlled vocabularies and multidimensional frameworks for organizing and classifying content. This study is the first to examine the meanings chief knowledge officers (CKOs) ascribe to corporate taxonomy mapping for enabling sustainable performance-driven knowledge management (KM). Utilizing a qualitative methodology, the research corpus comprised in-depth interviews, focus groups, participant observation, and cyber-ethnography. The findings underscore the essential role of investing resources in systematic taxonomy management as a cornerstone for attaining excellence in KM. Empirical evidence is provided for the critical importance of consistent taxonomies in establishing standardized terminology, facilitating systematic knowledge retrieval, and streamlining access within KM systems. Insight is provided into the constraints of contemporary technological advancements, including the capabilities of auto-tagging and classification through artificial intelligence (AI) and natural language processing (NLP) techniques. We underscore the nuanced interaction between human cognition and automated human-like capabilities in taxonomic classification, stressing the importance of embracing a balanced leadership socio-technical approach to the dynamic development of taxonomies. Furthermore, the study proposes promising avenues for future research to enhance the depth of inquiry into this subject matter.

Keywords: Taxonomy, Corporate Taxonomies, Controlled Vocabulary, Knowledge Management, Knowledge Management Systems, Knowledge Item

1. Introduction

Knowledge is a critical organizational asset that is vital for achieving strategic goals and maintaining sustainable competitive advantage. Knowledge management (KM) is a management discipline that emerged towards the end of the 20th century with the purpose of supporting the leveraging of existing knowledge and the development of new knowledge to enhance firm performance. Since its inception, KM has been enriched by an inexhaustible abundance of academic contributions and accumulated practical experience (Chang and Chuang 2011; Dalkir 2023; Mat Nor et al. 2020; Nakash and Bouhnik 2023). To successfully implement KM within an organization, strategic planning is required, including clear definitions of long-term goals, resources, and implementation plans (Bolisani and Scarso 2015).

In a sense, corporate taxonomy serves as a common language that connects knowledge workers to organizationally relevant knowledge. By moving from broad categories to increasingly specific ones, it provides a multidimensional framework for organizing and classifying content. Successful implementation of corporate taxonomy in the knowledge management system (KMS) can enhance the navigation of organizational resources (APQC 2019, 2021, 2023; Chaudhry et al. 2008; Fouché 2006). As such, the development of a corporate taxonomic framework has been identified as a key milestone for achieving KM excellence (Nakash et al. 2023).

Despite the considerable importance of developing corporate taxonomies to support performance-enhancing KM, this topic has received scant attention in the scientific literature to date, with a notable lack of recent empirical studies focusing specifically on this issue. An integral yet understudied component of KM, taxonomies are vital for structuring organizational knowledge and promoting the discovery and accessibility of useful information for employees. Substantial knowledge gaps persist regarding best practices for optimal taxonomy design and implementation that dedicated research could help address. The present study aims to fill this gap by examining the contemporary perspectives of chief knowledge officers (CKOs) on corporate taxonomy mapping, including the meanings they ascribe to this process as well as the perceived benefits stemming from well-constructed taxonomies. Furthermore, we seek to deepen understanding of emerging innovations and future directions pertaining to the development of automated solutions in this domain.

2. Theoretical Background

A taxonomy is a hierarchy of categories used to classify a body of knowledge (APQC 2021; Ihongo et al. 2021; Sisson et al. 2019). It is a controlled vocabulary that expresses hierarchical (broader/narrower) or equivalent (synonymous) relationships between terms (Whittaker and Breininger 2010). The term “taxonomy” originated in biology and was later discussed extensively in library science. In organizational contexts, a corporate taxonomy represents the collection of terms used within the organization and reflects relationships between

them. It serves as a foundation for the organization's knowledge architecture (Cruz 2004; Fouché 2006; Gilchrist 2001; Gilchrist and Mahon 2004; Whittaker and Breininger 2008; Woods 2004; Zhonghong et al. 2006).

Many firms face challenges in implementing and maintaining productive KMSs (Mat Nor et al. 2020). Organizing knowledge for reuse is a major difficulty (Sharma et al. 2016). To ensure efficient knowledge use, organizations are increasingly interested in categorization. Corporate taxonomies play a critical role in organizing business knowledge (Bolisani et al., 2016; Sharma et al., 2016; Wibbenmeyer 2015) thereby easing information overload for knowledge workers (Gilchrist 2001).

In many ways, taxonomy provides a system of labels forming a hierarchical navigation scheme (Fouché 2006; Gilchrist and Mahon 2004; Ihongo et al. 2021). When standardized taxonomies are lacking, problems like inconsistencies and inaccuracies in content emerge (Munkvold et al. 2006). A logical taxonomy enables users to effectively locate, access, and retrieve knowledge items (Knox and Logan 2003). A specific methodology for implementing corporate taxonomy was presented by Wibbenmeyer (2015). A taxonomy works within ontology structures outlining organizational term relationships in KMSs (Castillo-Barrera et al. 2013). The classification scheme layout differs across organizations based on scope, role, and characteristics (Chaudhry et al. 2008).

Defining taxonomy structure is preceded by determining content volume/type and identifying target users (Lambe 2014; Nakash et al. 2023; Whittaker and Breininger 2008). Corporate taxonomy is a living, expensive entity to maintain and create (APQC 2023), requiring significant time investments (APQC 2019). Differing content catalogs across departments hamper taxonomy development (Vom Brocke et al. 2011). As knowledge organization sets, intuitive taxonomies provide basic structures and controlled vocabularies that allow effective categorization, storage, retrieval, and access to information (Lambe 2014).

3. Materials and Methods

The research was conducted using a qualitative methodology, relying on interpretive foundations, and adopting an inductive approach. Fifty-two CKOs participated in a semi-structured in-depth interview and/or in one of two focus groups. The participants have an average of 12 years of experience in KM methodologies and technologies and they operate in various sectors in the local and global industry. As part of their roles, they are responsible for mapping corporate taxonomies in KMS. Each meeting lasted between an hour and an hour and a half and was recorded and transcribed with the knowledge and consent of the participants.

In addition, we conducted participant observation in KM units in organizations that differ from each other in size and business lines. The observations were designed to allow us to get an impression of the structure of the corporate taxonomies that were implemented in a variety of KMS, produced by different software providers.

Cyber-ethnography, also known as web ethnography, digital ethnography, and netnography, was used as a fourth data collection tool. This method applies an adaptation of ethnographic methods to the study of communities formed in computer-mediated social interaction (Kozinets 2015; Kulavuz-Onal 2015). We thoroughly reviewed 20,349 posts and comments from two public and visible Facebook groups dealing with KM in organizations that have over 7,500 people as members. During the systematic review, we marked 3,459 posts and comments as relevant. Analytical analysis was performed on every third posting, creating a broad database for in-depth analysis of 1,019 posts and comments. The materials collected in the network fieldwork were consistently documented and we recorded field notes.

Text analysis of the data collected both in the physical and virtual spaces was performed by the MAXQDA software according to the thematic analysis method's principles. This paper incorporates authentic testimonies obtained from informants. It should be noted that the results and insights presented here are part of a more comprehensive study we conducted to clarify the position, development, and future of the KM discipline.

4. Findings

4.1 Corporate Taxonomy in the View of CKOs

As part of the process of organizing the knowledge items in KMS, CKOs build a taxonomic schematic structure. The knowledge items are indexed and cataloged in a logical and consistent manner by implementing division into categories and sub-categories of key core business issues. The categories create the classification system – it is the taxonomic framework – which captures the interrelationships between knowledge items.

The taxonomy reflects the organizational glossary, which undergoes a process of *"classification and organization, in a hierarchical and related manner of various contents belonging to the same content world"* (F330). To prepare the taxonomic infrastructure, tagging operations and adding metadata are applied to the knowledge items during their creation. Constant maintenance accompanies the treatment of taxonomy, including an ongoing need to classify each new knowledge item. CKOs are also required to decide where to place items that may possibly fall into more than one category.

Based on corporate taxonomy mapping, a computerized hierarchical tree is built, in which knowledge items are associated in a balanced manner with its branches. This is how a CKO in a global management consulting firm described the process of taxonomy building:

> *"It is important to define a structured taxonomy, that someone sits down and defines that this* [the one content type] *belongs to this* [the other content type]*, and this is somehow related to this. ... I mean, we invest a lot of thinking in this construction* [of the professional content]*. ... In serious organizations, there is an organizational steering committee that meets once a quarter to approve entries for the taxonomy, download entries* [from the knowledge tree]*, and analyze the use* [in the contents]*. That is, manage the taxonomy"* (C2).

4.2 Benefits of Effective Taxonomy

The informants emphasized that, first and foremost, a good taxonomy creates a uniform language between the various officials in the organization. That is, it prevents an unlikely reality in which *"substantial differences exist in the way different units in the organization define the same product or the same process"* (F105).

The ambition of CKOs to create *"performance-supporting KM"* (C6) was a recurring motif in the four data collection tools. Specifically, an effective taxonomy is seen as assuming a solid foundation for effective orientation in knowledge bases. Furthermore, it helps employees understand the broader associative relationships of the knowledge item. One of the members of the KM virtual community on Facebook explained the importance of taxonomic mapping accuracy as helping to reduce the cognitive effort required of employees to locate the knowledge needed to complete their tasks:

> *"Most employees prefer that 'we spoon-feed them' (and rightly so...), because they are not measured by the way knowledge is consumed and used, but by the results and goals they have achieved. Knowledge is only the means* [for outputs]*. This is where taxonomy and the use of metadata come into play. ... The important principle here is mapping as accurately as possible. For example, it is possible to divide the professional subject into four levels of hierarchy – a kind of funnel from the macro to the micro. Any measurement of the taxonomy used will help us further refine the search terms, make them more precise, and adapt them to the end user"* (F8).

Moreover, the results reveal that a good taxonomic infrastructure will be able to support the search engine's success in quickly retrieving relevant content: *"Taxonomy is of enormous importance for locating the specific knowledge item in real-time and with minimal effort. ... All items must contain tags and keywords which will allow them to be cataloged and retrieved"* (F77). The close interrelationships between taxonomy and organizational search engines were well illustrated in the following parable: *"The search engine will allow us to find a needle in a haystack. The taxonomy will make sure that we have reached the right haystack and that we have not gone astray in the barn"* (F279).

One of the CKOs elaborated and compared this infrastructure to *"a backbone that helps the KM activity in the organization to stay upright. ... It* [the corporate taxonomy] *is what allows me to search, retrieve content and understand its contexts"* (C8). Another parable given to the importance of adequate mapping of the taxonomic structure came up in the following quote: *"Organizations tend not to devote enough energy to it, but it is the basis. It is like architecture, like the foundations of a building"* (C2).

4.3 Emerging Innovations and Future Directions in Taxonomy Automation

The informants reported that today a taxonomy practice almost always requires human intervention:

> *"Auto-tagging is certainly an existing capability which is currently realized in a few organizations, and it is essential to start realizing it in others, but it does not eliminate the need for people to label according to the context known only to them"* (F112).

This argument is explained in the following online response:

> *"The automated tools* [that exist today] *know how to base themselves on the content of a knowledge item, tag it, and formulate a corporate taxonomy automatically. It's a shame that too few firms examine this possibility, but it is necessary to implement human tagging as well. It should be remembered that people have the ability to tag according to context, even if the* [related and specific] *term is not even hinted at in the content"* (F239).

However, research participants anticipate significant automation developments in this area: *"There will be tools that will run over a million documents and say, 'this is your taxonomy.' It* [the KM discipline future] *is going there"* (C2). In fact, *"the auto-tagging will take the use of tags one step further and make the search smart, advanced and above all adapted to the user and his / her needs"* (F238). We found an interesting perspective in the following quote:

> *"It may be a favorable point in time to see what machines can do in the future (which is already here) (such as smart indexing and deeper taxonomy) and reconsider the CKOs' role in the emerging reality. Technological developments will allow CKO to deal less with technique, but more in essence"* (F489).

The forecast for future developments envisages automatic extraction of unstructured content from multi-page documents, as well as automatic taxonomy creation using techniques of natural language processing (NLP), pattern recognition, and sentiment analysis.

If the situation today is that *"no technological 'monster' can manage knowledge without a touch of a human hand"* (C14), it seems that according to the predictions, human involvement in KM will decrease and it will be replaced by machines. In many ways, the development of artificial intelligence (AI) technologies, which rely on robotic abilities to imitate human cognition, is nothing but perceived by the informants as *"inevitable"* (M8). As one of the focus group participants stated: *"AI will not replace KM but will change its face"* (C1).

5. Discussion and Conclusions

This study provides an integrative perspective on mapping corporate taxonomies for performance-supporting KM. The results empirically validate claims in the literature regarding the criticality of consistent taxonomies for standardizing terminology, enabling systematic knowledge retrieval, and facilitating access in KMSs (Munkvold et al. 2006; Vom Brocke et al. 2011; Milton and Lambe 2016; Wibbenmeyer 2015). This substantiates why taxonomy is a foundational KM element (APQC 2019, 2023). We find that KM excellence depends on systematic taxonomy mapping while advancing understanding of taxonomies' intrinsic value in ensuring effective organizational knowledge reuse to improve performance. Well-designed taxonomies can greatly reduce KMS search times. Decreasing time wasted searching may increase productivity and generate major financial savings (Nakash and Bouhnik 2024).

Although technology is becoming central to KM, it remains an enabling rather than a disruptive force. The participants indicate that continued improvements in cognitive computing, machine learning (ML), and AI will automate KM tasks. Specifically, auto-tagging and machine taxonomic classification are emerging. However, over-reliance on software solutions to create a corporate taxonomy has long been defined as involving risk (Gilchrist 2001). CKOs in our study confirm such concerns, noting limitations of existing software in inferring broad context compared to human cognition. Thus, monitoring, feedback, and supervision needs persist. A corporate taxonomy must be scalable (Cruz 2004). But more than that, it should be adaptable. Taxonomies should change as business lines shift, tracking contemporary content domains of interest to employees. Therefore, CKOs should continually reexamine classification schemes to align with strategic priorities.

To summarize, advances in AI, specifically ML and NLP, are poised to transform the creation and ongoing evolution of corporate taxonomies. leveraging ongoing exponential advances in AI for corporate taxonomy construction appears set to accelerate mapping of organizational knowledge architectures. However, a purely technology-centric approach discounting human guidance risks suboptimal structures. instead, an integrated socio-technical solution harnessing both algorithmic insights and expert assessment shows promise in improving taxonomy development and evolution to strengthen KMSs. This distributed development pathway will leverages complementary human and machine capabilities.

6. Implications

6.1 Theoretical Implications

This study makes several key contributions to KM theory regarding organizational taxonomies. First, it provides empirical validation of taxonomy's foundational role in enabling effective knowledge reuse, navigation, and access in KMS platforms. This confirms and strengthens theoretical perspectives on the intrinsic value of taxonomies for overall KM outcomes. Second, the findings reveal sophisticated, context-dependent aspects of taxonomy development, such as the need for human judgment in inferring implied content meanings. This advances conceptual thinking on taxonomy design, going beyond basic structural issues to complex cognitive challenges requiring blended human-machine input. Finally, identifying the adaptable, “living” nature of effective taxonomies makes a theoretical contribution, revealing that static classification schemes will likely fail. This insight can shape taxonomy models and best practices emphasizing flexibility and continual alignment with shifting organizational priorities.

6.2 Practical Implications

For industry practice, documenting the substantial productivity and financial benefits derived from streamlined taxonomy-enabled knowledge access provides tangible evidence for justified investments in taxonomy development and maintenance. Firms now have a greater rationale for allocating resources and leadership attention to taxonomy creation. Additionally, illuminating the gaps between human cognition and AI capacities regarding taxonomic classification cautions managers against over-dependency on software tools without ongoing human guidance and correction. A blended socio-technical approach balancing automated classification with expert oversight is recommended to mitigate risk.

7. Future Research Directions

Several productive avenues exist for further research on organizational taxonomies. As adopting NLP expands, researchers could examine how effectively these tools automate taxonomy mapping versus requiring supplemental human input. Studying taxonomy evolution across longer timeframes would also offer practical insights into sustainably managing “living” taxonomies. Additionally, comparative case studies on taxonomy approaches between high and low performing firms could uncover best practices for maximizing taxonomy value. Taken together, such research directions hold promise for uncovering best practices that enable high-performing organizations to leverage taxonomies as strategic drivers of competitive advantage.

References

APQC. (2019) *Implementing a User-Oriented Taxonomy,* American Productivity & Quality Center, Available at: https://www.apqc.org/resource-library/resource-listing/implementing-user-oriented-taxonomy (Accessed: September 10, 2023).

APQC. (2023) *Taxonomy Is the Foundation of Good Content Management*, American Productivity & Quality Center, Available at: https://www.apqc.org/resource-library/resource-listing/taxonomy-foundation-good-content-management (Accessed: August 15, 2023).

APQC. (2021) *Using a Process Framework as a Taxonomy,* American Productivity & Quality Center, Available at: https://www.apqc.org/resource-library/resource-listing/using-process-framework-taxonomy (Accessed: July 4, 2023).

Bolisani, E. and Scarso, E. (2015) "Strategic planning approaches to knowledge management: a taxonomy", *VINE Journal of Information and Knowledge Management Systems*, Vol 45 No. 4, pp 495-508.

Bolisani, E., Scarso, E. and Zięba, M. (2016) "How to deal with knowledge in small companies? Defining emergent KM approach", *International Journal of Learning and Intellectual Capital*, Vol 13 No. 2-3, pp 104-118.

Castillo-Barrera, F. E., Durán-Limón, H. A., Médina-Ramírez, C. and Rodriguez-Rocha, B. (2013) "A method for building ontology-based electronic document management systems for quality standards—the case study of the ISO/TS 16949: 2002 automotive standard", *Applied Intelligence*, Vol 38, pp 99-113.

Chang, T. C. and Chuang, S. H. (2011) "Performance implications of knowledge management processes: Examining the roles of infrastructure capability and business strategy", *Expert systems with applications*, Vol 38 No. 5, pp 6170-6178.

Chaudhry, A. S., Wang, Z. and Khoo, C. S. (2008) "Potential of bibliographic tools for developing organizational taxonomies", In *Proceedings of the Annual Conference of CAIS/Actes du congrès annuel de l'ACSI*.

Cruz, B. (2004) "Corporate taxonomies can open up the big picture", *Handbook of Business Strategy*, Vol 5 No. 1, pp 247-251.

Dalkir, K. (2023) Key Milestones in the Evolution of Knowledge Management: What Is Next?, In *The Future of Knowledge Management: Reflections from the 10th Anniversary of the International Association of Knowledge Management (IAKM)* (pp 47-65), Cham: Springer Nature Switzerland.

Fouché, M. L. (2006) *The role of taxonomies in knowledge management*, Doctoral dissertation, Department of Management, *University of South Africa,* South Africa.

Gilchrist, A. (2001) "Corporate taxonomies: report on a survey of current practice", *Online Information Review*, Vol 25 No. 2, pp 94-103.

Gilchrist, A. and Mahon, B. (2004) *Information architecture: Designing information environments for purpose*, vol 1, Facet publishing.

Ihongo, D. A., Tor-Akwer, H. and Diyong, U. J. (2021) knowledge organisation systems as tools for enhanced information access and retrieval: a need for use of corporate taxonomies on library portals, *Library Philosophy and Practice*, vol 5287, pp 1-20.

Knox, R. E. and Logan, D. (2003) *What taxonomies do for the enterprise*, Gartner, Available at: www.gartner.com/resources/117200/117204/117204.pdf (Accessed: September 10, 2023).

Kozinets, R. (2015) Management netnography: axiological and methodological developments in online cultural business research, *The Sage handbook of qualitative business and management research methods, London: Sage*.

Kulavuz-Onal, D. (2015) Using netnography to explore the culture of online language teaching communities, *Calico journal*, Vol 32 No. 3, pp 426-448.

Lambe, P. (2014) *Organising knowledge: taxonomies, knowledge and organisational effectiveness*, Elsevier.

Mat Nor, N., Mat Khairi, S.M., Rosnan, H., Maskun, R. and Johar, E.R. (2020) "Establishing a knowledge-based organisation: Lesson learnt and KM challenges in Malaysian organisation", *Innovation & Management Review*, Vol 17 No. 3, pp 235-249.

Milton, N. and Lambe, P. (2016) *The knowledge manager's handbook: a step-by-step guide to embedding effective knowledge management in your organization*, Kogan Page Publishers.

Munkvold, B. E., Päivärinta, T., Hodne, A. K. and Stangeland, E. (2006). Contemporary issues of enterprise content management, *Scandinavian Journal of information systems*, Vol 18 No. 2.

Nakash, M. and Bouhnik, D. (2023) "Motivations for the initiation of knowledge management activities in times of routine and emergency", *Aslib Journal of Information Management*, Vol. ahead-of-print No. ahead-of-print. https://doi.org/10.1108/AJIM-10-2022-0458

Nakash, M. and Bouhnik, D. (2024) "How Much Time does the Workforce Spend Searching for Information in the 'new normal'?". *iConference 2024 Proceedings.* http://dx.doi.org/10.13140/RG.2.2.28311.59043

Nakash, M., Baruchson-Arbib, S. and Bouhnik, D. (2023) "Seven-Layer Model for Creating Organizational KM Excellence", *Proceedings of the Association for Information Science and Technology*, Vol 60 No.1, pp 1083-1085. https://doi.org/10.1002/pra2.952

Sharma, R. S., Chia, M., Choo, V. and Samuel, E. (2010) "Using a taxonomy for knowledge audits: some field experiences", *Journal of knowledge management practice*, Vol 11 No. 1, pp 1-16.

Sisson, P. W., Mazzuchi, T. and George, T. M. (2019) "Bloom's taxonomy of educational objectives: A template for primary school km education", In *20th European Conference on Knowledge Management,* Vol 59.

Vom Brocke, J., Simons, A. and Cleven, A. (2011) "Towards a business process-oriented approach to enterprise content management: the ECM-blueprinting framework", *Information Systems and e-Business Management*, Vol 9, pp 475-496.

Whittaker, M. and Breininger, K. (2008) "Taxonomy development for knowledge management", In *74th general conference and council of the world library and information, Quebec, Canada*.

Wibbenmeyer, K. (2015) "How to Successfully Implement a Corporate Taxonomy", *Global journal of computer science and technology*, Vol 15, No. 5.

Woods, E. (2004) Building a corporate taxonomy: benefits and challenges. *Ovum expert advice*.

Zhonghong, W., Chaudhry, A. S. and Khoo, C. (2006) Potential and prospects of taxonomies for content organization, Knowledge Organization, Vol 33 No. 3, pp 160-169.

Knowledge Management Meets Artificial Intelligence: A Systematic Review and Future Research Agenda

Maayan Nakash[1,2] and Ettore Bolisani[1]

[1] Department of Management and Engineering, University of Padova, Vicenza, Italy

[2] Department of Management, Bar-Ilan University, Israel

Maayan.Nakash@biu.ac.il

Ettore.Bolisani@unipd.it

Abstract: In the complex mosaic of the digital age, the tactical incorporation of artificial intelligence (AI) within knowledge management (KM) is revealed as a central business component of technology management. The current study aims to clarify the intersection between KM and AI in organizational contexts. Specifically, this paper represents a preliminary step to investigate the potential impacts of AI on KM research and practice. Building on a database we created from Scopus, we shine a spotlight on trends in pertinent peer-reviewed scientific articles published in the last decade (2013-2023) on the KM-AI nexus. In addition, the paper presents an extended systematic analysis of literature, which synthesizes theoretical and empirical works conducted to date on this topic. Through a review of the available studies, we strive to shed light on effective KM frameworks and strategies in the era of AI. As extant research in the literature is largely theoretical, we propose to conduct empirical research on AI technologies in core KM processes such as acquisition, documentation, sharing, and application of knowledge. In addition, we recognize that the challenges and barriers to implementing AI in KM systems are not in focus and deserve to ignite further research. The anticipated contributions from such inquiries promise not only to augment the corpus of knowledge within the discipline, but also to furnish KM practitioners with the insights necessary for the crafting of efficacious systems. This research marks the advent of a transformative scholarly epoch, wherein the harmonious integration of KM and AI emerges as the bedrock of organizational ingenuity and strategic acumen. It distinguishes itself from prior works by pinpointing knowledge gaps in the synergy between disciplines and underscores the imperative for future research to bridge these lacunae.

Keywords: Artificial Intelligence, Cognitive Computing, Machine Learning, Knowledge Management, Knowledge-Driven Organizations

1. Introduction

Knowledge management (KM) has been recognized for decades as a key component of business strategies for organizational success (Al Mansoori et al. 2020; Bolisani and Bratianu, 2018; Jallow et al. 2020). It is identified as “the process of creating value from an organization’s intangible assets” (Liebowitz 2004, p.4). Sometimes it is associated with a formal approach to governing the creation, transfer, retention, and use of a firm's explicit and tacit knowledge resources (O'Leary 1998) while other times it is simply an informal or “emergent” approach (Bolisani et al. 2016). KM is now a pervasive attitude that integrates concepts of information technology, computer science, organizational behavior, human resource management, strategic management, and more (Bolisani et al. 2023; Edwards and Lönnqvist 2023; Liebowitz 2001).

Technology is often seen as a key element of KM since it enables better knowledge flow facilitation (Nakash and Bouhnik 2022). For this reason, the rapid upsurge of widespread artificial intelligence (AI) applications can have a tremendous impact on how we see KM and KM processes (KMPs). AI leverages computational techniques for machine learning (ML) and has been widely adopted across various domains (Sanzogni et al. 2017). Simply put, AI refers to instilling intelligence into autonomous machines, aiming to enable the performance of tasks requiring human cognition. That is, AI attempts to mimic functions like human learning, decision-making, and problem-solving (Jallow et al. 2020; Sanzogni et al. 2017; Vadari and Desik 2021).

AI is considered one of today’s most disruptive technologies. Its benefits have been assessed in terms of improved outputs, amplified innovation, and greater profitability (Yigitcanlar et al. 2020). Moreover, AI is a powerful competitive tool (Jackson 2019) with significant business impacts (Malik et al. 2023). It can optimize diverse processes, reducing labor requirements and increasing efficiency (Mishra and Pani 2021). Consequently, AI can disrupt today’s KM landscape by providing an integration of the two extreme views of KM: one that sees KM as a substantial technological challenge, where the new systems can process structured explicit knowledge in a highly efficient way; and the other that describe the core KM challenge as that where humans need to create, handle, and effectively share their tacit knowledge components. Indeed, even in the history of companies that intensively use KM (Bolisani et al. 2016), there has often been a struggle to combine these opposite views that represent two sides of the same coin. Today, AI presents the opportunity to ultimately and conclusively integrate the technological and human viewpoints within the field of KM.

At the same time, effective KM can enhance the potential of AI to achieve better business performance compared to competitors (Leoni et al. 2022). In fact, AI has been deemed to "desperately need KM" (Edwards and Lönnqvist 2023, p.914). On the other hand, since the 2000s AI has been recognized as potentially catalyzing core KM tenets (Liebowitz 2001). Practitioners have predicted that it will shape knowledge creation and consumption, transforming the KM discipline (Nakash and Bouhnik 2021). However, the connections between KM and AI remain unclear in research (Jallow et al. 2020; Renukappa et al. 2020). In other words, as is affirmed in some recent papers (Zbuchea et al., 2019; Bencsik 2021), the literature is still poor in studies that deal with the theoretical and practical validity of the connection points between the two fields.

Acknowledging the lack of focus on the KM-AI nexus, our exploratory, techno-centric study aims to elucidate this intersection in organizational contexts and to reveal cross-disciplinary synergies. To provide significant insights on this subject, we have delineated two key objectives: (1) Identify trends in current peer-reviewed publications at the nexus of KM and AI; (2) Synthesize relevant theoretical and empirical works via a systematic literature review (SLR). These goals were accomplished through the utilization of popular scientific database, enabling us to identify knowledge gaps in the literature and propose promising avenues for further inquiry. The methodology is based on two steps: first, a quantitative bibliometric analysis of papers published in the last decade and indexed in the Scopus citation database, to reveal main trends and provide a basic classification of articles; second, a qualitative analysis of selected articles, to provide insights into the missing gaps and the directions of research.

The scope of this paper encompasses a comprehensive consideration of AI technologies. While AI has been a topic of discussion for decades, it is only recently that its pervasive potential in the business domain has begun to be fully realized; mainly due to the emergence of Gen-AI, large language models (LLMs), and related applications that are, today, readily available to a broad market. This emergence has prompted a closer scientific investigation of AI's relationship with KM. In any case, since there are still different categories of AI systems and applications, we prefer to adopt an inclusive approach that deliberately refrains from focusing on any singular technology or distinct AI implementation.

2. Materials and Methods

To address the first objective of elucidating publication patterns, we utilized the Scopus scientific database, which is a highly reputable digital database providing inclusive, extensive coverage and advanced search and filtering capabilities. Launched in 2004 by Elsevier, it is a worthy alternative competing with the monopoly established by Web of Science (WoS) (Abrizah et al. 2013; Meho and Yang 2007) and for this reason, is often used for a systematic analysis of the scientific literature. Scopus offers accessible and comprehensive coverage of lead journals across scientific disciplines, including in the management, organization, and technology fields.

An initial search for "knowledge management" AND "artificial intelligence" in titles, abstracts, or keywords yielded 4,029 records across books, reports, and conference papers. Our inclusion criteria specified only English, peer-reviewed journal articles, leaving 949 results. Specifically, we ran this Scopus query: TITLE-ABS-KEY ("knowledge management" AND "artificial intelligence") AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (DOCTYPE , "ar")). To obtain a contemporary portrait, search results were limited to the past decade (2013-2023).

Regarding the second research objective, we aspired to provide a general perspective on previous works that discussed the application of AI technologies to KM in organizations. By accumulating theoretical and empirical publications, we implemented the SLR protocols that are often used in management and organizational research (Denyer and Tranfield 2009). The systematic review was performed without constraints on document types or publication timeframes, except for an English language filter.

Our search strategy was achieved in two sequential steps. First, we identified readily accessible scientific articles that were highly ranked on the list of most-cited publications in these subject areas. We also used relevant keyword combinations in title and abstract fields, harnessing Boolean operators and adjacency functions to optimize results. After that, we read the publications' abstracts and if the content was considered relevant, we reviewed the full text to consider its inclusion in the final qualitative analysis. That is, a text analysis methodology was employed to further refine the selection of pertinent literature. This expansive purview enabled a broad synthesis of conceptual models, existing frameworks, empirical findings, and analytical methodologies to thoroughly map the scholarly territory. By reviewing available studies, this paper elucidates effective KM frameworks and strategies in an era of AI.

3. Results

This section presents the core findings of our research, organized into two critical segments: The first, detailed in sub-section 3.1, refers to a bibliometric analysis, while the second, described in sub-section 3.2, to the results of a textual analysis.

3.1 Bibliometric Analysis

Limiting the analysis to the last decade, the results revealed that from 2013 to 2023, 572 articles were published at the KM-AI intersection, of which, as of February 2024, 534 were in the final version and 38 were articles "in press". Increased interest has been found in combining these fields, with an exponentially consistent upward trend in the last four years. Within a decade there was an acute increase in the number of articles (from 25 articles in 2013 to 136 in 2023). The results also reveal that between 2022 and 2023, when advanced AI applications (such as ChatGPT, Gemini, Midjourney, Leonardo AI, and Claude AI) burst into our lives, there was a tremendous increase of approximately 1.5 times in publications under KM-AI (see **Figure 1**).

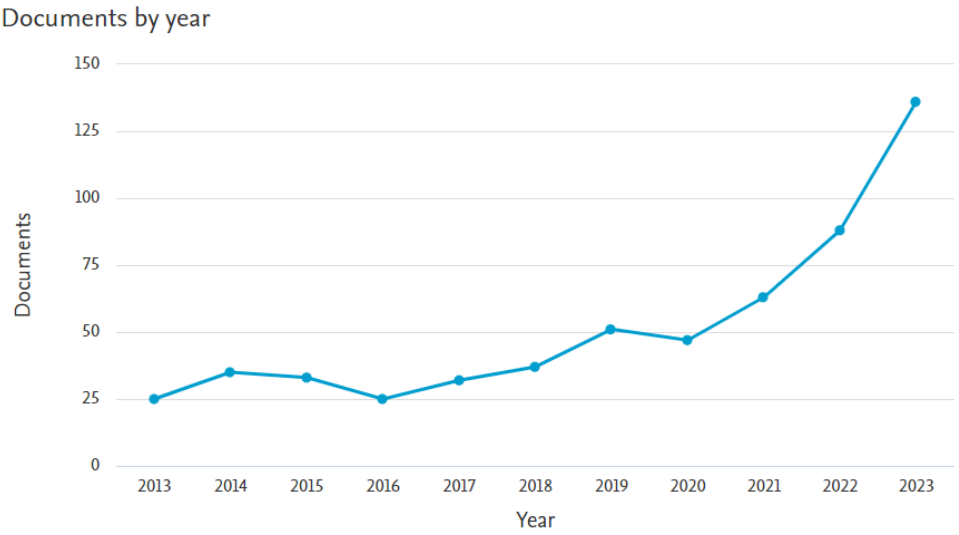


Figure 1: Segmentation of the articles dealing with KM and AI according to years

The two leading fields are "hard" sciences: computer science (n=363, 30.5%) and engineering (n=207, 17.4%). Articles classified under business, management, and accounting (n=117, 9.8%) ranked third (see **Figure 2**).

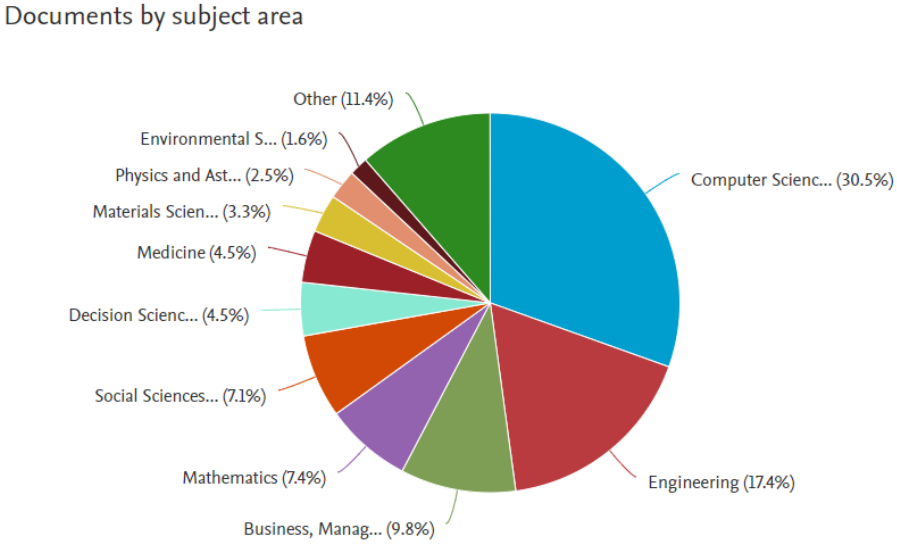


Figure 2: Segmentation of the articles dealing with KM and AI according to areas of expertise

Regarding the academic journals, the articles published in IEEE Access appear most often (n=19). The three journals, known for their specific focus on KM, which led in publications are “Knowledge-Based Systems” (n=9), “Knowledge Management Research & Practice” (n=6), and “Journal of Knowledge Management” (n=6).

The most cited article was published in “Knowledge-Based Systems” by Lu et al (2015) and deals with transfer learning using computational intelligence. An overview of the citations of the 572 articles retrieved on KM and AI revealed that throughout the decade there was a constant consistent increase, with the articles being cited 3,109 times in 2023 alone (see **Figure 3**).

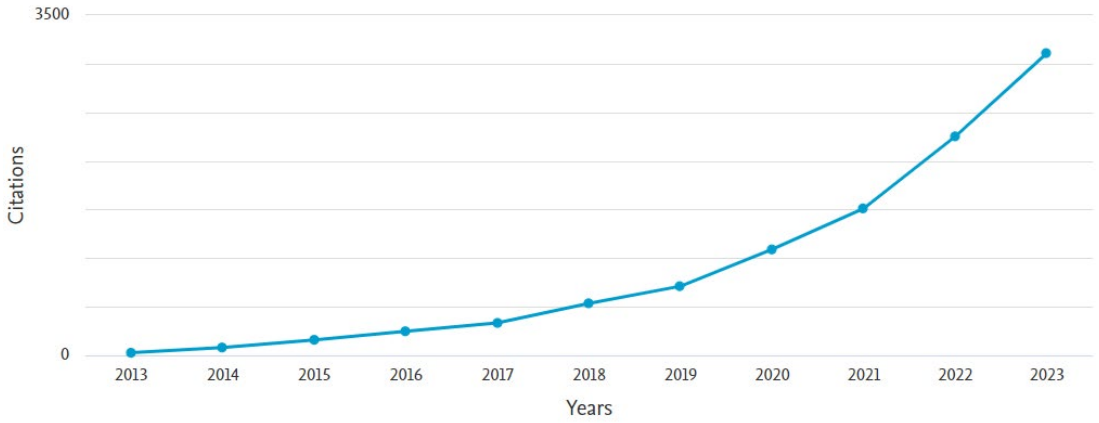


Figure 3: Segmentation of the articles dealing with KM and AI according to the number of citations

The main contribution to the body of knowledge on KM-AI in the last decade came through authors from China (n=120), the United States (n=109), and the United Kingdom (n=55) (see **Figure 4**).

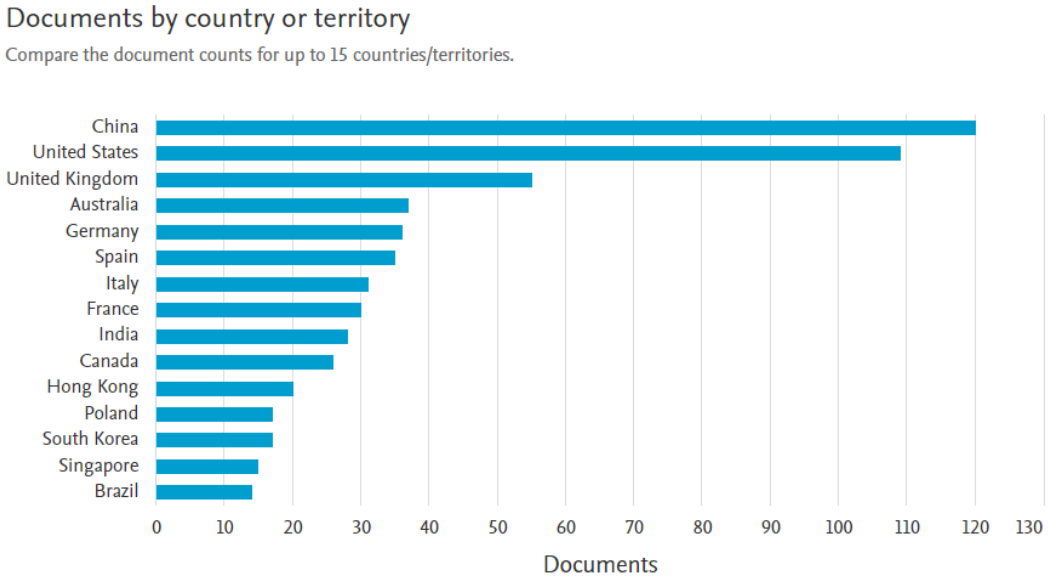


Figure 4: Segmentation of the articles dealing with KM and AI according to authors' countries

The top five keywords provided to the 572 articles in the last decade are “knowledge management” (n=494), “artificial intelligence” (n=407), “learning systems” (n=113), “machine learning” (n=94), and “decision making” (n=83) (see **Figure 5**). Not considering the two initial all-encompassing words (KM and AI), the first in the rank that directly refers to the typical KM keywords is “knowledge transfer”, only in the ninth place. In addition, few KM-related terms appear in the list. In general, based on the keyword analysis, it may be said that the majority of articles tend to adopt more of a technical perspective.

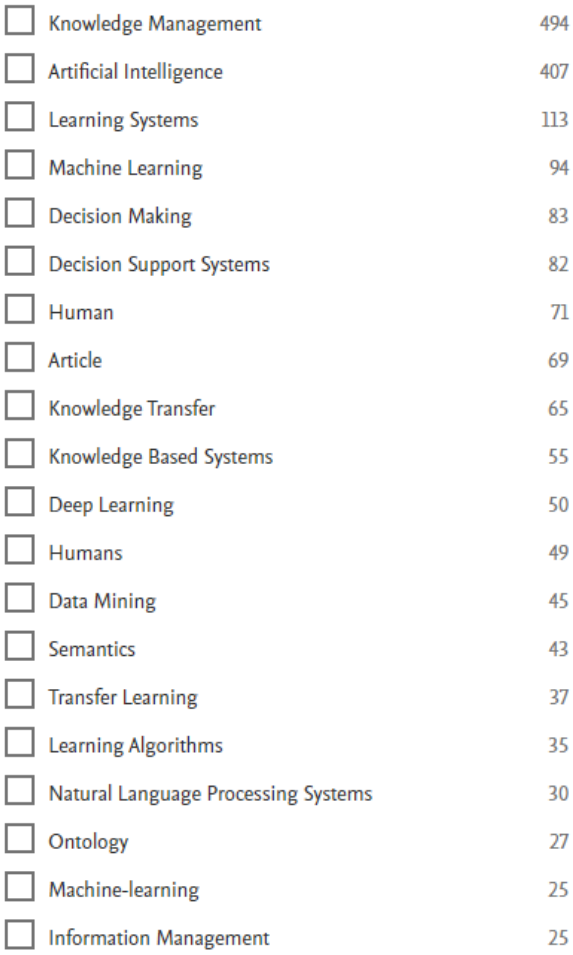


Figure 5: Segmentation of the articles dealing with KM and AI according to keywords

3.2 Textual Analysis: SLR Outcomes of Previous Works Discussing the Interplay Between KM and AI

In this section, we illustrate a classificatory analysis of key papers analyzed, to delineate the predominant perspectives at the intersection of AI and KM. This makes it possible to draw a picture of the state-of-the-art of literature on the selected topic and detect the current research directions.

3.2.1 Knowledge as an Interweaving Factor

The core concept of "knowledge" is the main linkage between the two fields of study, as can be expected. Considering that both are multidisciplinary in nature and intensively bound to knowledge, KM and AI are intuitively linked (Bencsik 2021; Cantu-Ortiz 2021; Jarrahi et al. 2023; Taherdoost and Madanchian 2023; Zbuchea et al. 2019). KM provides a conceptual platform for a better understanding of knowledge, while the second gives machines the ability to learn, create and use knowledge (Mohammad et al. 2022; Pai et al. 2022). Given that, since the revolutionary development of AI, humans are no longer seen as the sole source of knowledge in organizations (AlGhanem et al. 2022).

To enhance business competitiveness and organizational effectiveness, many companies still look for ways to improve their KM practices (Al Mansoori et al. 2020). The novelty is that AI is being presented as a key building block for the development of "advanced" KM (Kai and Yingxin 2022). Furthermore, it has been characterized as changing the way knowledge is handled (Taherdoost and Madanchian 2023). Various AI technologies, such as robotics, computer vision, and voice recognition, have a high potential to fertilize organizational KM (Cantu-Ortiz 2021). Their abilities may contribute to raising KM to the next level (Al Mansoori et al. 2020).

3.2.2 The Potential of AI to Improve KMPs

KMPs are one of the constitutional elements of the KM field. Although there are variations, four key KMPs can be identified in the literature: acquisition, documentation, sharing, and application of knowledge (Lei and Wang 2020; Scarso and Bolisani 2023). Previous studies examined how knowledge flow processes affect AI systems (AlGhanem et al. 2020). However, a minority of researchers have explored the inverse correlation in-depth. In a survey conducted in Italy with 120 senior executives, it was found that AI adoption has positive effects on the effectiveness of KMPs in manufacturing firms (Leoni et al. 2022). In a qualitative study conducted with 10 managers in the UK construction industry, the researchers concluded that AI technologies can be built and used to assist KMPs that businesses have already implemented (Jallow et al. 2020).

Thanks to the capabilities of AI to create new knowledge, integrate existing knowledge, determine relationships between contents, help in the search, and distribute knowledge to users, modern organizations can rely on AI mechanisms to enhance KMPs (Alghanemi and Al Mubarak 2022; Al Mansoori et al. 2020; Kovačić et al. 2022; Lei and Wang 2020; Leoni et al. 2022; Mohammad et al. 2022; Zhou 2022). A special case is the conversion of tacit to explicit knowledge. It has long been appreciated that smart technologies might close the gap between codification and collaboration (Sanzogni et al. 2017). Considering that the vast majority of a firm's intellectual assets is knowledge in the minds of employees (Nemati et al. 2002), the implementation of AI may provide new ways of knowledge sharing (Gurian et al. 2023).

3.2.3 Smart Systems for KM

A knowledge management system (KMS) is a platform for implementing KM (Zhou 2022), which includes a combination of information technologies to capture, organize, transfer, and distribute knowledge (Al Mansoori et al. 2020). KMSs are designed to support intra-organizational business processes based on KM. Their recent progress based on AI is of great interest, particularly the application of human-simulate cognitive computing capabilities (Nakash and Bouhnik 2022). The accelerated pace of technological progress dictates organizational practices to introduce these advanced contemporary technologies (Bencsik 2021). Applications such as user profile identification, pattern matching, and sentiment analysis have received high attention given the automation of KM practices (Al Mansoori et al. 2020).

One of the main goals of KM policies is to make corporate knowledge more available and accessible to employees. Therefore, businesses struggle to adopt efficient KMSs (Taherdoost and Madanchian, 2023). The AI-oriented KMS adds additional features to the traditional KMS approaches (Sundaresan and Zhang 2022). Based on the premise that AI can allow quick access to relevant and high-quality knowledge (Jallow et al. 2020; Pai et al. 2022), thereby supporting informed decision-making (Bencsik 2021), intelligent virtual agents are being proposed as support in search and retrieval of knowledge from KMS (Liebowitz 2001; Malik et al. 2023).

3.2.4 Adoption of AI in Terms of KM

AI includes a lot of different applications, ranging from expert systems to virtual reality (VR), from natural language processing (NLP) to visual recognition (Cantu-Ortiz 2021; Jackson 2019). However, it is the recent appearance of powerful generative AI tools that is leading to a new potentially disruptive era of organizational KM (Alavi et al. 2024). Gen-AI applications, built on LLMs, are becoming common in the daily activities of many people (Makridakis et al. 2023), although the real scope and usefulness of their adoption in the business environment have not yet been clarified (Mishra and Pani 2021; Zbuchea et al. 2019). AI can play a meaningful role in enriching and strengthening KMSs: these can be significantly enhanced with AI technologies (Vadari and Desik 2021) and thus facilitate knowledge work (Sundaresan and Zhang 2022).

There are, however, several criticalities. First, knowledge workers' perception of intelligent robots as a real occupational threat to their career path can lead to efforts of “knowledge hiding” by employees who can be afraid of sharing their precious knowledge (Arias-Pérez and Vélez-Jaramillo 2022). In addition, although the burgeoning transformation in this field hints at an immense opportunity for firms, there is still a lack of understanding of how to appropriate business value from the nascent technology – which explains the existing gap between potential and actual AI adoption (Mishra and Pani 2021). More specifically, the strengthening of AI for KM in organizations is relatively limited. AI algorithms are considered slow in their approach to providing KM support in industries. Furthermore, it has been recognized that AI-based technology alone does not necessarily solve the KM problems of companies (Pai et al. 2022).

4. Critical Issues and Future Directions

The bibliometric analysis and the findings of the SLR indicate that AI in the context of KM is a developing field of research. However, there is still a real need for joint and converging research work in both fields (Cantu-Ortiz 2021; Malik et al. 2023; Sanzogni et al. 2017). In fact, the comprehensive landscape review exposed critical blind spots in the meeting between KM and AI. By mapping the scholarly discourse, this paper identifies overlooked yet important directions ripe for future investigation. Based on the results, we outline below some high-potential avenues to spark progress in follow-up studies.

First, very few empirical studies have been conducted to date to deepen the understanding of the potential symbiosis between KM and AI. Specifically, the SLR shows that most works in these fields were mainly theoretical (e.g., Al Mansoori et al. 2020; Bencsik 2021). One gets the impression that even when empirical research has been done, it has a narrow perspective limited to specific industries (Jallow et al. 2020; Leoni et al. 2022; Renukappa et al. 2020). Furthermore, the usage of AI capabilities for KM tasks has only been examined in outdated reviews (Birzniece 2011). KM research on AI is required to keep pace with digital transformation. Integrating AI into KM strategies may improve business performance and support value creation, but researchers need to empirically explore this fruitful area using quantitative, qualitative, or mixed methods to enhance understanding of the KM-AI nexus.

Second, despite AI's clear potential for positive organizational change, little research examines how it can be practically linked to KM (Renukappa et al. 2020). While studies have analyzed how KMPs can affect AI systems (AlGhanem et al. 2020), the opposite relationship remains unexplored. A minority of works have highlighted AI's de facto impacts on organizational KM (Al Mansoori et al. 2020), even as its technologies are recognized to promote KM practices (Jallow et al. 2020). Mohammad et al. (2022) highlighted the need for research clarifying the connections between KM and AI techniques. Specifically, the literature lacks professional recommendations outlining supportive AI approaches (Bencsik 2021). Empirical research is needed to illustrate how AI can benefit the specific core KMPs which, being different in nature, can require different AI tools and approaches. Integrating AI with KMPs involves strategic themes like knowledge use, learning organizations, value generation from knowledge, and business process changes.

Third, while technology presents opportunities, it also poses considerable challenges (Makridakis et al. 2023; Malik et al. 2023; Mishra and Pani 2021; Nakash and Bouhnik 2022). There are still limitations to the application of AI to KM (Al Mansoori et al. 2020). Insufficient AI adoption can hinder organizational progress in an increasingly digitized world (Pai et al. 2022). As AI is expected to soon support KM across sectors (Taherdoost and Madanchian 2023), research on its usage scope is needed to benefit KM in diverse industries. Barriers like resource constraints, inadequate infrastructure, resistance to automation, and change difficulties can impede emerging technology adoption. Although AI would clearly benefit KM (Zhou 2022), it is vital to investigate hindrances from human, cultural, technological, financial, ethical, and regulatory perspectives.

5. Conclusion

We recognize the potential for bias inherent in our literature selection strategy for the bibliometric analysis and SLR. However, this paper, which represents a preliminary analysis on the topic, makes new contributions by mapping the scholarly landscape relating to the integration of KM and AI. We outlined the current and potential AI contributions to organizational KM to highlight the most promising research areas. Since AI disruptions in KM remain largely unexplored in corporate settings, some potentially fruitful future research directions emerge, which we have elaborated on in detail within this paper.

Especially, there is a need for empirical studies that deepen our understanding of AI benefits for KMPs in the real life of companies, as well as the challenges and implementation barriers. Gaining valuable insights into these areas is vital for designing AI technologies that facilitate, support, and promote organizational KM excellence. Building on this foundation, this article distinguishes itself from previous literature reviews by providing not only a pioneering synthesis of the integration of KM and AI, but also offering an updated and forward-looking perspective that serves as a beacon for subsequent empirical investigations.

References

Abrizah, A., Zainab, A.N., Kiran, K. and Raj, R.G. (2013) "LIS journals scientific impact and subject categorization: a comparison between Web of Science and Scopus", *Scientometrics*, Vol 94, pp 721-740.

Al Mansoori, S., Salloum, S. A. and Shaalan, K. (2020) "The impact of artificial intelligence and information technologies on the efficiency of knowledge management at modern organizations: a systematic review", *Recent advances in intelligent systems and smart applications*, pp 163-182.

Alavi, M., Leidner, D.E. and Mousavi, R. (2024) "A Knowledge Management Perspective of Generative Artificial Intelligence", *Journal of the Association for Information Systems*, Vol 25 No.1, pp 1-12.

AlGhanem, H., Shanaa, M., Salloum, S. and Shaalan, K. (2020) "The role of KM in enhancing AI algorithms and systems", *Adv. Sci. Technol. Eng. Syst. J*, Vol 5 No.4, pp 388-396.

Alghanemi, J. and Al Mubarak, M. (2022) "The Role of Artificial Intelligence in Knowledge Management", In *Future of Organizations and Work After the 4th Industrial Revolution: The Role of Artificial Intelligence, Big Data, Automation, and Robotics* (pp 359-373), Cham: Springer International Publishing.

Arias-Pérez, J. and Vélez-Jaramillo, J. (2022) "Understanding knowledge hiding under technological turbulence caused by artificial intelligence and robotics", *Journal of Knowledge Management*, Vol 26 No.6, pp 1476-1491.

Bencsik, A. (2021) "The sixth generation of knowledge management–the headway of artificial intelligence", *Journal of International Studies*, Vol 14 No.2, pp 84-101.

Bolisani, E. and Bratianu, C. (2018) "Knowledge and strategy formulation in a turbulent world", in: *Emergent Knboliowledge Strategies: Strategic thinking in knowledge management,* pp 117-145, Springer, Cham.

Bolisani, E., Scarso, E. and Kassaneh, T.C. (2023) "The Pervasive Identity of Knowledge Management: Consolidation or Dilution?", In *The Future of Knowledge Management: Reflections from the 10th Anniversary of the International Association of Knowledge Management (IAKM)* (pp 23-45), Cham: Springer Nature Switzerland.

Bolisani, E., Scarso, E. and Giuman, L. (2016) "Knowledge management in client–supplier relationship: emergent vs deliberate approach in small KIBS", *Knowledge Management Research & Practice,* Vol 14 No.2, pp 178-185.

Birzniece, I. (2011) "Artificial intelligence in knowledge management: Overview and trends", *Computer Science (1407-7493)*, Vol 46.

Cantu-Ortiz, F.J. (2021) "Knowledge management and artificial intelligence analytics: A bibliometric study of research trends", *A Research Agenda for Knowledge Management and Analytics; Edward Elgar Publishing: Cheltenham, UK*, pp 67-88.

Denyer, D. and Tranfield, D. (2009) "Producing a systematic review", In Buchanan, D.A. and Bryman, A. (Eds), The SAGE Handbook of Organizational Research Methods, SAGE Publications Ltd, London, pp 671-689.

Edwards, J. and Lönnqvist, A. (2023) "The future of knowledge management: an agenda for research and practice", *Knowledge Management Research & Practice*, Vol 21 No.5, pp 909-916.

Gurian, G., Bolisani, E. and Kirchner, K. (2023) "Virtual Reality for Supporting Knowledge Sharing: An Exercise of Technology Assessment", In *European Conference on Knowledge Management*, Vol 24, No.1, pp 477-485.

Jackson, P.C. (2019) *"Introduction to artificial intelligence",* Courier Dover Publications.

Jallow, H., Renukappa, S. and Suresh, S. (2020) "Knowledge management and artificial intelligence (AI)", In *ECKM 2020 21st European Conference on Knowledge Management* (p.363), Academic Conferences International Limited.

Jarrahi, M.H., Askay, D., Eshraghi, A. and Smith, P. (2023) "Artificial intelligence and knowledge management: A partnership between human and AI", *Business Horizons*, Vol 66 No.1, pp 87-99.

Kai, G. and Yingxin, M. (2022) "Knowledge Management (KM) and Artificial Intelligence (AI): Future Trends Towards an Integration Between KM and AI", *Global Social Science and Humanities Journal*, Vol 1 No.1, pp 10-15.

Kovačić, M., Mutavdžija, M., Buntak, K. and Pus, I. (2022) "Using artificial intelligence for creating and managing organizational knowledge", *Tehnički vjesnik*, Vol 29 No.4, pp 1413-1418.

Lei, Z. and Wang, L. (2020) "Construction of organisational system of enterprise knowledge management networking module based on artificial intelligence", *Knowledge Management Research & Practice*, pp 1-13.

Leoni, L., Ardolino, M., El Baz, J., Gueli, G. and Bacchetti, A. (2022) "The mediating role of knowledge management processes in the effective use of artificial intelligence in manufacturing firms", *International Journal of Operations & Production Management*, Vol 42 No.13, pp 411-437.

Liebowitz, J. (2001) "Knowledge management and its link to artificial intelligence", *Expert systems with applications*, Vol 20 No.1, pp 1-6.

Liebowitz, J. (2004) "Will knowledge management work in the government?", *Electronic Government, An International Journal*, Vol 1 No.1, pp 1-7.

Lu, J., Behbood, V., Hao, P., Zuo, H., Xue, S. and Zhang, G. (2015) "Transfer learning using computational intelligence: A survey", *Knowledge-Based Systems*, Vol 80, pp 14-23.

Makridakis, S., Petropoulos, F. and Kang, Y. (2023) "Large language models: Their success and impact", *Forecasting*, Vol 5 No.3, pp 536-549.

Malik, T., Dwivedi, Y., Kshetri, N., Hughes, L., Slade, E. L., Jeyaraj, A., ... and Wright, R. (2023) "'So what if ChatGPT wrote it?' Multidisciplinary perspectives on opportunities, challenges and implications of generative conversational AI for research, practice and policy", *International Journal of Information Management*, Vol 71, 102642.

Meho, L. I. and Yang, K. (2007) "Impact of data sources on citation counts and rankings of LIS faculty: Web of Science versus Scopus and Google Scholar", *Journal of the american society for information science and technology*, Vol 58 No.13, pp 2105-2125.

Mishra, A. N. and Pani, A. K. (2021) "Business value appropriation roadmap for artificial intelligence", *VINE Journal of Information and Knowledge Management Systems*, Vol 51 No.3, pp 353-368.

Mohammad, A., Zahrawi, M., Al-Emran, M. and Shaalan, K. (2022) "A Systematic Review on the Relationship Between Artificial Intelligence Techniques and Knowledge Management Processes", *Recent Innovations in Artificial Intelligence and Smart Applications*, pp 67-83.

Nakash, M. and Bouhnik, D. (2021) "'Knowledge management is not dead. It has changed its appearance. And it will continue to change'", *Knowledge and Process Management*, Vol 28 No.1, pp 29-39.

Nakash, M. and Bouhnik, D. (2022) "'A system that will do magic': organizational perspective on the technological layer in knowledge management", *Aslib Journal of Information Management*, Vol 74 No.6, pp 1089-1102.

Nemati, H.R., Steiger, D.M., Iyer, L.S. and Herschel, R.T. (2002) "Knowledge warehouse: an architectural integration of knowledge management, decision support, artificial intelligence and data warehousing", *Decision Support Systems*, Vol 33 No.2, pp 143-161.

O'Leary, D.E. (1998) "Using AI in knowledge management: Knowledge bases and ontologies", *IEEE Intelligent Systems and Their Applications*, Vol 13 No.3, pp 34-39.

Pai, R.Y., Shetty, A., Shetty, A.D., Bhandary, R., Shetty, J., Nayak, S., ... and D'souza, K.J. (2022) "Integrating artificial intelligence for knowledge management systems–synergy among people and technology: A systematic review of the evidence", *Economic research-Ekonomska istraživanja*, Vol 35 No.1, pp 7043-7065.

Renukappa, S., Suresh, S. and Jallow, H. (2020) "Knowledge management and artificial intelligence (AI)", Academic Conferences and Publishing International Ltd.

Sanzogni, L., Guzman, G. and Busch, P. (2017) "Artificial intelligence and knowledge management: questioning the tacit dimension", *Prometheus*, Vol 35 No.1, pp 37-56.

Scarso, E. and Bolisani, E. (2023) "Knowledge management processes and innovation phases: insights from metalworking SMEs", *Knowledge Management Research & Practice*, pp 1-11.

Sundaresan, S. and Zhang, Z. (2022) "AI-enabled knowledge sharing and learning: redesigning roles and processes", *International journal of organizational analysis*, Vol 30 No.4, pp 983-999.

Taherdoost, H. and Madanchian, M. (2023) "Artificial Intelligence and Knowledge Management: Impacts, Benefits, and Implementation", *Computers*, Vol 12 No.4, p. 72.

Vadari, S. and Desik, P. A. (2021) "The role of AI/ML in enhancing knowledge management systems", *IUP Journal of Knowledge Management*, Vol 19 No.2, pp 7-31.

Yigitcanlar, T., Desouza, K.C., Butler, L. and Roozkhosh, F. (2020) "Contributions and risks of artificial intelligence (AI) in building smarter cities: Insights from a systematic review of the literature", *Energies*, Vol 13 No.6, p. 1473.

Zbuchea, A., Vidu, C. and Pinzaru, F. (2019) "Is Artificial Intelligence Changing Knowledge Management", *Strategica*, pp 445-452.

Zhou, H. (2022) "A study of technical support for artificial intelligence systems applied to knowledge management systems", In *2022 IEEE 2nd International Conference on Power, Electronics and Computer Applications (ICPECA)* (pp 921-924). IEEE.

Innovation in Food Processing Supply Chains: The Role of Social, and Cognitive Capital Development

Hung Nguyen[1], George Onofrei[2] and Ying Yang[3]
[1]RMIT University, The Business School, Hanoi, Vietnam
[2]Atlantic Technological University: Letterkenny, IE Ireland
[3]Newcastle University Business School, Newcastle upon Tyne, UK

Hung.nguyen@rmit.edu.vn
george.onofrei@atu.ie
Ying.Yang2@Newcastle.ac.uk

Abstract: In supply chains, social attributes, such as trust, and commitment, are key drivers of efficiency performance. In the agriculture industry in developing countries like Vietnam, social capital may have a greater role when other formal systems are not in place. This study empirically tests the mediating role of supply chain absorptive capability as a complementary asset to leverage social, and cognitive capital to enhance innovation performance. This research examined small food producers using a standard questionnaire and captured 85 responses in Vietnam. The findings showed that social capital plays a more significant role in enhancing absorptive capability, highlighting the need for a structural resource network in developing regions. Food processing firms benefit from the direct and indirect influence of absorptive capability. Absorptive capability acts as a catalyst in enhancing cognitive, and social capital for improving innovation outcomes, such as new product development. The food producers should not just stop at sharing and capturing information, but move forward to deploy new ideas and learned knowledge. The results urge agricultural businesses to establish networks with supply chain partners, who can significantly impact the development of new ideas, and quickly exploit new knowledge to accommodate resources for sustainable agricultural strategies.

Keywords: Knowledge Management, Supply Chain Management, Innovation

1. Introduction

Organizations compete based on the capabilities they can accumulate across their supply chains. Although firms face resource scares, and knowledge deficits (Tunisini, Harrison, & Bocconcelli, 2023), however, some outperform others due to their abilities to absorb, transform, and apply external partners' knowledge in supply chains (Horvat, Dreher, & Som, 2019; Malhotra, Gosain, & Sawy, 2005). In operations, and strategic management research, efforts to understand the relationships between these performance improvements have typically focused on firm-based, and industry-based research. Due to the unpredictable and turbulent business environment, the dynamic of supply chain knowledge depends on the linkages between the knowledge network, and synchronization among members (Arenas, Díaz-Guilera, Kurths, Moreno, & Zhou, 2008; Simatupang, Wright, & Sridharan, 2002). This study argues that the interrelationship between social, and cognitive capital, and a firm's absorptive capability can leverage external knowledge from suppliers, and customers to enhance competitive advantage and innovation performance. It can serve as an alternative explanation that may inform an enhanced understanding of the dynamic of this phenomenon.

Social capital is captured from the goodwill that exists between SC partners highlighting trust, cooperation, friendship, respect, and reciprocity in interactions. Effective networking allows firms to build high-quality ties that enable the transfer of knowledge (Horvat et al., 2019), the building of new knowledge, and faster, and more comprehensive learning (Loermans, 2002). Cognitive capital represents alignments among organizational actors about business visions and shared cultural values (Tsai & Ghoshal, 1998). Literature suggests that cognitive capital can be developed when supply chain partners share a common understanding of business norms, and technical terminologies, align business visions, and conduct joint workshops to identify issues, and opportunities (De Carolis & Saparito, 2006).

This study posits that absorptive capability (APC) mediates the relationship between social and cognitive capital and performance based on congruence theory. The concept of the APC is an emergent dynamic capability that facilitates better capturing, disseminating, and utilizing external knowledge to support their operations and sustain firms' competitiveness. Supply chain absorptive capability refers to abilities to capture, disseminate, and apply knowledge of markets and know-how from supply chain partners, to apply in enhancing final product quality and reducing costs (Ramanathan & Gunasekaran, 2014).

According to the congruence theory, cognitive capital derived from supply chain collaborative efforts can enhance tangible social-economic satisfaction when supply chain partners align, and achieve common

objectives, culture, and business practices. Organizational goal congruence facilitates knowledge-sharing practices that mitigate opportunistic behaviors among supply chain partners (Dyer & Singh, 1998), thus leading to more collaboration. In this sense, goal congruence is a useful supply chain coordinating mechanism that leads to superior outcomes (Roh, Min, & Hong, 2011).

Vietnam's agricultural industry is less structured, characterized by high transaction costs, and poor public, and private institutions (Ba, de Mey, Thoron, & Demont, 2019). Social capital can emerge from a network of cooperatives and unstructured traders. The agricultural industry in Vietnam plays a fundamental role in the country's economic growth, contributing 13 percent of GDP, and 29 percent of employment in 2021 (Van Huong et al., 2021). Vietnam's policies are highly appreciated in motivating to promote potentials, and advantages of the agricultural sector, which turns Vietnam from a recipient of food aid to a food exporting country. Agri-food in Vietnam includes mainly SMEs, who act as elements of cohesion in agricultural processes in which the activity is carried out. The agri-food supply chains serve international, and local markets through innovation and the management of multiple value chains. Vietnamese consumer needs are not limited to food safety, and quality, but increasingly include innovation, sustainability, competitive pricing, and value for money.

This current study addresses the above, in the Vietnamese agricultural context, by examining relationships between social, and cognitive capital, and firms' absorptive capability, and its impacts on performance. While literature indicated that social capital can bring the focal company long-term benefits (De Carolis & Saparito, 2006; Phadnis, 2024), others assert that supply chain managers must examine the stage of development, and identify facilitating factors in designing their supply chain operations. This study investigates the following questions:

- To what extent do social, and cognitive capitals affect the supply chain's absorptive capability?
- How do these knowledge dimensions, and supply chain absorptive capability impact innovation performances?

This study provides a better understanding of how knowledge from supply chain partners in the agricultural context (e.g. farmers, and cooperatives) contributes to absorptive capability and innovation performance. For operations managers, this empirical study highlights the importance of leveraging suppliers', and customers' knowledge in enhancing innovation development, and performance. A comprehensive picture of facilitating factors associated with supply chain absorptive capability can help smaller food producers allocate resources to enhance innovation performance, thus staying competitive. Furthermore, by investigating the APC and social networks in an emerging agricultural context, this study shed different views on research and practice areas.

Theoretical background, and research hypotheses

The paper introduces the theoretical background, highlighting the mediating role of supply chain absorptive capability and social capital knowledge literature.

1.1 Absorptive Capability - APC

A firm's absorptive capability refers to abilities to recognize and obtain external knowledge (Aboelmaged & Hashem, 2019; Kurniawan, Hartati, Qodriah, & Badawi, 2020). From an economic stand, a firm can recognize the value of new, external information, assimilate it, and effectively apply it for commercial purposes (Cohen & Levinthal, 1990). Literature is divided into four basic building blocks: acquisition, assimilation, transformation, and exploitation. In a supply chain context, partners find and exchange knowledge from the internal, and external environment, such as their customers, and suppliers. Furthermore, accessing novel information about markets, and products/services encourages the organization to be involved more in supply chain collaboration, and partnerships, thus creating further knowledge (Ramanathan & Gunasekaran, 2014). In the context of agricultural supply chains, farmers often add complementary knowledge about materials, and processes that can be combined with the buyer´s knowledge for further processing foods.

When agri-food firms combine farmers' knowledge, and their expertise as a strategic resource, the nature of internal combination makes these resources a "hidden" competitive advantage that cannot be easily imitated. APC measures knowledge acquisition, assimilation, transformation, and knowledge exploitation (Jiménez-Barrionuevo, García-Morales, & Molina, 2011). This is particularly important when farmers use specialized or unique resources. The social capital created among farmers, and buying firms (food processors) represents collaborative activities and can transform, and implement new ideas, thus enhancing absorptive capability (Ye & Kankanhalli, 2013), and innovation performance. In the environmental context, famer usage of sustainable materials can be an innovative idea. Supply chain partners, like food producers, can utilize the farmers'

specialized know-how in such green projects to remodify their existing processes, leading to better innovation measures, such as frequencies of new products, reduced time to market, etc. Thus, this study proposes that:

Hypothesis H1. A supply chain absorptive capability has a positive influence on innovation performance.

1.2 Social Capital and Innovation Performance

Social capital theory suggests that an organization can generate benefits from the knowledge captured within an organizational network (Tsai & Ghoshal, 1998). Operations management literature contends that social capital among different partners in a supply chain represents stages and levels of capturing, dissemination, and using of such creative ideas as knowledge, and information. Social capital can emerge between customers and product designers. Firms nowadays pay attention to understanding customer experiences, perceptions, demands, expectations, and preferences (namely, customer knowledge) that can be effectively leveraged by R&D teams to enhance innovation performance. Customer insights have been a critical factor for many industries to keep up the trends, and meet dynamic customer needs. Customer insights enable Zara to replenish products rapidly driven by customer demand and also offer frequent assortment rotation of products within 2 weeks of fulfillment (Aftab, Yuanjian, Kabir, & Barua, 2018). In 2015, timely knowledge created from the network with customers innovated Zara's pink scarves. 500,000 pink scarves were dispatched, and sold within 7 days later, in more than 2,000 Zara stores globally (Roll, 2020). The social capital created by collocated designers, and other members of the supply chain like the buying team, merchandising team, pattern-makers, and suppliers enhances lead time and responsiveness. This capital is from co-locating them to enable cross-functionality, and high coordination, increase product knowledge, and streamline the product design decision-making process. The team can use standard frameworks, and process mapping which can quickly be communicated across the supply chain (Phadnis, 2024; Roll, 2020). These capabilities, in return, disseminate the newly obtained knowledge and provide opportunities for creating innovative processes resulting in future market share, and revenues. Accordingly, this study proposes that:

Hypothesis 2. A manufacturer's social capital has a positive effect on innovation performance.

1.3 Cognitive Capital and Innovation Performance

Cognitive capital emerges when supply chain partners align their visions, and develop shared cultural values. Congruency refers to "the degree to which the needs, demands, goals, objectives, and/or structure of one component are consistent with the demands, goals, objectives, and/or structure of another component" (Nadler & Tushman, 1980). Without a common understanding between these partners (e.g. quality, and technological concepts), or lack of business vision, and top management support. Toyota shares technological understanding with suppliers to enhance supply chain quality. When the company discovered that some suppliers did not understand its technological innovations, they quickly shared an information system to give the supplier access to necessary knowledge of Toyota's process. This shared understanding enabled Toyota and the supplier to collectively improve the process, thus enhancing performance and creating benefits for the supplier. It also allowed the supplier to become a valued knowledge partner of Toyota, rather than merely operating as a low-cost vendor (Dyer, 1996).

After COVID-19, farmers continue to command the deepest trust, driven by expertise, and demonstrating shared values around caring for the planet. A green, and sustainable environment can be the shared value, and visions that have deepened consumer trust in the food supply chain – retailers and food service operators have been the key beneficiaries (Berti & Mulligan, 2016). Ensuring sustainable food production systems, and implementing resilient agricultural practices become important drive plans for many actors in the agri-food supply chains. Collaboration in this sphere enhances mutual understanding, a shared vision of green, and safety in food production systems. Cognitive capital plays an important role in enhancing production and maintaining ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding, and other disasters, and that progressively improve land and soil quality.

Furthermore, farmer's knowledge could facilitate the process of sensing the new niche market. Through its understanding of the product's nature and local niche market, thus creates new markets. Cognitive social capital is created when farmers and food producers share their understanding of the new product and new materials. This connection can emerge some collaborative ideas on new markets and potential demands, which directly influence performance such as market share. Therefore, this study proposes that:

Hypothesis 3. A supply chain cognitive capability exerts a direct positive effect on innovation performance.

1.4 Mediating Roles of Absorptive Capability (APC) Between Social, and Cognitive Capital, and Performance

The role of social, and cognitive capital, and knowledge created have been discussed in the above sections concerning innovation performance. Previous sections discuss the influences of social and cognitive capital on performances. This study suggests that the influence of newly created capital on innovation performance can be even greater when organizations enhance their absorptive capabilities. APC indicates the degrees or levels of implementation, and exploitation of new knowledge, and organizational resources. The accumulated knowledge from social networks and alignments with supply chain partners enhances organizations' ability to design more efficient and innovative products, and processes that contribute to improving quality, flexibility, and delivery, and reducing cost (Cousins, 2005; Ketchen Jr & Hult, 2007).

The APC could be a possible means to strengthen the relationship because the buying firm benefits from Absorptive capability such as quality improvements. With social capital gains from customer insights, Zara enhanced supply chain integration to support 2-week innovation delivery (Aftab et al., 2018). The intensive communication and joint workshops between designers and operations improve the quality of the final products. Literature shows that social capital creates pressures that can eventually enhance supply chain quality through better integration and more collaborations (Chu, Yang, Lee, & Park, 2017; Quibria, 2003). Cognitive capital gained from aligning corporate strategies and business cultures enhanced VW's supplier quality significantly in Brazil's automobile industry (Marx, Zilbovicius, & Sergio Salerno, 1997; Nguyen, Onofrei, & Truong, 2020).

Food producers often handle customers' innovative feedback, and suggestions to keep updated with the market trends. This capital and knowledge created will likely guarantee customer acceptance and market fit (Mansor, Yahaya, & Okazaki, 2016; Tarhini, El-Masri, Ali, & Serrano, 2016). On the other hand, customers who have been consulted and engaged in the designing and production stages can directly benefit from new or improved products or services, thus continuing the collaboration, and knowledge sharing. APC facilitates innovation and provides linkages to customers' and suppliers' knowledge, which will further influence the process and product innovation stages; thus enhancing quality improvements, and cost reductions on the buying firm's side (Malhotra et al., 2005; Saenz, Revilla, & Knoppen, 2014). Therefore, this study proposes the following hypothesis:

Hypothesis 4a,b. APC mediates the positive relationship between social (a), and cognitive (b) capital, and innovation performances

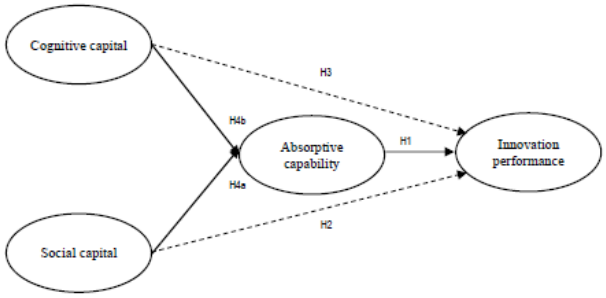


Figure 1: Research model

2. Research Methodology and Analyses

2.1 Research Design

This study employed a survey among food producers in Northern Vietnam. The original survey was in English, translated to Vietnamese using back-translation to ensure consistent use of the scales. Several changes have been adjusted to reflect better local practices after pilots with local experts in the Vietnamese Food Science and Technology Association. Table 1 indicates company profiles and characteristics. The questionnaire was sent via email to the members of the association and got 85 completed, and useable responses. The majority of the

samples were small, and medium-sized companies (90%). Firms included in the survey were mainly local (without foreign direct investment, FDI) and heavily import-oriented for their equipment and materials. These firms came from seven major agricultural products such as vegetables, fruits, cassava, meat, etc.

Table 1: Survey respondent profiles and characteristics

Industry	Frequency	Percent	**Size**	Frequency	Percent
Rice	5	5.9	Large	9	10.6
Vegetables and fruits of cultivation products	22	25.9	Medium	22	25.9
Meat and meat products	6	7.1	Small	54	63.5
Seafood and processed products	4	4.7	**Export Orientation**	85	100.0
Agricultural products (cassava, tea, cashew, coffee)	13	15.3	FullyExport	5	5.9
Drinks (juice, bottled water)	2	2.4	LittleExport	19	22.4
Sweet and candy	4	4.7	Local	41	48.2
Other processed foods	29	34.1	Significant	20	23.5
Foreign Direct Investment - FDI	85	100.0	**Import Orientation**	85	100.0
Dominant_FDI	2	2.4	FullyImport	5	5.9
Full_FDI	9	10.6	LittleImport	23	27.1
Local	67	78.8	Local	39	45.9
Small_FDI	7	8.2	SignificantImport	18	21.2
Total	85	100.0	Total	85	100.0

2.2 Research Constructs Development

Table 2 provides research constructs, questionnaire items, and their statistics. Supply chain absorptive capability includes questions related to the capability of obtaining, acquiring, and applying new knowledge (Cao & Zhang, 2011). Social and cognitive capital constructs were derived from existing literature (De Carolis & Saparito, 2006; Menor, Kristal, & Rosenzweig, 2007). Cognitive capital reflects firms' ability to share common language and codes; developing a common understanding of the same concepts such as quality, and delivery (Menor et al., 2007). Innovation performance was measured based on the number, frequency, and market share of new products (Chen, Lin, & Chang, 2009; Sadikoglu & Zehir, 2010).

This study employed several methods to check the reliability, validity, and consistency of the model. Cronbach's alphas indicated good results [0.82-0.89], which were above 0.60, the threshold value (Hair, Black, Babin, & Anderson, 2010). The confirmatory factor analysis indicated four unique constructs with good model fit indices ($\chi 2/df$ =1.46) and a moderate fit with RMSEA = 0.075. The CFA indicates in Table 3 acceptable discriminant validity.

Table 2: Constructs means, and reliability measures

Research construct measurements	**Estimate**	**Means**	**SD**
Coginitive capital - This organization and its partners have ...			
common understanding about what activities are best for our relationship.	0.680	4.81	1.19
shared objectives and visions.	0.758	4.60	1.16
share common language and codes (e.g. special vocabulary, abbreviation, and technical terms).	0.806	4.86	1.11
common understanding about the same concepts (e.g. good, fast, quality and safety).	0.899	5.11	1.24
similar behavioral rules and norms.	0.936	5.05	1.21
Social capital			
Establishing networks with suppliers and customers has had a significant impact on developing new ideas for our organization	0.885	5.36	1.17
I have an informal network among customers, suppliers and competitors	0.813	5.11	1.18
I consider that our future is related to other firms in the area	0.774	5.11	1.21
My organization has received considerable information about products and markets from local institutions	0.639	4.98	1.25
Absorptive capability			
Application of external information to our business contributes to our profitability	0.926	5.41	1.20
We convert external information directly into new business applications to be used on our business	0.991	5.32	1.16
Employees on our business record and store newly acquired knowledge for future reference	0.764	5.42	1.19
Our business regularly considers the consequences of changing market demands in terms of new products and services	0.537	5.42	1.25
Innovation performance			
Frequency of new products introduction.	0.921	4.59	1.17
Speed of introducing new products.	0.978	4.71	1.16
Number of new products.	0.881	4.81	1.17
Percentage of total sales stemming from new products.	0.773	4.76	1.13

Notes: χ2 = 152; df = 110; χ2/df = 1.38; CFI = 0.961; GFI = 0.931; RMSEA = 0.068. Note: SD: Standard Deviation; RMSEA=Root Mean Square Error of Approximation, GFI=Goodness-of-fit Index, CFI=Comparative Fit Index. The scale format for each of these measures was 1=strongly disagree to 7=strongly agree.

Table 3: Correlation matrix, and construct validity measures

Research measurements	CR	AVE	MSV	ASV	[1]	[2]	[3]	[4]
[1] Cognitive capital	0.90	0.70	0.14	0.09	**0.808**			
[2] Social capital	0.89	0.57	0.33	0.11	0.270**	**0.724**		
[3] Absorptive capability	0.88	0.64	0.59	0.18	0.220**	0.244**	**0.783**	
[4] Innovation Perf.	0.87	0.69	0.11	0.03	0.063*	0.068*	0.335**	**0.811**

Note: Diagonal elements in (bold-underlined) are the square root of the average variance extracted (AVE) between the constructs and their measures. Off diagonal elements are correlations between constructs. MSV – Max shared variance, and ASV – Average shared variance. For discriminate validity, AVE should be greater than off-diagonal elements. ** Correlation is significant at 0.001.

2.3 Hypothesis Testing

The model was tested using a structural equation model (SEM) in AMOS software. The sample size is slightly small compared to the rule of thumb around 100 cases for SEM analysis(Wang & Wang, 2012); however, considering the normally distributed data in this study, a ratio of 5 to 10 cases per variable may be sufficient. Besides, all the major indexes such as the Comparative Fit Index (CFI), Root Mean Square Error of Approximation (RMSEA) indicate good model fit, thus the model can be considered valid (Schermelleh-Engel, Moosbrugger, & Müller, 2003; West, Taylor, & Wu, 2012). Table 4 provides the results of the hypotheses among the research constructs. Supply chain absorptive capability has a positive impact on innovation performance measures (H1 accepted). Both social and cognitive capital influenced positively and significantly on APC.

Table 4: Results of the hypothesis testing

Research impacts		Estimate	S.E.	C.R.	P
Cognitive	=> Absorptive	0.306	0.138	2.21	0.027
Social	=> Absorptive	0.562	0.116	4.832	***
Absorptive	=> Innovation Perf	0.324	0.105	3.092	0.002

χ2 = 165.83; df = 113; χ2/df = 1.46; CFI = 0.95; NFI = 0.94; RFI = 0.84; RMSEA = 0.075. Note: S.E = Standard Errors;

P = *** Correlation is significant at 0.001.

2.4 Mediating Roles of APC

The influences of social, and cognitive capital can be directly, and indirectly via APC. This study employs structural equational models with boot-trapping procedures, recommended by (Mallinckrodt, Abraham, Wei, & Russell, 2006) to test for such mediation effects. Bootstrapping can be useful in this case with a relatively small sample size as it does not rely on assumptions of normality (Nevitt & Hancock, 2001). Table 4 provides outcomes of the direct effects with, and without the mediator. The test of the indirect effects between the Cognitive capital → APC → Innovation performances was significant (β = 0.058, p = 0.02). Since both direct and indirect relationships were significant, the mediation is partial. On the other hand, Social capital → APC → Innovation performances were significant (β = 0.205, p = 0.05), and fully mediated.

Table 4: Results of the mediating role of APC

Mediating factor - APC	Direct with mediator	Indirect	Mediation
Cognitive capital and InnPerf	0.215*	0.058*	Partial
Social capital and InnPerf	0.362	0.205*	Full

Note: ** significant at 0.01

2.5 Theoretical and Practical Implication

This research argued that supply chain absorptive capability, and innovation performance in an agricultural context can be influenced differently. Drawing upon the knowledge-based view, this study confirmed that both social and cognitive capital are important sources of developing supply chain absorptive capability. Development of social networks, and exchanging knowledge among supply chain partners may not be not enough for innovation performances. The results from this study show that managers should pay more attention to the application, and exploitation of newly learned knowledge. The accumulated capital created by the collaboration, shared business visions, and technological knowledge among farmers, producers, and customers become important resources for innovation development. In addition, supply chain partners, farmers, traders, and food processors should align their business vision, and goals to facilitate better collaboration, and innovation performance. The empirical results provide support to the argument of the importance of APC in enhancing social, and cognitive capital from supply chain partners to enhance agricultural innovation performance.

These results confirm the previous literature mainly in operations management that social, and cognitive capitals are key components for enhancing absorptive capability, and innovation performance (Ali, Hussin, Haddad, Alkhodary, & Marei, 2021; Aribi & Dupouët, 2015). It provides evidence that absorptive capability further enhances the impacts of social knowledge created by exploitations, and dissemination (Scuotto, Del Giudice, & Carayannis, 2017; Tortoriello, 2015). Recent literature indicates that food security and cleaner food supply chains are the top drivers for innovation in supply chains (Mehmood, Ahmed, Viza, Bogush, & Ayyub, 2021; Sharma, Mangla, Patil, & Liu, 2019). This study contributes to this important area of research by highlighting the mediating role of firm's supply chain absorptive capability in enhancing social and cognitive capital. This concept provides additional aspects of collaborative efforts among supply chain partners in jointly capturing, and applying knowledge in developing new products, and services, and improving processes (Cao & Zhang, 2011; Phadnis, 2024; Ramanathan & Gunasekaran, 2014). These results support previous research on social, and cognitive capital and their associated trust that facilitates higher absorptive capability (Ali et al., 2021; Malhotra et al., 2005). APC plays a significant role as "business intelligence" in connecting the dots and enhancing collaboration through organizational boundaries.

3. Limitations and Future Research

The results of this study are subject to several limitations. First, this study was conducted for small food producers, and cooperatives in Vietnam, thereby it has limited generalizability power. Therefore, it is recommended to explore findings in other types of industry sectors other than the agricultural processing industry.

References

Aboelmaged, M., & Hashem, G. (2019),"Absorptive capacity and green innovation adoption in SMEs: The mediating effects of sustainable organisational capabilities", *Journal of Cleaner Production,* Vol. 220 No., pp. 853-863. doi:10.1016/j.jclepro.2019.02.150

Aftab, M. A., Yuanjian, Q., Kabir, N., & Barua, Z. (2018),"Super responsive supply chain: The case of Spanish fast fashion retailer Inditex-Zara", *International Journal of Business and Management,* Vol. 13 No. 5, pp. 212-227.

Ali, M. A., Hussin, N., Haddad, H., Alkhodary, D., & Marei, A. (2021),"Dynamic capabilities and their impact on intellectual capital and innovation performance", *Sustainability,* Vol. 13 No. 18, pp. 10028.

Arenas, A., Díaz-Guilera, A., Kurths, J., Moreno, Y., & Zhou, C. (2008),"Synchronization in complex networks", *Physics reports,* Vol. 469 No. 3, pp. 93-153.

Aribi, A., & Dupouët, O. (2015),"The role of organizational and social capital in the firm's absorptive capacity", *Journal of Knowledge Management,* Vol. 19 No. 5, pp. 987-1006.

Ba, H. A., de Mey, Y., Thoron, S., & Demont, M. (2019),"Inclusiveness of contract farming along the vertical coordination continuum: Evidence from the Vietnamese rice sector", *Land Use Policy,* Vol. 87 No., pp. 104050.

Berti, G., & Mulligan, C. (2016),"Competitiveness of small farms and innovative food supply chains: The role of food hubs in creating sustainable regional and local food systems", *Sustainability,* Vol. 8 No. 7, pp. 616.

Cao, M., & Zhang, Q. (2011),"Supply chain collaboration: Impact on collaborative advantage and firm performance", *Journal of Operations Management,* Vol. 29 No. 3, pp. 163-180. doi:http://dx.doi.org/10.1016/j.jom.2010.12.008

Chen, Y.-S., Lin, M.-J. J., & Chang, C.-H. (2009),"The positive effects of relationship learning and absorptive capacity on innovation performance and competitive advantage in industrial markets", *Industrial Marketing Management,* Vol. 38 No. 2, pp. 152-158.

Chu, S. H., Yang, H., Lee, M., & Park, S. (2017),"The impact of institutional pressures on green supply chain management and firm performance: Top management roles and social capital", *Sustainability,* Vol. 9 No. 5, pp. 764.

Cohen, W. M., & Levinthal, D. A. (1990),″ Absorptive capacity: A new perspective on learning and innovation″, *Administrative Science Quarterly* No., pp. 128-152.
Cousins, P. D. (2005),″ The alignment of appropriate firm and supply strategies for competitive advantage″, *International Journal of Operations & Production Management,* Vol. 25 No. 5, pp. 403-428.
De Carolis, D. M., & Saparito, P. (2006),″ Social capital, cognition, and entrepreneurial opportunities: A theoretical framework″, *Entrepreneurship Theory and Practice,* Vol. 30 No. 1, pp. 41-56.
Dyer, J. H. (1996),″ Specialized supplier networks as a source of competitive advantage: Evidence from the auto industry″, *Strategic Management Journal,* Vol. 17 No. 4, pp. 271-291.
Dyer, J. H., & Singh, H. (1998),″ The relational view: Cooperative strategy and sources of interorganizational competitive advantage″, *Academy of management review,* Vol. 23 No. 4, pp. 660-679.
Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010), *Multivariate data analysis: A global perspective* (Vol. 7). Upper Saddle River, NJ, USA: Pearson.
Horvat, D., Dreher, C., & Som, O. (2019),″ How firms absorb external knowledge—Modelling and managing the absorptive capacity process″, *International Journal of Innovation Management,* Vol. 23 No. 01, pp. 1950041.
Jiménez-Barrionuevo, M. M., García-Morales, V. J., & Molina, L. M. (2011),″ Validation of an instrument to measure absorptive capacity″, *Technovation,* Vol. 31 No. 5-6, pp. 190-202. doi:10.1016/j.technovation.2010.12.002
Ketchen Jr, D. J., & Hult, G. T. M. (2007),″ Bridging organization theory and supply chain management: The case of best value supply chains″, *Journal of Operations Management,* Vol. 25 No. 2, pp. 573-580.
Kurniawan, P., Hartati, W., Qodriah, S. L., & Badawi, B. (2020),″ From knowledge sharing to quality performance: The role of absorptive capacity, ambidexterity and innovation capability in creative industry″, *Management Science Letters* No., pp. 433-442. doi:10.5267/j.msl.2019.8.027
Loermans, J. (2002),″ Synergizing the learning organization and knowledge management″, *Journal of Knowledge Management,* Vol. 6 No. 3, pp. 285-294.
Malhotra, A., Gosain, S., & Sawy, O. A. E. (2005),″ Absorptive capacity configurations in supply chains: Gearing for partner-enabled market knowledge creation″, *MIS quarterly* No., pp. 145-187.
Mallinckrodt, B., Abraham, W. T., Wei, M., & Russell, D. W. (2006),″ Advances in testing the statistical significance of mediation effects″, *Journal of Counseling Psychology,* Vol. 53 No. 3, pp. 372.
Mansor, N., Yahaya, S. N., & Okazaki, K. (2016),″ Risk factors affecting new product development (NPD) performance in small medium enterprises (SMEs)″, *Int. J. Rev. Appl. Soc. Sci,* Vol. 27 No., pp. 18-25.
Marx, R., Zilbovicius, M., & Sergio Salerno, M. (1997),″ The modular consortium in a new VW truck plant in Brazil: new forms of assembler and supplier relationship″, *Integrated Manufacturing Systems,* Vol. 8 No. 5, pp. 292-298.
Mehmood, A., Ahmed, S., Viza, E., Bogush, A., & Ayyub, R. M. (2021),″ Drivers and barriers towards circular economy in agri-food supply chain: a review″, *Business Strategy & Development,* Vol. 4 No. 4, pp. 465-481.
Menor, L. J., Kristal, M. M., & Rosenzweig, E. D. (2007),″ Examining the influence of operational intellectual capital on capabilities and performance″, *Manufacturing & Service Operations Management,* Vol. 9 No. 4, pp. 559-578.
Nadler, D. A., & Tushman, M. L. (1980),″ A model for diagnosing organizational behavior″, *Organizational Dynamics,* Vol. 9 No. 2, pp. 35-51.
Nevitt, J., & Hancock, G. R. (2001),″ Performance of bootstrapping approaches to model test statistics and parameter standard error estimation in structural equation modeling″, *Structural equation modeling,* Vol. 8 No. 3, pp. 353-377.
Nguyen, H., Onofrei, G., & Truong, D. (2020),″ Supply chain communication and cultural compatibility: performance implications in the global manufacturing industry″, *Business Process Management Journal,* Vol. 27 No. 1, pp. 253-274. doi:10.1108/bpmj-08-2019-0314
Phadnis, S. S. (2024),″ Creating Value Through Supply Chain Orchestration as a Business Model″, *Academy of Management Perspectives,* Vol. 38 No. 1, pp. 1-22.
Quibria, M. G. (2003),″ The puzzle of social capital a critical review″, *Asian Development Review,* Vol. 20 No. 02, pp. 19-39.
Ramanathan, U., & Gunasekaran, A. (2014),″ Supply chain collaboration: Impact of success in long-term partnerships″, *International Journal of Production Economics,* Vol. 147 No., pp. 252-259.
Roh, J. J., Min, H., & Hong, P. (2011),″ A co-ordination theory approach to restructuring the supply chain: an empirical study from the focal company perspective″, *International Journal of Production Research,* Vol. 49 No. 15, pp. 4517-4541. doi:10.1080/00207543.2010.497506
Roll, M. (2020). The Secret of Zara's Success: A Culture of Customer Co-creation. Retrieved from https://martinroll.com/resources/articles/strategy/the-secret-of-zaras-success-a-culture-of-customer-co-creation/
Sadikoglu, E., & Zehir, C. (2010),″ Investigating the effects of innovation and employee performance on the relationship between total quality management practices and firm performance: An empirical study of Turkish firms″, *International Journal of Production Economics,* Vol. 127 No. 1, pp. 13-26.
Saenz, M. J., Revilla, E., & Knoppen, D. (2014),″ Absorptive capacity in buyer–supplier relationships: empirical evidence of its mediating role″, *Journal of Supply Chain Management,* Vol. 50 No. 2, pp. 18-40.
Schermelleh-Engel, K., Moosbrugger, H., & Müller, H. (2003),″ Evaluating the fit of structural equation models: Tests of significance and descriptive goodness-of-fit measures″, *Methods of psychological research online,* Vol. 8 No. 2, pp. 23-74.
Scuotto, V., Del Giudice, M., & Carayannis, E. G. (2017),″ The effect of social networking sites and absorptive capacity on SMES'innovation performance″, *The Journal of Technology Transfer,* Vol. 42 No., pp. 409-424.

Sharma, Y. K., Mangla, S. K., Patil, P. P., & Liu, S. (2019),″ When challenges impede the process: For circular economy-driven sustainability practices in food supply chain″, *Management Decision,* Vol. 57 No. 4, pp. 995-1017.

Simatupang, T. M., Wright, A. C., & Sridharan, R. (2002),″ The knowledge of coordination for supply chain integration″, *Business Process Management Journal,* Vol. 8 No. 3, pp. 289-308.

Tarhini, A., El-Masri, M., Ali, M., & Serrano, A. (2016),″ Extending the UTAUT model to understand the customers' acceptance and use of internet banking in Lebanon: A structural equation modeling approach″, *Information Technology & People,* Vol. 29 No. 4, pp. 830-849.

Tortoriello, M. (2015),″ The social underpinnings of absorptive capacity: The moderating effects of structural holes on innovation generation based on external knowledge″, *Strategic Management Journal,* Vol. 36 No. 4, pp. 586-597.

Tsai, W., & Ghoshal, S. (1998),″ Social capital and value creation: The role of intrafirm networks″, *Academy of management Journal,* Vol. 41 No. 4, pp. 464-476.

Tunisini, A., Harrison, D., & Bocconcelli, R. (2023),″ Handling resource deficiencies through resource interaction in business networks″, *Industrial Marketing Management,* Vol. 109 No., pp. 154-163.

Van Huong, N., Van Hung, H., Huyen, M. T., Diep, N. T. B., Duc, H. M., & Van Chuong, N. (2021),″ Impact of accession to WTO on agriculture sector in vietnam″, *AgBioForum,* Vol. 23 No. 1, pp. 56-64.

Wang, J., & Wang, X. (2012),″ 7.1 The Rules of Thumb for Sample Size Needed for SEM″, *Structural Equation Modeling: Applications Using Mplus* No., pp.

West, S. G., Taylor, A. B., & Wu, W. (2012),″ Model fit and model selection in structural equation modeling″, *Handbook of structural equation modeling,* Vol. 1 No., pp. 209-231.

Ye, J., & Kankanhalli, A. (2013),″ Exploring innovation through open networks: A review and initial research questions″, *IIMB Management Review,* Vol. 25 No. 2, pp. 69-82. doi:10.1016/j.iimb.2013.02.002

Social Impacts of Digitalisation Through the Lens of Hungarian Experts

Nóra Obermayer, Tivadar Máhr and Zsuzsanna Banász
University of Pannonia, Faculty of Business and Economics, Veszprém, Hungary

obermayer.nora@gtk.uni-pannon.hu
mahr.tivadar@gtk.uni-pannon.hu
banasz.zsuzsanna@gtk.uni-pannon.hu

Abstract: Nowadays, we live in the fourth industrial revolution (the so-called digital revolution), which is fundamentally reshaping industry and business as well as the economy and civil society. Within the research activities of the National Laboratory for Social Innovation project, a research plan has been drawn up taking into account the quadruple helix model. The aim of this research is to map the social impacts of digitalisation based on the perspective of Hungarian experts. The research aims to map the social impact of digitalisation, whether the perception of the impact of digitalisation on society depends on the individual perceptions of the experts involved in the research (age, education) or organisational (sector of the organisation represented). The research seeks to answer the following research questions: Q1. How can the social impact of digitalisation be described? Q2. Do individual (age, education) or organisational (sector of the organisation represented) characteristics influence the experts' opinion? Q3. Are there any significant relationships between experts' responses to questions on the social impact of digitalisation and, if so, how strong are they? The data analysed are the results of a qualitative and quantitative, empirical survey carried out in 2021 with experts from academia, government, business and civil society. The former was conducted in the form of focus group interviews with invited experts (n=9) and the latter, in the form of an online questionnaire survey (n=78) using descriptive statistics and relationship analysis methods (Cramer's V and Kendall's Tau). The results show that the majority of experts consider the social impact of digitalisation to be rather positive, highlighting for example more efficient problem solving. It can be shown that the development of digitalisation requires a well thought-out but not over-regulated framework. As the transfer of knowledge improves, the opportunities for those who use digital technologies increase, but so does awareness of its harmful effects. The results can guide digital policy makers in identifying key areas for intervention.

Keywords: Digitalisation, Society, Experts, Focus Group, Questionnaire

1. Introduction

Throughout history, innovation has mostly taken the form of major industrial revolutions (Kagermann et al., 2013), aiming to both facilitate everyday life and increase the efficiency of production systems through new technologies (Horvath & Szabo, 2019). In the first three industrial revolutions, productivity growth was realised, driven by mechanisation, electricity and information technology (Kagermann et al, 2013). Nowadays, the fourth industrial revolution (also known as Industry 4.0) is considered to be the digital revolution, which is fundamentally transforming all aspects of life (Horvath & Szabo, 2019). Digitalisation has positive impacts on both society and economic development. Research shows that the spread of digitalization stimulates growth (Myovella et al., 2020), reduces income inequality and supports financial development (Ha, 2022). Thanks to the increasing use of the Internet and mobile phones, people around the world can connect with each other faster and more cost-effectively. Consequently, a new economic structure based on the use of information and communication technology (ICT) is of utmost importance (Lapatinas, 2019), especially for faster development (Donou-Adonsou, 2019). Digital technologies have become indispensable for a wide range of human, social and economic activities (Visser, 2019). The social distance constraints caused by the COVID-19 pandemic have inevitably increased the use of digital technology among the population (De, et al., 2020). A major consequence of the emergence of the viral pandemic is the rise of contactless technologies, which increasingly require people and technologies to interact (Manimuthu et al., 2021). Social actors have opened up to innovations that would not have been accepted in the ordinary circumstances before the epidemic. While its importance is unquestionable, few studies have examined the impact of digitalisation on society, and those that have, have tended to measure the environmental impact (Liu et al., 2019). An international survey examined whether digitalisation has an impact on the sustainable development of society. The results showed that the social components of the countries studied are positively affected by the process of digitalisation (Jovanović et al., 2018).

A national survey analysed the social impact of 21st century innovations in terms of generations. These impacts were examined from the perspective of older age groups in an ageing Hungarian society. It was found that the supportive power of the community and the efforts against loneliness are at the core of the social relevance of innovative solutions (Bene et al., 2020).

2. Theoretical Background

Some believe that robots may take over human work in the future. This belief is unfounded, seeing that robots are already carrying out tasks which human resources do not, or do not fully have the required capacities for. They are not taking over work done by people, but rather facilitate, accelerate problem solving. No jobs were lost to the emergence of the computer, the product of the third industrial revolution. It only created new ones, and the same future is expected from the fourth industrial revolution. However, this age will bring new challenges for both enterprises and employees (Kaasinen et al., 2020). Controlling new technologies requires new skills and competencies and a more flexible business environment, as corporate performance is still hugely impacted by the capability and dedication of managers and employees (Stachová et al., 2019). The human factor must be an integral part of the fourth industrial revolution. The future must be shaped so as to emphasize people, as the most dehumanized form of the fourth industrial revolution does “robotize” human beings. The impact of digitalization, the speed and scale of current changes, and the emergence of digital technologies have led to a radical transformation of workplaces and daily life, with a decreasing demand for workers performing routine, manual tasks (Bertani et al., 2020), while the demand for digitally skilled workers is steadily increasing (Kozanoglu & Abedin, 2020).

From a societal perspective, three other important factors can be identified: demographic change (the emergence of new generations), increasing virtual work (the impact of COVID-19), and increasing process complexity. The terms digital divide or digital inequality are used to illustrate the differences between social groups. These gaps can be demographic (age) (older generation lagging behind), geographical (lagging regions) or social (people living on the periphery). The state has a key role to play in closing the digital divide and in creating equal opportunities. The development of specific programmes should focus on developing the digital competence of disadvantaged people (Vinnai, 2020).

An adequate level of digital competence in the use of digital technologies is a key competence that all citizens need. Digital competence is *"the confident, critical and responsible use of, and engagement with, digital technologies for learning, at work, and for participation in society. It includes information and data literacy, communication and collaboration, media literacy, digital content creation, safety, intellectual property related questions, problem solving and critical thinking."* (European Commission, 2019:10). The DESI (Digital Economy and Society Index) measures the development of the digital economy and society. In 2022, 54% of Europeans had at least basic digital skills and less than a third had more advanced digital skills (26%), meaning that a large proportion of the EU population still lacks the digital skills required by most companies and positions. Hungary ranks 22nd and only around half of the population has at least basic digital skills (49%) (EC, 2022). The expected impacts of digitalisation have been investigated by national (Horváth & Szabó, 2019; Makó et al., 2018) and international research (Frey & Osborne, 2017; Li et al., 2019). In addition to academic research, consultancies have also addressed the issue (Bughin et al., 2018), but none of the studies have examined the social impacts.

3. Research Framework

The aim of this study is to explore the social impacts of digitalisation based on the opinion of national experts, and to answer the following three research questions:

- Q1. How can the social impact of digitalisation be described?
- Q2. Does the expert's opinion depend on individual (age, education) or organisational (sector of the organisation represented) characteristics?
- Q3 Are there significant relationships between the experts' answers to each question on the social impact of digitalisation and, if so, how strong are they?

3.1 Data collection - Quantitative

Before the quantitative research a qualitative survey was conducted to assess the social impact of digitalisation, using a focus group interview. The interviews were carried out by a research team within the framework of the research activities of the National Laboratory for Social Innovation (TINLAB). The research plan has been drawn up taking into account the quadruple helix model. This model is a further development of the triple helix model, where the fourth helix is the civil society, thus including the civil and public sectors in the university-industry-government nexus (Birkner & Máhr, 2016). The semi-structured interviews took place online on 26 March 2021 with 9 invited experts representing academia-government-business-civil society. Based on the results of the focus group interviews a questionnaire was compiled. This study is only focusing on the results of the

quantitative research. The online survey was carried out anonymously in compliance with GDPR rules. In line with the four-helix model, 80 professionals from the academic-government-business-civil sector were invited to complete the questionnaire. The invited respondents were well-known Hungarian actors in these fields, experts working as social innovators or in potential social innovation organisations, whose activities are related to digitisation with a social impact. The selection was based on the TINLAB network's connectivity and database. The full questionnaire survey used in the research consisted of 11 sets of questions. The present study examined demographic characteristics and the impact of digitalisation on society, as well as the influence of social media presence on individuals' social interactions. The research team chose to analyse these issues because the experts' opinions were the most divergent during the interviews.

Descriptive statistics and relationship analysis are used as research methods. The former is used to answer research question Q1, the latter for questions Q2, Q3. A total of (3·10=) 30 relationship tests are analysed between the answers to the 3 independent (X) and 10 dependent (Y) questions. The level at which the questions are measured determines the indicator used to quantify the relationship between them. All variables considered as dependent (Y) are measured on an ordinal scale. Two of the independent variables (X) (X1. age: 1: 30-49 years, 2: 50-64 years, 3: 65 years and over; X2. highest level of education: 1: secondary education, 2: higher education (university, college)) are measured on ordinal scale, and their relationship with the variables to be explained can therefore be explored using the Kendall tau (τ) indicator, which quantifies the rank correlation and ranges in the interval [-1, 1]. The questionnaire respondent's sector (X3: academic degree) can only be measured at the lowest level, the nominal scale. The Cramer indicator (V), which can take a value in the interval [0, 1], is used to determine the relationship of this sector with the variables to be explained (Y). All relationship tests are interpreted at 5% significance level using SPSS software. If the p-value for the test is < 0.05, then a significant relationship exists between the two criteria being tested. In the case of significant relationships, the absolute value of the indicator indicates the strength of the relationship (Sajtos & Mitev, 2007): below 0.2 is considered a weak relationship, from 0.7 a strong relationship, and between these two numbers a moderately strong relationship. The Cramer indicator can only take a positive value, so the sign of the indicator cannot be interpreted here. Since the indicator τ can be both positive and negative, the sign of this indicator, which indicates the direction of the relationship, is also interpreted here. A negative (positive) τ means that the higher the ranking of one variable, the more likely it is that the other variable will have a lower (higher) ranking.

4. The Results of the Questionnaire Survey

The questionnaire was completed by 78 of the 80 experts invited to participate. In terms of age, there were exactly half and half of respondents under 50 (39) and 50 and over (39). The majority (57) had the highest level of education (university or college), 14 also had a degree and 7 only a school leaving certificate. In terms of field of work, 36 people belong to the business sector, 17 to the academic sector, 15 to the civil or media sector and 10 to the public sector.

4.1 Descriptive Statistics (Q1)

Y1 asked respondents to choose between statements 'a' and 'b' on the societal impact of digitalisation, indicating negative or positive attitudes. On a scale of 1 to 4, 1 and 2 represent negative attitudes (a) and 3 and 4 represent positive attitudes (b). Experts agree most with the statement where the mode, the mean, is highest and, in addition, the relative dispersion of responses is low. The distribution of responses (%) between the 1-4 response options is shown in Figure 1. The black rectangles indicate the proportion of non-responders, for the other colours the darker colour indicates the proportion of more positive experts (agreeing with response option ‘b').

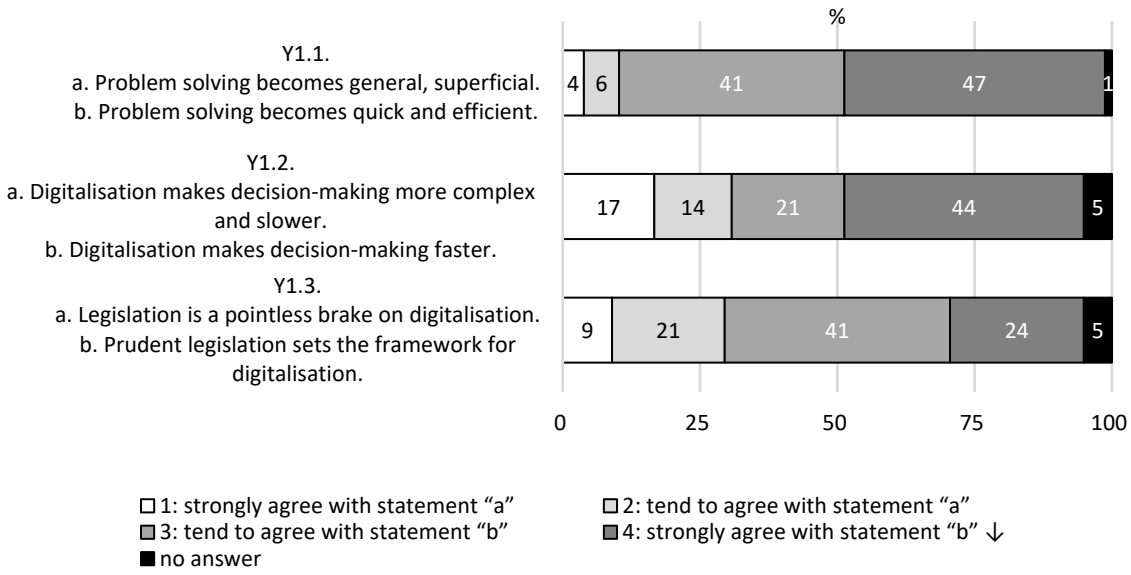


Figure 1: Y1. Which statement do you think is most representative of the social impact of digitalisation? (%)

88% think that problem solving is becoming faster and more efficient rather than generic and superficial (Y1.1). Apine and co-authors' (2020) research aimed to explore how leadership practices are changing in the digital age. Similar to the results of our research, they also concluded that digitalisation provides better, faster, simpler tools and channels for organising information and problem solving. 65% believe that digitalisation makes decision-making faster rather than more complex and slower (Y1.2). In his research, Hoßfeld (2017) investigated whether digitalisation will be a relevant topic to improve decision making. His results are in line with our findings that digitalisation (especially smart technology) speeds up decision-making. The use of smart technologies to speed up decision-making is becoming more and more common for companies. On the one hand, it can reduce human error and can therefore be important for decisions that rely heavily on data, and on the other hand, it can help automate certain decision-making situations.

65% believe that well-considered legislation provides a framework for digitalisation rather than pointlessly curbing it (Y1.3). The digital revolution is challenging traditional legislation, as legislation cannot keep pace with rapidly changing technologies (e.g. self-driving cars, drones, digital contracts), as the environment to be regulated is dynamically evolving (Kardos, 2020).

In question Y2, respondents had to decide how much they agreed with 7 statements. The statement where experts agree the most is the one with the highest mode, the mean, and also where the relative dispersion of responses is low. The responses are shown in more detail in Figure 2, which shows the distribution of responses (%) between the 1-4 response options. The order of the statements reflects the preference of the respondents.

98% of the participants thought that it is important to regulate the new world order created by digitalisation processes and the ethical issues that arise (Y2.1). This issue has been addressed by several researchers at the international level, for example Roša (2021) explores the role of ethics in the context of digital technologies through a systematic literature review. Among others, he finds that research such as Baldini et al (2018) argue that the legal framework alone cannot fully cover all privacy risks and that a model that addresses ethical issues is needed.

A new and previously untested finding is that 78% of respondents believe that the development of digitalisation has improved the transfer of knowledge between generations (Y2.2).

88% of the experts claim that larger companies can take advantage of the opportunities of digitalisation (Y2.3), and 62% also agree that smaller companies can also take advantage of the opportunities of digitalisation (Y2.4). A survey by Csizmadia and co-authors (2022) also found that the larger the size of the company, the higher the adoption of digital technologies, as highlighted by an international survey (Savastano, Amendola, Bellini, & Ascenzo, 2019). The OECD report also confirms that large companies are at the forefront of business digitalisation, and in Hungary this is mostly the case for foreign-owned subsidiaries (Éltető & Sass, 2021).

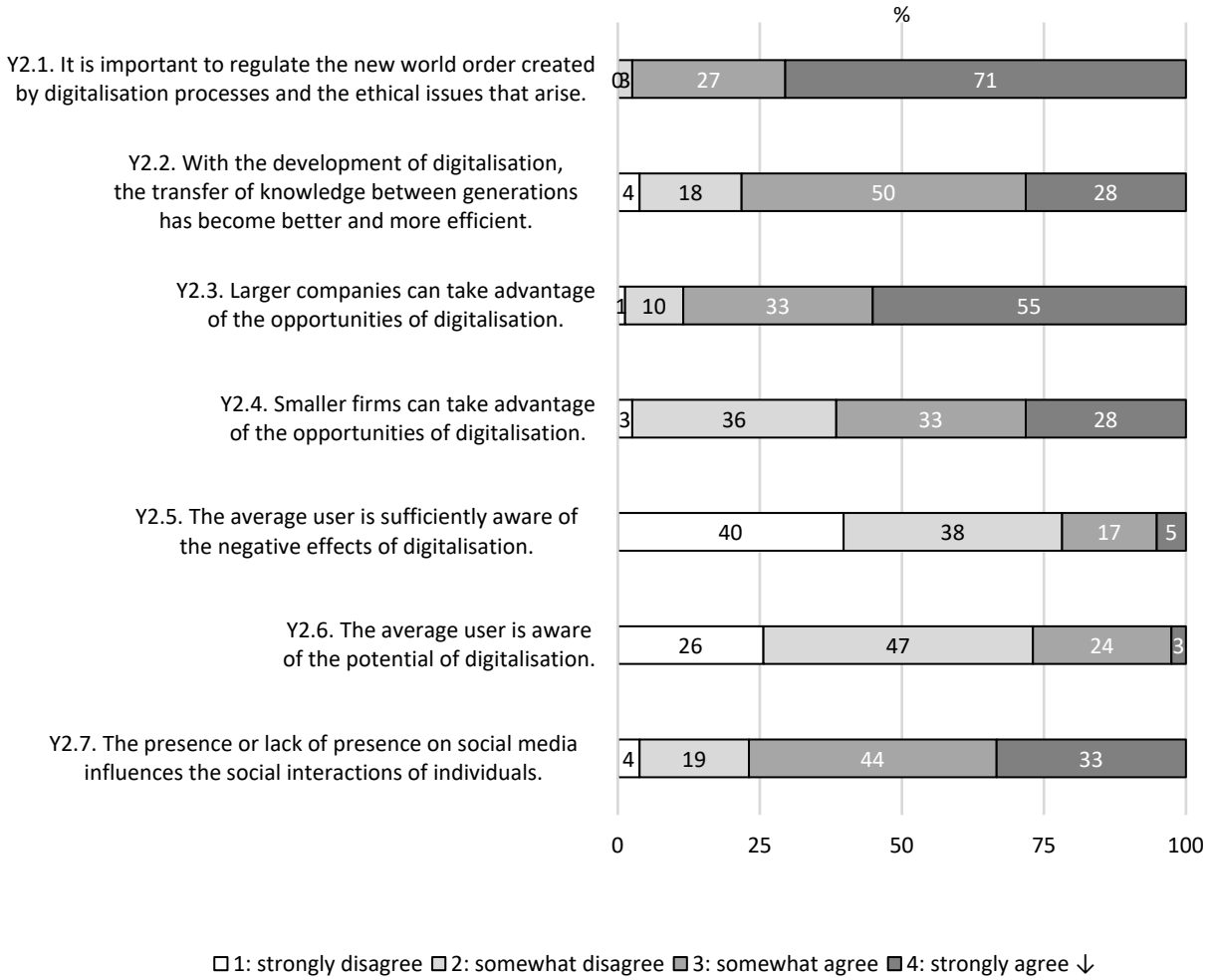


Figure 2: Y2. How much do you agree with the following statements? (%)

78% disagree that the average user is sufficiently aware of the negative effects of digitalisation (Y2.5) and 73% disagree that the average user is aware of the potential of digitalisation (Y2.6). The results were supported by Meggyesfalvi's (2021) research, as it is a serious problem that digitalisation and new algorithms increase the risk of exposure to harmful content, especially for younger generations.

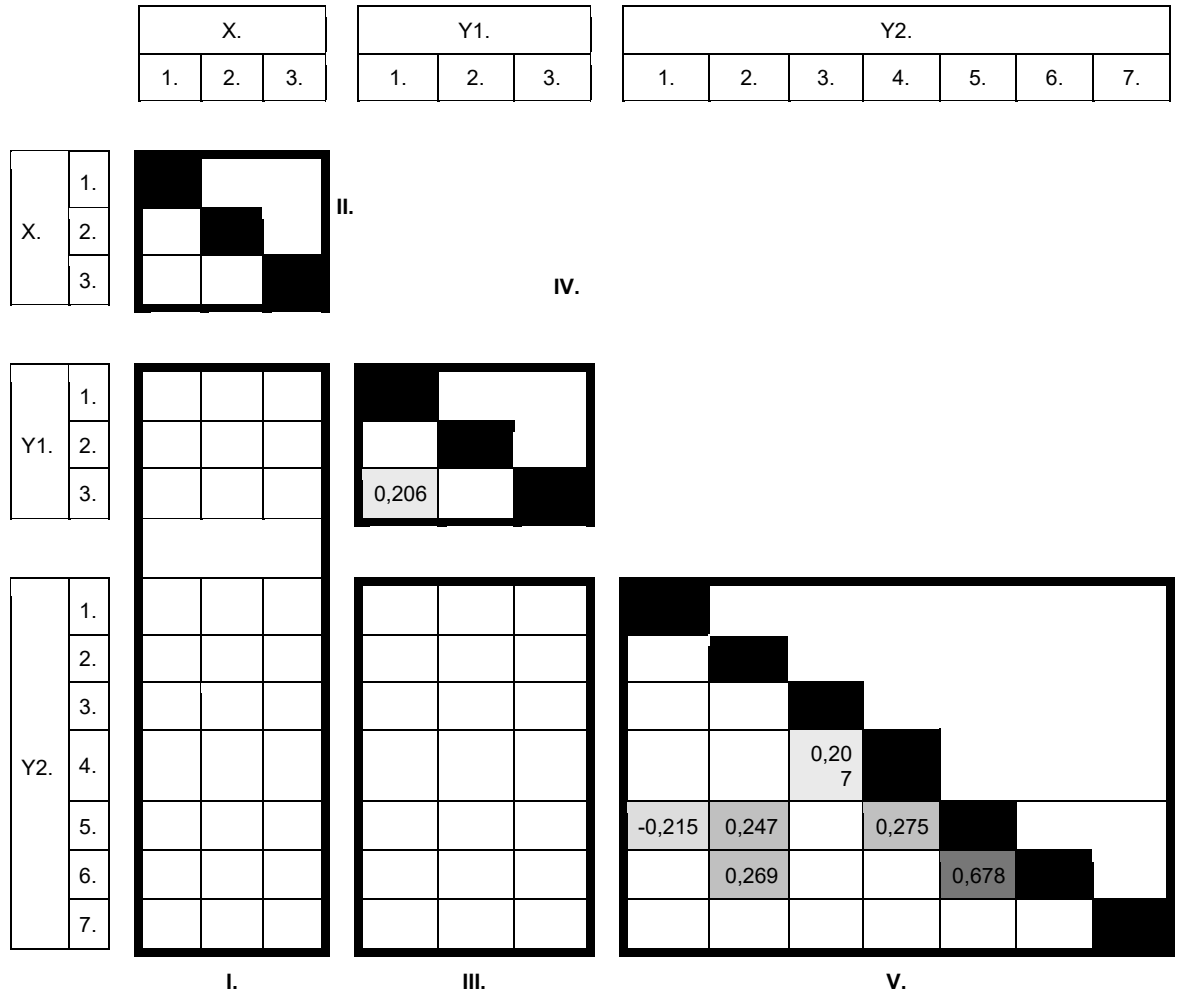
More than two thirds (77%) believe that the presence or absence of social media influences one's social interactions (Y2.7). Social media helps communication between generations, allowing people who are geographically distant from each other but have similar interests to find a way to connect. However, excessive use of social media has negative effects, for example, users often want to present a perfect image of themselves, or excessive use can take valuable time away from other activities.

4.2 Relationship Analyses: (Q2, Q3)

In the following, we move from descriptive statistics to relationship analyses in order to answer the second and third research questions mentioned in the introduction (Q2, Q3). The significant results of the relationship analyses are summarised in the relationship matrix in Table 1.

In the diagonal of the correlation matrix, cells with a black background indicate the relationship of each indicator to itself, on which diagonal the results are symmetrically duplicated, so only the part of the matrix below the black diagonal is examined.

Table 1: Significant results of relationships



The background colour of the cells indicates the strength of significant relationships: weaker stronger relationship

4.2.1 Relationship Analyses: Demographics and Digitalisation (Q2)

Q2 asked whether the experts' opinion on the social impact of digitalisation depends on the individual (age, education) or organisational (sector of the organisation represented) characteristics of the expert making the statement. The relevant relationship analyses aim to identify significant relationships between the answers (Y) to the questions on the social impact of digitalisation and the experts' characteristics (X) as potential explanatory variables. This section is shown in sub-matrix I of Table 1, which however does not contain any significant relationship. This means that our hypothesis that the individual and organisational characteristics of experts (age, education, sector) influence their opinions has to be rejected.

This result is interesting because it implies that the experts' opinion on the social impact of digitalisation does not depend on the age of the expert, the highest level of education or the sector in which the expert is classified as an expert. The analysis shows that the social impact of digitalisation is a phenomenon experienced by all adults in the same way, regardless of their level of education and employment. This leads to the conclusion that if the social impact of digitalisation is to be communicated to experts, it is not necessary to use segmented communication elements, as the demographic characteristics of these groups can be interpreted as a single target group. This is also true for marketing, social or corporate communication.

Part II shows the relationships between the characteristics (Xs) of the experts, where there is also no significant correlation. This is not surprising, because it means that the age of the expert does not affect his/her education or sector, nor does education affect the sector in which he/she works.

4.2.2 Relationship Analysis: Digitalisation (Q3)

More interesting, however, are the relationships between the variables (Y's) to be explained (Part III-V), which answer the third research question (Q3), whether and how strong significant relationships can be detected between experts' responses to questions on the social impact of digitalisation. For the answers to questions Y1 and Y2 (Part III), we also find that there are no significant relationships, thus the experts think similarly. There was a significant relationship ($\tau = 0.206$) between the responses to the Y1 questions (Part IV), which was moderately strong and positive. This can be interpreted as the more experts agree that the societal impact of digitalisation is to make problem solving faster and more efficient (rather than general or superficial) (Y1.1), the more they agree that legislation should frame (rather than constrain) digitisation (Y1.3). The results of the relationship analysis therefore suggest that the faster and more efficient solution to a problem requires, according to respondents, a careful legislative process. This may be related to the fact that the rapid and rapid development of digitalisation - to the benefit of society - can only be envisaged within a well thought-out but not over-regulated - legal - framework.

The most significant relationships were found between the answers to the Y2 questions (Part V): 6 out of the 21 relationships concerned. All of these relationships are moderately strong. The direction of the relationships is positive in five cases and negative in one case. The almost strong relationship ($\tau = 0.678$) relates to the experts' opinion of the average user. The more they believe they are sufficiently aware of the harmful effects of digitalisation (Y2.5), the more they believe they are aware of the opportunities of digitalisation (Y2.6). Experts believe that as users perceive the opportunities of digitalisation to increase, they also recognise its harmful effects. This may be related to the fact that experts, who have more and deeper professional knowledge, think the same about the average user.

Four of the other five medium-strong relationships can be linked to one of the responses to these two statements. The more the expert agrees that the average user is aware of the opportunities of digitalisation (Y2.6), the more the development of digitalisation has improved the transfer of knowledge between generations (Y2.2) ($\tau = 0.269$). The experts' opinion shows that the increase in opportunities for digitalisation also increases the opportunities for knowledge transfer. This may be related to the fact that experts, who are more aware of the potential of digitalisation, are better able to use its achievements in knowledge transfer and feel the same about ordinary users.

The more the expert agrees that the average user is sufficiently aware of the harmful effects of digitalisation (Y2.5),

- the less they agree that it is important to regulate the new world order created by digitalisation processes and the ethical issues that arise (Y2.1) ($\tau = -0.215$),
- on the one hand, the more he agrees that the development of digitalisation has made the transfer of knowledge between generations better and more efficient (Y2.2) ($\tau = 0.247$),
- on the other hand, that smaller firms can take advantage of the opportunities offered by digitalisation (Y2.4) ($\tau = 0.275$).

The experts argue that the average user who understands the adverse effects of digitalisation - but also its potential - does not need to be constrained by over-regulated processes, as the world has become faster, we communicate more efficiently, we share knowledge more quickly. The same is true of the business opportunities for small businesses, which are typically fast, change-ready and dynamic, and can take advantage of the rapid opportunities offered by the digital world.

The last almost weak relationship ($\tau = 0.207$) can be interpreted as the experts who agreed more that larger firms can take advantage of digitalisation (Y2.3), had similar views about smaller firms (Y2.4). This correlation shows that the flexibility and speed of small firms helps them in the field of digitalisation: the success of larger firms in exploiting the opportunities of digitalisation naturally goes hand in hand with the success of smaller firms in exploiting the opportunities of digitalisation.

5. Discussion

Based on our research, we found that the majority of experts consider the social impact of digitalisation to be positive rather than negative. Several factors of this positive impact are worth highlighting: problem solving has become more efficient, which needs to be further strengthened, as users are not sufficiently aware of the potential of digitalisation. Contrary to our assumption, the experts' opinion on the social impact of digitalisation is not significantly influenced by their age, education or the sector in which they work. On the one hand, this

implies that there is convergence among experts, they are well prepared, and regardless of their demographic characteristics, it is safe to use their opinions in decision-making. On the other hand, communication to them on the social impact of digitalisation can be uniform, there is no need to use different communication methods and channels, no need to define specific target groups.

Finally, there were only a few significant relationships between the answers to the questions on the social impact of digitalisation, but it should be pointed out that the development of digitalisation requires a well thought out, but not over-regulated framework. As the transfer of knowledge improves, so the opportunities for those using digitalisation increase, but so does awareness of its harmful effects. The success of businesses through digitalisation is primarily a credit to small businesses, but it also has an impact on larger firms.

5.1 Practical Implications

Businesses are able to take advantage of the opportunities offered by digitalisation, but as digitalisation processes evolve, the ethical issues that arise need to be regulated, and this is also true of social media: the presence or lack of presence on social media has an impact on the user, which ultimately has an impact on socio-economic processes. These processes have brought cybercrime to the forefront and this social problem needs to be addressed, as users are not sufficiently aware of the harmful effects of digitalisation. It is worthwhile to raise the awareness of the average user through training and better information transfer, as they are the main victims of the negative effects of digitalisation, while businesses, the media, academia and NGOs can be the shapers of these effects. It is worthwhile to launch practical programmes and developments to address these issues in the future. Our results can provide food for thought for decision-makers on where to allocate resources and where to develop reinforcement/prevention programmes when allocating scarce resources. EU countries, including our own, already have frameworks in place that can be used effectively to improve digital inequalities in society, both for the population and for workers. The digital divide can be tackled through training and development. In addition to developing the digital competences of the younger generations in a school setting, there is a need to provide free educational opportunities for adults to develop the digital competences that are increasingly essential in the labour market.

5.2 Limitations and Future Research

One of the limitations of our research is that the surveys were only conducted in Hungary. We consider it worthwhile to repeat both the qualitative and the quantitative survey in English in the near future, with foreign professionals working in Hungary. In this research, we asked experts to assess the social impact of digitalisation. It would also be interesting to examine the views of average users, not experts, and compare the results with those presented here.

Prepared in the "National Laboratory for Social Innovation" project (RRF-2.3.1-21-2022-00013), within the framework of Hungary's Recovery and Resilience Plan, with the support of the Recovery and Resilience Facility of the European Union.

References

Apine, H., Liu, G., & Bin Zainal Fitri, M. F. (2020). Effects of digitalization on managerial practices as experienced by managers, Research. Digitala Vetenskapliga Arkivet. https://www.diva-portal.org/smash/get/diva2:1435701/FULLTEXT01.pdf

Baldini, G., Botterman, M., Neisse, R., & Tallacchini, M. (2018). Ethical Design in the Internet of Things. Science and Engineering Ethics, 24(3), 905–925. https://doi.org/10.1007/s11948-016-9754-5

Bene, Á., Móré, M., & Zombory, J. (2020). A digitalizáció néhány elemének időseket érintő hatásai – Karantén előtti helyzetkép. Magyar Gerontológia, 12(39), 29–51. https://doi.org/10.47225/mg/12/39/9328

Bertani, F., Raberto, M., & Teglio, A. (2020). The productivity and unemployment effects of the digital transformation: an empirical and modelling assessment. Review of Evolutionary Political Economy, 1(3), 329–355. https://doi.org/10.1007/s43253-020-00022-3

Birkner, Z., & Máhr, T. (2016). Interpreting innovation – in another way. Vezetéstudomány, 47(10). 39–50. https://doi.org/10.14267/VEZTUD.2016.10.04

Bughin, J., Hazan, E., Lund, S., Dahlström, P., Wiesinger, A., & Subramaniam, A. (2018). Skill shift: Automation and the future of the workforce. Discussion paper, McKinsey&Company. https://www.mckinsey.com/featured-insights/future-of-work/skill-shift-automation-and-the-future-of-the-workforce

Csizmadia, T., Obermayer, N., & Banász, Zs. (2022). Going digital in business life: examining contactless digital technologies (CDTs) in the midst of the Coronavirus (COVID-19). Emerging Science Journal, Special Issue COVID-19: Emerging Research, 6, 212–228. https://doi.org/10.28991/esj-2022-SPER-015

De, R., Pandey, N., Pal, A. (2020). Impact of digital surge during Covid-19 pandemic: a viewpoint on research and practice. International Journal of Information Management, 55, 102171. https://doi.org/10.1016/j.ijinfomgt.2020.102171

Donou-Adonsou, F. (2019). Technology, education, and economic growth in Sub-Saharan Africa. Telecommunications Policy, 43(4), 353–360. https://doi.org/10.1016/j.telpol.2018.08.005

European Commission (2019). Key competences for lifelong learning. Report. https://op.europa.eu/en/publication-detail/-/publication/%20297a33c8-a1f3-11e9-9d01-01aa75ed71a1/language-en

European Commission (2022). Digital Economy and Society Index (DESI) 2022. Report. https://ec.europa.eu/newsroom/dae/redirection/document/88764

Éltető, A., & Sass, M. (2021). A kapitalizmus változatai és az ipar 4.0 a visegrádi országokban, Közgazdasági Szemle, 68(5), 490–514. https://doi.org/10.18414/KSZ.2021.5.490

Frey, C. B., & Osborne, M. A. (2017). The future of employment: How susceptible are jobs to computerisation? Technological Forecasting and Social Change, 114, 254–280. https://doi.org/10.1016/j.techfore.2016.08.019

Ha, L. T. (2022). Effects of digitalization on financialization: empirical evidence from European countries. Technology in Society, 68, 101851. https://doi.org/10.1016/j.techsoc.2021.101851

Horvath, D., & Szabo, R. Z. (2019). Driving forces and barriers of Industry 4.0: do multinational and small and medium-sized companies have equal opportunities? Technological Forecasting and Social Change, 146, 119–132, https://doi.org/10.1016/j.techfore.2019.05.021

Hoßfeld, S. (2017). Optimization on Decision Making Driven by Digitalization. Economics World, 5(2), 120–128. https://doi.org/10.17265/2328-7144/2017.02.004

Jovanović, M., Dlačić, J., & Okanović, M. (2018). Digitalization and society's sustainable development – Measures and implications. Journal of Economics and Business. Proceedings of Rijeka. Faculty of Economics and Business, 36(2), 905–928. https://doi.org/10.18045/zbefri.2018.2.905

Kagermann, H., Wahlster, W., & Helbig, J. (2013). Recommendations for implementing the strategic initiative INDUSTRIE 4.0: Final report of the Industrie 4.0 Working Group, Acatech. https://www.din.de/blob/76902/e8cac883f42bf28536e7e8165993f1fd/recommendations-for-implementing-industry-4-0-data.pdf

Kardos, S. (2020). Törvényhozás a digitális korban. Miskolci Jogtudó, 4(1), 47–58. https://jogtudo.uni-miskolc.hu/files/8812/MJ2020iss1art6Kardos.pdf

Kozanoglu, C. D., & Abedin, B. (2021). Understanding the role of employees in digital transformation: conceptualization of digital literacy of employees as a multi-dimensional organizational affordance, Journal of Enterprise Information Management, 34(6), 1649–1672. https://doi.org/10.1108/JEIM-01-2020-0010

Lapatinas, A. (2019). The effect of the Internet on economic sophistication: an empirical analysis. Economics Letters, 174, 35–38. https://doi.org/10.1016/j.econlet.2018.10.013

Li, D., Fast-Berglund, Å., & Paulin, D. (2019). Current and future Industry 4.0 capabilities for information and knowledge sharing. International Journal of Advanced Manufacturing Technology, 105(9), 3951–3963. https://doi.org/10.1007/s00170-019-03942-5

Liu, R., Koehler, A., Gailhofer, P., Gensch, C-O., & Wolff, F. (2019). Impacts of the digital transformation on the environment and sustainability. Technical report, Öko-Institut e.V. https://ec.europa.eu/environment/enveco/resource_efficiency/pdf/studies/issue_paper_digital_transformation_20191220_final.pdf

Makó, Cs., Illéssy, M., & Borbély, A. (2018). A digitalizáció és a munkavégzési formák. Magyar Tudomány, 179(1), 61–69. https://doi.org/10.1556/2065.179.2018.1.7

Manimuthu, A., Dharshini, V., Zografopoulos, I., Priyan, M. K., & Konstantinou, C. (2021). Contactless Technologies for Smart Cities: Big Data, IoT, and Cloud Infrastructures. SN Computer Science, 2(4), 334. https://doi.org/10.1007/s42979-021-00719-0

Meggyesfalvi, B. (2021). A káros online tartalmak ellenőrzése a közösségi média platformokon. Belügyi Szemle, 69(6), 26–38. https://doi.org/10.38146/BSZ.SPEC.2021.6.2

Myovella, G., Karacuka, M., & Haucap, J. (2020). Digitalization and economic growth: a comparative analysis of Sub-Saharan Africa and OECD economies. Telecommunications Policy, 44(2), 101856. https://doi.org/10.1016/j.telpol.2019.101856

Roša, A. (2021). Exploring the Role of Ethical Issues in the Context of Digital Transformation. Trends – Economics and Management, 15(38), https://doi.org/10.13164/trends.2021.38.23

Sajtos, L., & Mitev, A. (2007). SPSS Kutatási és adatelemzési kézikönyv. Alinea.

Savastano, M., Amendola, C., Bellini, F., & D'Ascenzo, F. (2019). Contextual Impacts on Industrial Processes Brought by the Digital Transformation of Manufacturing: A Systematic Review. Sustainability, 11(3), 891, https://doi.org/10.3390/su11030891

Vinnai, E. (2020). Az állam szerepe a digitális társadalmi leszakadás kezelésében. Miskolci Jogi Szemle, 15(1. különszám), 347–356. https://www.mjsz.uni-miskolc.hu/files/10843/41_vinnaiedina_t%C3%B6rdelt.pdf

Visser, R. (2019). The effect of the internet on the margins of trade. Information Economics and Policy, 46, 41–54. https://doi.org/10.1016/j.infoecopol.2018.12.001

A Comparative Study of ECKM Academic Papers 2017-23

Johan Olaisen and Birgit Helene Jevnaker
BI Norwegian Business School, Oslo, Norway

Johan.olaisen@bi.no
Birgit.h.jevnaker@bi.no

Abstract: The purpose of this paper is to analyze and compare all the academic papers in the proceedings of ECKM in 2017 (Barcelona), 2018 (Padua), 2019 (Lisbon), and the digital conferences in Coventry 2020 and 2021. In 2022, the conference was arranged in Naples, and 2023, in Lisbon, both as hybrid conferences. The study classifies the papers according to methodology, analysis, discussion, and conclusion regarding their contribution to the four paradigmatic boxes. The approach uses the five philosophy of science framework and compares this to the content of the research papers. We will use the findings in four representations of knowledge, two typologies of concepts, four paradigmatic classifications, and the concluding framework for knowledge management research. The seven conferences heavily emphasize knowledge-itis and instrumental itis and much less on problem-itis. The papers are mostly centered around existing knowledge and accepted methodology and are less related to new problems. The results indicate a conference based upon as-is knowledge and less upon new and often unsolvable issues. The ECKM academic papers in 2017, 2018, and 2019 have relatively low complexity and are presented in an empirical and materialistic paradigmatic framework through definitive concepts representing a form of atomistic research. The papers in 2020, 2021, and especially 2022 and 2023 are delivered within a more robust, clarified subjectivity and action research-based framework through definitive and sensitizing concepts. What would ECKM have been with more complexity in action and subjective paradigmatic framework through sensitizing concepts representing holistic research? A more creative, engaged, and relevant conference. It will also be a more scientific conference discussing what is acceptable or not acceptable and what is adequate. Studies concerning sustainability, digitalization, and globalization might require another research approach. The more critical and green papers in the 2020 and 2021 conferences are open to new perspectives on methodology, problems, and knowledge. The 2022 and 2023 conferences represent a turning point for critical sustainability and digitalization papers that clarify subjectivity through action-based research. The 2022 and 2023 papers represent the turning point of ECKM into improved relevance through more critical and constructed studies based on the societal climate crisis and sustainable strategies and business models.

Keywords: Paradigms, Concepts, Perspectives, Knowledge Creation, Knowledge Accumulation, Sustainability

1. Research Justification

We have experienced knowledge management (KM) as a research field developed from Information systems (IS), Information Resources (IRM), Information management(IM), Intellectual capital (IC), and Information and communication technology (ICT) management. KM has been concerned with theoretical and practical implications, while the other fields have been mainly concerned with practical implications(Jevnaker & Olaisen, 2022 b). The other fields have eroded as disciplines while KM keeps stubbornly on. Artificial intelligence (AI) has been the hot spot for the last two years and has yet to be convincing as an own research discipline. KM might be a part of AI, or AI might be a part of KM. There are many KM journals, but the main outlet for reflections and discussion of KM is the ECKM conference going on for more than 30 years with more than 110 reviewed academic research papers yearly.KM is a broader discipline, including business models for sustainability, equality, digitalization, globalization, climate issues, and AI. The contributions include anthropology, art, aesthetics, philosophy, psychology, scenario learning, pattern studies, biology, neuroscience, and traditional business studies(Jevnaker&Olaisen, 2021). KM is at a crossroads, either eroding as its own discipline or developing further as its own research domain(Jevnaker and Olaisen, 2022 a). Where is KM heading, and why is KM heading in this direction? Are there other directions in which to look? The most valid and trustworthy way to investigate KM is to evaluate the ECKM academic papers. We have used five conceptual and theoretical frameworks from the philosophy of science to do the evaluation. The strength of the evaluation is the pluralism of using five different frameworks.

2. Conceptual and Theoretical Framework

Tornebohm (1983) conceives social science as a sequence of partly cumulative and partly non-cumulative transformations of Knowledge (K), problems (P), and instruments(I). Tornebohm (1983) argued that if the sciences and social sciences progress, there must be a balance between K, P, and I. An overemphasis on any of them will hinder a free scientific discourse and the development of any scientific field. For instance, a central notion from the compound (K1, P1, I 1) to (K2, P1, I2) occurs when the problems P1 are solved to increase the stock of Knowledge from K1 to K2. In problem-solving, new instruments may be developed or borrowed from

other disciplines, changing I1 to I2. If one of the three aspects dominates the other two, the domain becomes less relevant. Overemphasis on knowledge ("knowledge-itis") may result in empirically empty structures irrelevant to the problems.

The initial KPI maps the aspect of interest (in this case, a feature of knowledge structures or processes). The KPI compound in this process filters through what is called the "researchers' orientation and worldview" or perspectives in Tornebohm's words (1983) or paradigms in Kuhn's words (1970) or research domains in Olaisen's words (1985). These authors are all referring to the fact that there are alternative ways of approaching the social sciences and, by that, also knowledge management research. The aspects studied are not given once and for all. New knowledge widens the boundaries, as might happen after broadening knowledge management research. Thornebohm believes that pluralism is needed in any discipline to accumulate knowledge.

Galtung's (1972) idea was to identify four ways of approaching the social sciences in a triangle of theory, data, and values:

1. Empiricism – is what we are presenting true or false (if true consonance, if false dissonance)
2. Criticism – is what we are giving acceptable or not acceptable (if acceptable consonance, if not acceptable dissonance)
3. Constructivism – is what we are presenting as adequate or inadequate (if adequate consonance, if not adequate dissonance)
4. Pluralism – a triangulation of empiricism, criticism, and constructivism (if congruence consonance, if not congruence dissonance)

Galtung (1972) assumes that a common goal of all social sciences is to establish what are called sentences dichotomizing their "world space" by including some defining the empirical world by having some "world points" and excluding others. Hence, data sentences explain the empirical world by including what they observe and eliminating what they do not see or imagine. On the other hand, theory sentences (hypotheses or propositions) define the foreseen world, including aspects predicted by the underlying theory. Finally, value sentences refer to the preferred world, including what is accepted and excluding what is rejected. Galtung proposed that all social sciences needed criticism, constructivism, and pluralism in addition to traditional empiricism. Constructivism might be constructing our data or practice to develop new alternatives. The constructed worldview is dependent upon our judgment and interpretation. The constructed story demands great imagination and creativity to tell an excellent relevance. Galtung believed all the social sciences could be analyzed according to this framework. Our research paper is the first time Galtung's and Tornebohm's approaches are used to analyze a research discipline.

Blumer (1969) argued that research concepts in any social science might be divided into definitive and sensitizing concepts. Definitive concepts are empirical concepts defining what is accurate or not true while sensitizing concepts look for new directions and ask about what is adequate or inadequate. The concepts have an essential role in any scientific inquiry. They are usually the anchor point in the interpretation of findings.

The purpose of the definitive concept is to:

Describe-Explain-Predict and Control and Rule (A definitive and objective process). Bunge (1967) named this process "the process of all serious systematic research."

The sensitizing concepts have another purpose:

Describe-Explore-Reflect-Participate and Change (A subjective and relative process). Glaser and Strauss (1967) named this process "Grounded-theory-research."

Olaisen (1985) divided any Knowledge into four types of knowledge:

1. What we know about defining
2. What we do not know implying
3. What we do not know that we know as a part of
4. What we do not know that we do not know

According to Olaisen(1985), to get a scientific, intuitive, and creative movement between these four types of knowledge to represent the essence of representable and non-representable knowing modes in any science and social science. The known directs us to the known unknown and further to the unknown known together with the unknown.

Olaisen (1985) divided the social sciences into four paradigms in a quadrate of harmony versus conflict and objectivity versus subjectivity:

1. The empirical paradigm
2. The materialistic political paradigm
3. The clarified subjective paradigm
4. The action paradigm

According to Olaisen, any social science paper could be placed within these four paradigms.

These are the five scientific philosophy frameworks used as analytical tools for analyzing academic papers.

3. Methodology

This paper analyze and compare all the academic papers in the proceedings of ECKM in 2017, 2018, 2019, 2020, 2021, 2022, and 2023. A total of 770 double-blind-reviewed academic documents were reviewed, each 5000 words and ten pages long. The approach uses a philosophy of science framework and compares this to the content of the research papers.

We have used five philosophy of science frameworks to analyze all the papers:

1. Tornebohm's knowledge, problem, and instrument description (1983)
2. Galtung's scientific perspective triangle (1972)
3. Olaisen's four kinds of knowledge identification (1985)
4. Blumer's two types of scientific concepts (1969)
5. Olaisen's four types of paradigms identification (1985)

This paper combines (4) and (5) as pluralistic proposals for future knowledge management research progress.

Each paper has been classified according to the following:

1. Problem
2. Methodology
3. Theoretical foundation
4. Propositions or hypotheses
5. Analyze
6. Discussion of results
7. Conclusions
8. Theoretical and practical implications

A decision has been made for each of the five frameworks according to which format the paper fits within each academic writing. The decision is based on the reading of the article. For two-thirds of the documents, placing them into a category was clear. We had to decide which type we set them within for one-third of the papers. The decision is based upon our notes from each piece; if in doubt, we reread the article.

After reading each section of the paper, we classify within each of the eight criteria. When the session is missing, our decision is based on our classification. The subject classification is done according to the keywords in the documents, the abstract, and the introduction. The exactness of the category has continuously been approved. Therefore, we have reclassified 2017, 2018, and 2019 for our 2024 paper.

4. Knowledge-Itis, Instrument-Itis, and Problem-Itis

The papers are suffering from "instrument-itis" and to some extent from "knowledge-itis," but they are indeed not suffering from "problem-itis." Problem-oriented research demands systematic and logical argumentation (Lawrence, 1992). Problem-orientated research might need to be improved for knowledge management researchers. The researchers do the statistical tests well, presenting the data in "nice" total packages as a form of scholarly truth. However, only some results conflict with existing marks. 2 of 3 hypotheses are correct, and 1 of 3 needs to be corrected. There are many similar hypotheses/propositions (54%) in papers dealing with knowledge sharing and knowledge management, while 61% reach the same result and 39% reach a different outcome for similar propositions and hypotheses. The Popperian falsification process (1973) is used for both explicit and tacit knowledge processes even if 82% in 2017, 84% in 2018, 83% in 2019, 68% in 2020, 57% in 2021, 52% in 2022, and 48% of the papers in 2023 do not make any distinction between tacit and explicit knowledge

processes. The inability to distinguish between tacit and explicit knowledge might represent a lack of theoretical sophistication. Two-thirds of the papers need a definition of knowledge, information, management, leadership, or the situations included in these concepts. The lack of definitions presents a kind of storytelling where a story exemplified by statistics is told. The scholarly and scientific storytelling is what Kuhn (1970) defined as a pre-scientific situation where anything might be equal in importance or what Popper (1968) described as the situation for psychology as a field. Kuhn (1970) called this "something less than research." The lack of problem-itis makes it challenging to make progress and accumulate knowledge; as Nonaka (2018) noted, there had yet to be any progress in understanding and performing tacit knowledge(Olaisen&Revang, 2018). There is, however, a greater degree of sophistication in the 2021, 2022, and 2023 papers regarding problem formulations and the knowledge content, making the papers more relevant at a business and societal level. The sustainability and green leadership questions have increased the imagination and creativity of solving several problems that have yet to be solved or even pure speculation as a band wagon effect (Merton,1967).

More than 60% of the papers write about the need for new ways of sustainability and knowledge leadership, management, and organizing. The documents, however, are centered around traditional leadership, management, and organizational issues. The paper's label and marketing propose new leadership, management, and organizing ways. However, they neither define today as the situation nor how we will take us tomorrow. The papers are promising the "promised land," but in the end, tomorrow's management is the same as today's management. The papers' problems are centered around solvable matters and seldom relate to unsolvable problems. In knowledge management research, we define "instrument-itis" and "knowledge-itis" as a misdirecting striving for respectability. Eighty-three of 770 papers (11%) discuss our ecological systems' problems and what we need to do to solve the climate crisis through sustainable businesses. These green ecological papers ask several questions they cannot answer and are thus speculative and are all conceptual papers without any empirical basis. The 2022 and 2023 conferences doubled the number of such papers and increased the conference's relevance for our actual and future business situation. The bearing, creativity, and scientific quality are enormously improved from our earlier analyses of these aspects (Jevnaker & Olaisen, 2021). The 2022 and 2023 papers confirmed the trend toward critical papers discussing sustainability, the climate crisis, and moral issues of what is morally adequate and morally inadequate for businesses. AI is addressed from the angle of what is good for our civilization versus what is suitable for AI businesses. Human control is compared to machine control according to consequences. The 2022 and 2023 papers are more pluralistic in their problem formulation, choice of methodology, and discussion of findings.

5. The Aspects of the World Studied

We are making a distinction between four areas of knowledge in management research: "What we know" (1), "What we know that we do not know" (2), and "What we do not know that we know (3) and What we do not know that we do not know" (4). Area (1) will define area (2), while there will be a misinterpretation and bias towards area (3) and area (4).

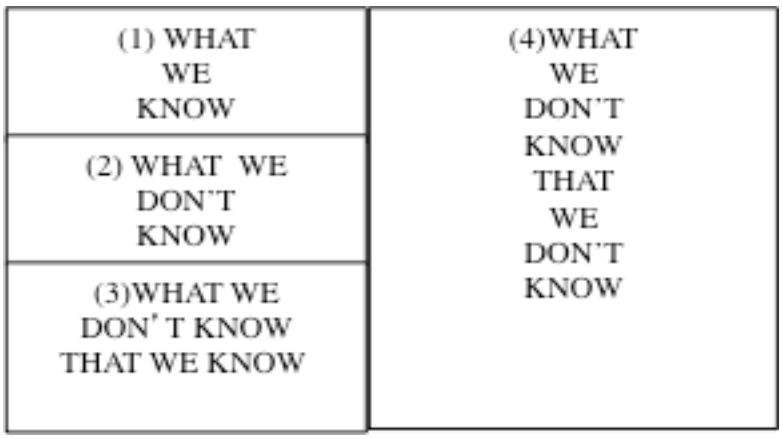


Figure 1: Knowledge representations (Olaisen, 1985).

For areas (3) and areas (4), will imagination and intuition be necessary for the creativity needed to make a scientific movement in knowledge management in zones 3 and 4? If we expand only into area two, it will be limited knowledge research emphasizing instruments and knowledge while the problems will be defined by what

we know. We distinguish between the known, the known unknown, the unknown known, and the unknown. The exciting part is the dynamics between the known and unknown and how we make a part of the unknown known in our research process. The papers have progressed from 2016 to 2023 in defining what is unknown and discussing why tacit knowledge remains unknown in most situations. There is also a beginning discussion of the need to approach the unexplored areas and the challenges looming in the unknown domains.

If we want to move between areas one and two, logical, empirical studies ("secure and clean studies") will be ideal. However, the source of bias and misinterpretations starts as soon as we move into what we do not know anything experienced. We will here begin to involve imagination and intuition. Experience-based intuition is the starting point of any essential research effort. Simultaneously, the movement from area one to area two is only instrumental puzzle-solving, often without knowledge accumulation (Minzberg, 1979; Morgan, 1980). “The way to improve our technique is not to attempt to analyze things into their elements, reduce them to measure and determine functional relations but to educate and train our intuitive powers to make the unimaginative and the unknown known” (Knight, 1936, p. 103). Suppose our role is only to produce some publishable or travelable research. In that case, we are reduced to mechanical puzzle-solving, demonstrating that we can master the techniques we learned in our Ph. D's. Between 50 and 60% of the research papers at ECKM represent this kind of mechanic puzzle-solving (Morgan, 1980). The empirical ECKM researchers are sending out a questionnaire to a large sample, getting a 5-20% response rate. Applying statistics and getting a research classification results in nice tables, diagrams, and figures, getting more of the same trivial already known knowledge. The 2020 and 2021 papers are based on qualitative, in-depth interviews, constructed datasets from several studies, and theoretical foundations. Primarily, the 2022 and 2023 papers represent an improvement with more problem-oriented papers and more speculative papers, including imagination and speculation as a part of the research process. The unknown and unknown areas have gotten more interest, including a few papers (5) in 2021 based upon a constructed empirical basis where the authors discuss unexplored areas to see solutions for sustainability for discussing what green leadership and a green organization represent. The ECKM academic papers at their best in 2021 represent the societal issues addressed later at the Cop 26 conference in Glasgow (Olaisen, 2022). The papers of 2022 and 2023 follow up on these critical issues, wondering if knowledge management represents the problem or the solution.

6. Scientific Orientations

Galtung (1972) assumes that a common goal of all social sciences is to establish what are called sentences dichotomizing their "world space" by including some defining the empirical world by having some "world points" and excluding others. Hence, data sentences explain the empirical world by including what is observed and excluding what is non-observed. On the other hand, theory sentences (hypotheses or propositions) define the foreseen world, including aspects predicted by the underlying theory. Finally, value sentences refer to the preferred world, including what is accepted and excluding what is rejected. We developed Galtung's approach into our research model (Figure 2).

Most of the papers (65%) in 2017, 63% in 2018, 61% in 2019, 52% in 2020, 46% in 2021, and 41% in 2022 and 2023 do not develop hypotheses but only describe the theory's findings without concluding them into hypotheses for testing (Bunge, 1967). However, the research compares data sentences with theory sentences without using Popper's falsification principle (Popper, 1972). The increasing number of papers using hypotheses or propositions increases the discussion of verifying and falsifying the findings. The testing of hypotheses and propositions is making the ECKM conferences more scientific. Dissonance does not produce new theory sentences, while consonance notes that the research results align with mainstream knowledge management research. Criticism is a scientific activity where data sentences are confronted with value sentences. By the tenets of this orientation, consonance is created by producing new data sentences by changing reality into an acceptable condition. Criticism is an increasing part of the ECKM 2017, 2018, 2019, 2020, 2021, 2022, and 2023 papers (15% versus 16% versus 18% versus 23% versus 26% versus 28% versus 30%). The trend is clearly towards more criticism-based pieces. Criticism is needed through values, speculations, and ad hoc methods to advance a field, even if the validity and reliability are lower.

Constructivism implies comparing theory sentences with value sentences to see to what extent the foreseen world is preferred. Consonance refers to what is adequate, and dissonance to what is inadequate. In dissonance, theory and value sentences are prioritized equally, and both might be changed in knowledge management research. Constructivism represents 33% of the papers, increasing from 15% in 2017 to 33% in 2023. The business reality is today complex, sustainable, digital and global. A combination of understanding wholisms and atomisms is needed in a good research strategy (Minzberg, 1979) and actionable puzzle solving (Morgan, 1980).

Imagination and intuition are required for this process (Bunge, 1967; Alvesson & Skjoldberg, 2009). The intuitive powers are less trained among the ECKM researchers even if the number of papers, including a constructed empirical basis through speculations and intuition, increases to meet a higher degree of complexity, like the solutions of future sustainability problems. Papers concerned about sustainability and a circular economy must construct a reality we neither have tried nor have an empirical basis for. To be Marxist, we need a new superstructure for the economic basis, which has to be constructed as adequate for a sustainable business and society.

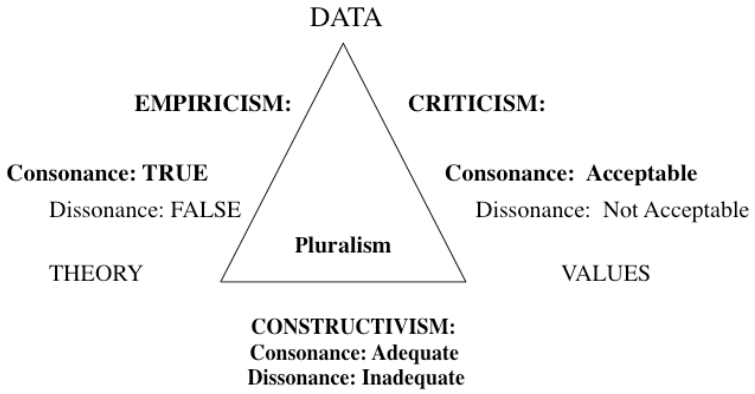


Figure 2: Empiricism, Criticism, and Constructivism

7. The Rise and Fall of Paradigms

Kuhn's position (1970) is that paradigms serve a normative and conserving function. When a standard prevails in a discipline, "normal" science practice evolves as a puzzle-solving activity. During normal science, the scientific community works under the assumption that "it knows what the world is like" and is prepared to defend this assumption "at any cost." (Kuhn, 1970, p. 5). Normal science often suppresses "major novelties, conceptual or phenomenal" (Kuhn, 1970, p. 36). Thus, scientists are only preoccupied with solving problems/puzzles according to accepted rules according to traditional viewpoints or preconceptions. With such anomalies built up and scientists losing faith, the field enters the crisis stage.

Kuhn writes that "there can be a sort of scientific research without paradigms, schools, perspectives"… (1970:11); in such research, "… though the field's practitioners were scientists, the new findings of their activity were something less than science or social science" (1970, p.13). He further notes that "… every individual researcher starts over again from the beginning" (1970, p.13), "… that some competing schools are directing their publications where they may be published. A continued discussion over the same fundamentals and no scientific progress is made at all" (1970, p.159). In the KM papers at ECKM, we have not found any schools of KM or any clearly defined KM research domain. There are no competing schools or paradigms, but mainly papers repeating more or less the same findings. There are new perspectives but not an accumulation of knowledge or defined scientific progress. Feyerabend (1974,p.103) summarized such a situation as scientific storytelling.

We may sum up Kuhn (1970) in this way:

1. Only readily available facts are collected.
2. At this stage, all points seem equally relevant.
3. To get "false" respect the instruments are overemphasized and often presented in "quasi-fanciful" ways to get "false" respect.

Looking at knowledge management research at ECKM, we conclude that this is the situation for more than 63% of the papers. The 2020, 2021, 2022, and 2023 papers were more scientific than the 2017, 2018, and 2019 papers – 63% versus 83%. In 2020-2023, progress was made in making knowledge management more scientific and robust. We found that Feyerabend's and Kuhn's descriptions fit the situation in KM research well. Every researcher starts over again from the beginning with an easily collected survey, and case data are assembled and presented in fancy scientific ways. The papers in 2021, 2022, and 2023 (24%) focused on sustainable businesses, greener businesses and societies, and the future of knowledge work, representing a positive change. The 2022 and 2023 conferences might illustrate a turning point for making knowledge management research more relevant and scientific.

8. Alternative Concepts

The concepts have an essential role in any scientific inquiry. They are usually the anchor point in interpreting findings (Blumer 1969 and Baugh 1990). The concepts are the glasses we have used since our Ph.D. We discuss two different worlds of ideas. The definitive concept is based on empirical data or "evidence" and often searches for causal relationships. Blumer(1969:52) wrote, "… to do robust research is defining and handling your concepts … research without concepts is not researching, but something else….". "Defining the concepts are the start point for any serious research discipline" (Bunge, 1969, p. 97) and "… the only way to get progress" (Feyerabend, 1973, p. 9)."When concepts are not defined there is not a scientific clarification process"(Kuhn 1971, p.87).

In knowledge management studies, the definitive concepts are taking over the ground of the sensitizing concepts(directions along which to look). Taking all the papers and dividing them into one of these ideas, around 65% of the studies rely on definitive deductive theories, while 35% rely on inductive sensitizing concepts. In the ECKM 2020, about 55% depend upon definitive concepts, while 45% rely upon inductive sensitizing concepts compared to 50/50 in 2021-23. The induction process described as "directions along which to look and use intuition and curiosity" (Blumer 1969,p.18) instead of facts or data is less used. Intellectual curiosity might be the path to choose for creative scholars. The papers are becoming more inductive and sensitizing in the 2021,2022, and 2023 conferences than in 2017, 2018, 2019, and 2020). The papers regarding sustainability and green leadership are more complex, focusing upon internal business models as drivers for an external greener and more innovative market and a sustainable societal environmentOlaisen&Revang,2017). Sensitizing concepts are used to find directions to walk in an undefined new, brave, sustainable world. The opening up into new directions, including AI, might strengthen KM or erode KM into conceptual fragments.

9. Alternative Research Paradigms

It is here proposed to analyze knowledge management research from four main perspectives. These alternative realities are different meta-theoretical assumptions about the nature of social science. The empirical paradigm, where its explanatory power establishes causal relationships between variables. The knowledge systems and the knowledge technology relations have a concrete, actual existence and systematic character, producing quantitative and qualitative findings according to the needs of societies and businesses. The business world is considered primarily conflict-free and harmonious at a higher level of aggregation. 50% of the studies in 2018 versus 45% of the 2019 papers belong here, compared to 38% in 2020, 36% in 2021, 31% in 2022 and 29% in 2023. The trend is towards fewer traditional empirical papers and more subjective and exploring papers. We explain the change towards more articles about green, sustainable business models and a new class of younger European researchers and consultants. Today's green reality is a higher external complexity met by clarified subjective and action-based business models. The modus is explorative versus explaining business models. ECKM is in 2021,2022, and 2023, starting to complete this change in the content of their academic papers.

In the materialistic political paradigm, physical events and behavior are the surface manifestations of underlying mechanisms. The materialistic paradigm relies on the assumption of predictable uniformities in the knowledge systems. The world of knowledge systems exchanges is defined by concrete, measurable, ontologically fundamental structures and interdependencies in knowledge systems. 20 % of the studies in 2018 are here versus 21% in the 2019 conference, 16% in 2020, 15% in 2021, 13% in 2022 and 11% in 2023. The importance of the measurable fundamental structures in KM is of lesser importance.KM moves from slow, large samples of definitive quantitative measurements to fast-sensitizing qualitative facts. AI and digitalization require fast decisions.

The clarified subjectivity paradigm holds that social reality does not exist in any concrete sense but is the product of individuals' and organizations' subjective and inter-subjective experiences(Berger&Luckmann, 1966).According to this paradigm, knowledge behavior must be understood from the employee and organization's viewpoint rather than the outside observer. We can only get such understanding by direct, give-and-take interaction with the employees and organizations. We can get surveys as questionnaires, but then we define the questions and the business situation. 25% of the studies in 2018 are here versus 27% in 2019, 32% in 2020, 35% in 2021, 36% in 2022, and 40% in 2023. The action paradigm (5% of the studies in 2018 and 7% of the studies in 2019 compared to 14% in 2020,15, % in 2021, and 20% of the 2022 and 2023 studies) also assumes that what passes for reality is socially determined. The move towards clarifying subjective and action-based paradigms in 2021, 2022, and 2023 is significant. Most ECKM studies are now found within the clarified subjectivity and action paradigm. The change is impressive over a concise period. The change represents a movement from explaining to exploring and exploiting studies. Most studies are empirical, but the findings are

discussed through open-sensitizing glasses rather than definitive glasses. The implications and interpretations are drawn much further, representing complex issues like sustainability, digitalizing, globalization, robotics, and AI. The empirical part is constructed to grasp future survey implications in increasing studies within the clarified paradigm. The teams have a more significant variation of knowledge, experience, and attitudes designed for taking action-driven change decisions based on subjective clarification basics. Academic research is based on slow facts, while business is based on fast facts. The action-driven paradigm then conflicts with academic research, but understanding the paradigm might strengthen KM's relation to practice(Jevnaker and Olaisen, 2022).

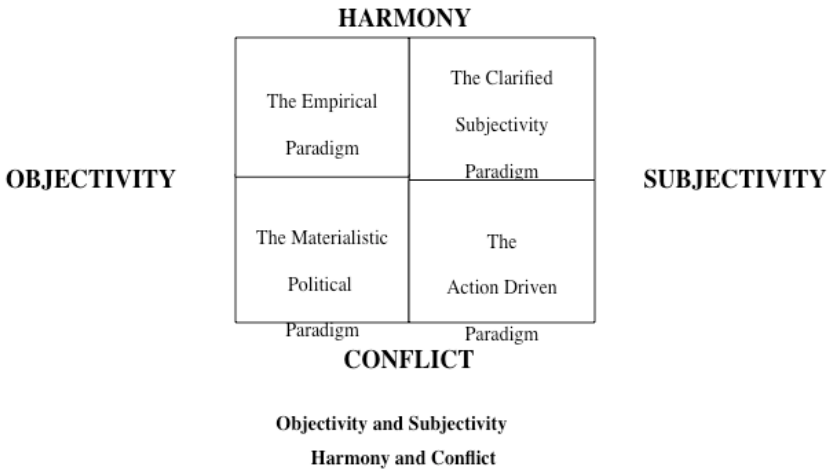


Figure 3: Research paradigms (Olaisen. 1985)

10. The Fall of Knowledge Management as Objective Research?

The action-driven and the clarified subjectivity paradigms represent a different degree of complexity and subjectivity. They represent both harmony and conflict. Various levels of complexity require different research paradigms; Pluralism is demanded to catch other aspects of reality. Subjectivism is necessary to capture complexity. The greener and more sustainable business models, the higher complexity and internal focus to get green action-driven business models. Traditional business models reduce complexity and uncertainty through a higher external market focus. The reality offers inductive exploring versus deductive explaining business models. The driving force for the explorative models is to be ahead of the market, offering new sustainable solutions.

In contrast, they explain that business models are already existing market needs in the traditional industrial way. Disruption, efficiency, and connectivity versus scale economics and effectiveness. Explorative inductive models versus deductive explaining models. Kuhn(1971) will describe it as different paradigms. The standard business science paradigm is under attack, not explaining a new societal and business reality. More and more academic papers at ECKM explore the sustainable and new green reality using more subjective and action-based business models, criticizing existing models and constructing new models. The times are 'changing, and the research methodology with new problems demands other instruments to be helpful in another reality (Jevnaker & Olaisen, 2022).

Consequently, we will have to define this discipline as a subjective multidiscipline, and we will have to explore, innovate, simulate, and experiment to a much higher degree. We need more subjectivity conflicts and less harmony and objectivity in our research. Leadership and organizational methodology movement toward phenomenon research takes research from the iron jacket into a flexible and soft jacket, opening up for alternative realities (Doh, 2015; Schwartz & Stensaker, 2014; von Krogh et al., 2012). The driving force for the future might be green climate business models, giving KM research new possibilities for understanding the green corporation. A green vision, strategy, and business models were nonexistent in the 2017,2018 and 2019 conferences but appeared as fashion in the 2022 and 2023 studies. The first AI studies appeared in 2023

11. Synthesis and Conclusion

Figure 4 presents a synthesis of our reflections. One of the axes represents the degree of complexity, and the other the level of subjectivity. The definitive concepts represent a small degree of subjectivity (i.e., a high degree

of objectivity, if possible), while the sensitizing concepts express a high degree of subjectivity. The four paradigms might be subjective or objective. The problematic question is: if we choose one model, will it be possible to move on from a low degree of complexity to a higher level of complexity (i.e., can we generalize from a tiny part of reality to a more substantial portion) of the reality)? Corporations with green business models, management, and organizational systems will drive societal and market changes. Societies and needs are changing too slowly, and the green knowledge-creating corporation is changing faster and might be the driving force for societal changes. The question is: How does KM's research contribute to green business models and green public strategies and alterations? There may be a new era for KM research.

Are the models interchangeable? It might be impossible or desperate to move up the line from origo to a higher degree of complexity and from the top to Origo (Alvesson & Skjolberg, 2009; Bunge, 1967). The knowledge research reality in AI, digitalization, sustainability, and climate conflicts offers global complexity. To understand this, we must apply subjective paradigms combined with empirical investigations for theory building (Eisenhardt & Grabner, 2007). We have to use sensitizing concepts coupled with actionable, definitive ideas. We have a field like KM research to understand whether applying it is subjective, but it is systematic and logically rigid. Future green business models will move from high complexity and subjectivity (i.e., more explorative and exploiting internal models) to more definitive and objective ones. Today, politics demand green models, solutions, promises, and concrete green business deliveries.

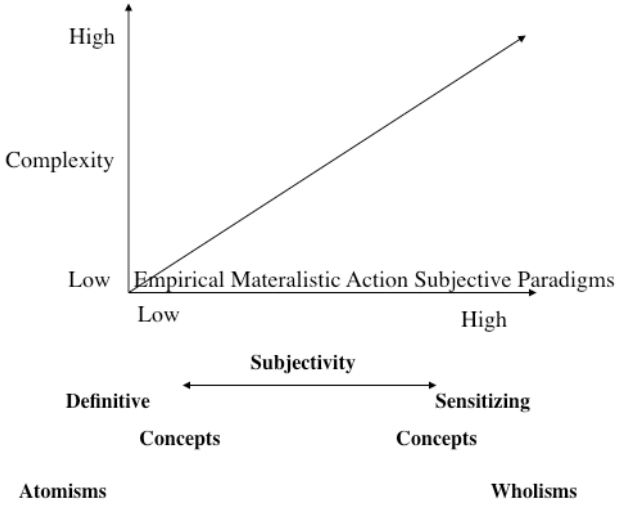


Figure 4: Complexity and subjectivity versus paradigms and concepts

Will KM erode and disappear as a discipline? Interpreting Feyerabend(1987), any storytelling discipline will erode, and we will get a new AI storytelling discipline. Our study reports remarkable adjustments in 2022-23 and changes in all the conceptual and theoretical frameworks used. KM has developed into a pluralistic discipline describing and analyzing the making of a fast-changing reality, including constructions of the future.KM has also kept the notion of understanding tacit knowledge(Olaisen&Revang, 2018). We conclude that KM will remain, and AI will instead become a part of KM rather than the opposite.IS, IRM, IM.IC and ICT are eroded as diciplines(Jevnaker and Olaisen, 2022a) and KM might be the remaining discipline.

References

Alvesson, M., and Skjolberg, K., (2009). Reflexive Methodology, Sage, London.
Berger, P., and Luckmann, T., (1966). The Social Construction of Reality, Wiley, New York.
Blumer, H., (1969). Symbolic Interactionism, Prentice-Hall, New York.
Bunge, M.; (1967), Scientific Research, Springer Verlag, New York.
Doh, JP (2015). "Why We Need Phenomenon-based Research in International Business," Journal of World Business, Vol. 50, No. 9, pp. 609–611.
Feyerabend, P., (1974). Against Methodology, Verso, London.
Feyerabend, P., (1987). Farewell to Reason, Verso, London.
Eisenhardt, K. M., and Graebner, M. E. (2007) “Theory Building from Cases: Opportunities and Challenges," Academy of Management Journal, Vol. 50, No. 1, pp. 25-32.
Jevnaker,B.H., and Olaisen,J.,(2022a), Reimagining Sustainable Organizations, Palgrave Macmillan, London.

Jevnaker, B.H., and Olaisen, J., (2022b). "A Comparative Study of Knowledge Management Research," Knowledge Management Research& Practice, Vol.31, pp. 1-12.
Jevnaker, B.H., and Olaisen, J., (2021). "Making Knowledge Management Research More Scientific, Relevant and Engaged." Electronic Journal of Knowledge Management, 19(2), pp. 194-212.
Knight, F., (1936). The Ethics of Competition, Longman, London.
Kuhn, T., (1970). The Structure of Scientific Revolutions, Chicago University Press, Chicago.
ECKM, (2017,2018, 2019, 2020, 2021, 2022, and 2023), Proceedings, Barcelona, Padua, Lisbon, Coventry (digital), Naples (hybrid), Lisbon (hybrid).
Lawrence, P. R. (1992). "The Challenge of Problem-Oriented Research," Journal of Management Inquiry, Vol.1, No. 1, pp. 139–142.
Nonaka (1985) The knowledge-creating company, Wiley, New York.
Merton, R., (1968). "The Matthew Effect in Science," Science, Vol. 47, No. 1, 56–63.
Mintzberg, H., (1979). "A Strategy for Research," Administrative Science Quarterly, Vol. 24, No. 1, pp. 582-589.
Morgan, G., (1980). "Paradigms for Puzzle Solving," Administrative Science Quarterly, Vol. 25, No. 6, pp. 605–622.
Olaisen, J., and Revang, O.,(2017). "The Dynamics of Intellectual Property Rights." International Journal of Information Management, 37,6, pp. 583-589.
Olaisen, J., (1985). "Alternative Paradigms in Information Science," Libri, Vol. 35, No. 2, pp. 129–150.
Olaisen, J., and Revang, O.,(2017). "Working smarter and greener." International Journal of Information Management, 37,1, 1441-1448.
Olaisen, J., and Revang, O.,(2018). "Exploring the Performance of Tacit Knowledge." International Journal of Information Management, 43,1, pp. 295-304.
Olaisen, J. et al. (2022). "Climate Change and COP26: Are Digital Technologies and Knowledge Management Part of the Problem or the Solution." International Journal of Information Management, 63,1,1-137.
Popper, K (1968). The logic of scientific discovery, Harper&Row, New York.
Schwarz, G., and Stensaker, I. (2014). "Time to Take Off the Theoretical Straightjacket and (Re-) Introduce Phenomenon-Driven Research," Journal of Applied Behavioral Science, Vol. 50, No. 4, pp. 478-501.
Tornebohm, H., (1983). Research reflections and research sentences, Gothenburg University Press, Gothenburg.
VendeVen, A. H., (2007). Engaged scholarship, Oxford University Press, Oxford.
Von Krogh, G., Rossi-Lamastra, C., and Haefliger, S. (2012). "Phenomenon-based Research in Management and Organisation Science: When is it Rigorous and Does it Matter?", Long Range Planning, Vol. 45, pp. 277-298.

Applying Knowledge Management to Support Artificial Intelligence Chatbot Applications

Gustavo Oliveira[1], Matheus Argôlo[1], Carlos Eduardo Barbosa[1,2], Yuri Oliveira de Lima[1], Herbert dos Santos[1], Alan Lyra[1] and Jano de Souza[1]

[1]Programa de Engenharia de Sistemas e Computação do Instituto Alberto Luiz Coimbra de Pós-Graduação e Pesquisa em Engenharia, Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil
[2]Centro de Análises de Sistemas Navais, Marinha do Brasil, Rio de Janeiro, Brazil

ogustavo@cos.ufrj.br
matheusargolo@cos.ufrj.br
eduardo@cos.ufrj.br
yuriodelima@cos.ufrj.br
herbertsds@cos.ufrj.br
alanlyra@cos.ufrj.br
jano@cos.ufrj.br

Abstract: As the diversity and complexity of Artificial Intelligence (AI) systems increase, there is a growing need for advanced knowledge representation methods to enhance decision-making capabilities. Existing research indicates a gap between AI and Knowledge Management (KM), emphasizing the necessity of coordinating learning and knowledge creation processes between humans and machines. Despite the widespread use of generative AI, as seen through the growing popularity of conversational AI tools like chatbots powered by Large Language Models in recent years, the absence of a theoretical framework for effectively managing the knowledge they generate could mean missing out on significant opportunities. This work seeks to bridge this gap between KM and IA through an integrated framework that aims to apply KM to support IA chatbot applications, adapted from the Internet of Everything Integrated Knowledge Management Model (IoE IKM Model). The IoE IKM Model's original goal is to support knowledge creation in IoE applications, but here, we show how it can be adapted to bring KM to the context of AI. We accomplish this by explaining the development process of the IoE IKM Model, identifying shared aspects between IoE and AI general applications, and adapting necessary elements to establish our integrated KM framework tailored for supporting AI chatbot applications. The resulting framework is then discussed, and examples of how it can be applied to enhance human interaction with a chatbot, namely Open AI's ChatGPT. Research has been conducted to demonstrate the advantages of applying AI in KM. However, we aim to take a different approach by showing how KM can contribute to AI applications. We expect this work to be helpful for those whose professional activities may involve the usage of AI systems by providing them with the necessary tools to manage the knowledge generated by these same AI systems and by offering a Knowledge Manager's perspective on how to boost human-machine interaction.

Keywords: Artificial Intelligence, Knowledge Management, Internet of Everything, Chatbots, ChatGPT

1. Introduction

Artificial Intelligence (AI) has become an important and vast field with fast-growing usage recently (Liu *et al.*, 2018). Its applications range from natural language processing to predictive analytics, image recognition, etc. Nonetheless, as AI systems become more diverse and complex, they continuously require more sophisticated knowledge representation and management methods to support their decision-making competencies. The more AI studies and technology expand, the more it interacts with humans (Real de Oliveira and Rodrigues, 2021), thus increasing the need to coordinate human and AI systems' learning and knowledge-creation processes.

Research on Knowledge Management (KM) has focused on understanding the complex relationships between data, information, and knowledge creation, how they are impacted and benefited by the sources of data and information, and the contexts in which they are analyzed and shared (Philip, 2018). Research in the AI and KM fields of studies suggests a gap between those two, which needs to be filled so studies can continue (Jallow, Renukappa and Suresh, 2020). This work proposes an integrated framework to apply KM to support chatbot applications, adapted from the Internet of Everything Integrated Knowledge Management Model (IoE IKM Model) (Costa and Souza, 2022).

The original purpose of the IoE IKM Model was to assist in knowledge creation within the context of IoE applications (Costa and Souza, 2022). However, in this case, we will demonstrate how the model can be adjusted to incorporate KM (Knowledge Management) in the context of AI (Artificial Intelligence). We will achieve this by elucidating the development process of the IoE IKM Model, highlighting the commonalities between IoE and

general AI applications, and customizing the necessary elements to create our integrated KM framework, specifically designed to support AI chatbot applications.

2. Methodology

Design Science Research (DSR) is a research paradigm that employs the principles of Design Science to create artifacts, i.e., objects intentionally created by humans to solve practical problems. Within the domain of information systems design, the Soft Design Science Research (SDSR) methodology serves as an approach for artifact development. It encompasses the formulation of hypotheses, the construction of artifacts through experimentation, and the evaluation of results within a continuous iterative loop that iterates between the development of artifacts and the evaluation of these artifacts until their usefulness and validity are achieved and verified (Baskerville, Pries-Heje and Venable, 2009).

However, developing a new artifact from scratch is only sometimes necessary. Dresch (2021) suggests that, first, searching for an existing artifact that solves the overall problem is necessary. In this work, the practical problem could be summarized as follows: the lack of a framework that assists in managing the knowledge generated by artificial intelligence applications. Suppose an existing artifact has characteristics that identify it as a potential solution. In that case, this artifact should be addressed to ensure that the research is well-developed and will offer a relevant contribution to a specific class of problems (Dresch, Lacerda and Antunes Júnior, 2021).

Initially, we conducted a brief literature review on possible interactions between KM and AI. The practical problem to be solved was the potential need for a framework guiding the application of KM to AI applications. The research question was, "What are the possible theoretical models that integrate KM with AI applications?" This step is necessary to raise awareness of the problem. We were presented with some key concepts summarized in Section 3. The research returned an ideal ready-made artifact: the IoE IKM Model could solve our stated practical problem. Thus, Section 4 is dedicated to showing how the model can be effectively applied to solving the knowledge management problem of AI applications.

3. Key Concepts

Before introducing the framework that will ground this work, we shall discuss the nature of knowledge and its classification. Knowledge is divided into five categories: Explicitness, Structure, Trust, Outcome, and Act. For this work, only Explicitness will be addressed. The Explicitness category has three subcategories: Tacit, Explicit, and Implicit (Ein-Dor, 2008).

Tacit knowledge in AI refers to individuals' expertise, intuition, and skills in AI development and application. It is often difficult to express. It includes insights gained through experience, an understanding of complex patterns, and the ability to make intuitive decisions based on expertise. This tacit knowledge plays a crucial role in designing AI models, selecting appropriate algorithms, and making informed decisions during the AI development (Ein-Dor, 2008).

Explicit knowledge in AI refers to the knowledge that can be articulated, codified, and shared formally and systematically. It includes documented information, algorithms, models, datasets, and best practices that others can easily communicate and understand. It is typically stored in knowledge repositories, documentation, and technical specifications. It can be easily accessed, shared, and transferred between individuals and AI systems (Ein-Dor, 2008).

Implicit knowledge in AI refers to the knowledge embedded within the AI system or the data it processes. It is not explicitly expressed or documented but is derived from the patterns, correlations, and relationships discovered through AI algorithms and machine learning techniques. It is often hidden within large volumes of data and can be extracted through data analysis, pattern recognition, and machine learning models. It may involve insights and information that are not readily apparent or explicitly stated (Ein-Dor, 2008).

Next, we present the two main KM models that influenced the development of the IoE IKM Model: the SECI model (Nonaka and Toyama, 2003) and the SERI cycle (Kim, 2019). Their significance in KM studies cannot be overstated, as they, along with the Hierarchical Model for Knowledge Management proposed by Prat (2006), form the foundation of much of the KM methodology.

The knowledge-creation model expresses the SECI process (Nonaka and Konno, 1998), consisting of four knowledge conversion processes: Socialization, Externalization, Combination, and Internalization (Nonaka and Toyama, 2003). Socialization involves creating opportunities for individuals to interact, collaborate, and engage

in face-to-face or direct communication; Externalization involves articulating and expressing tacit knowledge in a form that can be captured and shared with others; Combination involves collecting, organizing, and synthesizing explicit knowledge from various sources to create new insights, perspectives, and ideas, and Internalization involves the absorption, assimilation, and internal adoption of explicit knowledge by individuals.

According to Kim (2019), the SERI cycle defines the evolution of products and services as a spiral trajectory encompassing four evolution quadrants: Servitization, Establishment, Reinforcement, and Infrastructure:

- *Servitization* represents the initial phase of the product or service evolution. In this stage, the focus is on shifting from a product-centric approach to a service-oriented approach. Companies have started to offer value-added services alongside their core products. For example, a manufacturing company may begin offering maintenance, repair, and training services related to their products.
- *Establishment* is characterized by the growth and consolidation of the service offerings. At this stage, companies refine their service capabilities and develop expertise in delivering the added services. They establish processes, frameworks, and service standards to deliver consistent, high-quality service. This quadrant is about solidifying the foundation of the service-oriented business model.
- *Reinforcement* is when the focus shifts towards strengthening the integration between the product and service components. The goal is to create a seamless and mutually beneficial relationship between the product and the associated services. This quadrant may involve enhancing product features to support better service delivery or adapting services to take full advantage of the product's capabilities. The reinforcement quadrant aims to maximize the synergy between products and services.
- *Infrastructure* represents the final stage of the SERI cycle. In this stage, companies develop the necessary infrastructure and systems to support the delivery of integrated products and services at scale. Infrastructure also includes implementing advanced technologies, establishing robust service management frameworks, and creating efficient service delivery and customer support processes. The infrastructure quadrant ensures the long-term sustainability and scalability of the integrated product-service system.

Finally, the Hierarchical Model for Knowledge Management proposed by Prat (2006) provides an effective conceptual representation of knowledge management from a strategic point of view and proved to be adequate for distinguishing knowledge management processes between strategic processes and operational processes, making it possible to abstract the concepts of value and trust (more strategic point of view regarding knowledge identification and evaluation), from the way knowledge is managed, shared and stored. The evaluation process guides the evaluation of knowledge, knowledge systems, and projects.

4. The IoE IKM Model

Gao et al. (2017) reviewed the definitions of KM. They concluded that despite the vast amount of definitions and descriptions of KM, the essence of KM is to support learning efficacy and integrate different information resources to improve competitiveness advantages. This work suggests using an integrated KM model to support the effective governance of AI applications and help managing the knowledge generated by them. The Internet of Everything Integrated Knowledge Management Model (IoE IKM Model) proposed by Costa and Souza (2022) will be adapted to harness the insights gained from intelligence sources in AI applications, considering AI enablers and observation capabilities, supporting governance and knowledge creation in the AI ecosystem.

The IoE IKM Model was developed by integrating service science and knowledge management research. It leverages awareness of intelligence sources in IoE applications, considering IoE enablers, observation capabilities, supporting e-governance, and knowledge creation (Costa and Souza, 2022). The model integrates the knowledge creation model (SECI process) and service evolution cycles to support the design of intelligent services centered around creating knowledge and value in the IoE context (Costa and Souza, 2022). Figure 1 shows a visua representation of the IoE IKM Model.

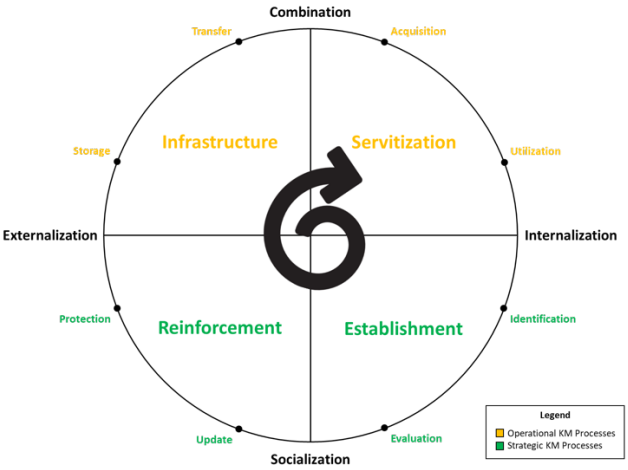


Figure 1: The IoE IKM Model, adapted from Costa and Souza (2022).

The purpose of the IoE IKM Model is to provide a specific knowledge management model that supports knowledge creation in IoE applications (Costa and Souza, 2022). As the model aims to facilitate KM by designing and implementing strategies that consider collaboration between machines, people, and processes, it appeared as a good choice for solving the practical problem stated before.

To adapt the work to AI applications, the focus should be on integrating AI algorithms into the existing knowledge-based strategy for machine-to-machine, human-to-human, and machine-to-human interactions in IoE applications. This integration would enhance the intelligent services provided by the applications by leveraging AI capabilities to process and analyze data more efficiently. Table 1 below shows the adaptations necessary in the defined contextual recommended activities that guide the application of the IoE IKM Model in order to create our AI-adapted IM Model.

Table 1: AI-adapted IKM Model. Adapted from Costa and Souza (2022).

AI-adapted IKM Model			
Service Design	**Knowledge Management Strategy**		
Service Cycle Process	**Knowledge Conversion Process**	**Knowledge Management Process**	**Contextual recommended activities**
Servitization	Combination and Internalization	Acquisition	Analyze data generated by various sources and devices, analyze generated social data to achieve collective intelligence, maintain context-awareness of social relationships from users and devices, maintain context-awareness of infrastructure capabilities as well as information semantic perspective, and support contexts for different individuals to internalize tacit knowledge using the explicit knowledge communicated through the AI applications.
		Utilization	Offer personalized services and customized content according to the user's social context, use of artificial social agents to generate and manage actionable social knowledge within the application environment, allow devices in the execution of automatic tasks without the involvement of the humans, support collaboration and cooperation between AI applications, maintain context-awareness and record the resulting interactions between humans and machines and learn by doing, and interact with analytical software to gain experience.
Establishment	Internalization and Socialization	Identification	Support intelligence orchestration in interactions between humans and machines, understand the AI contexts and customize services and applications accordingly, and foster human-to-machine interactions in a shared time and different places.

AI-adapted IKM Model			
Service Design	**Knowledge Management Strategy**		
Service Cycle Process	**Knowledge Conversion Process**	**Knowledge Management Process**	**Contextual recommended activities**
		Evaluation	Maximize the system knowledge about the social dimension of the users, maximize context-awareness of knowledge in AI applications, computational capability perspective as well as information semantic reasoning perspective, and evaluate knowledge sources, knowledge systems, and KM strategy for service evolution.
Reinforcement	Socialization and Externalization	Update	Develop machines' thinking abilities side-by-side with their social integration abilities, maintain tight coupling of AI techniques merged with the humans' and machines' social context, and cultivate a serendipitous environment through the collaboration of users of AI applications.
		Protection	Evaluate the trust level of AI-generated content, implement a social privacy preserving scheme to support trust, protect the social properties of users as sensitive information to support the customization of offered services, and provide a knowledge protection strategy on behalf of critical knowledge identified for AI applications.
Infrastructure	Externalization and Combination	Storage	Support data management activities at every application, involving pre-processing and filtering tasks, such as data aggregation and data compression, support data acquisition for future training of AI models and AI-generated content.
		Transfer	Use social networks to solve AI-related issues, support service recommendation system to leverage the social relationships between AI applications users, support a socially connected community of users, integrate communication and processing technologies near end-user devices, improve AI application performance and foster information exchange between users, and provide state-of-the-art technologies, software, databases, and repositories.

5. Evaluation

Many AI systems could have been used in this evaluation. A quick Internet search could find examples like BARD, Copilot, SciSummary, AI Lawyer, Dall-E, Midjourney, and Stable Diffusion, to name a few. For now, and for convenience, we will focus on the Large Language Models chatbot applications, which have Open AI's ChatGPT as the most popular. One of the various generative AI, i.e., AI capable of generating new content, such as text, images, or music, based on patterns learned from large datasets, the GPT-3.5 (Generative Pre-trained Transformer 3.5), a transformer-based language model capable of generating coherent and context-relevant texts. GPT-3.5 is trained using a large amount of textual data for translation, text summarization, and dialog generation, among other applications. ChatGPT is a specific implementation of the GPT-3.5 model focused on conversation. It can answer questions, provide information, assist with problem-solving, and engage in natural language dialogues.

The emergence of ChatGPT signifies the advancement of technologies facilitating processing, inference, and dissemination in the realm of information and knowledge. In the field of KM, which encompasses continuous processes such as acquisition, audit, organization, dissemination, value creation, and application of knowledge to achieve business goals, intelligent processing and communication technologies are particularly crucial (Hassanzadeh, 2022). Using these technologies will make access to specific knowledge faster and tailored to individual needs, solving problems related to content, language, and search skills. Dynamic and intelligent systems improve knowledge applicability, bridging the knowledge gap and promoting acquisition. Auditing and replacing outdated information enhances knowledge application (Hassanzadeh, 2022). ChatGPT presents an innovative opportunity for designers to acquire knowledge by providing a comprehensive and integrated platform for knowledge retrieval. Within this centralized system, designers can access a wide range of knowledge, including common sense, domain-specific, engineering, and technical knowledge (Hu *et al.*, 2023).

Integrating AI and KM can potentially boost innovations in diverse sectors such as wireless networks, education, healthcare, businesses, and organizations. Research indicates that AI has already made significant advancements in enhancing the quality and effectiveness of KM. It has proven beneficial in various areas, including knowledge acquisition, problem-solving strategies, knowledgeable tutoring, optimal solution systems, organization, and modeling (Taherdoost and Madanchian, 2023).

Thera are yet many more examples of contributions that ChatGPT in particular can make to the field of KM. Jarrari et al. (2023) highlight potential AI application in different KM processes such as sifting through organizational data and discovering relationships in knowledge creation processes, harvesting, classifying, organizing, storing, and retrieving explicit knowledge in knowledge storing and retrieving, and promoting equitable access to knowledge without fear of reprisal or social cost in knowledge application. Other authors state that organizations ma adopt ChatGPT to store, transform, and distribute organizational data (Korzynski *et al.*, 2023). However, we aim to take a different approach by showing how KM can contribute to AI applications.

The effectiveness of KM is increasing and fostering connections between knowledge and business tasks within organizations. AI agents assist in creating comprehensive conceptual networks, improving the understanding and utilization of organizational knowledge. We asked ChatGPT about how it could be used together with KM. More particularly, we started from the hipotetical existence of an implemented KM system that could benefit from ChatGPT. The question posed was “Imagine I already have a well-established Knowledge Management System (KMS) in my organization. Instead of using ChatGPT to improve it, I want to use it to enhance my interactions with ChatGPT. What would you suggest?” The suggestions given by ChatGPT and their relationship with our proposed AI-adapted IKM Model are shown in Table 2.

Table 2: How KM can benefit ChatGPT?

How KM can benefit ChatGPT?		
Suggestion	**Description**	**Relation with AI-adapted IKM Model**
Integration of ChatGPT with KMS	Integrate ChatGPT directly with your KMS so that it can access relevant information and provide more accurate and up-to-date responses based on the stored data.	Acquisition, Utilization and Identification processes.
Use of Plugins or APIs	If your KMS offers plugins or APIs, explore ways to connect ChatGPT to these resources so it can fetch real-time information and provide contextualized responses.	Transfer process.
Training ChatGPT with Data from the KMS	Feed ChatGPT with data from your KMS during training so that it can learn to interpret and respond to queries more accurately and relevantly.	Update and Storage processes.
Feedback and Continuous Learning	Use interactions with ChatGPT as an opportunity to provide feedback on the quality of responses compared to your KMS. This will help improve the model over time.	Utilization, Identification, Update and Storage processes.
Personalization of Responses	Configure ChatGPT to personalize responses based on specific information from your KMS, such as policies, procedures, or relevant documents.	Utilization, Identification, Update and Storage processes.
Monitoring and Performance Analysis	Track and analyze interactions with ChatGPT to identify areas for improvement and opportunities to optimize the KMS.	Update, Evaluation and Protection processes.
Integration with Workflows	Integrate ChatGPT with existing workflows in your KMS to automate tasks and improve operational efficiency.	Transfer process.

6. Discussion

As can be seen in Table 2, chatbot applications can benefit directly from specific KM processes taking place. The research showed relationships between contextual activities recommended by our AI-adapted IKM Model and the suggestions given by ChatGPT itself. The first one is that knowledge acquisition can enhance integration

between chatbots and a KMS, fostering human-to-machine interactions and helping Interternalization processes. If there are well-structured knowledge transfer processes, integrating a KMS using plugins and APIs to search for contextualized responses is possible. Knowledge transfer practices can also guarantee a good integration with existing workflows in a KMS to automate tasks. Knowledge storage processes can have multiple uses: stored knowledge can be used to train chatbots to give better answers and provide personalized responses. Knowledge storage itself can help make new knowledge generated by AI enduring. Knowledge evaluation and knowledge update processes have the potential to make the performance of AI systems even better. Even though the application of AI seems to be all beneficial, there are still some ethical discussions regarding the use of AI solutions.

Responsible AI entails the ability of AI to provide ethical and legally compliant guidance from a human-centric perspective. The research and development of natural language models significantly emphasize their reliability (Jang *et al.*, 2021). This reliability directly impacts the accuracy of the generated content, which in turn influences the acceptance and effectiveness of the AI. However, the presence of false and outdated information that carries inherent biases can lead to incorrect output, ultimately undermining the reliability of the AI system and eroding user trust.

Also, promoting transparency in AI is a crucial aspect of responsible development. As AI technology advances, the community has a growing consensus to prioritize transparency in decision-making systems. Transparency enables users to understand the underlying basis and sources of their responses, allowing them to verify the accuracy of the provided information (Felzmann *et al.*, 2020).

To address the lack of empirical evidence, we suggest that future research include an empirical study to validate and refine our AI-adapted IKM Model. This empirical study could involve implementing our model in various organizations, ranging from small businesses to large enterprises, ensuring broad applicability. Over six to twelve months, data could be collected on performance metrics such as response time, accuracy of responses, user satisfaction, and the efficiency of knowledge transfer and storage processes. Additionally, user feedback could be gathered through surveys and interviews to gain insights into the human-centric perspective on AI and KM integration.

Detailed case studies of these implementations could be documented, highlighting specific challenges, solutions, and the overall impact on organizational knowledge management and AI performance. These case studies would provide rich qualitative data and practical insights. Ethical considerations would be a key focus, assessing transparency, reliability, user trust in AI systems, data usage, and privacy.

Based on the empirical data, the effectiveness of our model could be evaluated, and areas for improvement could be identified, refining the model to enhance its practical applicability and address any shortcomings. This comprehensive empirical study would provide robust evidence supporting our theoretical framework and demonstrate its real-world effectiveness, contributing significantly to the broader field of knowledge management and artificial intelligence integration.

7. Conclusion

Artificial Intelligence (AI) has grown significantly in recent years. However, there is a gap between this rapid growth and our ability to harness the full potential of knowledge generated by AI-based systems. The field of Knowledge Management (KM) can not only benefit from the application of AI but also provide the theoretical framework and best practices necessary to bridge the existing gap between the two areas. Thus, if correctly applied, KM processes can also enhance AI-based systems and applications.

This work has contributed to the effort to strengthen the relationship between AI and KM by suggesting the adaptation of a KM model initially developed for Internet of Everything applications. This model can be easily adapted for AI application KM, with the necessary adaptations presented and discussed. An evaluation of how appropriate this adaptation was has also been made, specifically for chatbots.

The objective was to pinpoint an effective framework that could seamlessly integrate KM principles into AI applications. Amidst the vast literature, the focus was on finding a holistic framework that clearly merges KM with AI. This endeavor was motivated by the need for a structured method that ensures the efficient use of knowledge assets in AI systems, thereby enhancing their functionality. The aim was to fill the existing knowledge gaps and offer organizations a definitive, actionable guide for incorporating KM in their AI initiatives, effectively enhancing AI's capabilities through the strategic management of knowledge.

When it comes to AI applications such as chatbots based on Large Language Models like ChatGPT, we evaluated the suitability of our adapted KM model for AI by asking ChatGPT itself what possible contributions knowledge management—or an already implemented knowledge management system—could bring to the use of applications like ChatGPT. We concluded that each suggestion would be related to a KM process in the model and to the contextual recommended activities freely adapted from the original IoE IKM model.

The evaluation of the model was limited and represents only a suggestion for the application of our AI-adapted IKM Model. Further testing must be done for the model to prove helpful in incorporating KM practices into the development of AI applications. It would be interesting for the KM field to obtain evidence that the application of KM techniques does indeed bring tangible and measurable benefits in terms of AI system performance. Confirmation of this point could renew interest in the area of KM applied to knowledge generated by AI. Another possible future work would be the development of strategies to externalize the implicit knowledge in algorithms and already trained systems.

In conclusion, integrating knowledge management processes with artificial intelligence applications, particularly chatbots, presents significant potential for enhancing technological and organizational efficiencies. Our AI-adapted IKM Model's theoretical framework offers a structured approach for this integration, detailing the benefits of knowledge acquisition, transfer, storage, and evaluation in AI contexts. Although our study primarily focuses on theoretical insights, future empirical research could provide concrete validation of these concepts. By implementing our model in diverse organizational settings and collecting performance data, we could offer robust evidence of its practical applicability and effectiveness. This empirical work would substantiate our theoretical claims and contribute to refining the model, ensuring it addresses real-world challenges and optimizes AI functionalities. Ultimately, this dual theory and empirical validation approach would provide a comprehensive understanding of the relationship between knowledge management and artificial intelligence, paving the way for more efficient, transparent, and user-centric AI systems.

We expect this work to be helpful for those whose professional activities may involve the usage of AI systems by providing them with the necessary tools to manage the knowledge generated by these same AI systems and by offering a Knowledge Manager’s perspective on how to boost human-machine interaction.

References

Baskerville, R., Pries-Heje, J. and Venable, J. (2009) ‘Soft design science methodology’, in Proceedings of the 4th International Conference on Design Science Research in Information Systems and Technology - DESRIST ’09. 4th International Conference, Philadelphia, Pennsylvania: ACM Press, p. 1. Available at: https://doi.org/10.1145/1555619.1555631.

Costa, V.C.F. da and Souza, J.M. de (2022) A Knowledge-Based Approach to Support Internet of Everything (IoE) Lifestyle. Universidade Federal do Rio de Janeiro.

Dresch, A., Lacerda, D.P. and Antunes Júnior, J.A.V. (2021) Design science research: método de pesquisa para avanço da ciência e tecnologia. Porto Alegre: Bookman.

Ein-Dor, P. (2008) ‘Taxonomies of Knowledge’, in M.E. Jennex (ed.) Knowledge Management. IGI Global, pp. 162–170. Available at: https://doi.org/10.4018/978-1-59904-933-5.ch013.

Felzmann, H. et al. (2020) ‘Towards Transparency by Design for Artificial Intelligence’, Science and Engineering Ethics, 26(6), pp. 3333–3361. Available at: https://doi.org/10.1007/s11948-020-00276-4.

Gao, T., Chai, Y. and Liu, Y. (2017) ‘A review of knowledge management and future research trend’, in Proceedings of the 2nd International Conference on Crowd Science and Engineering. ICCSE’17: 2nd International Conference on Crowd Science and Engineering, Beijing China: ACM, pp. 82–92. Available at: https://doi.org/10.1145/3126973.3126997.

Hassanzadeh, M. (2022) ‘Intelligent Agents and Facilities for Knowledge Management: ChatGPT and Beyond’, Sciences and Techniques of Information Management, 8(4), pp. 7–22. Available at: https://doi.org/10.22091/stim.2023.2421.

Hu, X. et al. (2023) ‘Opportunities and challenges of ChatGPT for design knowledge management’, Procedia CIRP, 119, pp. 21–28. Available at: https://doi.org/10.1016/j.procir.2023.05.001.

Jallow, H., Renukappa, S. and Suresh, S. (2020) ‘Knowledge Management and Artificial Intelligence (AI)’, in Proceedings of 21st European Conference on Knowledge Management. 21st European Conference on Knowledge Management, ACPI. Available at: https://doi.org/10.34190/EKM.20.197.

Jang, J. et al. (2021) ‘Towards Continual Knowledge Learning of Language Models’. Available at: https://doi.org/10.48550/ARXIV.2110.03215.

Jarrahi, M.H. et al. (2023) ‘Artificial intelligence and knowledge management: A partnership between human and AI’, Business Horizons, 66(1), pp. 87–99. Available at: https://doi.org/10.1016/j.bushor.2022.03.002.

Kim, H. (2019) ‘Service Science: Past, Present, and Future’, Journal of Service Science Research, 11(2), pp. 117–132. Available at: https://doi.org/10.1007/s12927-019-0006-5.

Korzynski, P. et al. (2023) 'Generative artificial intelligence as a new context for management theories: analysis of ChatGPT', Central European Management Journal, 31(1), pp. 3–13. Available at: https://doi.org/10.1108/CEMJ-02-2023-0091.

Liu, J. et al. (2018) 'Artificial Intelligence in the 21st Century', IEEE Access, 6, pp. 34403–34421. Available at: https://doi.org/10.1109/ACCESS.2018.2819688.

Nonaka, I. and Konno, N. (1998) 'The Concept of "Ba": Building a Foundation for Knowledge Creation', California Management Review, 40(3), pp. 40–54. Available at: https://doi.org/10.2307/41165942.

Nonaka, I. and Toyama, R. (2003) 'The knowledge-creating theory revisited: knowledge creation as a synthesizing process', Knowledge Management Research & Practice, 1(1), pp. 2–10. Available at: https://doi.org/10.1057/palgrave.kmrp.8500001.

Philip, J. (2018) 'An application of the dynamic knowledge creation model in big data', Technology in Society, 54, pp. 120–127. Available at: https://doi.org/10.1016/j.techsoc.2018.04.001.

Prat, N. (2006) 'A Hierarchical Model for Knowledge Management', in D. Schwartz (ed.) Encyclopedia of Knowledge Management. IGI Global, pp. 211–220. Available at: https://doi.org/10.4018/978-1-59140-573-3.ch028.

Real de Oliveira, E. and Rodrigues, P. (2021) 'A Review of Literature on Human Behaviour and Artificial Intelligence: Contributions Towards Knowledge Management', Electronic Journal of Knowledge Management, 19(2), pp. pp165-179. Available at: https://doi.org/10.34190/ejkm.19.2.2459.

Taherdoost, H. and Madanchian, M. (2023) 'Artificial Intelligence and Knowledge Management: Impacts, Benefits, and Implementation', Computers, 12(4), p. 72. Available at: https://doi.org/10.3390/computers12040072.

Developing Human Skills for Well-Functioning Business Analytics Capability

Johanna Orjatsalo, Henri Hussinki and Jan Stoklasa
LUT University, Business School, Lahti, Finland

johanna.orjatsalo@lut.fi
henri.hussinki@lut.fi
jan.stoklasa@lut.fi

Abstract: The ability to support both strategic and operational management with data-informed insight can generate significant benefits for organizations. Industries continue to become increasingly data-driven, and organizations continue to develop their business analytics capability to seize the value potential embedded in data. Consequently, organizations are investing in data and technology resources and, to leverage these investments, also in human and intangible resources, such as technical skills, managerial skills, and data-driven culture. While the integral role of human skills in an organization's business analytics capability is widely acknowledged within the extant research literature, there is much less discussion and evidence on how organizations develop these skills. However, such investigation would help provide organizations with new perspectives on maximizing the business value of their business analytics capability investments. Using 36 semi-structured interviews, this study explores what kind of measures organizations apply to develop the skills of their analytics professionals. Building on the extant business analytics capability literature and the resource-based view of the firm, this study contributes by deepening the current understanding of the development of human skills in building a well-functioning business analytics capability. Our findings show that, besides technical and managerial skills, organizations should also proactively develop the collaboration skills of their analytics professionals. The practical examples of skills development measures described in this study, such as job rotation, mentoring and role overlaps, provide new ideas for analytics professionals and decision-makers to enhance their business analytics capability development.

Keywords: Business Analytics, Capability Development, Technical Skills, Managerial Skills, Data-Driven

1. Introduction

Business analytics capability (BAC), defined as an organization's ability to effectively leverage its data, technology, and talent to generate data-driven insight (Kristoffersen et al, 2021) is a widely discussed concept among information systems and management science scholars. Since the first conceptualizations (see, e.g., Cosic et al, 2012; Cosic et al, 2015; Gupta and George, 2016), it has been leveraging the resource-based view (RBV) of the firm (Barney, 1991; Penrose, 1959) to elaborate those resources the organizations should possess and combine to form a well-functioning BAC that helps them create value.

As part of the discourse on human and intangible business analytics (BA) resources, several scholars have been seeking to identify what kind of human resources are essential for forming a successful BAC, as well as what is the role of intangible resources, such as the intensity of organizational learning and data-driven culture. The extant literature on human BA resources has extensively focused on listing various human BA skills (see, e.g., Cosic et al, 2015; Qin et al, 2023) and emphasizing the importance of developing those skills (see, e.g., Shao et al, 2023). While such research has helped scholars and managers to understand the significance of human BA skills when forming BAC, it does not offer many practical examples of how organizations develop their human BA skills.

In this study, we explore what kind of measures organizations apply to develop their human BA skills. First, we describe the current literature on BAC and especially the human BA skills and their development. After this, we introduce our research approach, followed by the empirical findings on the observed measures for human BA skills development. Finally, we discuss how this study relates to the extant literature on human BA skills, and how our findings can support both scholars and organizations to increase their understanding of human BA skills development.

2. Theoretical Background

2.1 Business Analytics Capability

This study draws on the resource-based view of the firm (RBV), especially its sub-streams of resource combination (Penrose, 1959), complementarity (Harrison et al., 1991), relatedness (Dierickx and Cool, 1989, and co-specialized resources (Lippman and Rumelt 2003), as well as the emerging discussion on BAC (e.g., Cosic et

al. 2015; Gupta and George, 2016). As per the theoretical underpinnings, firm resources could be far more valuable if they are combined and used together instead of in isolation (Penrose, 1959). By combining complementary, related, and co-specialized resources firms can establish capabilities that help them undertake productive activities through simultaneous deployment of their resources (Lockett et al., 2009; Teece et al., 1997).

In essence, BAC is conceptualized as a multidimensional third-order formative construct, comprising three BA-specific dimensions (i.e., resource categories), including: tangible resources, human resources, and intangible resources (Gupta and George, 2016; Kristoffersen et al, 2021; Mikalef et al, 2020). These dimensions are conceptualized as second-order formative constructs, encompassing seven first-order constructs (Figure 1): tangible resources include data, technology, and financial investments, human resources consist of technical and managerial skills, and data-driven culture and intensity of organizational learning are considered intangible resources, whereas BAC itself is an outcome of an organization-specific combination of these resources (Gupta and George, 2016; Mikalef et al, 2020).

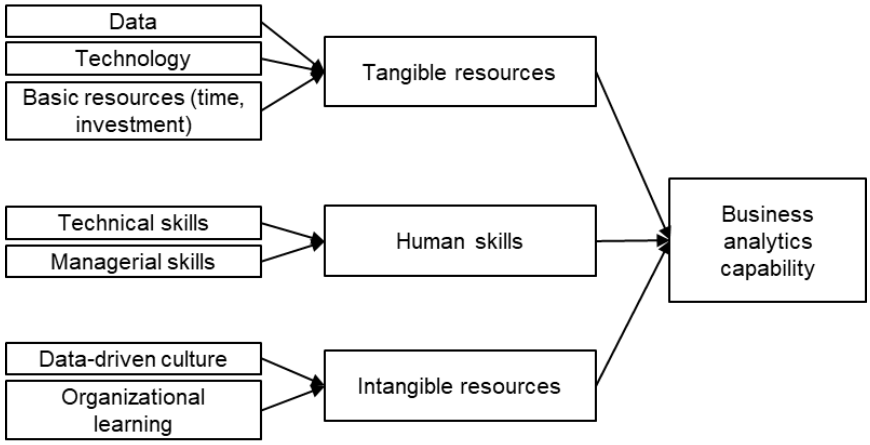


Figure 1: Business analytics capability as construct of tangible, human and intangible resources (e.g., Gupta and George, 2016)

The formative nature of BAC indicates that a firm-specific combination of data, technology, basic resources, technical skills, managerial skills, data-driven culture, and organizational learning are required to establish the capability (Gupta and George, 2016). Having a suitable combination of tangible (also called infrastructure), human, and intangible BA resources is touted as a crucial feature for establishing a well-functioning BAC (Mikalef et al, 2020; Morimura and Skagawa, 2023).

2.2 Human BA Skills

The role of human resources and especially human BA skills is pronounced in the previous literature. For instance, Fosso Wamba et al (2017) conclude that the expertise of analytics personnel is more important for organizations than analytics infrastructure or analytics management in general, and it should be managed dynamically. Further, Kristoffersen et al (2021) warn firms not to focus too much on tangible resources (i.e., data and infrastructure), as the investments targeted on human talent and data-driven culture are equally important for establishing BAC and reaping business benefits.

Human BA resourcesarerequired not only to operate and use BA but also its output. This requires people involved in BA-related activities to possess adequate technical and managerial skills (Gupta and George, 2016; Shamim et al, 2019). Technical BA skills refer to the ability to use BA technology to produce the intended outputs (Gupta and George, 2016; Mikalef et al, 2019), such as skills related to data management and utilization, modeling, and improving the performance of analytical models (Cosic et al, 2012; Srivastava and Dixit, 2023). The technical skills required from the analytics professionals highly depend on the data and technology resources they have at their disposal, but also on the intended use of analytics (Qin et al, 2023; Srivastava and Dixit, 2023). Managerial BA skills are described as a combination of the individual's business acumen and an adequate level of understanding of data and analytics processes, as these help them to understand how BA output is generated and what are those decision-making situations it can be applied in (Carillo, 2017; Mikalef et al, 2019; Shamim et al, 2019; Srivastava and Dixit, 2023). Certain coordination skills, such as resource

management skills (Srivastava and Dixit, 2023) and setting goals and monitoring analytics performance (Cosic et al, 2012) are also required from those who run and develop BA.

Whereas the extant literature seems to agree on the importance of technical BA skills and managerial BA skills as crucial elements of BAC, also skills that facilitate collaboration between business and analytics professionals are important for well-functioning BAC (Carillo, 2017). People leveraging BA should also be endowed with a certain attitude that promotes the collaboration and innovative use of BA (Cosic et al, 2012). Analytics professionals should be able to enhance analytics understanding within the organization, e.g., when they communicate and present their findings to business managers (Carillo, 2017). To be able to collaborate with business managers, analytics professionals should also understand the business they are supporting (Cosic et al, 2012; Ghasemaghaei et al, 2018). For this study, we have combined these skills into one category, describing the collaboration skills needed for operating BAC. A summary of the three categories of human BA skills identified in the extant literature can be found in Table 1.

Table 1: Summary of the three human BA skill categories described in the extant literature.

Category	Description	Related literature
Technical BA skills	Ability to use data and analytics technology to produce intended BA outputs	Cosic et al, 2012; Gupta and George, 2016; Mikalef et al, 2019; Qin et al, 2023; Srivastava and Dixit, 2023
Managerial BA skills	Ability to understand how BA output is generated and where it can be applied Ability to manage BA work and monitor BA performance	Cosic et al, 2012; Gupta and George, 2016; Carillo, 2017; Mikalef et al, 2019; Shamim et al, 2019; Srivastava and Dixit, 2023
Collaboration skills	Communication skills, presentation skills, business understanding, proactive attitude	Cosic et al, 2012; Carillo, 2017; Ghasemaghaei et al, 2018

The extant literature provides various listings of human BA skills that would support organizations in establishing a well-functioning BAC. However, the actual measures that organizations could apply to develop their human BA skills have received significantly less attention. Therefore, it is worthwhile to take a closer look at how organizations develop their human BA skills in practice to ensure a well-functioning BAC.

2.3 Developing Human BA Skills

Organizations' growing need to develop their BAC has increased the demand for human BA skills in the job market (Qin et al. 2023). Possessing a set of human BA skills, however, does not alone guarantee that an organization could be able to leverage these skills to establish a well-functioning BAC (Srivastava and Dixit, 2023). Recent studies have continued to emphasize that organizations should pay increasing attention to continuously develop their employees' BA skills to enhance their performance on individual level (Shao et al, 2023) but also to improve data-driven decision making on organizational level (Srivastava and Dixit, 2023). While the extant management literature contains excellent examples of potential measures for skills development in organizations, it has not been examined, how these measures are applied when developing human BA skills.

Learning takes place continuously and on different levels within organizations, and a large share of individual-level skills that are relevant to conducting organization-specific work tasks are learned as part of everyday work practices and interaction at the workplace (see, e.g., Brown and Duguid, 1991; Tynjälä, 2008). It should be acknowledged that the human BA skills introduced in the extant literature are already based on empirical data, and thereby can be considered as a solid representation of skills that are relevant for operating and leveraging BA in practice.

To enhance the learning of individual employees, organizations can support skills development with various measures (Huselid, 1995; Manuti et al. 2015), including, e.g., job rotation, specific training programs, mentoring programs, talent management programs, or communities of practice for knowledge sharing purposes. Each organization differs in what kind of measures they prefer to apply (Tynjälä, 2008). In this study, we address the question of what kind of measures organizations apply to intentionally support and foster their human BA skills development. Next, we explain how we approached such an endeavor in this study.

3. Methodology

3.1 Data Collection

While the extant literature has mostly focused on identifying the required human BA skills for building a well-functioning BAC, how these skills are developed is a rather unexplored phenomenon. This study pursues to commence this discourse by sharing the observations on measures applied in organizations. To enable collecting novel insight on this topic, we chose to conduct a qualitative inquiry (Timmermans and Tavory, 2012).

The empirical context of this study was informed by the framing of an ongoing research project that had been established to investigate BA usage and development in large Finland-based organizations. To identify suitable informants, we asked these organizations to name informants they considered capable of providing input on BA usage and development (an approach complying with criterion sampling, see, e.g., Patton, 1990). For data collection, we decided to use semi-structured interviews, as this enabled us to adjust the interview themes depending on the role of the interviewee (Qu and Dumay, 2011). Our data was collected between September 2022 and January 2023, and it consisted of 36 interviews that were transcribed with the help of a third-party service provider.

3.2 Data Analysis

The focus of our data analysis was to identify those measures that organizations have applied to develop their human BA skills. Our analysis proceeded through three phases described in Figure 2.

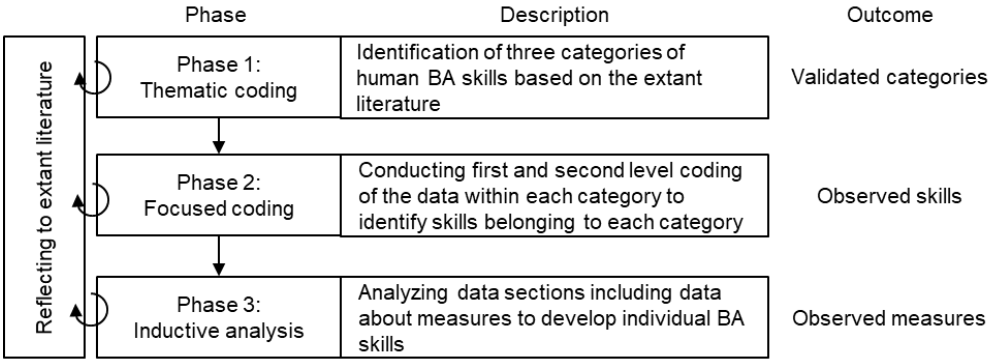


Figure 2: Three-phase analysis approach applied in this study.

Phase 1 had an objective to understand which of the human BA skills observed in previous literature were observable in our data. Hence, we chose to start our analysis by reflecting our data on human BA skills identified in the extant literature in a deductive manner (Fereday and Muir-Cochrane, 2006; Timmermans and Tavory, 2012). This was done as thematic coding, using the three human BA skills categories identified in the extant literature as a starting point (see Table 1).

For Phase 2, we moved into focused coding to further identify the individual skills under each of the three categories we had already used to categorize our data during Phase 1. During this phase, we also continuously returned to extant literature to validate our coding. As a result of the second phase, the structure consisted of three levels of coding (see, e.g., Saldaña, 2013): 1) aggregated third-level codes to describe the categories identified in extant literature (Technical BA skills; Managerial BA skills; and Collaboration skills); 2) thematic second-level codes describing skills within these categories; and 3) focused first-level codes to describe the more granular sub-areas under each skill.

After examining our data from the perspective of human BA skills, we moved on to Phase 3, where we applied a more flexible inductive analysis approach (Timmermans and Tavory, 2012) to identify, what kind of skills development measures we were able to observe from those sections of our data where any of the human BA skills were discussed. Through cross-comparison of our findings, triangulated both between the authors as well as between the data from individual informants (see, e.g., Shenton, 2004) we identified measures that we were able to link to developing specific skills. A summary of these findings is included in Table 2.

Finally, we used our data structure and inductive observations as a basis to form a narrative report of our empirical findings (see, e.g., Krippendorff, 2019) regarding the development of each of the identified categories of human BA skills: technical skills, managerial skills, and collaboration skills.

4. Empirical Findings

4.1 Development of Technical BA Skills

Technical BA skills consist of various skills that are required to leverage an organization's tangible BA resources, such as data and technology (Gupta and George, 2016). According to our informants, the needs for technical BA skills are mostly connected to analytics technologies and tools that the organization has invested in. Examples of such skills identified in our analysis include using various analysis and modeling tools; ensuring analytics output quality; building and maintaining analytics-related tools and services; and – as a skill enabling the other technical BA skills – the ability to identify and apply suitable methods and approaches. Skills related to data management and utilization were emphasized by most of the informants, independent of how they had described the role of other technical BA skills.

Based on our observations, the analytics professionals develop their technical BA skills mainly by attending trainings arranged by external vendors. Analytics professionals also attend analytics-related communities inside and outside organizations to learn from other analysts. Additionally, analytics team managers seem to enable learning at the workplace by offering opportunities for job rotation and to some extent, allowing overlaps in the roles of individual analysts to support peer-to-peer learning. Senior analytics professionals also intentionally get engaged as sparring partners with their more junior colleagues, which we interpreted as a form of workplace mentoring. Our data also indicate that organizations that consider having major gaps in their existing technical BA skills tend to either recruit new analytics professionals with these skills or contract external consultants to temporarily fill in the need for such skills, instead of assuming their existing analytics professionals to develop these skills for themselves.

4.2 Development of Managerial BA Skills

Regarding managerial BA skills, we observed three types of skills that were directly related to BAC. First, analytics professionals are expected to be able to plan, manage, and deliver analytics projects and initiatives. Second, they also need to monitor the value generated through these projects and communicate it to various stakeholders in their organization. Third, our data suggest that individual analysts are often expected to work rather independently, and to organize and manage their own work.

Senior analytics professionals support their more junior colleagues to help develop their skills and improve their readiness to start managing analytics projects and initiatives and monitoring and communicating the value resulting from these projects and initiatives. However, managerial skills, and especially the self-organizing skills in general do not seem to be supported with other development measures. Instead, we paid attention to some of our informants explaining that certain managerial skills and proactive attitude are used as criteria when selecting new members for the team.

4.3 Development of Collaboration Skills

In contrast to technical and managerial BA skills, collaboration skills are not an established concept within BAC-related literature, yet it has been discussed in earlier research. Our data show that analytics professionals collaborate with various intra-organizational stakeholders, such as business managers and their team members, business controllers, other analysts in their own team and across other teams, as well as information systems professionals. They are also involved in inter-organizational collaboration with external consultants and to some extent fellow analytics professionals from other organizations, such as technology vendors. Based on the extant literature, however, skills that can be linked to collaboration with relevant analytics stakeholders are facilitation and presentation skills, business understanding, and a set of skills that form what we have named a “proactive attitude” (see Table 1).

Based on our data, facilitation, and presentation skills are important in many aspects. Whereas presentation skills often manifest through the ability to document and visualize analytics outcomes, analytics professionals are often also expected to present their output to decision-makers and facilitate the discussion during the presentation. Such activities assume them to be able to adjust the level of details in their presentation according

to the audience, as well as apply a conversational approach that enables their audience to understand how the output has been formed and what it means from decision-making perspective. Our data also suggest that an effective measure for developing these skills is to involve more junior analysts into situations where they can learn such skills by shadowing their more senior colleagues.

We also found a strong indication that facilitation skills are required to establish a longer-term collaboration with different analytics stakeholders. Ability to facilitate continuous collaboration and dialogue seems to help analytics professionals to adjust their work based on the business needs and thereby increase the relevance and value delivered by analytics. Additionally, analytics professionals are expected to share analytics-related knowledge and educate their stakeholders, such as business managers and information systems professionals, on analytics-related matters. While these skills emerged through our analysis, we did not identify any evidence in our data of intentional measures to develop these skills, and unlike facilitation and presentation skills concerning the presentation of analytics output, these facilitation skills are not highlighted within the extant BAC literature.

In addition, business understanding is an enabler of collaboration, especially between analytics professionals and business decision-makers. Understanding the internal and external business logic, such as internal processes or industry and market dynamics, combined with the ability to identify business side needs, helps analytics professionals create analytics models that produce the intended output. Therefore, it is connected to the ability to document and visualize analytics outcomes on shorter term but also to the ability to establish a longer-term collaboration with business stakeholders.

Business understanding develops as part of collaboration between business and analytics, and organizations also expect their analytics professionals to proactively accumulate their business understanding as part of their work. To develop business understanding of their analytics professionals, organizations involve them in business meetings and forums on a permanent basis, allow analytics professionals to move between analytics and business roles as part of career development plans, and offer them opportunities to work with various business stakeholders. We also found some indication that business experience and understanding may be valued when recruiting new analytics professionals.

Lastly, we observed a group of "skills" that can be described as individual characteristics or behaviors expected from analytics professionals. These include, e.g., willingness to learn, ability to think critically and to challenge the status quo, creative mindset, and proactive approach to networking and communication. While these characteristics may not be categorized as skills, they may represent the attitude described by, e.g., Cosic et al (2012), and we decided to include them into this category. What comes to achieving such a proactive attitude, our data suggest that this – similarly to the managerial BA skills – is a criterion when hiring new analytics professionals.

Table 2: Summary of empirical findings.

Category	Observed Skills	Observed Measures
Technical BA skills	Managing and utilizing data; Using analysis and modeling tools; Ensuring quality of analytics output; Building and maintaining analytics-related tools and services; Identifying and applying suitable methods and approaches	Participating in externally organized trainings Intra- and inter-organizational analytics communities Job rotation between analytics roles Role overlaps Mentoring Recruitments, temporary hires (consultants)
Managerial BA skills	Planning, managing, and delivering BA-related work and projects; Monitoring and communicating value through analytics; Organizing own work	"Assumed" from new hires Mentoring
Collaboration skills	Facilitation and presentation skills	Job shadowing
	Business understanding	Permanent roles of analytics professionals in business meetings and forums Job rotation between analytics and business roles Offering opportunities to collaborate with various business stakeholders Recruitments
	Proactive attitude	"Assumed" from new hires

5. Discussion and Conclusions

Building on the extant literature on the RBV (e.g., Barney, 1991), resource combination as means to achieve competitive advantage (Lockett et al. 2009; Teece et al. 1997), and the emerging BAC (see, e.g., Gupta and George, 2016) and human BA skills (see, e.g., Srivastava and Dixit, 2023) literature, our study goes beyond the state-of art by offering the first glimpse on the measures that organizations apply to develop those skills.

Our study contributes to extant research in three ways. First, it helps validate the suggested scope of technical BA skills and managerial BA skills already outlined in the extant literature (see, e.g., Gupta and George, 2016; Mikalef et al, 2019; Srivastava and Dixit, 2023). Our analysis shows that the existing high-level descriptions of the technical and managerial BA skills form a solid basis for examining BA skills in organizations and can be applied deductively in qualitative data analysis. On more detailed level, the technical BA skills also seem to vary between organizations, depending on the data and technology resources as well as the intended scope of BA in each organization (Qin et al, 2023; Srivastava and Dixit, 2023). For organizations that aim to develop and improve their BAC, this indicates that they are likely to achieve good results by aligning their BA strategy and technical BA skills, instead of following, e.g., industry trends in terms of talent acquisition.

Second, it combines the various collaboration skills mentioned by, e.g., Cosic et al. (2012), Carillo (2017), and Ghasemaghaei et al (2018), and extends this skill category with additional findings on facilitation skills that promote longer-term collaboration and education of analytics stakeholders, as well as a proactive attitude that represents the individual characteristics expected from analytics professionals. While the human BA skills discussed by our informants were mostly consistent with those human BA skills recognized in the extant literature, collaboration skills received significantly more attention from the informants than the technical and managerial BA skills. Therefore, while our study encourages organizations to continue developing their human BA skills with a wide scope, it highlights the key role of collaboration skills in a well-established BAC and points out the facilitation skills and a proactive attitude as potential new focus areas that could help organizations reap more benefits from their BAC.

Third, it goes beyond the extant BA literature by introducing a set of measures applied in organizations to achieve and develop human BA skills, providing BA scholars and practitioners with a new layer of actionable knowledge on the top of BAC frameworks. Based on our findings, organizations hire analytics professionals mainly when they need to add completely new technical BA skills. As part of the recruitment process, organizations also evaluate candidates based on their collaboration skills, such as business understanding and attitude. Organizations may also fill in the skill gap temporarily by using consultants. Human BA skills are also developed using several measures, such as enabling job rotation within analytics and between analytics and business, offering opportunities for job shadowing, mentoring and peer-to-peer learning, involving analysts in business meetings and forums, and allowing analytics professionals to attend specific (mainly external) trainings to develop their technical BA skills.

The observations made during this study also generated some future research ideas. The extant research already includes manifestations about how business managers should be interested in learning about analytics processes and the potential benefits of using BA to support their decision-making (Carillo et al, 2019; Chen and Nath 2018; Peterson et al, 2023), and thereby understanding the BA skills required from business managers, as well as how to develop them would increase understanding on how to establish a well-functioning BAC. Also, the significance of organizational learning as a crucial element of BAC indicates the dynamic nature of this capability, and organizations should nurture their organizational learning culture to continuously develop their human BA resources and skills (Mikalef et al, 2019; Shao et al, 2023). Thereby, understanding organizational learning mechanisms (see, e.g., Argyris and Schön, 1996) and applying them to identify innovative mechanisms for human BA skills development might help organizations to create a BAC that enables them to achieve competitive advantage.

Simultaneously, the limitations of this study should not be ignored. While the number of interviews forming the empirical data of this study can be considered to provide an adequate basis for conducting a qualitative analysis (Saldaña et al, 2011), our data is collected among large Finland-based organizations and is thereby geographically and contextually limited. We have also aimed at reporting our analysis approach in a transparent manner. However, we also see that further examination of the topic within other contexts (e.g., different geographies, different company sizes) and conducted by other scholars would further support forming an understanding of potential measures for developing human BA skills in organizations.

References

Argyris. C. and Schön, D.A. (1996) *Organizational Learning II. Theory, Method, and Practice*. Addison-Wesley, Reading, Massachusetts.

Barney, J. (1991) "Firm Resources and Sustained Competitive Advantage", *Journal of Management*, Vol. 17, No. 1, pp 99-120.

Brown, J.S. and Duguid, P. (1991) "Organizational learning and communities-of-practice: toward a unified view of working, learning, and innovation", *Organization Science*, Vol. 2, No. 1, pp 40-57.

Carillo, K.D.A. (2017) "Let's stop trying to be "sexy" – preparing managers for the (big) data-driven business era", *Business Process Management Journal*, Vol. 23, No. 3, pp 598–622.

Carillo, K.D.A., Galy, N., Guthrie, C. and Vanhems, A. (2019) "How to turn managers into data-driven decision makers. Measuring attitudes towards business analytics", *Business Process Management Journal*, Vol. 25, No. 3, pp 553-578.

Chen, L. and Nath, R. (2018) "Business analytics maturity of firms: an examination of the relationships between managerial perception of IT, business analytics maturity and success", *Information Systems Management*, Vol. 35, No. 1, pp 62–77.

Cosic, R., Shanks, G., and Maynard, S. (2012) "Towards a Business Analytics Capability Maturity Model", *23rd Australasian Conference on Information Systems, Geelong, 3-5 Dec 2012*.

Cosic, R., Shanks, G., and Maynard, S.B. (2015) "A business analytics capability framework", *Australasian Journal of Information Systems*, Vol 19, pp S5-S19.

Fosso Wamba, S., Gunasekaran, A., Akter, S., Ren, S. J. F., Dubey, R., and Childe, S. J. (2017) "Big data analytics and firm performance: Effects of dynamic capabilities", *Journal of Business Research*, Vol. 70, pp 356-365.

Garavan, T.N., Morley, M., Gunnigle, P. and McGuire, D. (2002) "Human resource development and workplace learning: emerging theoretical perspectives and organisational practices", *Journal of European industrial training*, Vol.26, No. 2/3/4, pp 60-71.

Ghasemaghaei, M., Ebrahimi, S. and Hassanein, K. (2018) "Data analytics competency for improving firm decision making performance", *Journal of Strategic Information Systems*, Vol. 27, pp 101–113.

Gupta, M., and George, J.F. (2016) "Toward the development of a big data analytics capability", *Information & Management*, Vol. 53, No. 8, pp 1049–1064.

Huselid, M.A. (1995) "The impact of human resource management practices on turnover, productivity, and corporate financial performance", *Academy of Management Journal*, Vol. 38, No. 3, pp 635-672.

Kristoffersen, E., Mikalef, P., Blomsma, F., and Li, J. (2021) "The effects of business analytics capability on circular economy implementation, resource orchestration capability, and firm performance", *International Journal of Production Economics*, Vol. 239, 108205.

Krippendorff, K. (2019) *Content Analysis: An Introduction to its Methodology*, Thousand Oaks, CA: SAGE Publications, Inc.

Lockett, A., Thompson, S., and Morgenstern, U. (2009) "The development of the resource-based view of the firm: A critical appraisal", *International Journal of Management Reviews*, Vol 11, No. 1, pp. 9-28.

Manuti A., Pastore, S., Scardigno, A.F., Giancaspro, M.L. and Morciano, D. (2015) "Formal and informal learning in the workplace: a research review", *International Journal of Training and Development*, Vol. 19, No. 1.

Mikalef, P., Boura, M., Lekakos, G., and Krogstie, J. (2019) "Big data analytics and firm performance: Findings from a mixed-method approach", *Journal of Business Research*, Vol. 98, pp 261–276.

Mikalef, P., Krogstie, J., Pappas, I.O. and Pavlou, P. (2020) "Exploring the relationship between big data analytics capability and competitive performance: The mediating roles of dynamic and operational capabilities", *Information & Management*, Vol. 57, 103169.

Morimura, F., and Sakagawa, Y. (2023) "The intermediating role of big data analytics capability between responsive and proactive market orientations and firm performance in the retail industry", *Journal of Retailing and Consumer Services*, Vol. 71, 103193.

Patton, M. (1990) *Qualitative evaluation and research methods*, Beverly Hills, CA: Sage.

Penrose, E.T. (1959) *The Theory of the Growth of the Firm*, John Wiley, New York.

Peterson, J., Tahssain-Gay, L., Salvetat, D., Perez, F. and Hennekam, S. (2023) "How managers approach data analytics: a typology through a Resource Orchestration perspective", *Management Decision*, Vol. 61, No. 5, pp 1225-1243.

Saldaña, J., Leavy, P. and Beretvas, N. (2011) *Fundamentals of Qualitative Research*. Oxford University Press, Incorporated.

Saldaña, J. (2013) *The Coding Manual for Qualitative Researchers*. SAGE, London.

Shamim, S., Zeng, J., Shariq, S.M. and Khan, Z. (2019) "Role of big data management in enhancing big data decision-making capability and quality among Chinese firms: A dynamic capabilities view", *Information & Management*, Vol. 56, 103135.

Shao, Z., Benitez, J., Zhang, J., Zheng, H. and Ajamieh, A. (2023) "Antecedents and performance outcomes of employees' data analytics skills: an adaptation structuration theory-based empirical investigation", *European Journal of Information Systems*, Vol. 32, No. 6, pp 921-940.

Shenton, A.K. (2004) "Strategies for ensuring trustworthiness in qualitative research projects", *Education for Information*, Vol. 22, pp 63–75.

Srivastava, S. and Dixit, G. (2023) “Value of analytics for decision-making: role of managers and analysts”, Journal of Computer Information Systems.

Timmermans, S. and Tavory, I. (2012), “Theory construction in qualitative research: from grounded theory to abductive analysis”, *Sociological Theory*, Vol. 30, No. 3, pp 167–186.

Tynjälä, P. (2008) “Perspectives into learning at the workplace”, *Educational Research Review*, Vol. 3, pp 130–154.

Qin, H., Koong, K., Wen, H. and Liu, L. (2023) “Mapping business analytics skillsets with industries: empirical evidence from online job advertisements”, *Journal of Business Analytics*, Vol. 6, No. 3, pp 167–179.

Qu, S.Q. and Dumay, J. (2011), “The qualitative research interview”, *Qualitative Research in Accounting & Management*, Vol. 8, No. 3, pp 238-264.

Study of the Level of Innovation in the European Union: Poland Compared to the Leading Countries

Zuzanna Ostraszewska and Agnieszka Tylec
Czestochowa University of Technology (CUT), Częstochowa, Poland

zuzanna.ostraszewska@pcz.pl
agnieszka.tylec@pcz.pl

Abstract: Knowledge and innovation are key resources of modern economies. The ability to transform knowledge into new products, technologies, marketing methods and organizational solutions (and thus into broadly understood innovations) is not only the basis of entrepreneurship, but also the foundation for building competitive advantage. Thus, supporting innovation remains the main challenge for managers and staff in power, and the very concept of innovation in enterprises, regions and countries is rightly considered an important area of research. Innovation is therefore an economic category that is measurable. The theory and practice of economic life have allowed the development of a number of metrics for measuring innovation, enabling the assessment of not only its level, but also the source of the innovative potential of individual entities. Taking into account the above, the article presents the results obtained by the EU and its individual countries, based on short theoretical considerations regarding the essence of innovation and the methodological basis for its measurement by the European Commission (in the annual European Innovation Scoreboards EIS using the Summary Innovation Index - SII). The basis for the study is the data contained in the EIS from 2016-2023. The article uses the method of analysis, synthesis and graphical presentation of data. The research focused on Poland and Denmark, which was the leader in innovation in the last study, overtaking the long-term front-runner Sweden.

Keywords: Innovation, Summary Innovation Index

1. Introduction

Innovations are currently treated as one of the most progressive factors of competitiveness, growth and development. Supporting innovation therefore remains the main challenge for managers and staff in power, and the very concept of innovation in enterprises, regions and countries is rightly considered an important area of research (Szklarz et al, 2021; Bielińska-Dusza and Hamerska, 2021; Stojanović, Puška and Selaković, 2022). Innovation is therefore an economic category that is measurable. The theory and practice of economic life have allowed the development of a number of metrics for measuring innovation, enabling the assessment not only of its level, but also the indication and assessment of the sources of innovation potential of individual entities (Krawczyk-Sokołowska, Pierscieniak and Caputa, 2021). Without a doubt, a special area of interest in this matter is human capital: knowledge, entrepreneurial attitudes and appropriate resource management. The above may be confirmed by the fact that the above-mentioned categories were included in the structure of the Summary Innovation Index, a measure used by the EU to monitor the innovation of its countries.

The aim of the article was to conduct an analysis of the level of innovation in Poland compared to EU countries, with reference to nations that have been innovation leaders for years. The study was based on the latest European Innovation Scoreboard (EIS 2023) data. The countries, to which the results obtained by Poland were referred, are Sweden (the leader in previous years) and Denmark, with the best results among all EU countries in 2023. Indirectly (due to the interdependence of knowledge and innovation) this will allow us to determine how Poland uses knowledge and the potential of its resources compared to other countries. In the era of globalization and the race of economies, innovation and knowledge - as their sources - have become particularly important. Therefore, conducting dedicated research and showing the results, as presented in the article, is important due to the need to monitor this phenomenon. This allows us to determine the level of innovation in individual countries and the factors determining it (developing and inhibiting it). They can thus become a contribution to identifying the directions of necessary changes and optimizing decision-making processes in this area.

To achieve the indicated goal, first of all, short theoretical considerations were presented in the field of the essence of innovation and knowledge as its basis. Then, the methodological assumptions for measuring innovation in the EU using the Summary Innovation Index and the data taken into account when determining the level of innovation in individual countries and the entire EU are presented. The essential part of the presented considerations is a descriptive and graphical presentation of the level of innovation in the EU and member states, with particular emphasis on the comparison of the results obtained by Poland with the results of countries placed on the innovation map in the Innovation Leaders group. The presented data will allow for the identification and preliminary comparisons to other EU countries of Poland's innovative potential, based, in

the authors' opinion, mainly on knowledge and financial resources. At the same time, it is an introduction to further work, in which Poland's innovation profile will be determined based on the decomposition of the SII index. The results of this work will be presented in the publication: "Analysis of Poland's innovation profile based on the decomposition of the Summary Innovation Index (SII)".

2. Knowledge as the Basis for Innovation - Outline of the Issues

Innovation and knowledge are basic components of the development of enterprises, countries, economies and various organizations. Innovation-oriented entities are modern knowledge enterprises. These entities recognize its power and see it as a key factor in shaping competitive advantage, resulting from the ability to transform knowledge into new products, services, technologies, marketing techniques and organizational solutions, i.e. into innovations. When analysing the issues of knowledge and innovation, it is impossible not to notice a certain interdependence. Without appropriate knowledge potential, it is difficult to plan and implement any changes and innovations. On the other hand, innovations create demand for new areas of knowledge (Kokot-Stępień and Krawczyk, 2023; Chomać-Pierzecka, 2018). Going further, the greater the knowledge in the field of innovation processes, the more productive are human resources, which translates directly into an increase in knowledge capital and innovation capital (Myjak, 2022).

It is obvious that the scale of innovative activity is determined by the innovative potential of organizations, the use of which in an effective manner means having innovative capacity (including the creative creation process). Managerial and employee competencies are assumed to be the key determinants of building and developing innovative capacity - in particular "inside" knowledge (creativity and knowledge of employees, databases held by the enterprise/organization) and knowledge obtained from outside. Other elements include: modern infrastructure, work organization, cooperation in knowledge management (i.e. building knowledge alliances with clients and other entities and using open sources of knowledge, purchasing technology (Karaś, 2021; Haberla and Kuźmińska Haberla, 2013). The process of converting external knowledge into internal knowledge and back into external knowledge - materialized in innovations - is also considered particularly important in the innovation process (Baruk, 2016; Castaneda, and Cuellar, 2020).

Innovation and innovativeness are identified with novelty, or more precisely, with beneficial novelty that will not exist without scientific and technical knowledge. Innovation is a category with a large semantic capacity. This results in numerous definitions and taxonomies (Ostraszewska and Tylec, 2017; Kogabayev and Maziliauskas, 2017; Taylor 2017), with particular importance given to the interpretation contained in the Oslo Manual (2018), which allows for distinguishing individual types of innovation, as well as its important feature indicating that the innovation must find practical application. Thus, the term "innovation" means "a new or improved product or process (or combination thereof) that differs significantly from the entity's previous products or processes and which has been made available to potential users (product) or put into use by the entity (process)". According to this definition, there are two main types of innovations, i.e. product innovations (new or improved product/service) and business process innovations. In the previous edition of the Manual (2005), four of them were distinguished, i.e. product, process, marketing and organizational innovations (OECD, 2018). Quoting the above definition here is important because the Oslo methodology is used by Eurostat (including the EIS) and is the basis for developing the Summary Innovation Index (SII), which is a set of sub-indicators grouped into dimensions and categories (Onea, 2020; Janoskova and Kral, 2019).

3. The Essence of Measuring Innovation with the Summary Innovation Index (SII)

The analysis of the literature on the subject allows us to conclude that various and extensive tool sets and measures have been developed that can be used to assess the level of innovation of countries or enterprises. At the same time, methodological problems are identified in the construction of the measures themselves, which makes it difficult and sometimes impossible to conduct analyses and make comparisons (Podstawka, 2021; Szuper, 2021). Therefore, there is no ideal model of the innovation research system. The SII Summary Innovation Index used by the EU - despite its limitations - allows for a synthetic assessment of the innovativeness of EU countries and for making appropriate comparisons (Mikołajczyk, 2016). The SII index is a composite index calculated (since 2001) on the basis of sub-indexes, grouped within categories and dimensions. Tables 1-3 present the categories and dimensions of the indicator, divided into the last 3 periods in which its significant modifications were made. The last major revision took place in 2021. As a result, the SII indicator from 2021 is a set of 32 sub-indexes grouped into 4 main categories and 12 dimensions of innovation (European Commission, 2022; European Commission, 2023).

Table 1: Categories and dimensions of SII sub-indexes in 2010-2016

	Categories and dimensions of SII sub-indexes (2010-2016)		
	Catalysts	**Firm activities**	**Outputs**
Innovation dimensions	Human resources	Firm investments	Innovators
	Open, perfect and attractive research systems	Relationships and entrepreneurship	Economic effects
	Finance and support	Intellectual assets	
25 indicators			

Source: own elaboration on European Commission, 2016.

Table 2: Categories and dimensions of SII sub-indexes in 2017-2020

	Categories and dimensions of SII sub-indexes (EIS 2017-2020)			
	Framework conditions	**Investments**	**Innovative activities**	**Impacts**
Innovation dimension	Human resources	Firm investments	Innovators	On employment level
	Attractive research systems	Finance and support	Linkages	On sales level
	Innovation-friendly environment		Intellectual assets	
27 indicators				

Source: own elaboration on European Commission, 2018; European Commission, 2020.

Table 3: Categories and dimensions of SII sub-indexes in 2021-2023

	Categories and dimensions of SII sub-indexes (EIS 2021-2023)			
	Framework conditions	**Investments**	**Innovative activities**	**Impacts**
Innovation dimension	Human resources	Firm investments	Innovators	On employment level
	Attractive research systems	Finance and support	Linkages	On sales level
	Digitalisation	Use of information technologies	Intellectual assets	Environmental sustainability
32 indicators				

Source: own elaboration on European Commission, 2022; European Commission, 2023.

In previous years, the SII index included (European Commission, 2016, European Commission, 2018, European Commission, 2020):

- 25 indicators, 3 categories, 8 dimensions (2010-2016),
- 27 indicators, 4 categories, 10 dimensions (2017-2020).

The SII index ranges from 0 to 1. The closer to 1, the higher the level of innovation of a given country. Currently, this indicator is calculated based on 32 sub-indicators (Crisan and Stanica, 2022; Šofranková et al, 2022). Based on the value of the indicator and its level in relation to the EU average, belonging of a given country to one of the four groups of innovation efficiency for EU Member States is determined. The following classification scheme was adopted in EIS 2023:

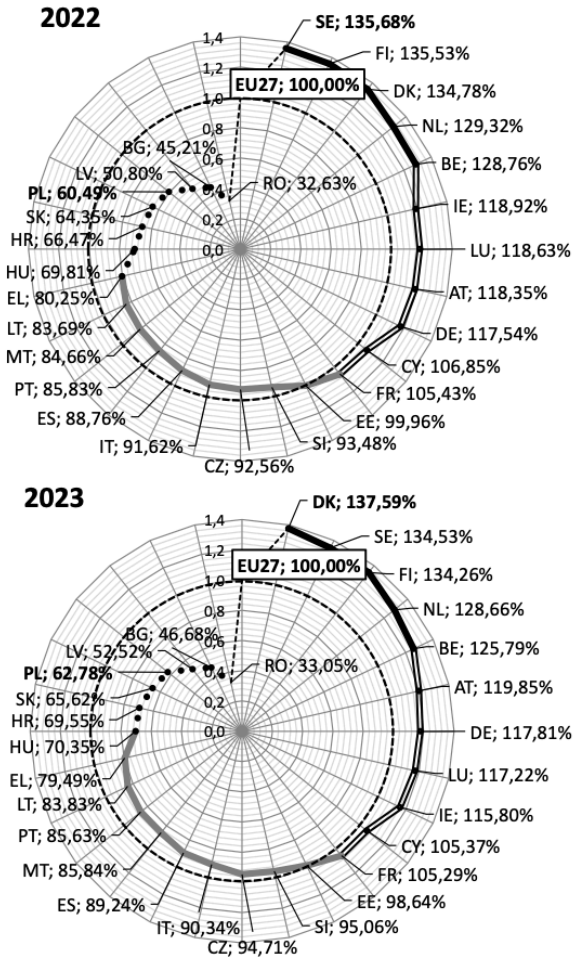
1. Innovation Leaders - countries for which the SII value was above 125% of the EU average,
2. Strong Innovators - countries for which the SII value was between 100% and 125% of the EU average,
3. Moderate Innovators - countries for which the SII value was from 70% to 100% of the EU average,
4. Emerging Innovators - countries for which the SII value was below 70% of the EU average.

These thresholds and the names of individual groups have also been modified compared to previous editions (Preda et al, 2019). Even a superficial analysis of the data allows us to conclude that Poland is classified in the fourth category, i.e. countries with the lowest level of innovation.

4. Innovation of the European Union According to the SII index value

The 2023 Innovation Scoreboard (EIS 2023; European Commission, 2023a), based on eight years of data, provides a comparative assessment of the research and innovation performance of EU Member States and selected third countries and the relative strengths and weaknesses of their research and innovation systems. It helps countries assess where they need to focus their efforts to improve their innovation performance. The EIS 2023 report is the third edition published using the new measurement framework introduced in 2021 and, as this report shows, in 2016-2023 the European Union improved its innovation performance (expressed by the SII index) by approximately 8.5 percentage points. Over this period, the innovation performance of most EU Member States has improved, confirming that the Union is a favourable environment for innovation. However, the innovation gap between countries persists because countries with weaker innovation systems are developing at a slower pace than the European Union.

	2022			2023	Ranking change	Performance change 2016-2023 (pp)
INNOVATION LEADERS	Sweden	SE	1	2	-1	10,4
	Finland	FI	2	3	-1	18,3
	Denmark	DK	3	1	2	16,0
	Netherlands	NL	4	4	0	8,6
	Belgium	BE	5	5	0	14,1
STRONG INNOVATORS	Ireland	IE	6	9	-3	2,3
	Luxembourg	LU	7	8	-1	-1,5
	Austria	AT	8	6	2	6,4
	Germany	DE	9	7	2	7,6
	Cyprus	CY	10	10	0	35,6
	France	FR	11	11	0	-1,6
EU27			**12**	**12**	**0**	**8,5**
MODERATE INNOVATORS	Estonia	EE	13	13	0	29,3
	Slovenia	SI	14	14	0	2,9
	Czechia	CZ	15	15	0	21,0
	Italy	IT	16	16	0	15,6
	Spain	ES	17	17	0	9,7
	Portugal	PT	18	19	-1	7,7
	Malta	MT	19	18	1	10,9
	Lithuania	LT	20	20	0	16,7
	Greece	EL	21	21	0	22,2
EMERGING INNOVATORS	Hungary*	HU	22	22	0	7,7
	Croatia	HR	23	23	0	14,8
	Slovakia	SK	24	24	0	6,4
	Poland	**PL**	**25**	**25**	**0**	**13,3**
	Latvia	LV	26	26	0	3,5
	Bulgaria	BG	27	27	0	4,4
	Romania	RO	28	28	0	1,4



*since 2023 Hungary's performance group is Moderate Innovators

where:

Innovation leaders; Strong innovators; Moderate Innovators; Emerging innovators

Figure 1: Development of innovation performance in EU member states according to the value of the Summary Innovation Index (SII) in 2022 and 2023 (as a percentage of the EU average)

Source: own elaboration on Eurostat data.

The analysis of research results contained in subsequent European Commission reports on innovation proves that over the years both the level of innovation in individual countries and the share of countries within the four groups characterizing the categories of innovators change. The modification of the methodology for 2021-2022 and the percentage range of classification of innovators also had a significant impact on these changes. Figure 1 shows the division of European Union countries into groups of innovators, corresponding to the results included in EIS 2022. This data is compared with the latest results from EIS 2023. The purpose of this graphical presentation was to show changes in the ranking on the innovation map of EU Member States over the course of the last two years of analysis and to present the evolution of innovation by comparing the results from 2016 with the latest results.

Between 2016 and 2023, differences in performance between Member States decreased, most significantly in the groups of strong and moderate innovators. However, the distribution of innovation performance groups still shows a geographical concentration - innovation leaders and most strong innovators are located in Northern and Western Europe, and most moderate and emerging innovators are located in Southern and Eastern Europe. As mentioned earlier, the EU's innovation performance has increased by 8.5 percentage points since 2016, driven by an increase in innovation in 25 EU Member States (except Luxembourg and France). The Member States that increased innovation the most are: Cyprus, Estonia, Greece, Czech Republic (by 20 percentage points or more; grey in the last column of the table). Generally speaking, the greatest improvement was recorded in the case of indicators included in the Innovative activities and Investments dimensions, i.e.: business process innovators (SMEs), venture capital expenditures, international scientific co-publications, job-to-job mobility.

In the latest edition of the European Innovation Scoreboard (EIS 2023), the distribution of Member States by performance groups remains largely unchanged compared to the previous year (Figure 1). It is worth emphasizing that Denmark is a new innovation leader with the best results in the EU, outdistancing Sweden after several years of its leadership position. According to the results of the latest Commission report, taking into account that the average SII innovation index for the European Union for 2023 was 0.54761, the group of other innovation leader countries included Sweden, Finland, the Netherlands and Belgium with innovation results significantly above-mentioned average. The SII index for this group of countries ranged from 0.6888 to 0.7535. Figure 1 presents the percentage of each country's SII index to the EU average, which was treated as a base value (100%). Its analysis shows that the percentage results of the strongest innovators significantly exceed the EU average - by a minimum of 25.79pp (Belgium) and a maximum of 37.59pp (leader - Denmark). Countries with decreasing SII index values, approaching the EU average (0.5766-0.6563; 105.29% and 119.85%, respectively), are included in the group of strong innovators and include, in descending order: Austria, Germany, Luxembourg, Ireland, Cyprus and France. By far the largest decline in the ranking of EU countries (and strong innovators) was recorded by Ireland, which dropped from 6th position in the ranking in 2022 to 9th in 2023. In turn, in France and Luxembourg, as the only European countries, there was a slight decline in results compared to the results in 2016. This highlights the need for continued efforts to increase innovation capacity, regardless of past performance.

The largest group, consisting of 10 members, comprise moderate innovators, i.e.: Estonia, Slovenia, the Czech Republic, Italy, Spain, Malta, Portugal, Lithuania, Greece, as well as a new member of this group - Hungary. In this group of innovators, Estonia showed the level of innovation closest to the EU average, differing only slightly from the EU average with a score of 98.64%. Hungary made significant progress and moved up to the better performing group, moving up the rankings from Emerging innovators. However, they still remained in 21st place among European countries (22nd including the average for the entire EU), so qualifying for the Moderate innovator category was due to the increase in the percentage of Hungary's SII in the EU average from 69.81% in 2022 to 70.35% in 2023. The results achieved by Croatia, Slovakia, Poland, Lithuania, Bulgaria and Romania with SII index values in the range of 0.1810-0.3809 place the above-mentioned countries well below the EU average, which resulted in their classification in the last group - Emerging innovators. In this group, the greatest progress in increasing innovation compared to 2022 was made by Bulgaria (increase in the share of the SII index in the EU average by 6.0pp) and Poland (increase in the share of the SII index in the EU average by 5.2pp), and taking into account the eight-year period - Croatia (increase in the SII share by 14.8pp) and again Poland (increase in the SII share by 13.3pp).

5. Poland's Innovativeness Compared to the European Union Leader Countries - Analysis of SII and Dimensions of Innovation

Poland, with an innovation index of 62.8% of the EU average, ranks in the last group of innovators - emerging. With the change in the methodology for calculating the SII index, starting from 2021, its innovation standing on the European Union results map deteriorated - from the position of a moderate innovator to the level of an emerging innovator. Figure 2 presents the evolution of Poland's results in the field of innovation, measured by the level of the SII index in 2016-2023, taking 2016 as the base year and presenting the annual pace of change. Poland's innovativeness has improved significantly over time, with this improvement occurring cyclically every second year of analysis. The largest declines in innovation were recorded in two years: in 2018 compared to the previous year (by 0.20%) and in 2020 compared to 2019 (0.89%). In the comparison of data from 2021/2020 and 2023/2022, the growth dynamics of the SII index was the highest, which ultimately translated into an overall improvement in Poland's innovativeness by 24.28% compared to 2016. The fastest pace of change was recorded in 2023 - the level of innovation measured by the SII index increased by 8.31% compared to the previous year.

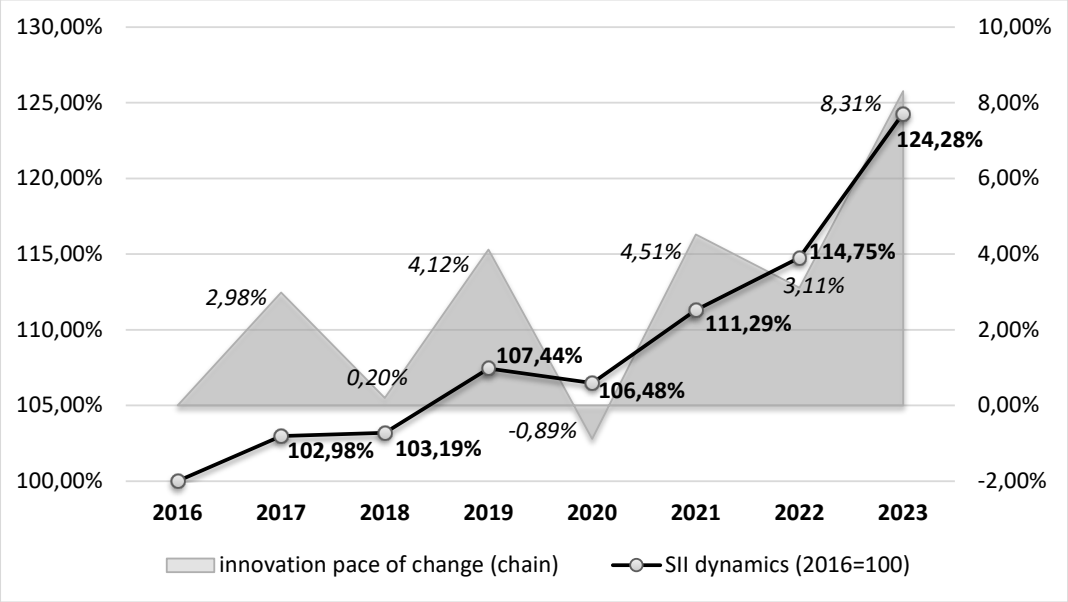


Figure 2: Evolution of Poland's level of innovation in 2016-2023

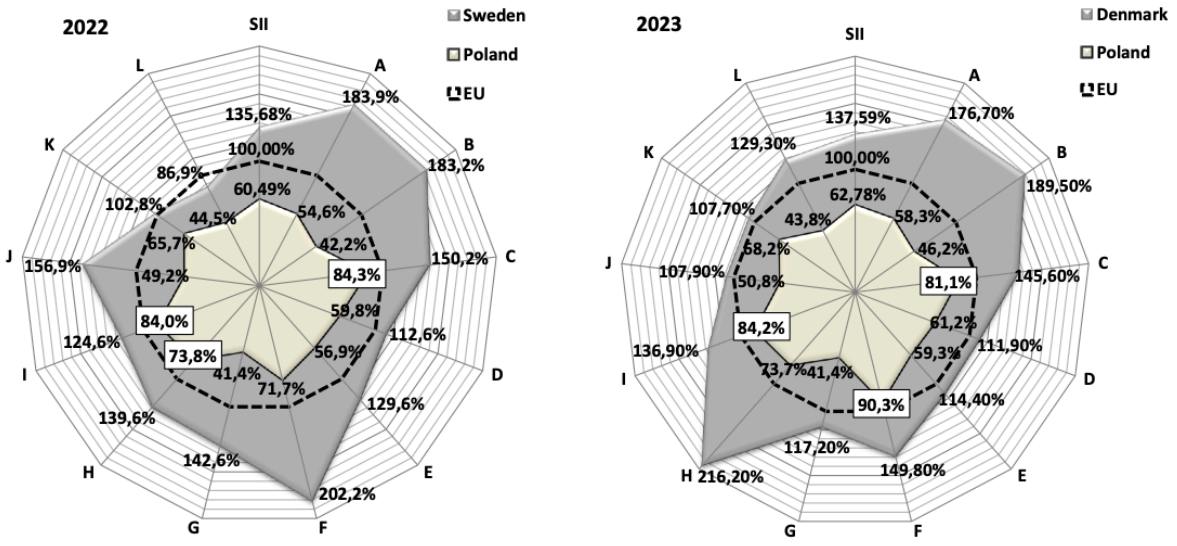
Source: own elaboration on Eurostat data.

In the further course of the analysis, the results of Poland, the innovation leader from 2022 - Sweden, and the innovation leader from 2023 - Denmark, were assessed in terms of the dimensions of innovation, which are presented in Figure 3. Similarly to Figure 1, reference was made to the EU average, and the aim was to show the strengths and weaknesses of both the 24th country in the innovation ranking of European countries - Poland, as well as to illustrate the results achieved in the field of innovation by countries considered the best in this matter over the last two years.

Despite a significant increase in innovation over the last year, Poland performs worse than the EU average in all 12 dimensions of the EU Summary Innovation Scoreboard (marked alphabetically), as presented in Figure 3. The distribution of Poland's innovation dimensions (light grey) also allows stating that progress is gradual and the results for 2023 do not differ significantly from the results from the previous year. In 2022, the average values for Poland in the twelve components of the indicator ranged from 41.4% of the EU average of the Innovators (G) dimension to 84.3% for Digitization (C), and in the case of the contemporary innovation leader - Sweden - in the range of 86.9% determined by the Environmental Sustainability (L) and 202.2% for the Use of Information Technology (F). In 2022, Sweden exceeded the EU average in 11 out of 12 dimensions of innovation, including in six cases by a minimum of 40.0pp (a maximum of 102.2pp).

In 2023, the Innovators (G) dimension was again the one in which Poland achieved the weakest results (41.4% of the EU average), while innovation measured in dimension F - Use of information technologies - came closest to the EU average. It was this dimension that developed the fastest in Poland, which resulted in an increase in the indicator, calculated as a percentage of the EU average compared to 2022, by 18.6pp - the highest for all

dimensions. The next result concerned Attractive research systems (B), but here the increase in the indicator was not so significant - only by 4 percentage points. Decreases were recorded for these dimensions: Digitization (-3.2pp), Environmental sustainability (-0.7pp) and Linkages (-0.1pp).



A - Human resources	**D - Finance and support**	**G - Innovators**	**J - Employment impacts**
B - Attractive research systems	**E - Firm investments**	**H - Linkages**	**K - Sales impacts**
C - Digitalisation	**F - Use of information technologies**	**I - Intellectual assets**	**L - Environmental sustainability**

Figure 3: Dimensions of innovation and the level of the Summary Innovation Index (SII) for Sweden, Denmark and Poland in 2022 and 2023 (as a percentage of the EU average)

Source: own elaboration on Eurostat data.

It is worth paying attention to the results achieved by the new (2023) European innovation leader, i.e. Denmark. This country, overtaking Sweden and Finland in 2023, became the innovation leader thanks to the SII index value of 137.6% of the EU average. This was partly due to significantly improved indicators for non-R&D innovation spending and sales of innovative products, and partly due to a decline in Sweden's innovation performance in 2022-2023. Denmark's innovation performance has been growing at a rate of 16pp since 2016, which is higher than the EU average (8.5pp; last column in Figure 1). In 2023, Denmark exceeded EU values in all 12 dimensions of innovation, although this result was not uniform. In 5 cases, the dimension values exceeded the EU average by 25.50pp, in three - by more than 50.0pp (including a maximum of 116.2pp). Both Denmark and Sweden were undisputed leaders in terms of Human resources (A), achieving 176.70% and 183.50% of the average EU indicator value in 2023, respectively (second and first place in the EU). Denmark's progress is particularly visible here, as it moved up from third place in the ranking to second, outclassing Finland. These countries are therefore distinguished by a high share of labour resources with appropriate skills and qualifications that are necessary to build a knowledge-based economy.

6. Conclusions

Innovation is the engine of development. The driving force of innovation is people and their knowledge. Man, thanks to his knowledge, skills and actions, is responsible for most of the processes taking place in modern organizations, including countries and their associations, such as the European Union. The ability to create and implement innovative solutions, and thus the ability to develop himself and the above-mentioned organizations, depends on a person's knowledge, ingenuity and creative involvement. In the literature on the subject one can find statements about the philosophy of development through innovation as a combination of knowledge and experience (Chomać Pierzecka, E 2018).

Innovation, knowledge and creativity are also familiar to Polish enterprises, but despite human resources (often indicated as a strong point of the Polish economy), it cannot be said to be innovative, especially when compared to other EU countries. Research on Poland's innovative performance based on 32 sub-indicators conducted in 2023 shows that the innovativeness of the Polish economy measured by the dynamics of the SII index, despite an almost 8.31% increase compared to 2022 and a 24.28% increase from 2016, is still very weak. Poland is most lagging behind in the area of innovative activities (in the Innovators dimension), expressed in the scope of introducing innovations to the market or within its organizations (41.4% of the EU average), Environmental sustainability (43.8% of the average) and Attractive research systems (46.2% of the EU average). Only three of the 12 dimensions come close to the EU average, i.e. the Use of information technologies (90.3% of the EU average), Intellectual assets (84.2% of the average) and Digitalization (81.1% of the average) and the rest of the analysis is devoted to these areas in the next publication, titled "Analysis of Poland's innovation profile based on the decomposition of the Summary Innovation Index (SII)". The elements undoubtedly influencing the results of innovation should include those regarding geopolitical variants, which have a decisive impact from at least February 2022 on the Polish economy. On the one hand, turmoil in supply chains that occurred much earlier (2020) in connection with the COVID-19 pandemic led to reduced profitability or even bankruptcy of many economic entities in Poland. On the other hand, the war started by Russia in Ukraine determined the need to quickly adjust the policy of energy supply and commodity exchange, which still has a significant impact on the country's economy. Despite these factors unfavourable for the competitiveness of the Polish economy, the Polish industrial system, in which small and medium-sized enterprises operate, forces them to be innovative as one of the conditions for staying on the market and to make strategic changes within enterprises, requiring the application of knowledge and the employment of qualified employees.

The presented data also confirm that the European Union is an organization bringing together countries with different economic profiles and - as can be seen from the presented data - a strongly differentiated level of innovation. The process of building and increasing the innovativeness of such different countries is a difficult and multi-stage task, therefore there is a need to constantly monitor progress in this area. The results of this monitoring and comparison allow for the optimization of decision-making processes, both at the EU level and in individual Member States. This article, through the analysis and systematics of data, contributes to the assessment of this process and can constitute a basis for further research.

References

Baruk, J. (2016) „Rola wiedzy w procesach tworzenia i wdrażania innowacji", *Marketing instytucji naukowych i badawczych No 3(21)*, pp 79-104.

Bielińska-Dusza, E. and Hamerska, M. (2021) „Methodology for Calculating the European Innovation Scoreboard - Proposition for Modification"*, Sustainability*, *13*(4), 2199.

Castaneda, D.I. and Cuellar, S. (2020) „Knowledge sharing and innovation: A systematic review"**,** *Knowledge and Process Management,* Vol. 7, Issue 3, pp 159-173.

Chomać-Pierzecka, E. (2018) „Siła kapitału determinantą innowacyjności przedsiębiorstwa", *Nowoczesne Systemy Zarządzania*, No 13, pp. 195-208.

Crisan, D.A. and Stanica, J.L. (2022) „Analysis of the correlation between innovation and ICT readiness for the EU-27 Member States", *Journal of Information Systems & Operations Management*, 16.2, pp 35-45.

European Commission (2016) European Innovation Scoreboard. Methodology report. Retrieved from https://eu.eustat.eus/elementos/ele0013600/methodology-report-eis-2016/inf0013699_e.pdf

European Commission (2018) European Innovation Scoreboard. Retrieved from http://innovation.lv/wp-content/uploads/2019/05/European-Innovation-Scoreboard-2018.pdf

European Commission (2020) European Innovation Scoreboard. Methodology report. Retrieved from https://www.google.com/url?sa=i&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=0CAIQw7AJahcKEwion6GUkI7_AhUAAAAAHQAAAAQAg&url=https%3A%2F%2Fec.europa.eu%2Fdocsroom%2Fdocuments%2F41861%2Fattachments%2F1%2Ftranslations%2Fen%2Frenditions%2Fnative&psig=AOvVaw2Kg3-ceby1kH_Cgc_ll-XK&ust=1685023536499921

European Commission (2022) European Innovation Scoreboard. Methodology report. Retrieved from https://research-and-innovation.ec.europa.eu/system/files/2022-09/ec_rtd_eis-2022-methodology-report.pdf

European Commission (2022a) European Innovation Scoreboard. Retrieved from https://research-and-innovation.ec.europa.eu/statistics/performance-indicators/european-innovation-scoreboard_en

European Commission (2023) European Innovation Scoreboard. Methodology report. Retrieved from https://research-and-innovation.ec.europa.eu/document/download/e59de361-e73c-42cf-8869-213b9d240383_en?filename=ec_rtd_eis-2023-methodology-report.pdf

European Commission (2023a) European Innovation Scoreboard. Retrieved from https://data.europa.eu/doi/10.2777/119961

Haberla, M. and Kuźmińska-Haberla, A. (2013) „Wiedza jako kluczowy czynnik rozwoju innowacyjności przedsiębiorstw", *Nauki o Zarządzaniu,* No 2(15), pp 62-72.

Janoskova, K. and Kral, P. (2019) „ An In-Depth Analysis of the Summary Innovation Index in the V4 Countries", *Journal of Competitiveness,* 11(2), pp 68-83.

Karaś, A. (2021) „Alianse wiedzy i ich wpływ na działalność innowacyjną przedsiębiorstwa", *Zeszyty Naukowe Małopolskiej Wyższej Szkoły Ekonomicznej w Tarnowie*, 51(3), pp 75-85.

Kogabayev, T. and Maziliauskas, A. (2017) „The definition and classification of innovation", *HOLISTICA – Journal of Business and Public Administration,* Vol 8, Issue 1, pp 59-72.

Kokot-Stępień, P. and Krawczyk, P. (2023) „Business Environment Institutions as a Catalyst for Knowledge and Technology Transfer*", Proceedings of the 24th European Conference on Knowledge Management*, Vol. 24 No. 1, Matos, F. and Rosa A. (eds.). Academic Conferences and Publishing International Limited, pp 692-699.

Krawczyk-Sokołowska, I., Pierscieniak, A., and Caputa, W. (2021) „The innovation potential of the enterprise in the context of the economy and the business model", *Review of Managerial Science*, 15, pp 103-124.

Mikołajczyk, B. (2016) „Obraz innowacyjności gospodarek w krajach UE mierzony wskaźnikiem SII", *Studia Ekonomiczne, Zeszyty Naukowe Uniwersytetu Ekonomicznego w Katowicach*, 282, pp 111-122.

Myjak, T. (2022) *Uwarunkowania procesów innowacyjnych w przedsiębiorstwie budowlanym* [in:] *Innowacyjność, konkurencyjność, jakość, wiedza i uczenie się komponentami rozwoju organizacji w zmiennym otoczeniu*, Chodyński, A., Fatuła, D., and Leśniewski M.A (eds.). Krakowska Akademia im. Andrzeja Frycza Modrzewskiego.

OECD (2018) *Oslo Manual: Guidelines for Collecting, Reporting and Using Data on Innovation,4th Edition, The Measurement of Scientific, Technological and Innovation Activities*, Eurostat. Retrieved from https://www.oecd.org/science/oslo-manual-2018-9789264304604-en.htm

Onea, I.A. (2020) „Innovation Indicators and the Innovation Process – Evidence from the European Innovation Scoreboard*", Management & Marketing. Challenges for the Knowledge Societ*y", 15(4), pp 605-620.

Ostraszewska, Z. and Tylec A. (2017) „Zasoby ludzkie i inwestycje przedsiębiorstw jako „motory" innowacyjności Polski – analiza w oparciu o subindeksy sumarycznego wskaźnika innowacyjności", *Ekonomika i Organizacja Przedsiębiorstwa*, 5(808), pp 79-83.

Podstawka, B. (2021) „Efekty działalności innowacyjnej w Polsce i w województwie lubelskim w latach 2016–2018", *Przegląd Prawno-Ekonomiczny*, 1, pp 9-24.

Preda, A.M., Crisan, D.A., Stanica, J.L., and Altar Samuel, A.N. (2019) „Innovation and ICT development: an analysis for the EU-28 Member States", *Journal of Information Systems & Operations Management*", 13.2, pp 154-163.

Šofranková, B., Kiseľáková, D., Širá, E., Grzebyk, M. (2022) „Analysis of relationships between innovative and digital performance of EU-27countries", *Journal of Management and Business: Research and Practice*", 14(2), pp 11-25.

Stojanović, A., Puška, M., Selaković, *A*. (2022) „Multi-Criteria Approach to the Comparative Analysis of the Global Innovation Index on the Example of the Western Balkan Countries", *Economics –Innovative and Economics Research Journal*, 10, pp 9-26.

Szklarz, P., Klóska, R., Czyżycki, R., Ociepa-Kicińska, E. (2021) „Do the innovative MNEs generate an added value in emerging economy? Evidence from Scandinavian enterprises in Poland", *Procedia Computer Science*, 192, pp 2180-2189.

Szuper, K. (2021) „Narzędzia polityki fiskalnej wspierające innowacyjność małych i średnich przedsiębiorstw w Polsce", *Przegląd Prawno-Ekonomiczny, 2,* pp 55-70.

Taylor, S.P. (2017) „What Is Innovation? A Study of the Definitions, Academic Models and Applicability of Innovation to an Example of Social Housing in England", *Open Journal of Social Sciences*, 5, pp 128-146.

Analysis of Poland's Innovation Profile Based on the Decomposition of the Summary Innovation Index (SII)

Zuzanna Ostraszewska and Agnieszka Tylec
Czestochowa University of Technology (CUT), Częstochowa, Poland

zuzanna.ostraszewska@pcz.pl
agnieszka.tylec@pcz.pl

Abstract: Knowledge and new technologies, and thus the innovation created based on them, determine the development opportunities of countries, regions and enterprises. Innovation built on the basis of human resources and their knowledge (and all activities aimed at its development) define the competitive position of the indicated entities and their place on the map of knowledge-based economies. The aim of the article was to analyse Poland's innovative profile against the background of EU countries, based on the latest data. To achieve this goal, first of all, the total Summary Innovation Index (SII) was decomposed and the indicators and data taken into account when determining the level of innovation in individual countries and the entire EU were presented. Then, the considerations focused on the dimensions in which Poland has achieved the most favourable results in recent years, i.e. closest to the EU average, as well as those in which there are the greatest delays. The basis for the research process, during which the method of graphical data presentation and analysis with elements of comparison was used, is the data contained in the European Innovation Scoreboards (EIS) during years 2016-2023. This article is an extension of the study submitted for publication, entitled: "Study of the level of innovation in the European Union - Poland compared to the leading countries". It is an attempt to answer the questions: where is the Polish economy located on the innovation map of the European Union?, what dimensions of innovation have a positive impact on its innovative position, and in which areas do they differ significantly from the EU average? It has cognitive value for the development of knowledge, science, and further improvement of the level of innovation in Poland, thanks to highlighting problem areas and sources of innovative advantage of the innovation leader countries.

Keywords: Innovation, Summary Innovation Index, Innovation Dimensions, Knowledge-Based Economy.

1. Introduction

Innovation is becoming more and more important and is a necessary condition for the survival and development of every organization. It also determines the strength of economies and their competitive advantage and is positively related to them (Kim and Koo, 2017; Edghiem and Mouzughi, 2018; Rajapathirana and Hui, 2018). The key factor in the innovativeness of enterprises and economies is access to knowledge (sharing it) and other intellectual resources. The use of existing knowledge, as well as the creation of new knowledge (in the innovation process), in turn determines the strength and direction of competition (Kokot-Stępień and Krawczyk, 2023; Karaś, 2021; Castandea and Cuellar, 2020).

Innovation, understood as an organization's ability to engage in innovative activities, is key to ensuring organizational survival, improved performance, and growth. The key to innovation, in turn, is knowledge and its management including promoting a culture of innovation and developing innovative teaching programs (Mohamad, Ramayah, and Chiun Lo, 2020; Mondal, Al-Kfairy, and Mellor, 2023; Simeoni, Caballero and Lepez, 2024). The importance of knowledge and intangible resources in modern (knowledge-based) economies is also visible in the way of measuring the innovation of EU countries, including the construction of the basic measure for its assessment, i.e. the Summary Innovation Index (SII). The decomposition of an indicator consisting of sub-indicators allows us to conclude that the knowledge and quality of human resources are incorporated into its construction. Thus, the analysis of its components and the results obtained by Poland should make it possible to answer the questions posed by the authors of the article, i.e. where is the Polish economy located on the innovation map of the European Union?, what dimensions of innovation have a positive impact on its innovative position, and in which they differ significantly from the EU average? An attempt to obtain answers to the indicated questions was the main goal of the undertaken considerations. During the work, an additional question also arose: if the innovative economy is based on knowledge, can it be said that it is/is becoming a knowledge-based economy based on Poland's innovation profile (examined based on the decomposition of the SII index)? In the article, in search of answers to the questions asked, an analysis of Poland's innovative profile against the background of EU countries was carried out. The presentation of the dimensions of innovation in which Poland achieves the most favourable results (based on the European Innovation Scoreboard (EIS) from 2016-2023) was preceded by short theoretical considerations in the field of innovation and knowledge (as the foundation of knowledge-based economies). Methodological aspects of the EU's innovation research were also presented. Due to the limitations of the text's volume, only a brief description of the dimensions of innovation that make

up the Summary Innovation Index is presented. For the same reason, only indicators from those dimensions are presented for which Poland achieved the most favourable results in the last study (EIS 2023). The article uses the method of analysis, synthesis and graphical presentation of data.

2. Innovation in the Times of Knowledge-Based Economies – Chosen Aspects

Organizations are constantly looking for ways to stay ahead of their rivals, and one way to stay competitive is to equip themselves with knowledge, knowledge management, innovation and innovativeness. Innovation is understood as a process in which existing knowledge is acquired, shared and assimilated to create new knowledge that includes products and services, methods and processes, and social and environmental contexts (Castandea and Cuellar, 2020). The importance of knowledge is obvious because it is an introduction to the company's innovation (Abubakar, et al., 2019; Haberla and Kuźmińska Haberla, 2013). Therefore, knowledge and innovations are the subject of interest for theoreticians and practitioners of socio-economic life, as well as various organizations (including the European Union).

The importance of knowledge and innovation is also visible in one of the interesting phenomena observed in the modern world, i.e. the reorientation of the economy consisting in a gradual transition from an economy consuming materials to an economy based on knowledge and information. Competition between countries and regions based on material resources was replaced by competition based on human resources (knowledge and new technologies). The development opportunities of countries and regions are increasingly influenced by human intellectual potential and knowledge related to the latest achievements of modern science. A knowledge-based economy, in which innovations play a key role, is a fundamental challenge in the 21st century for countries whose goal is to achieve a high level of development and competitiveness (Mosbah, 2020, Dolińska, 2009; Milewska, 2018).

The knowledge-based economy (as well as the knowledge management process) is becoming more and more important for developing countries. This is caused by several factors. First, it enables such countries to participate in the global economy and leverage their strengths in technology, education and innovation. Secondly, the shift towards a knowledge-based economy can help address some key challenges such as poverty, inequality and unemployment. This is possible by creating new opportunities for economic growth, innovation and jobs, especially in the technology and services sectors. Moreover, the knowledge-based economy can also help create a better educated and skilled workforce, which is crucial for sustainable economic growth and competitiveness in the global market (Kulkarni, 2023; Ode and Ayavoo, 2020; Trivedi and Srivastava, 2022). These phenomena are not only the domain of developing countries. The prospects for social, economic and technological development, also in the economically developed countries of the European Union, increasingly depend on the ability to initiate, disseminate and implement innovations in all spheres of life, especially in new sectors oriented on knowledge and high technologies (Melnikas, 2012).

1. Dimensions and Sub-Indexes of the SII Index - Methodological Basis

The Summary Innovation Index ranges from 0 to 1. The closer to 1, the higher the level of innovation in a given country. Currently, this index is calculated based on 32 sub-indexes grouped into four categories and twelve dimensions (Crisan and Stanica, 2022; Šofranková, et al., 2022).

The first category included in the SII is "Framework Conditions", which allows you to identify the main factors influencing innovation performance. They consist of the following dimensions (European Commission, 2023):

- Human resources, which measures the availability of a highly skilled and educated workforce,
- Attractive research systems that measure the international competitiveness of the science base,
- Digitalisation - the dimension within which the level of digital technologies is measured.

"Investments" is a category covering investments made in both the public and private sectors, defined by 3 consecutive dimensions (European Commission, 2023):

- Financing and support - includes three indexes, including private financing (venture capital investment), research and development spending in universities and government research organizations, and direct government financing and government tax support for enterprise research and development),
- Corporate investment - includes three indexes on research and development and non-R&D investments, investments that companies undertake to generate innovations, including expenditure on R&D, expenditure on innovation other than R&D and innovation expenditure on employed person,

- Use of information technologies - a dimension that includes two indexes: enterprises actively improving the information and communication skills of their staff and employed ICT specialists.

The next category is: "Innovative activities" analysed in dimensions (European Commission, 2023):

- Innovators, including SMEs introducing innovations,
- Connections – indexes used to measure cooperation between the public and private sectors,
- Intellectual assets illustrating patent activity.

The last category of innovation included in the SII structure is "Impact". This category includes the effects of innovative activities of enterprises in three dimensions (European Commission, 2023):

- Impact on employment - indexes illustrating the level of employment in innovative sectors,
- Impact on sales - sub-indexes relating to the level of sales of innovations on the domestic and foreign markets,
- Environmental impact - indexes of this dimension focused on improvements aimed at reducing the negative impact on the environment.

Table 1 highlights the dimensions for which the EIS 2023 results for Poland are the most favourable, i.e. most similar to those of EU countries.

Table 1: Dimensions of innovation for which Poland achieved the most favourable results in EIS 2023

SELECTED INDEXES OF INNOVATION IN EU COUNTRIES CALCULATED UNDER SII		
Dimensions of innovation	Components of the SII index/ (Year of "availability" of the latest data)	Data source
FRAMEWORK CONDITIONS		
Digitalisation	1.3.1 Broadband penetration (2022) 1.3.2 Individuals who have above basic overall digital skills (%share) (2021)	Eurostat Community Survey of ICT Usage and E-commerce in Enterprises EU survey on the ICT usage in households and by individuals
INVESTMENTS		
Use of information technologies	2.3.1 Enterprises providing training to develop or upgrade ICT skills of their personnel (2022) 2.3.2 Employed ICT specialists (2022)	Eurostat, Community Survey of ICT Usage and E-commerce in Enterprises
INNOVATION ACTIVITIES		
Intellectual assets	3.3.1 PCT patent applications per billion GDP (in PPS) (2019) 3.3.2 Trademark applications per billion GDP (in PPS) (2022) 3.3.3 Design applications per billion GDP (in PPS) (2022)	Eurostat Patent data from the OECD EUIPO

Source: own elaboration on European Commission, 2023; European Commission, 2023a.

The SII calculation methodology includes several basic steps, presented in Table 2.

Table 2: Stages of calculation of the SII index

STAGE	ACTIONS
Setting reference years	For each indicator, a reference year is identified for all countries based on data availability for all those countries for which data availability is at least 75%. For most indicators, this reference year lags one or two years behind the year in which the EIS is published.
Imputing for missing values	Reference year data are then used for “2023”, etc. If data for a year-in-between are not available, missing values are replaced with the value from the previous year. If data are not available at the beginning of the time series, missing values are replaced with the next available year. If data are missing for all years, no data will be imputed (the indicator will not contribute to the Summary Innovation Index.

STAGE	ACTIONS
Identifying and replacing outliers	Positive outliers are identified as those country scores which are higher than the mean across all countries plus twice the standard deviation. Negative outliers are identified as those country scores which are smaller than the mean across all countries minus twice the standard deviation. These outliers are replaced by the respective maximum and minimum values observed over all the years and all countries excluding the identified outliers. With replacing positive (or negative) outliers, more countries can share the highest (lowest) normalised score of 1 (0).
Transforming data that have highly skewed distributions across countries	Most of the indicators are fractional indicators with values between 0% and 100%. Some indicators are unbound indicators, where values are not limited to an upper threshold. These indicators can be highly volatile and can have skewed data distributions (where most countries show low performance levels, and a few countries show exceptionally high levels of performance). For these indicators where the degree of skewness across the full eight-year period is above one, data have been transformed using a square root transformation, i.e. using the square root of the indicator value instead of the original value.
Determining Maximum and Minimum scores	The Maximum score is the highest score found for the eight-year period within all countries excluding positive outliers. Similarly, the Minimum score is the lowest score found for the eight-year period within all countries excluding negative outliers.
Calculating re-scaled scores	Re-scaled scores of the country scores (after correcting for outliers and a possible transformation of the data) for all years are calculated by first subtracting the Minimum score and then dividing by the difference between the Maximum and Minimum score. The maximum re-scaled score is thus equal to 1, and the minimum re-scaled score is equal to 0. For positive and negative outliers, the re-scaled score is equal to 1 or 0, respectively.
Calculating composite innovation indexes	For each year, a composite Summary Innovation Index is calculated as the unweighted average of the re-scaled scores for all indicators where all indicators receive the same weight (1/32 if data are available for all 32 indicators).
Calculating relative-to-EU performance scores	Performance scores relative to the EU are calculated as the SII of the respective country divided by the SII of the EU multiplied by 100. Relative performance scores are calculated for the full eight-year period compared to the performance of the EU in 2016 and for the latest year also to that of the EU in 2023. For the definition of the performance groups, only the performance scores relative to the EU in 2023 have been used.

Source: own elaboration on European Commission, 2023.

The method of calculating the SII index and the thresholds for membership of individual countries in innovation efficiency groups were presented by the authors in the article "Study of the level of innovation in the European Union - Poland compared to the leading countries", which is an introduction to the data presented in this study. On their basis, it can be concluded that Poland is among the countries with the lowest level of innovation.

2. Poland's Position in the European Union in Terms of the Use of Information Technologies, Intellectual Assets and Digitalisation Against the Background of the Summary Innovation Index (SII)

While in previous years the EIS data indicated dimensions such as Human Resources, Intellectual Assets and Enterprise Investments as sources of the innovative potential of the Polish economy, in the latest edition of the EIS Poland achieved results most similar to those of EU countries in the following dimensions (European Commission, 2023a; European Commission, 2022; European Commission, 2022a; European Commission, 2018):

1. Use of information technologies (dispersion of the percentage of the SII sub-index between the EU average and Poland in this category is the smallest: SII_{EU27}-SII_{PL}=9,7pp),
2. Intellectual assets (SII_{UE27}-SII_{PL}=15,8pp),
3. Digitalisation (SII_{EU27}-SII_{PL}=18,9pp).

The Use of information technologies dimension is an element included in the Investments category, covering investments made in both the public and business sectors. It contains two indicators determining the degree of use of information technologies, i.e.:

- 2.3.1 Enterprises providing training to develop or upgrade ICT skills of their personnel,
- 2.3.2 Employed ICT specialists.

Poland's result in the above-mentioned dimension was the best of the 12 dimensions considered. Therefore, first of all, it was analysed and the results on a European scale are graphically presented in Figure 1, assuming the division of countries into groups of innovators in accordance with the classification included in EIS 2023. The EU average was used as the cut-off point, which divided the chart into four parts, at the same time showing the

distribution of European countries according to the results achieved under the SII and the Use of information technologies dimension (as a percentage of the EU average). The same way of presenting the results was used in Figures 3 and 5 for the Intellectual assets and Digitalisation dimensions.

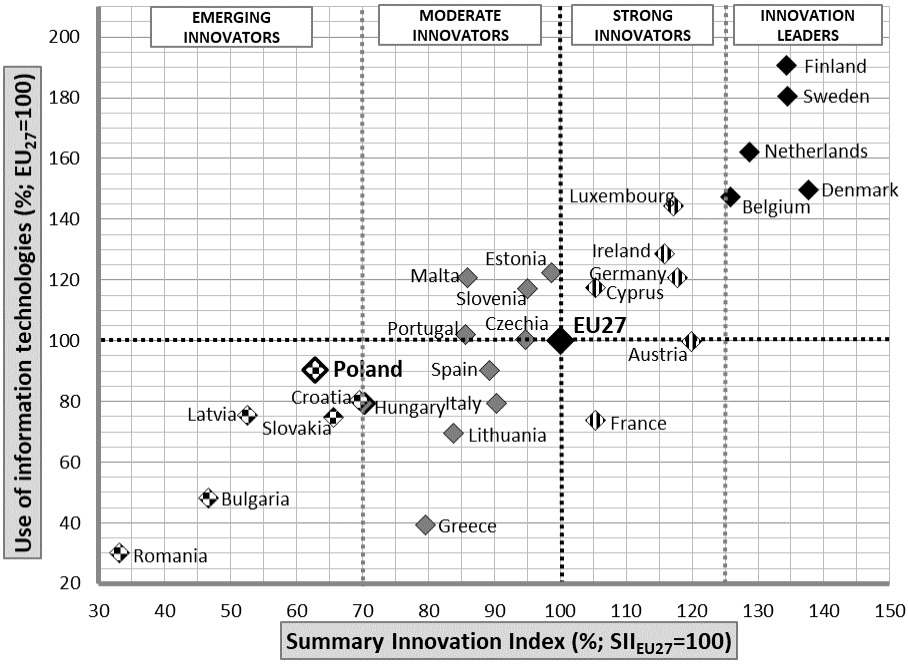


Figure 1: Poland's profile on the Use of information technologies dimension matrix compared to the innovative position of EU member states in 2023 (as a percentage of the EU average)

Source: own elaboration on Eurostat data.

The undisputed leaders in the Use of information technologies are Finland and Sweden. The analysis of Figure 1 also shows that 9 out of 11 countries whose results differ significantly from the EU average (both on the X and Y axis) come from groups of countries that are strong innovators and innovation leaders. 14 out of 27 European Union member states achieved results in the Use of information technology dimension above the EU average. Poland's position in this dimension has strengthened the most out of all twelve dimensions of innovation calculated under the SII index compared to 2022, which allowed it to rank 16th among European countries (an increase in the index from 71.7% of the EU average in 2022 to 90.3% in 2023). The weakest country in this area was Romania.

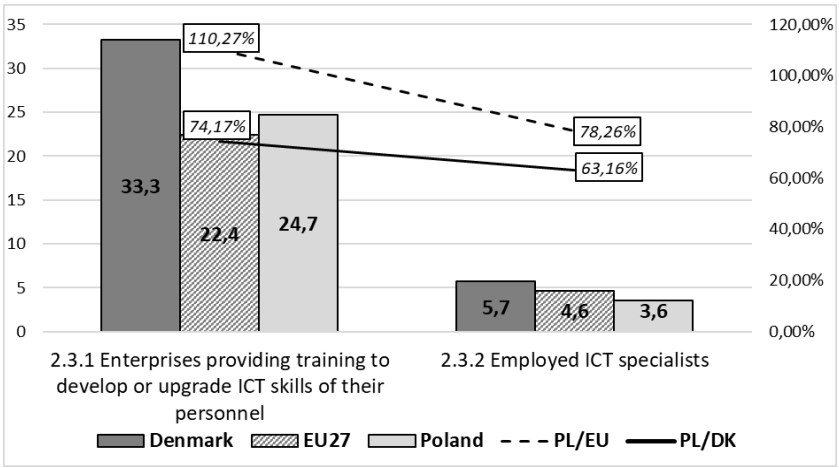


Figure 2: Sub-indexes included in the Use of information technologies dimension for the EU, Denmark and Poland in 2023

Source: own elaboration on Eurostat data.

ICT skills are particularly important for innovation in today's increasingly digitized economic realities. Eurostat defines ICT professionals as "workers who have the ability to develop, operate and maintain ICT systems and for whom ICT constitutes a core part of their work" (European Commission, 2022). The growing share of enterprises providing training in this area is also an indicator of the overall development of employee skills. The values of both sub-indexes - components of the Use of information technologies dimension - for Poland, the innovation leader - Denmark and the entire European Union in 2023 are presented in Figure 2. Additionally, the values of these indexes achieved by Poland were calculated and shown in relation to the results of Denmark and the EU. According to the analysis of the presented data, in Poland in 2023, for every 100 enterprises, there were nearly 25 entities that undertook to improve the digital competences of their employees. Thus, Poland's result was 74.17% of the result achieved by Denmark (33 enterprises out of 100) and 110.27% of the EU average (22.4 enterprises out of 100) and was the 11th best result in the EU. Unfortunately, this did not translate into the number of ICT specialists employed in companies - in Poland, out of 100 employees, only 3.6 employees had such competences, while in Denmark almost 6, and in the case of the leader - Sweden - 8.6.

The second dimension of innovation, in which Poland achieved the best results, includes Intellectual assets. This dimension is one of three areas of innovative activities, including: Innovators (two indexes, including SMEs introducing innovations), Connections (three indexes illustrating cooperation between the public and private sectors) and Intellectual assets (three indexes illustrating patent activity). The indexes that make up the Intellectual assets group include:

- 3.3.1 PCT patent applications per billion GDP (in PPS),
- 3.3.2 Trademark Applications per billion GDP (in PPS),
- 3.3.3 The number of industrial designs submitted per billion GDP (in PPS),

The results of the European Union member states for the Intellectual Assets dimension are presented in Figure 3, assuming the same assumptions as for Figure 1. According to its analysis, the countries that lead in the Intellectual assets dimension are Ireland and Austria, respectively (1st and 2nd place in the hierarchy). It is noteworthy that very good results in this dimension are achieved not by innovation leaders (Denmark, Finland, Sweden), but by countries classified as strong innovators (the above-mentioned Ireland and Austria, Germany) and moderate innovators (Malta, Estonia). Poland, with the results of indexes within this dimension presented in Figure 4, qualified in 18th place, taking into account the EU average (14th place). This result was most significantly influenced by the value of index 3.3.3, regarding the number of reported industrial designs per billion of GDP. Achieving over 150% of the EU average for registered industrial designs allowed Poland to rank fourth among the 27 EU member states. In turn, the European leader in innovation - Denmark - achieved much better results in the case of registered trademarks (per billion GDP). On average, in the European Union, there are 3.28 registered patent applications per billion GDP, over 7 registered trademarks and approximately 4 registered industrial designs.

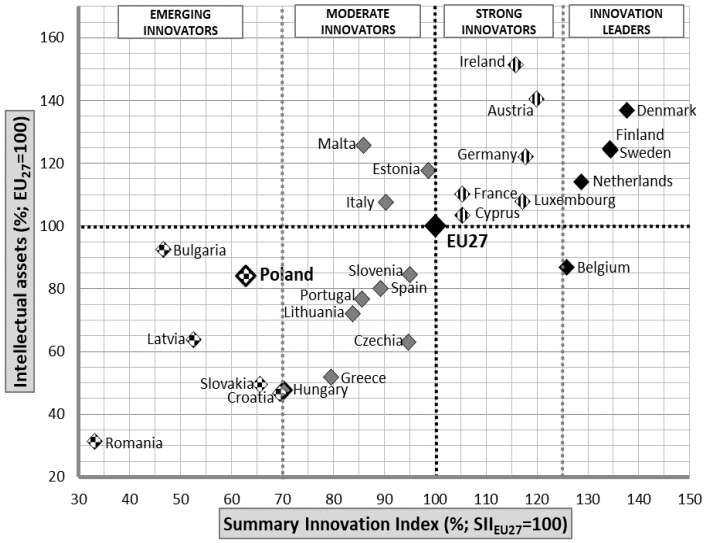


Figure 3: Poland's profile on the Intellectual assets dimension matrix compared to the innovation position of EU member states in 2023 (as a percentage of the EU average)

Source: own elaboration on Eurostat data.

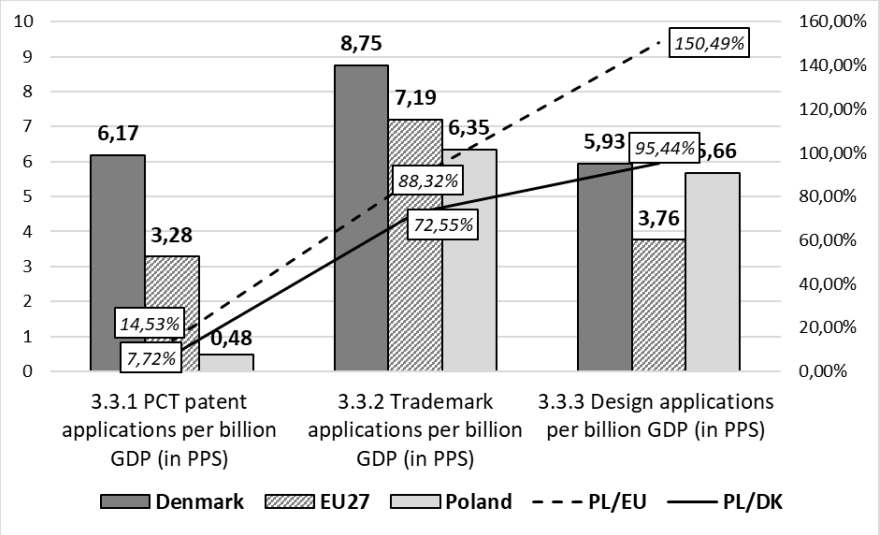


Figure 4: Sub-indexes included in the Intellectual assets dimension for the EU, Denmark and Poland in 2023

Source: own elaboration on Eurostat data.

The last dimension in which Poland achieved the best results as a percentage of the EU average was the Digitalisation dimension. This dimension falls within the SII category called "Framework conditions" and includes two indexes:

- 1.3.1 Popularization of broadband connections among enterprises (% share),
- 1.3.2 People with post-basic general digital skills (% share).

Framework conditions capture the main factors influencing the innovation performance of countries' economies. They consist of the following dimensions: Human resources, Attractive research systems and the above-mentioned Digitalisation. Digitalisation measures the level of digital technology through the spread of broadband connections among businesses and the supply of people with post-basic general IT skills.

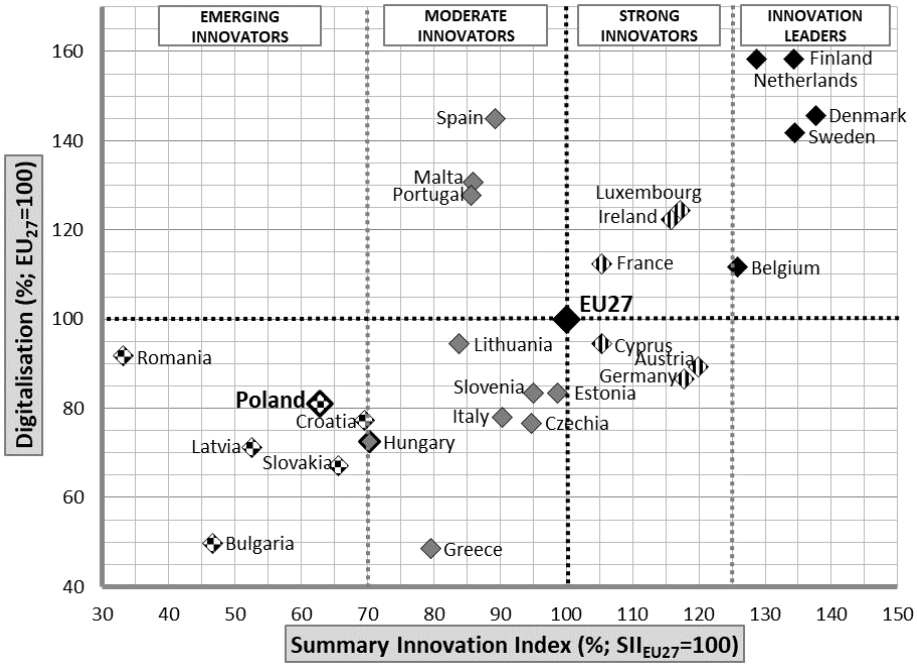


Figure 5: Poland's profile on the Digitalisation dimension matrix compared to the innovation position of EU member states in 2023 (as a percentage of the EU average)

Source: own elaboration on Eurostat data.

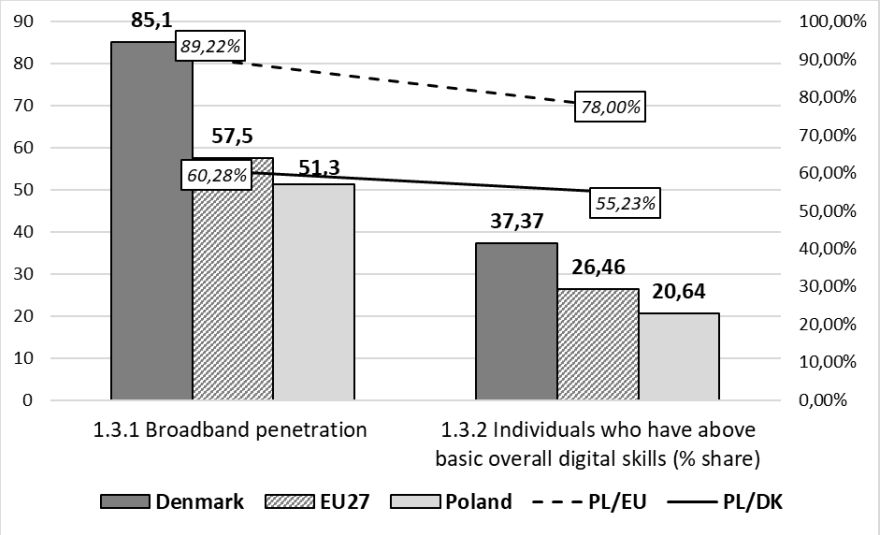


Figure 6: Sub-indexes included in the Digitalisation dimension for the EU, Denmark and Poland in 2023

Source: own elaboration on Eurostat data.

In Figure 5, Digitalisation (as a percentage of the EU average, which was assumed to be 100%) is compared on the X-axis with the percentage of the SII indicator (assuming that SII_{UE27}=100%). The results obtained indicate that the leaders in the European Union in the area of digitalisation are two countries - the Netherlands and Finland, with results of 158.3% and 158.2% of the EU average, respectively. Denmark - as a leader in innovation on a European scale - was in third place. The level of digitalisation of 81.1% of the EU average allowed Poland to rank 19th out of 27 member states. The EU average was 12th in the ranking of EU member states.

When decomposing the Digitalisation dimension into the above-mentioned two sub-indexes (Figure 6), it should be noted that Poland's results do not differ significantly from the EU average in this respect, constituting 89.22% and 78% of the EU average, respectively. This means that over 51% of enterprises in Poland have access to broadband Internet, and every fifth Pole has above-average IT skills (every fourth EU citizen). In the case of Denmark, these shares are correspondingly higher - 85% of enterprises use broadband connections, and 37% of the population has above-average IT skills. However, the decomposition of this dimension into component indexes leaves no doubt that despite Poland's good result against the background of 12 dimensions of innovation, this area is not the country's strongest point. The use of Poland's full e-potential depends on creating conditions for the development of e-commerce and the Internet, as well as on constantly improving the basic general digital skills of citizens aged 16-74 on the Internet, covering the areas of information, communication, problem solving and content creation. Considering that - according to the EIS 2023 report - within these two sub-indexes of the Digitalisation dimension, Poland is in 17th and 23rd position in the EU, respectively, it can be confidently stated that the country's innovative position is weak and requires intensification of financial outlays from the government.

3. Conclusions

Knowledge and innovation are the pillars of the knowledge-based economy. Without knowledge there is no innovation, information society and knowledge-based economy. The emergence of innovations, economic development, progress in scientific and technical knowledge, and the creation of an information society are considered important social problems, both in individual countries and in the entire European Union. Therefore, special attention should be paid to creating innovation, including through the development of knowledge - the potential to create a knowledge-based economy. The development prospects of the European Union and its role in the global system depend on the use of innovation potential, including the dissemination of humanitarian and democratic values, in order to create a new society which, among other things, through innovation in the field of technology, will create a knowledge-based economy. It should also be emphasized that human and intellectual resources provide enormous opportunities for activating innovation in the European Union. Their diversity, highly developed infrastructure for activating and developing education, science, experience in creating and developing high technologies and maintaining international connections are sources of innovative potential and gaining a competitive advantage (Melnikas, 2012; Rynio, 2010; Kucznik, 2019).

The European Union is an organization of culturally, socially and economically diverse countries. Even a cursory analysis of the level of innovation and the innovation potential of individual countries allows us to observe many differences and disproportions. However, the analysis of EU innovation research results indicates innovation leaders who have been setting the direction for innovation for several years, constantly increasing expenditure on research and development and promoting the development of the economy whose basic pillar is knowledge. The dominant role of the Scandinavian countries can be seen here, and with the change in the methodology of monitoring innovation, the position of countries such as Luxembourg and Germany has decreased. Poland belongs to the group of countries with a level of innovation that differs unfavourably from the average calculated for the 27 European Union countries - indexes in all dimensions of innovation for Poland were below the EU average, and Poland itself was in 24th position on the EU innovation map, measured by the value of the SII index.

In response to the research questions posed in the introduction of the article, it should be noted that when analysing Poland's position, based on the dimensions included in the SII index, it was found that the Polish economy achieves the best results for three dimensions: Use of information technologies, Intellectual assets, Digitalization. Unfortunately, the term "best results" does not mean that these are the results that justify calling Poland an innovative or knowledge-based economy. Poland's innovativeness in these three best areas gives it only 16th, 17th and 19th place in the ranking of 27 European countries and is always lower than the EU average. The Polish economy performs worst in the area of attractive research systems, as an innovator - with a low percentage of SMEs introducing innovations in products and business processes, as well as in the field of environmental sustainability. Of course, the dimensions include indexes whose results clearly indicate a good or very good position of Poland in the examined area (for example, Poland's high, 4th position is given only by one measure included in the Intellectual assets dimension, i.e. the number of registered industrial designs per billion GDP, and the 11th place is due to the high percentage of enterprises that have undertaken to improve the digital competences of their employees, included in the dimension of the Use of information assets). This gives rise to the claim that the Polish economy is moving towards a knowledge-based economy, but time, effort and many resources are still needed to reduce development backwardness and minimize arrears based on access to funds co-financing various types of development projects, including innovative ones. Changes are also needed in the country's innovation policy, focusing on increasing expenditure on research and development.

References

Abubakar, A.M., Elrehail, H., Alatailat, M.A. Elçi, A. (2019) “Knowledge management, decision-making style and organizational performance”, *Journal of Innovation & Knowledge,* Volume 4, Issue 2, pp 104-114.

Castandea, C.I. and Cuellar, s. (2020) „Knowledge sharing and innovation: A systematic review”, *Knowledge and Process Management,* Vol. 27, Issue 3, pp 159-173.

Crisan, D.A. and Stanica, J.L. (2022) „Analysis of the correlation between innovation and ICT readiness for the EU-27 Member States”, J*ournal of Information Systems & Operations Management*, 16.2, pp 35-45.

Dolińska, M. (2009) „Innowacyjność organizacji w gospodarce opartej an wiedzy”, *Zeszyty Naukowe Uniwersytetu Szczecińskiego*, No. 554, pp 53-66.

Edghiem, F. and Mouzughi, Y. (2018) „Knowledge-advanced innovative behaviour: a hospitality service perspective”, *International Journal of Contemporary Hospitality Management*, 30(1), pp 197-216.

European Commission (2018) European Innovation Scoreboard. Retrieved from http://innovation.lv/wp-content/uploads/2019/05/European-Innovation-Scoreboard-2018.pdf

European Commission (2022) European Innovation Scoreboard. Methodology report. Retrieved from https://research-and-innovation.ec.europa.eu/system/files/2022-09/ec_rtd_eis-2022-methodology-report.pdf

European Commission (2022a) European Innovation Scoreboard. Retrieved from https://research-and-innovation.ec.europa.eu/statistics/performance-indicators/european-innovation-scoreboard_en

European Commission (2023) European Innovation Scoreboard. Methodology report. Retrieved from https://research-and-innovation.ec.europa.eu/document/download/e59de361-e73c-42cf-8869-213b9d240383_en?filename=ec_rtd_eis-2023-methodology-report.pdf

European Commission (2023a) European Innovation Scoreboard. Retrieved from https://data.europa.eu/doi/10.2777/119961

Haberla, M. and Kuźmińska-Haberla, A. (2013) „Wiedza jako kluczowy czynnik rozwoju innowacyjności przedsiębiorstw”, *Nauki o Zarządzaniu,* No 2(15), pp 62-72.

Karaś, A. (2021) „Alianse wiedzy i ich wpływ na działalność innowacyjną przedsiębiorstwa”, *Zeszyty Naukowe Małopolskiej Wyższej Szkoły Ekonomicznej w Tarnowie*, 51(3), pp 75-85.

Kim, M.S. and Koo, D.W. (2017) „Linking LMX, engagement, innovative behavior, and job performance in hotel employees”, *International Journal of Contemporary Hospitality Management*, 29(12), pp 3044-3062.

Kokot-Stępień, P. and Krawczyk, P. (2023) „Business Environment Institutions as a Catalyst for Knowledge and Technology Transfer*”, Proceedings of the 24th European Conference on Knowledge Management*, Vol. 24 No. 1, Matos, F. and Rosa A. (eds.). Academic Conferences and Publishing International Limited, pp 692-699.

Kucznik, K. (2019) *Gospodarka oparta na wiedzy jako trend stymulujący zarządzanie talentami* [in:] *Współczesne problemy ekonomiczne w badaniach młodych naukowców.* T.3*, Analizy makro- i mezoekonomiczne,* Gruszewska, E. and Roszkowska, M. (eds.). Polskie Towarzystwo Ekonomiczne, Białystok.

Kulkarni, M. (2023) *Knowledge based economy for sustainable economic development: the case of India*,

Master's Thesis, Tallin University of Technology, Retrieved from https://scholar.google.pl/scholar?q=KNOWLEDGE-BASED+ECONOMY+FOR+SUSTAINABLE+ECONOMIC+

DEVELOPMENT:+THE+CASE+OF+INDIA&hl=pl&as_sdt=0&as_vis=1&oi=scholar

Melnikas, B. (2012) „Knowledge economy in the European Union: Strategic decisions in the context of globalization", *Challenges of the global economy Working Papers Institute of International Business University of Gdańsk,* No. 31, pp 243-262.

Milewska, A. (2018) „Knowledge based economy: opportunities and challenges", Economic *Sciences for Agribusiness and Rural Economy*, No. 2, pp 313-318.

Mohamad, A.A., Ramayah, T. and Chiun Lo M. (2020) „Sustainable Knowledge Management and Firm Innovativeness: The Contingent Role of Innovative Culture", *Sustainability*, 12(17): 6910.

Mondal, C., Al-Kfairy, M. and Mellor, R.B. (2023) „Developing young science and technology parks: recent findings from industrial nations using the data-driven approach", Sustainability, 15(7): 6226.

Mosbah, M. (2020) *Rola gospodarki opartej na wiedzy w rozwoju sztucznej inteligencji AI oraz wpływ automatyzacji procesów biznesowych na konkurencyjność organizacji* [in:] *Gospodarka oparta na wiedzy - wybrane problemy*, Skrzypek, E., (ed.). Uniwersytet Marii Curie-Skłodowskiej w Lublinie (UMCS).

Ode, E. and Ayavoo, R. (2020) „The mediating role of knowledge application in the relationship between knowledge management practices and firm innovation", *Journal of Innovation & Knowledge*, Vol. 5, Issue 3, pp 210-218.

Rajapathirana, R.P.J. and Hui, Y. (2018) „Relationship between innovation capability, innovation type, and firm performance", Journal *of Innovation & Knowledge*, Volume 3, Issue 1, pp 44–55.

Rynio, D. (2010) „Podstawy budowy gospodarki opartej na wiedzy i innowacjach w UE w warunkach gospodarki globalnej", *Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu*, No. 132, pp 263-273.

Simeoni, I.A., Caballero, R. and Lepez, C.O. (2024) „ Curricular innovation in the knowledge society", Seminars in Medical Writing and Education, Vol. 3, pp. 58-58.

Šofranková, B., Kiseľáková, D., Širá, E., Grzebyk, M. (2022) „Analysis of relationships between innovative and digital performance of EU-27countries", *Journal of Management and Business: Research and Practice*", 14(2), pp 11-25.

Trivedi, K. and Srivastava, K.B.L. (2022) „The role of knowledge management processes in leveraging competitive strategies to achieve firm innovativeness", *The Bottom Line*, Vol. 35, No. 2/3, pp. 53-72.

Business Transformation Powered by Knowledge Management in the Context of Corporate Sustainability

Krystian Pawlowski
Poznan University of Technology, Faculty of Engineering Management, ul. J. Rychlewskiego 2, 60-965 Poznan, Poland

krystian.pawlowski@put.poznan.pl

Abstract: The economic objectives in the different stages of the development of industrial era enterprises were operationalised by changing paradigms. After the industrial revolution and mass production stages, the economies of scale paradigm was followed by the waste elimination paradigm initiated by Toyota, based on the assumption that it is possible to reduce the costs of producing a car without employing the economies of scale. Lean companies improved their ability to meet individual customer needs but continued to be equipped with capital-intensive fixed assets with limited flexibility, thus seeking to extend product series and life cycles. The development of technology accompanying the above organisational changes aimed at increasing the agility of enterprises and the concept of KM 4.0 concluded the fourth stage of industrial production development. A new market objectives of enterprises was the customisation of a product to the individual requirements of a specific customer, characteristic of engineering-to-order production, but with the guarantee of low prices and short delivery cycle times typical of mass production. This paper addresses the issue of the relationship between the level of incorporation of KM 4.0 methods and tools allowing for transformation from Mass production to Mass Customization and the possibility of achieving objectives in terms of economic, human resources and environmental aspects. The empirical research covered 150 medium-sized and large enterprises operating in Poland in various industries. In summary, it can be concluded that there is a correlation between the implementation level of chosen KM 4.0 methods and tools supporting product customisation and the level of efficiency in terms of achieving "triple bottom line" goals in the aspect of economics, the aspect of human resources and the aspect of ecological goals. The methods indicated above largely concern operational and production processes and allow flexible delivery of highly customised products at a price comparable to that of mass products. The conditions and developments in the knowledge economy mean that modern organisations need to build an organisational strategy based at an operational level on KM methods and tools.

Keywords: Knowledge Management 4.0, Mass Customisation, Lean Management, Agile Enterprise, Modern Manufacturing Practices, Industry 4.0

1. Introduction

Mass production initiated at Cadillac Motor Car with the implementation of interchangeable parts technology led to significant price reductions through economies of scale, but at the same time reduced the manufacturer's ability to meet individual customer needs. Companies following the lean organisational strategy pioneered by TOYOTA Motor Company (based on the assumption of waste elimination) while managing to increase their ability to meet individual customer needs, continued to be equipped with capital-intensive fixed assets with limited flexibility, thus seeking to extend product series and life cycles (Trzcielinski, 2011), (Trzcielinski, Włodarkiewicz-Klimek, Pawlowski, 2013), (Jasiulewicz-Kaczmarek, Legutko, Kluk, 2020), (Pawlowski, 2020). The waste elimination paradigm proved to be insufficient in view of the increasing volatility and unpredictability of the environment. The ability to succeed in a competitive environment characterised by constant unpredictable changes creating market opportunities became the paradigm of the fourth stage of industrial production development. The development of technology accompanying the organisational changes aimed at increasing the agility of enterprises and the concept of Industry 4.0 concluded the fourth stage of industrial production development. Industry 4.0 has become an accepted reality, which affects the way companies operate (Jasiulewicz-Kaczmarek, Legutko, Kluk, 2020). A new market objectives of enterprises was the customisation of a product to the individual requirements of a specific customer, characteristic of engineering-to-order production, but with the guarantee of low prices and short delivery cycle times typical of mass production.

2. Research Problem, Literature Review

This paper addresses the issue of the relationship between the level of incorporation of Industry 4.0 methods and tools allowing for mass customisation and the possibility of achieving the company's goals in terms of economic, human resources and environmental aspects. The empirical research covered 150 medium-sized and large enterprises operating in Poland in various industries.

The literature on the subject provides numerous typologies of mass customisation forms, where customisation means adapting a product to the individual requirements of a specific customer (Bednarz, 2010), (Gilmore, Pine,

1997). Gillmore, J.H. and Pine B.J. organised this concept and proposed a general typology, distinguishing forms of mass customisation based on changes in the product itself, and changes in the customer's perception of the product. They also introduced the important concept of customer sacrifice, defining it as "the difference between what the customer accepts and what the customer actually needs, even if he or she cannot clearly name it" (Gilmore, Pine, 1997). By addressing the issue of customer sacrifice, the company can decide on the extent of the changes in the functionality of the product or the perception of the product. The aim of using mass customisation is to tailor the product to the individual requirements of a specific customer, characteristic of engineering-to-order production, but with the guarantee of low prices and short delivery cycle times typical of mass production. A narrower definition describes the concept of mass customisation as a system that uses information technology, flexible processes and organisational structures to enable the delivery of a wide range of products that meet specific customer requirements (often by selecting predefined options from a set) at costs comparable to those typical of mass production (Bednarz, 2010). Duray was the first researcher to use the notion of modularity of the product itself as well as the manufacturing process to identify the various forms of mass customisation. In the case of mass customisation, modularity guarantees low costs. The typology put forward by Duray (2002) identifies between two dimensions: the point of customer involvement and the type of modularity employed. However, the developed classifications do not answer the question of what changes are necessary in operational processes to effectively deliver customised products in an efficient manner (Bednarz, 2010), (Duray, 2002). In Industry 4.0, one of the market objectives of companies is to tailor the product to the individual requirements of a specific customer. The literature on the subject does not offer a single widely accepted definition of Industry 4.0. nor principles of adapting companies to its requirements (Herman, Pentek, Otto, 2015), (Mrugalska, Wyrwicka, 2017), (Alcácer, Cruz-Machado, 2019). The main ideas of industry 4.0 were first published in Germany in 2011 (Kagermann, Lukas, Wahlster, 2011), (Kagermann, Wahlster, Helbig, 2013). A broad analysis of the issue was developed by M. Hermann, T. Pentek, B. Otto, who provided an overview of the definitions and key principles of Industry 4.0 (Herman, Pentek, Otto, 2015). The authors defined four core elements of Industry 4.0: Cyber- Physical Systems, Internet of Things, Internet of Services, and Smart Factory. They also developed six principles to support a company's adaptation to the requirements of Industry 4.0. These include: interoperability, virtualization, decentralization, real-time capability, service orientation, and modularity. With regard to the issue of Knowledge Management 4.0, a wide range of possible research topics has been developed by Ribeiro at all (2023). While Ansari (2019) proposed the following definition of KM 4.0 "as a strategic and operational function comprising exploration and exploitation processes. KM 4.0 is responsible to accomplish the following tasks, namely i) continuously support value generation through enhancing and balancing need- or opportunity-driven knowledge generation and knowledge utilisation capacities, and ii) persistently facilitate developing and protecting human-machine collective intelligence across manufacturing enter-prises and in particular smart factories". With regard to the above this paper focuses on two issues:

1. The issue of operationalisation of mass customisation through the application of Industry 4.0 methods and tools. Salvador et al. identified three key areas of mass customisation (Salvador, Holen, Piller, 2009), (Doligalski T. 2009):

- defining the area of customisation **(solution space development)**,
- designing an efficient process **(robust process design)**,
- and customer selection process **(choice navigation).**

To each of these areas they assigned a so-called core competence (fundamental capability) and a set of methods and tools to develop them. And so:

- As a core competence in terms of defining the area of customisation, the authors identified the selection of product elements that can be customised by the customer. The authors assigned to this competence a set of innovation tools, (*innovation tool kits*), such as virtual product tests (*virtual concept testing*) and customer experience monitoring (*customer experience inteligence*). This paper, referring to the methods and tools of Industry 4.0, analyses the aspects of the level of tracking changes by the companies examined in the customer market, in the economic segment, in the socio-demographic segment of the environment, and in the natural environment, as a way of searching for areas of product customisation. Companies must use new product development as a strategy for remaining competitive in the market place in response to changing consumer demands (Miranda at all, 2019).
- The authors identified the use and configuration of the resources of the organisation or its partners in the value chain to meet the diverse needs of a large number of customers as a core competence for designing an efficient process. Among the methods and tools conducive to the development of this

competence such aspects as flexible automation, process modularity and adaptable human capital were identified. With regard to the above competence, the author asks questions about the level of application of the toolkit supporting the process of adaptation to the requirements of Industry 4.0 pointed out, among others, by Herman, Pentek and Otto (2015). The toolkit covered by this study includes:

- Internet of Things.
- Artificial Intelligence.
- Cloud computing.
- CAD, CAM, CAE.
- Reverse engineering.
- 3D printers.
- Transport robots(Automated Gaided Vehicle).
- SCADA.
- MES (Manufacturing Execution System).
- e-Kanban.

- In terms of the customer selection process, the authors identified support in identifying the customers' needs while reducing the complexity of their choices as a core competence. With regard to this competence, the authors identified three tools: assortment matching trial and error (*fast cycle, trial-and-error learning*) and embedded configuration. With reference to the above, the authors have posed questions about the level of application of such tools as: artificial Intelligence (computer algorithms process large databases and make decisions without human intervention). Cloud computing (computing is carried out by a service provider without the need to install and administer own software).

2. The second issue addressed in the paper is the effectiveness of the applied methods and tools of Industry 4.0 in relation to corporate sustainability goals (Elkington, 1997). The paper asks questions about the trend of the company's development in business terms, and the level of achievement of the objectives in terms of human resources and environmental aspects in relation to the level of applied methods and tools of Industry 4.0 employed for the purpose of product customisation.

3. Objectives

The aim of the paper is to answer the following question: Is there a correlation between the level of application of Industry 4.0 methods and tools for product customisation and the level of achievement of corporate sustainability goals.

4. The Research

4.1 Research Sample

The research sample comprised 150 medium and large industrial companies (including 60 large ones) operating in 19 different industries in Poland. The respondents were persons directly involved in the management of the production and engineering area (president/managing director; technical director; other persons with similar competencies). The surveys and interviews were conducted through an external company on 28 December 20223.

4.2 Scope of Research

The scope of the research included the level of product customisation, the level of application of Industry 4.0 methods and tools, and the effectiveness of achieving the triple bottom line objectives in the economic, human resources aspect and environmental aspect.

4.3 Research Methods

As part of this study, a questionnaire survey was conducted on a sample of 150 medium and large industrial companies in Poland. The survey was conducted in the form of an interview. Respondents answered on a 1–5 (Likert) scale. In addition, data was partially processed using the Spearman's rank correlation test.

4.4 Data Processing Methodology

The following methodology was used to process the collected data:

- Stage 1 – A group of companies offering products with a high degree of customisation was selected from the research sample.
- Stage 2 – From the companies offering highly-customised products, a group of companies A – characterised by high performance in terms of the triple bottom line objectives - and a group of companies B – characterised by low performance in this respect.
- Stage 3 – For the research samples of companies A and B, indicators of the implementation level of Industry 4.0 management methods and tools were determined, analysed and synthesised. In order to calculate the implementation level of each method, fully implemented methods were identified (response scale 3,4,5 – for solution space development; and scale 4,5 – for robust process design, and choice navigation) in each research sample. Then, the number of fully implemented individual methods and tools was divided by the size of the respective sample (A and B). This yielded an indicator of the implementation level of the respective method (but fully implemented) in each group of companies A and B. In addition, as part of the synthesis, the average total indicator of the implementation of the methods was determined according to the areas of mass customisation: solution space development, robust process design, and choice navigation separately for groups A and B.
- Stage 4 – Spearman's rank correlation tests were carried out for some of the features.

4.4.1 Stage 1 – Product Customisation Level

The following question (E1) was asked in order to identify the group of companies offering highly customised products:

Customisation (personalisation) of the product:

1. none (no customisation of the product and no personalised communication with the customer);
2. narrow scope (standard product + additional services selected from catalogue; no personalised customer contact);
3. medium scope (multiple product variants offered + additional services determined through personalised contact with the customer);
4. extensive scope (customer co-creates the product via personalised contact);
5. very extensive scope (customer co-creates the product via an online service).

Responses 3,4,5 on the scale were rated as high levels of product customisation. 69 companies from the entire research sample of N=150 offered highly customised products.

4.4.2 Stage 2 – Level of Achievement of Triple Bottom Line Objectives – Identification of Group A and B Companies

In order to assess the effectiveness in terms of the achievement of the triple bottom line objectives in the economic, human resources and the environmental aspect, the following questions were posed:

- In terms of the economic aspect, question E2.1 was posed about the trend of the company's development in business terms, starting from the pre-pandemic periods.

1. negative (leading to business closure);
2. stagnant (no growth);
3. acceptable but not satisfactory;
4. good – satisfactory;
5. very good.

Responses 4, 5 on the scale were deemed to reflect a high level of efficiency in terms of economic objectives and a basis for classifying a given company to Group A. Responses of 1,2,3 on the scale, in turn, were deemed to reflect low efficiency in that respect and a basis for categorising the company in question to Group B.

- In terms of the human resources aspect, questions were posed about the degree of implementation of the following measures according to the following scale: (1 – not implemented at all; 2 – implemented to a very low degree; 3 – implemented to a moderate degree; 4 – implemented to a high degree; 5 – implemented to a very high degree)

(E2.2) An analysis of risks to human health and life is carried out in the design stage of products or services.

(E2.3) An analysis of risks to human health and life is carried out in the design stage of manufacturing systems/organising services.

Responses 4, 5 on the scale were deemed to reflect a high level of efficiency in terms of human resources objectives and a basis for classifying a given company to Group A. Responses of 1,2,3 on the scale, in turn, were deemed to reflect low efficiency in that respect and a basis for categorising the company in question to Group B.

- In terms of the environmental objectives, questions were posed about the degree of implementation of the following measures according to the following scale: (1 – not implemented at all; 2 – implemented to a very low degree; 3 – implemented to a moderate degree; 4 – implemented to a high degree; 5 – implemented to a very high degree)

(E2.4) Technologies harmful to the environment are replaced with environmentally-friendly alternatives.

(E2.5) Waste is neutralised to render it harmless to the environment.

Responses 4, 5 on the scale were deemed to reflect a high level of efficiency in terms of environmental objectives and a basis for classifying a given company to Group A. Responses of 1,2,3 on the scale, in turn, were deemed to reflect low efficiency in that respect and a basis for categorising the company in question to Group B.

10 companies with a high level of efficiency in terms of the triple bottom line objectives in all three aspects combined were classified as group A companies. On the other hand, group B included 5 companies with a low level of efficiency in terms of the triple bottom line objectives in all three aspects combined.

4.4.3 Stage 3 – Indicators of the Implementation Level of Industry 4.0 Management Methods and Tools in Groups A and B

In order to determine the implementation degree of methods and tools supporting processes in the solution space development area, the following question was posed: In order to identify market opportunities, changes are tracked according to the following scale: (not tracked at all; 2 – tracked only to a limited extent; 3 – tracked to a moderate extent; 4 – tracked to a large extent; 5 – tracked to a very large extent)

- (E3.1) In the economic segment of the environment.
- (E3.2) In the socio-demographic segment of the environment.
- (E3.3) In the natural environment.
- (E3.4) In the technological segment of the environment.
- (E3.5) In the customer market.

Responses of 3,4,5 on the scale were considered to reflect a high degree of implementation of methods and tools supporting solution space development. In group A companies, the total indicator of the level of implementation of methods was 46%. The detailed distribution of the levels of implementation is shown in Figure 1.

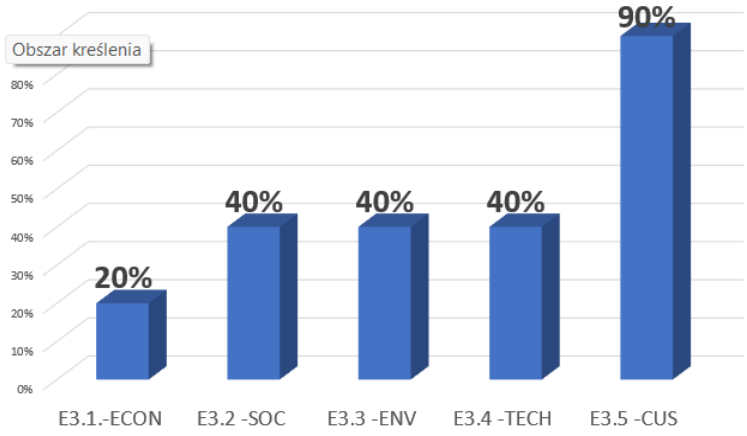


Figure 1: Chart 1. Detailed distribution of the level of implementation of methods supporting solution space development in group A companies.

On the other hand, in group B companies, the total indicator of the level of implementation of the methods was 72%. The detailed distribution of the levels of implementation is presented in Figure 2. These values were not in line with expectations, while the very fact of a considerable use of methods for tracking changes in the environment of group B companies results from high product customisation in the whole segment of enterprises with high customisation level.

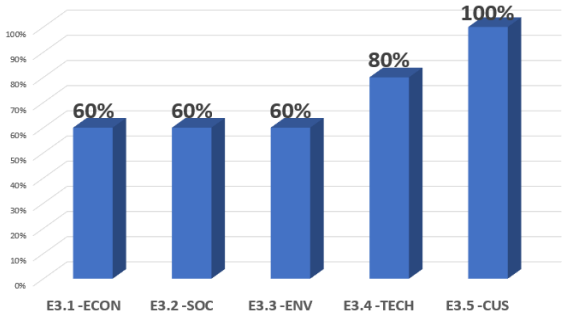


Figure 2: Detailed distribution of the level of implementation of methods supporting solution space development in group B companies.

In order to identify the group of companies supporting robust process design (questions a to j) and choice navigation (questions from b to c), the following questions were posed: The extent of application of the following technologies: (1 – not used, 2 – used to a very small extent; 3 – used to a small extent; 4 – used to a large extent; 5 – used to a very large extent)

- (E3.6) Internet of Things.
- (E3.7) Artificial Intelligence.
- (E3.8) Cloud computing.
- 9E3.9) CAD, CAM, CAE.
- (E3.10) Reverse engineering.
- (E3.11) 3D printers.
- (E3.12) Transport robots (Automated Gaided Vehicle).
- (E3.13) SCADA.
- (E3.14) MES (Manufacturing Execution System).
- (E3.15) e-Kanban.

Responses of 4,5 on the scale were considered to reflect a high degree of implementation of methods and tools supporting robust process design and choice navigation. In group A companies, the total implementation level of methods supporting robust process design was 60%, while the total implementation level of methods supporting choice navigation was 50%. Figure 3 shows a comparison of the implementation levels of methods supporting robust process design (questions from a to j) and choice navigation in groups A and B.

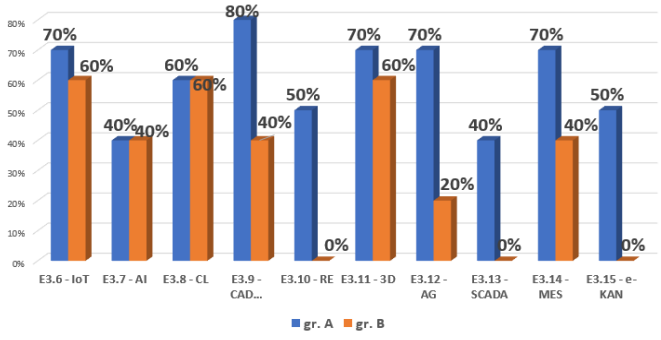


Figure 5: Comparison of implementation levels of methods supporting robust process design (questions from a to j) and choice navigation in groups A and B.

Detailed analysis of the distribution of implementation levels of methods supporting robust process design in group A indicates the highest level of implementation of CAD, CAM, CAE methods, which is most likely due to the wide availability of the above technologies. High implementation level of 70% was also identified for such methods as: a – Internet of Things, f – 3D Printers, g – Automated Gaided Vehicle and – MES. The lowest

implementation level for group A companies was identified for such methods as: b – Artificial Intelligence ora h – SCADA. In contrast, in group B companies, the total implementation level of methods supporting robust process design was 32%, while the total implementation level of methods supporting choice navigation was 50%. The detailed analysis of the distribution of the implementation levels of methods supporting robust process design in group B companies shows the highest scores for such methods as IoT, Cloud Computing and 3D printers. In contrast, three groups of methods: Reverse Engineering, SCADA and e-Kanban had zero implementation levels.

4.4.4 Stage 4 – Spearman's Rank Correlation Tests.

In order to verify whether there is a statistical correlation between the implementation level of Industry 4.0 management methods and tools and the performance of enterprises in terms of triple bottom line objectives, a correlation analysis was conducted. Since the variables take values on an ordinal scale, Spearman's rank correlation was used. Statistical analyses were performed using Statistica 13.1 software. Spearman's rank analysis was performed assuming a significance level of $p<0.05000$. The strength of the correlations was assessed based on the classification presented below in Table 1. The interpretation of the correlation coefficient does not provide a clear answer on the causal relationship, but indicates the existence of a certain statistical relationship between the variables examined, which is one of the conditions for the existence of a cause-and-effect relationship (Małkowska-Borowczyk, 2011).

Table 1: The strength of the correlations.

Correlation coefficient value	Interpretation
r ≤0.2	Virtually no relationship
0.2< r ≤0.4	Low but clear linear correlation
0.4< r ≤ 0.7	Moderate correlation
0.7< r ≤0.9	Significant correlation
0.9< r ≤1	Very strong correlation

Elaboration based on Ostasiewicz, Rusnak, Siedlecka, (2000) .

Table 2 presents the results of Spearman's Rang correlation between the implementation level of Industry 4.0 methods and tools supporting the processes of solution space development robust process design and choice navigation and the level of achievement of triple bottom line objectives.

Table 2: Spearman's Rang correlation.

Objectives/Methods		Human Resources aspect		Environmental aspect		Economic aspect
		E.2.2	E.2.3	E2.4	E2.5	E2.1
solution space development	E3.1	0,232510	0,055048	0,026032	0,092053	-0,007062
	E3.2	0,306320	0,067530	0,085222	0,053806	0,001929
	E3.3	0,409306	0,015822	0,073348	0,040235	0,063563
	E3.4	0,177733	0,075493	0,040583	0,058790	0,138388
	E3.5	0,051646	0,151659	0,229805	0,162892	-0,002757
sobust process design and choice navigation	E3.6	0,232510	0,055048	0,118231	0,184938	0,195864
	E3.7	0,306320	0,067530	0,088012	0,128992	0,178924
	E3.8	0,409306	0,015822	0,019361	0,186947	0,246889
	E3.9	0,177733	0,075493	0,068499	0,080334	0,116630
	E3.10	0,051646	0,151659	0,148908	0,096759	0,160551
	E3.11	0,279472	0,046321	0,094857	0,153698	0,160796
	E3.12	0,083694	0,190714	0,135461	0,205505	0,305156
	E3.13	0,131735	0,153927	0,201914	0,190439	0,339416
	E3.14	0,140805	0,128516	0,138452	0,176396	0,320284
	E3.15	0,332559	0,143282	0,209248	0,265239	0,217790

Analysis of Table 2 leads to the following conclusions:

- Figures highlighted indicate all significant correlation coefficients in the ranges between $0.2< r \leq 0.4$ and $0.4< r \leq 0.7$ which indicates a low but clear linear correlation in the first case and a moderate correlation in the second case.
- All significant correlation results are positive, which means that an increase in the implementation level of individual methods and tools supporting the solution space development robust process design and choice navigation processes is accompanied by an increase in the efficiency in terms of achieving triple bottom line objectives.
- The achievement of higher goals in the economic aspect is accompanied by an increase in the level of implementation of methods supporting robust process design, in particular (E3.12) Automated Guided Vehicles, (E3.13) SCADA, (E3.14) MES, (E3.15) e-Kanban, and (E3.8) Cloud computing. These methods and tools are related to the operational manufacturing of products.
- The achievement of more ambitious environmental targets is accompanied by an increase in the implementation level of methods: (E3.5) related to tracking changes in the customer market supporting solution space development processes and (E3.12) Automated Guided Vehicles, (E3.13) SCADA, and (E3.15) e-Kanban, which are conducive to robust process design.
- The achievement of more ambitious human resources objectives is accompanied by an increase in the implementation level of such methods as:(E3.1) tracking changes in the economic segment of the environment, (E3.2) in the socio-demographic segment of the environment, (E3.3) in the natural environment, to support solution space development processes, as well as (E3.13) SCADA, and (E3.15) e-Kanban conducive to robust process design.3. Results
- This section may be divided by subheadings. It should provide a concise and precise description of the experimental results, their interpretation, as well as the experimental conclusions that can be drawn.

5. Results and Discussion

The aim of the paper was to explore the question of a potential correlation between the implementation level of KM 4.0 methods and tools supporting product customisation and the level of corporate sustainability goals achieved. Exploring future directions in perspectives for stakeholders the following areas of using KM 4.0 methods and tools could be distinguished:

- Replace human labour with automated work.
- Increase resource flexibility through the use of network solutions.
- Support the identification and outsourcing of processes that do not meet best practice requirements.

Currently, the Polish market (as well as the entire EU market) is facing declining labour resource in all areas of business processes. The application of new emerging technologies not only improves the process of delivering a customized product at mass prices, but in many cases makes it possible to realise the process at all by replacing human labour with automated work. With reference to future directions in group A companies, highly efficient in terms of achieving triple bottom line goals, the implementation level of KM 4.0 methods and tools supporting robust process design and choice navigation was significantly higher compared to group B companies. The methods indicated above largely concern operational and production processes and allow flexible delivery of highly customised products at a price comparable to that of mass products. The result of applying the modern methods of Industry 4.0 in these areas is an increased efficiency in terms of achieving objectives in economics, human resources and environmental aspects. With regard to the implementation level of methods supporting solution space development processes, group B had higher scores than group A. Although the result differs from expectations, this is due to the high product customisation in the entire segment of the companies surveyed.

References

Alcácer, V. and Cruz-Machado, V. (2019) "Scanning the Industry 4.0: A Literature Review on Technologies for Manufacturing Systems", Engineering Science and Technology, an International Journal 22, 2019, pp. 899–919.

Ansari, F. (2019) Knowledge Management 4.0: Theoretical and Practical Considerations in Cyber Phisical Production Systems, IFAC PapersOnLine 52-13 (2019) 1597–1602.

Bednarz, L. (2010) Operacjonalizacja strategii masowej kastomizacji w: Konferencja - Innowacje w Zarządzaniu i Inżynierii Produkcji, Zakopane, Polska, pp. 102-111.

Doligalski T. (2009) "Możliwości zastosowania masowej kastomizacji jako usługi internetowej", [w:] Konsument w przestrzeni europejskiej, (red.) Dąbrowska, A. i Ozimek I. , Instytut Badań Rynku, Konsumpcji i Koniunktur, Warszawa.

Duray, R. (2002) "Mass customization origins: mass or custom manufacturing?", International Journal of Operations & Production Management, 2002, nr 3.

Elkington, J. (1997) Cannibals with Forks: The Triple Bottom Line of 21st Century Business, Capstone, Oxford.

Gilmore, J.H. and Pine, II B.J. (1997) "The four faces customization", Harvard Business Review, January-February 1997, pp. 21-30.

Hermann, M., Pentek, T., and Otto, B. (2015) Design Principles for Industrie 4.0 Scenarios: A Literature Review, Working Paper No. 01 /2015, Technische Universität Dortmund Fakultät Maschinenbau Audi Stiftungslehrstuhl Supply Net Order Management www.snom.mb.tu-dortmund.de

Jasiulewicz-Kaczmarek, M., Legutko, S. and Kluk P. (2020) "Maintenance 4.0 Technologies – New opportunities for sustainability-driven maintenance", Management and Production Engineering Review, Volume 11, Number 2, June 2020, pp. 74–87.

Kagermann H., Lukas, W. and Wahlster, W. (2011) Industrie 4.0 – Mitdem Internet er Dinge auf dem Wegzur 4. Industriellen Revolution, Industry 4.0: with the Internet of Things towards 4th industrial revolution, [online] VDI Nachrichte; http://www.vdi nachrichten.com/artikel/Industrie-4-0- Mit-dem-Internet-derDinge-auf-dem-Weg-zur-4-industriellen-Revolution/52570/1.

Kagermann, H., Wahlster, W, and Helbig, J. (2013) Securing the future of German manufacturing industry: recommendations for implementing the strategic initiative INDUSTRIE 4.0. Final report of the Industrie 4.0 working group. Berlin, ForschungsunionimStifterverbandfürdie Deutsche Wirtschafte, Berlin.

Małkowska-Borowczyk, M. (2011) "Otoczenie jako źródło problemów i presji na wybory strategiczne przedsiębiorstw", w: Urbanowska-Sojkin E. (red.). Podstawy wyborów strategicznych w przedsiębiorstwach, PWE, Warszawa.

Miranda, J., Pérez-Rodríguez, R., Borja, V., Wright, P. K. and Molina, A. (2019) "Sensing, smart and sustainable product development (S3 product) reference framework", International Journal of Production Research, 57:14, pp. 4391-4412.

Mrugalska, B. and Wyrwicka, M. (2017) "Towards Lean Production in Industry 4.0.", 7th International Conference on Engineering, Project, and Production Management, Procedia Engineering 182, 2017, pp. 466 – 473.

Ostasiewicz, S., Rusnak, Z. i Siedlecka, U. (2000) Statystyka. Elementy teorii i zadania, Wydawnictwo Naukowe PWN, Warszawa.

Pawlowski, K. (2020) "The State of Adaptation of Enterprises in Poland to the Paradigms of Industrial Production Industry 4.0", In Proceedings of the 36th International Business Information Management Association Conference (IBIMA), Sustainable Economic Development and Advancing Education Excellence in the era of Global Pandemic, ed.: Khalid S. Soliman: International Business Information Management Association, IBIMA, Granada, Spain, pp. 5023-5032.

Ribeiro, V. B., Nakano, D., Muniz Jr., J., and Oliveira, R. B. (2022) Knowledge management and Industry 4.0: a critical analysis and future agenda. Gestão & Produção, 29 e5222,

Salvador, F., De Holen P.B. and Piler F. (2009) "Cracking the Code of Mass Customization", MIT Sloan Management Review, vol. 50, nr 3, 2009.

Trzcieliński, S. (2011) Przedsiębiorstwo zwinne, Wydawnictwo Politechniki Poznańskiej, Poznań, Poland.

Trzcieliński, S., Włodarkiewicz-Klimek, H. and Pawłowski, K. (2013) Współczesne Koncepcje Zarządzania. Wydawnictwo Politechniki Poznańskiej, Poznań, Poland.

Analysis of Technological Competencies from an Economic Perspective

Leticia Pekk[1], Andras Hary[2] and Zoltan Kovacs[1]
[1]University of Pannonia, Veszprém, Hungary
[2]ZalaZONE Science Park Ltd., Zalaegerszeg Hungary

leticia.pekk@tc.org.hu
andras.hary@apnb.hu
kovacs.zoltan@gtk.uni-pannon.hu

Abstract: The research examines technological competencies from the perspectives of both human and technical components, emphasizing their significance in responding to corporate management challenges. Recent global changes have triggered significant technological transformations, presenting new challenges for corporate management. In this context, technological competence – encompassing both qualified human resources and technical innovations – plays a crucial role in the success of the responses provided by companies. The objective of the study is to demonstrate how technological competencies affect a company's economic performance and strategic adaptation capabilities. Data collected within the research framework included economic information provided by companies, such as revenue and staff numbers, as well as specific data related to technological forecasting methods. The analytical methods employed enabled the creation of a comprehensive understanding of the role technological competencies play in the economic context. The research underscores how the development of technological competencies can assist companies in successfully navigating through the challenges posed by technological changes. The findings indicate that the development of human resources and the integration of technological innovations are indispensable for strengthening corporate success and market position. Expert-type companies, which facilitate knowledge-based development and the introduction or marketing of new technologies, particularly benefit. In these companies, not just the technical equipment, but also human capabilities are decisive in successfully responding to technological challenges. This supports the importance of combining human resource development and technological innovations. The application of technological forecasting methods enables companies to better anticipate and manage market and technological trends, further strengthening their adaptive and innovative capacity. In summary, the research concludes that the harmony between technological competencies, knowledge, and corporate strategy enhances organizational competitiveness, highlighting the importance of knowledge-based development and the expansion of qualified human resources. To successfully adapt to the dynamics of technological changes, companies need to integrate technological competencies at a strategic level, thereby promoting knowledge-based economic growth and long-term success.

Keywords: Technological Competencies, Economic Performance, Corporate Management, New Technologies

1. Introduction

In recent years, the business landscape has undergone significant transformations due to rapid technological advancements and shifting global dynamics. These changes have not only redefined the market conditions but also reshaped the way companies operate and compete. Central to navigating this evolving environment is the development of technological competencies which encompass a blend of qualified human resources and advanced technical innovations.

Understanding and harnessing these competencies have become pivotal for companies aiming to maintain a competitive edge and respond effectively to management challenges. While it may seem intuitive that technical competency positively influences economic performance, empirical evidence is mixed. Some studies, such as Oztemel and Ozel (2019), highlight the substantial role of technological infrastructure in enhancing company performance, whereas others, like Ainin et al. (2010), emphasize the importance of technical capability, firm innovativeness, and e-business practices. These mixed findings indicate the need for further research to gain a deeper understanding of how technological competencies affect business performance across different contexts. This study seeks to explore the intricate relationship between technological competencies and corporate management, emphasizing how these elements contribute to a company's economic performance and strategic adaptation. Through a comprehensive analysis of various data sources, including company-provided economic information and technological forecasting methods, this research aims to provide insights into how organizations can leverage these competencies to foster sustainable growth and long-term success in a dynamic global market.

Wolff (2021) discusses the complexities and interconnectivity of modern technologies, such as artificial intelligence and the Internet of Things, emphasizing the challenges they pose for governance and social control.

She highlights the increasing difficulty of understanding and managing these technologies due to their sophisticated nature. Wolff (2021) argues for a more nuanced understanding of technological impact, stressing the need for scholars to explore both the positive and negative effects of technological advancements on society. Also, underlines the importance of developing social, political, and legal tools to guide the evolution of technology in beneficial directions.

The analysis by Ellingrud et. al (2020) highlights the significant impact of automation and digitization on the workforce in operationally intensive sectors. As technologies advance, up to 58% of operational tasks could be automated using existing technologies, dramatically shifting skill requirements. The future demand will focus increasingly on technological skills, with a projected rise of over 50%, and a similar increase for complex cognitive skills. However, many leaders are unprepared for these changes, hindered by a lack of clarity on future skill impacts and insufficient tools to manage the transition effectively.

Considering these global changes and technological advancements, it becomes clear that companies must not only focus on developing human resource competencies but also pay close attention to their strategy formulation processes to successfully adapt and thrive in the rapidly changing business environment.

Hunger and Wheelen (2020) outline that strategic management typically evolves through four phases: from basic financial planning and forecast-based planning to externally oriented strategic planning, and ultimately to strategic management, which incorporates implementation, evaluation, and control into strategy formulation. This evolution reflects the need for organizations to adapt to dynamic environments and transition from rigid, bureaucratic structures to flexible, learning organizations. Such adaptability is crucial as it enables organizations to maintain competitiveness by continually reassessing their strategies and responding quickly to environmental changes.

The novelty of the study lies in its comprehensive examination of how structured technology management and forecasting practices influence a company's technological competence, particularly focusing on both economic performance and strategic adaptability. Additionally, the authors introduce a specific approach to defining and measuring technological competencies using two key indicators: knowledge intensity and technical intensity. Through a comprehensive analysis of various data sources, including company-provided economic information and technological forecasting methods, this research aims to provide insights into how organizations can leverage these competencies to foster sustainable growth and long-term success in a dynamic global market.

Given the significant shifts in the business landscape, it is essential to investigate this area further. The study is based on interviews with representatives from 62 companies to gain deeper insights into their strategic practices and viewpoints. Publicly available business data were also analysed to assess the economic performance of these organizations, comparing them with their systematic approach to developing technological competencies. This comprehensive method enables an examination of how effectively organizations are using their technological competencies to improve their strategic and operational effectiveness amidst ongoing global and technological transformations.

2. Literature Review

Nowadays in the business landscape, the influence of new technologies on organizational strategy, management methods, and corporate performance is profound. The literature review synthesizes findings from various studies that explore these dynamics, offering insights into how businesses are adapting to the technological era.

Marinkovic et al. (2022) stress the critical role of corporate foresight in enabling organizations to anticipate and adapt to rapid technological changes and market dynamics. Their study highlights how effective foresight activities help companies maintain competitiveness by preparing for future scenarios and mitigating potential risks. Also, advocate to integrate corporate foresight into strategic management to enhance responsiveness and strategic flexibility. Zhao et al. (2022) discuss the distinction between corporate foresight and technology foresight in the context of strategic planning and technology management. The authors highlight that while both concepts involve anticipatory functions, they serve different strategic roles within organizations. Corporate foresight is identified as a broader process that encompasses not only technological insights but also environmental scanning, societal changes, and economic shifts, making it integral to overall strategic management. In contrast, technology foresight is more narrowly focused on emerging technologies and their potential impacts on sectors and markets, specifically aiding in technological planning and innovation management.

Ilyina et al. (2020) emphasize the necessity for organizations, particularly within scientific sectors, to adapt rapidly to market changes. They propose a unified digital platform that integrates scientometric indicators and Technology Project Readiness Levels to enhance the management and visualization of scientific and technological competencies, fostering collaboration and innovation across industries. Tronina et al. (2020) suggest a methodological approach to mapping key technological competencies within regions, advocating for "smart specialization" to leverage regional strengths and drive innovation. This strategy aims to align regional capabilities with emerging opportunities, enhancing strategic planning and promoting sustainable economic growth. Oztemel and Ozel (2019) discuss the importance of technological competency assessments in SMEs, particularly in the manufacturing sector. They introduce a model that evaluates essential technological capabilities, providing a roadmap for SMEs to enhance their competitive advantage by aligning their technological infrastructure with contemporary standards. Zoia et al. (2018) examine factors influencing the technological status of Italian firms, finding that firm size, internationalization, and cooperation significantly impact innovation capabilities. The study points to the importance of geographic location and the propensity of technologically capable firms to engage in innovative cooperation. Fuertes et al. (2020) analyse the strategic management literature, noting a lack of theoretical frameworks to guide the formulation and evaluation of strategies in the context of technological advancements. They advocate for a balance between systematic planning and adapting to the organic, often chaotic nature of strategic processes. Belas et al. (2020) investigate management practices within SMEs, noting the critical role of human resources and participative management styles in adapting to changing business environments. Their findings suggest that a strategic integration of human resources is essential for corporate adaptability and performance. Toborek-Mazur and Partacz (2023) delve into how technological development impacts corporate management methods, highlighting the increasing significance of knowledge and technology management as critical components of modern business practices. Hamdani et al. (2018) discuss the impacts of AI, blockchain, and data analytics on corporate structures, predicting a future where traditional hierarchical structures may become obsolete due to the decentralizing power of these technologies. Tanushev (2022) focuses on the strategic adaptation required for businesses to thrive in the digital age, using Kaplan and Norton's strategy maps to outline the influence of digital processes on enhancing customer value and developing sustainable business models. Agolla (2018) presents a model aligning innovation, strategy, and strategic human resource management, positing that integrating these elements enhances organizational competitiveness by fostering an innovative capacity through strategic HR practices. Singla et al. (2018) analyse the transition between technology push and demand-pull strategies in manufacturing, supporting the view that market needs are crucial drivers of innovation. Fettig et al. (2018) explore the impact of Industry 4.0 on organizational structures, showing how the integration of Cyber-Physical Systems necessitates a re-evaluation of corporate strategies to maintain competitiveness in a digitally transformed economy.

The significance of technological competencies has increased substantially in recent years, as demonstrated by numerous studies showing that technological innovations and the associated development of human resources directly impact the economic performance of companies.

This review underscores the importance of technology foresight in equipping organizations to navigate and adapt to rapid technological and market changes. It highlights how integrating foresight into strategic planning and management is crucial for anticipating future challenges and seizing opportunities, thereby enhancing organizational agility and competitive edge in the global marketplace.

3. Research Question

The main research question of the paper seeks to examine the link between management approaches in technology and a firm's ability to develop and maintain technological competencies as a critical factor in today's fast-paced business environment:

- How do structured technology management practices and the use of technology forecasting impact the technological competence of the companies?

Technological competence: The ability of a company to effectively utilize technological resources to achieve competitive advantage. This includes the capacity to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments. (Teece et al., 1997)

Technology management practices: These refer to the systematic approaches and processes that companies use to manage their technological resources and capabilities. This includes planning, implementation, and control of technological activities within the firm. (Gregory, 1995)

Technology forecasting: The process of predicting future technological developments and trends. This involves using various methods and tools to anticipate changes in technology that could impact the company's strategic planning and innovation efforts. (Watts and Porter, 1997)

Emerging from the identified need in the literature to understand the strategic integration of technological advancements, this study aims to:

- Assess the extent to which technology management practices are adopteded by companies.
- Analyse the relationship between the application of technology forecasting methods and technological competence levels.
- Determine the impact of these practices on a companies' capacities to innovate and compete.

Given the rapid evolution of technology and its disruptive impact on markets, the study is bounded by the examination of current technology management and forecasting practices, focusing on their direct correlation with measures of technological competence. It intends to contribute to the strategic management literature by offering empirical insights into the effectiveness of these practices, potentially guiding corporate leaders in optimizing their strategic responses to technological challenges.

4. Methodology

Data were gathered through structured interviews with representatives from 62 technology-intensive companies of varying sizes, including small, medium, and large enterprises. The selection of companies was based on identifying technology-intensive sectors. According to the research findings of Pekk et al. (2021), the telecommunications and electronics industries, as well as the machinery and automotive sectors, were selected for their high technology intensity. As a result of the interviews, two main areas were highlighted:

1. Technology Forecasting Application: Companies were asked about their use of technology forecasting methods, evaluated on a scale of 1 to 4, where:

- 1- indicates no use of technology forecasting,
- 2- acknowledges the importance of forecasting and its integration into decision-making,
- 3- signifies the use of simplified forecasting methods,
- 4- reflects the employment of comprehensive technology forecasting methods.

2. Technological Management Methodology: Companies were also rated on their systematic approach to technology management on a scale of 1 to 4, where:

- 1- Represents a non-systematic approach, where companies that apply technological forecasting and management methods on an ad-hoc or irregular basis.
- 2- Shows little evidence of a structured application of these methods.
- 3- Indicates that companies apply these methods consistently and moderately systematic approach.
- 4- Denotes a highly systematic and integrated technological management systems.

The evaluation of the Technological Management Methodology for the companies is based on several key factors: the systematic application of forecasting methods, the integration of strategy with new technologies, and the presence of systematic management practices. The Technological Management Methodology was classified and assessed accordingly by the authors.

Based on these assessments, a 4x4 matrix was constructed to classify companies according to their methodology in both areas, allowing for the identification of organizations with their systematic approaches in technology forecasting and management.

3. Technological competence was evaluated based on calculated values derived from public financial reports between 2012 and 2022. The calculation encompassed two components:

- Knowledge intensity: added value, derived from the average gross salary can reflect the skill level and knowledge of the workforce),
- Technical intensity: determined by the ratio of technology asset value to total revenue.

Knowledge intensity refers to the degree to which a company's operations and competitive advantage rely on specialized knowledge and skills. Higher knowledge intensity is linked to better innovation outcomes and higher productivity. For example, research by Ainin et al. (2010) demonstrates that companies with a more knowledgeable workforce are better positioned to implement advanced technologies and processes, leading to

sustained competitive advantages. Additionally, studies by Doloreux and Melançon (2008) emphasize the importance of knowledge-intensive industries in driving economic growth and innovation.

Technical intensity can also include other metrics such as the proportion of R&D expenditure to sales, the number of patents per employee, or the extent of technological equipment and infrastructure investments. This indicator measures the extent to which a company invests in technology relative to its overall size and is a key metric for understanding a company's commitment to maintaining and advancing its technological infrastructure. For example, studies like those by Hollenstein (1996) and Falk (2004) use similar measures to assess technical intensity in their respective analyses of innovation activities.

A 62x62 matrix was prepared, ranking companies according to these calculated values to position them based on their level of the two components of technological competence.

The final stage of the methodology involved a comparative analysis between the two matrices to investigate potential relationships or patterns between the companies' structured technology management practices, use of technology forecasting methods, and their overall technological competence. Figure 1 presents the interpretation of the two matrices and the way of examination of the correlations between them.

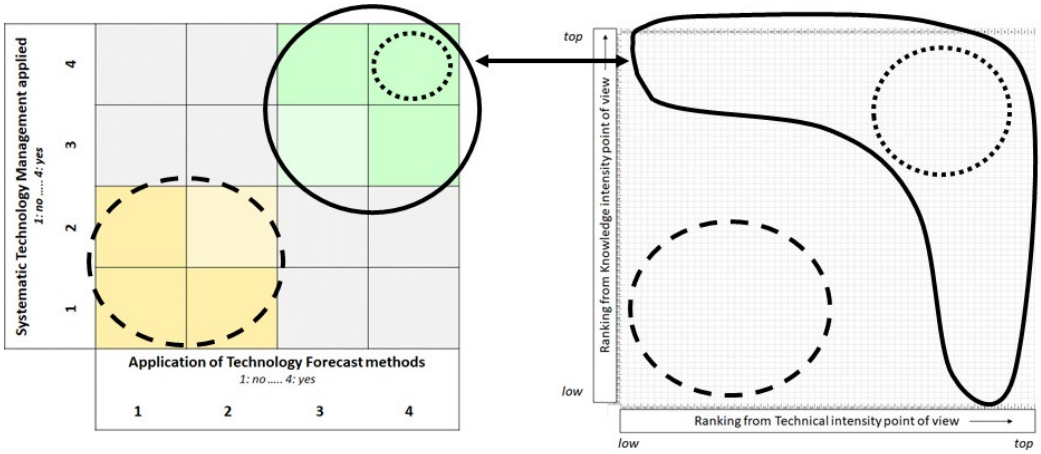


Figure 1: Display and expected relations of 4x4 and 62x62 matrices

This analysis aims to identify whether a systematic approach in these domains is indicative of higher technological competence, thereby providing valuable insights into effective management strategies for adapting to technological advancements.

5. Results and findings

This section highlights the findings derived from the analysis of the 4x4 and 61x61 matrices, which collectively represent the systematic application of technology management and forecasting alongside the calculated technological competence within the sample of the interviewed companies. The analysis aimed to explore how technological competencies - both human and technical - contribute to corporate success. Key observations include:

A. Contribution to corporate success: The study underscores that nearly 80% of the more systematic companies excel in either knowledge intensity or technical intensity, indicating that strong technological competencies in either dimension significantly contribute to corporate success.
B. Distinction in competence: Among the firms with more systematic approach, 3 out of every 7 exhibit strong competencies in both knowledge and technical intensity. This dual strength indicates that these companies, which excel in both dimensions of technological competence, are likely to achieve superior performance and adaptability in their respective industries.
C. Variability in approaches: Conversely, companies with less systematic approaches to technology management and forecasting tend to rank lower in both dimensions of technological competence. This suggests a correlation between the systematic application of technology strategies and higher levels of technological competence.

Figure 2 depicts the distribution of 62 companies based on the application of technology forecasting methods and the systematic nature of their technology management. The lower left quadrant, where both aspects score

low, is the most populated, indicating that majority of the companies do not employ systematic methods in either domain. Contrary, the upper right quadrant represents companies that score high in both, signifying a systematic approach in both technology forecasting and management. For the quadrants where companies have low technology forecasting but high technology management scores, it suggests these firms might prioritize internal processes and day-to-day operations over strategic foresight. This could imply a focus on current operational efficiencies rather than future-oriented planning, which may impact their long-term adaptability and innovation potential.

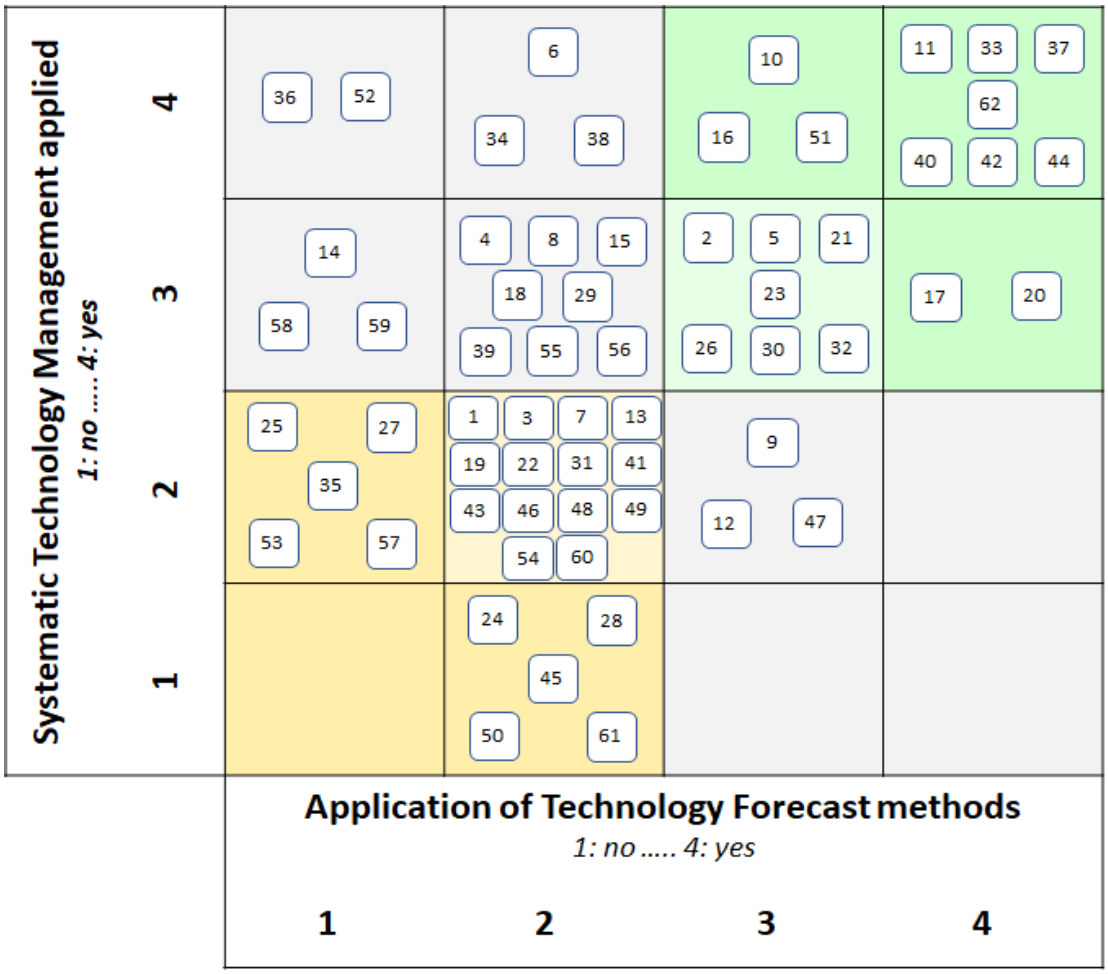


Figure 2: 4x4 matrix in the light of systematic Technology Management and Technology Forecasting methods across the analysed companies

Figure 3 illustrates a 62x62 matrix plotting the Knowledge Intensity and Technical Intensity of 62 companies, calculated from their business data. The marked 'L-shaped' area encloses companies that are strong in either or both dimensions, with those in the upper right quadrant excelling in both areas, indicating robust competencies. The green squares denote companies that were identified as methodical in both technology management and technology forecasting methods in the 4x4 matrix. Notably, three companies highlighted within the greens demonstrate high technical and knowledge intensities, pointing to their substantial capabilities in both domains.

The red squares indicate companies ranked as less methodical in the 4x4 matrix; these generally show weaker intensities in this matrix as well.

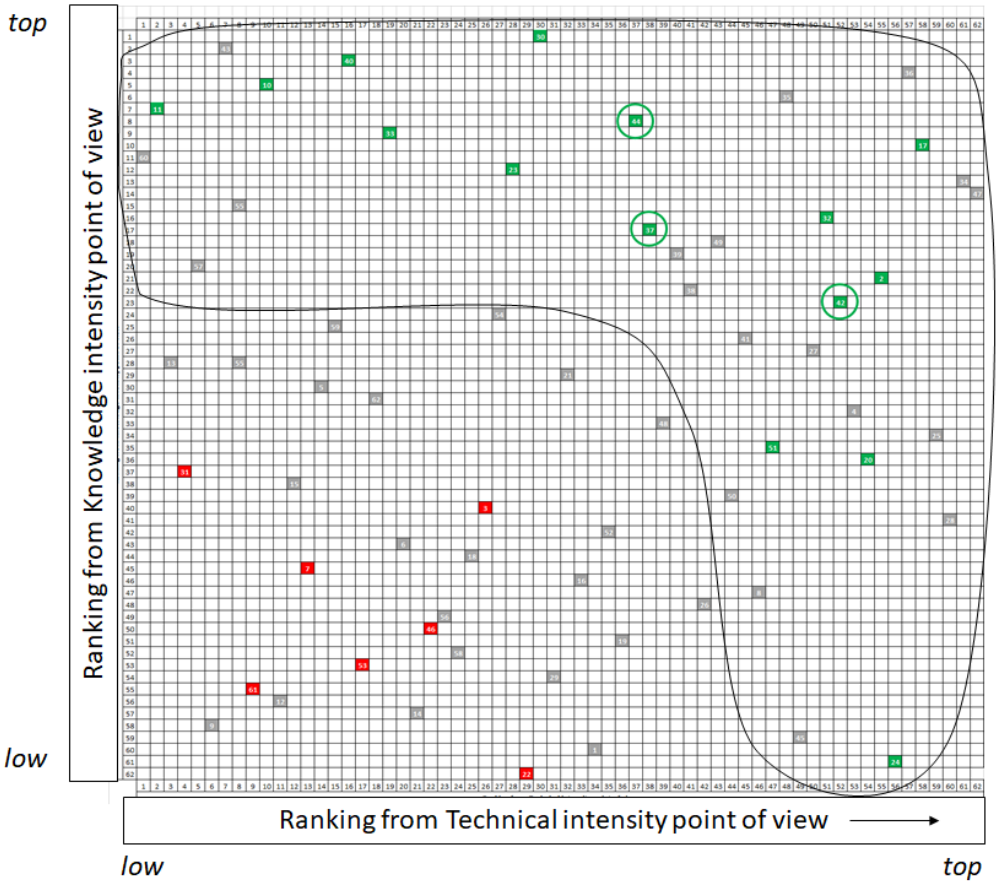


Figure 3: 62x62 matrix in the light of Knowledge intensity and Technical intensity across the analysed companies

The analysed companies do not necessarily show high scores in both dimensions to be successful. High Knowledge Intensity, derived from the added value or average gross wages, suggests that a higher wage is associated with higher-skilled personnel. On the other hand, Technical Intensity, calculated as the ratio of technological costs to revenue percentage, indicates investment in technology. There are successful companies that do not rely on expensive technology for added value, demonstrating that high performance can be achieved through various paths of technological competence.

The analysis of interview data and collected information has led to the following additional conclusions, providing deeper insights into specific trends and correlations observed among the companies:

- Profitability trends: The collected data indicates significant variability in the profitability of companies over the years. For example, "Company 17" experienced exceptionally high profitability in certain years, while in other years, it did not show significant profits. This suggests that some companies achieve periodic or project-based success, driven by specific technological developments or large-scale projects.
- Technology management systematic nature: Following the comprehensive evaluation of the companies' technology management practices, it was found that companies such as "Company 10" and "Company 11" both of which received a high rating (4), generally exhibit better technological intensity and profitability.
- Correlation between systematic technology management and profitability: The analysis reveals that the systematic application of technology management practices is positively correlated with profitability. Companies that more consistently apply these methods, such as "Company 11" (rated 4), generally achieve higher profitability compared to those that are less systematic in their approach, such as "Company 1" (rated 2).
- Impact of human/tech cost index: The analysis shows that companies with a higher human/tech cost index, such as "Company 5" (rated 3), generally achieve higher technological intensity and better long-term performance. This suggests that investments in technology tend to pay off in the long run.

- Sector-specific trends: The differences between sectors are also notable. For example, companies operating in the manufacturing sector, such as "Company 3" and "Company 4", generally exhibit higher technological intensity and productivity. However, their technology forecasting methods are rated lower (2), and their technology management systematic nature scores are (2) and (3), respectively. This suggests that while these sectors benefit from technology management and forecasting, there is still space for improvement in their systematic application to achieve even better performance.

6. Limitations and Future Research

While the study reveals insights into the relationship between technological management practices and corporate success, its scope is limited by several factors. The sample, consisting of 62 companies, provides a focused glimpse but may not reflect the broader industry landscape. Moreover, the research's cross-sectional design captures a single moment in time, which might not encompass the evolving nature of technological competencies and forecasting practices. Self-reported data from interviews could also introduce a degree of bias, as companies may present themselves in a more favourable light.

Further research could delve into how companies with high technical intensity approach innovation versus optimization. This research could explore the strategic decisions that lead companies to prioritize one over the other and how this affects their competitive advantage in the market. It would be insightful to examine if companies with both high knowledge and technical intensities are more innovation-oriented compared to those with high technical intensity but lower knowledge scores, which may focus on optimizing current processes. A more granular analysis of industry-specific trends could provide a detailed understanding of how different sectors adopt methodical technology management and forecasting practices. Investigating sectoral distributions of companies in the matrix may identify patterns that suggest certain industries are inherently more inclined towards systematic technological strategies. This line of research could uncover industry benchmarks and best practices that drive technological competence.

7. Conclusion and Discussion

This research has undertaken a comprehensive examination of how structured technology management and forecasting practices influence a company's technological competence. The findings from the analyses of both the 4x4 and 62x62 matrices provide insightful answers. Nearly 80% of companies with methodical orientations demonstrate excellence in either knowledge or technical intensity, indicating that a strong presence in at least one of these dimensions is pivotal to corporate success. Moreover, a significant portion of the - companies with systematic management show strength in both dimensions, underscoring the dual significance of robust knowledge and technical capabilities for superior industry performance and adaptability.

Contrary, companies with less structured approaches tend to exhibit lower levels of technological competence, as indicated by their positions in the lower left quadrant of the matrices. This alignment suggests that systematic practices in technology management and forecasting are correlated with enhanced technological capabilities.

The examination of the distribution of companies with systematic and less systematic approach within the 62x62 matrix has yielded additional insights. The green squares, representing the companies identified as methodical in the 4x4 matrix, are predominantly positioned within the 'L-shaped' area, reinforcing the notion that methodical practices correlate with higher technological competencies. Notably, the three companies that excel in both knowledge and technical intensities affirm that excellence in both areas can coexist within highly systematic frameworks.

The novelty of this research lies not only in examining the structured practices of technology management and forecasting but also in defining and measuring technological competencies using specific indicators: knowledge intensity and technical intensity. This approach provides a deeper understanding of how these competencies are developed and maintained within companies.

Practically, these findings suggest that companies should consider investing in systematic technology management and forecasting as part of their strategic planning. This does not negate the effectiveness of high technical intensity or the value of skilled personnel; rather, it emphasizes the additional competitive edge that structured foresight can provide.

In conclusion, as businesses continue to navigate the ever-changing technological landscape, it is evident that those who adopt structured and well-established strategies in their management and forecasting efforts are better positioned to exploit their technological competencies for economic and strategic gains.

The research highlights the importance of structured technological practices in enhancing both economic performance and strategic adaptability, providing insights for companies aiming to achieve long-term success in a dynamic global market. Furthermore, it contributes to the existing body of knowledge by providing empirical observations on the effectiveness of these practices, thus contributing to the understanding of the strategic integration of technological advancements.

Acknowledgements

Prepared with the professional support of the doctoral student scholarship program of the co-operative doctoral program of the ministry of innovation and technology financed from the national research, development and innovation fund.

References

Agolla, J. E. (2018) Modelling the relationship between innovation, strategy, strategic human resource management and organisation competitiveness, *African Journal of Business Management*, 12(14), pp. 428–438.

Ainin, S. et al., (2010) An Assessment of Technological Competencies on Professional Service Firms Business Performance*, World Academy of Science, Engineering and Technology*, 66, pp. 599-605.

Belas, J. et al. (2020) Selected Factors Of Corporate Management In Smes Sector, *Polish Journal of Management Studies*, 21(1), pp. 119–134, Poland.

Tanushev, C. (2022) Digital Transformation: The Impact on Corporate Strategy*, Economic Alternatives*, 28(3), pp. 383–404.

Doloreux, D. and Melançon, Y. (2008) On the Dynamics of Innovation in Quebec's Coastal Maritime Industry. *Technovation*, 28(4), 231-243.

Ellingrud, K., Gupta, R. and Salguero, J. (2020) *Building the vital skills for the future of work in operations,* McKinsey & Company.

Falk, M. (2004) What drives business R&D intensity across OECD countries? *Applied Economics*, 36(8), 937-946.

Fettig, K. et al. (2018) Impact of Industry 4.0 on Organizational Structures, *in 2018 IEEE International Conference on Engineering, Technology and Innovation (ICE/ITMC)*, pp. 1–8, Stuttgart.

Fuertes, G. et al. (2020) Conceptual Framework for the Strategic Management: A Literature Review—Descriptive, *Journal of Engineering*, pp. 1–21.

Gregory, M. J. (1995) Technology management: A process approach. Proceedings of the Institution of Mechanical Engineers, Part B: *Journal of Engineering Manufacture*, 209(5), 347-356.

Hamdani, A. et al. (2018) Technological progress and the future of the corporation, *Journal of the British Academy*, 6(s1), pp. 215–245.

Hunger, J. D. and Wheeler, T. L. (2020) *Essentials of strategic management (5th ed.)*, Pearson Education, USA.

Ilyina, E.A. *et al.* (2020) Digital platform of scientific and technological competencies, *Journal of Physics: Conference Series*, 1475 (012010).

Hollenstein, H. (1996) A composite indicator of a firm's innovativeness. An empirical analysis based on survey data for Swiss manufacturing. *Research Policy*, 25(4), 633-645.

Marinkovic, M. *et al.* (2022) Corporate foresight: A systematic literature review and future research trajectories, *Journal of Business Research*, 144, pp. 289–311, UK.

Minghui, Z. *et al.* (2022) Literature Review and Practice Comparison of Technology Foresight, *Procedia Computer Science*, 199, pp. 837–844.

Oztemel, E. and Ozel, S. (2019) Technological competency assessment, *International Journal of Services Technology and Management,* Vol. 25, No. 2, pp.138–159.

Pekk, L., Háry, A. and Tóth, C. (2021) Technology Features of the Differenct Sectors, *Conference Proceedings Of The 3rd International Conference On The Economics Of Decoupling, pp. 513-526.*

Singla, A., Sethi, A. and Ahuja, I. S. (2018) A study of transitions between technology push and demand pull strategies for accomplishing sustainable development in manufacturing industries, *World Journal of Science, Technology and Sustainable Development*, 15(4), pp. 302–312.

Teece, D. J., Pisano, G. and Shuen, A. (1997).Dynamic capabilities and strategic management. *Strategic Management Journal*, 18(7), 509-533.

Toborek-Mazur, J. and Partacz K. (2023) The impact of technological development on changes for corporate management, *Scientific Papers of Silesian University of Technology, Organization and Management Series*, No. 184.

Tronina, I. A. et al. (2021) Methodological Approach To Building A Map Of The Region Key Technological Competencies, *European Proceedings of Social and Behavioural Sciences*, pp. 1043–1050, Russia.

Watts, R. J. and Porter, A. L. (1997) Innovation forecasting. *Technological Forecasting and Social Change*, 56(1), 25-47.

Wolff, J. (2021) *How Is Technology Changing the World, and How Should the World Change Technology?, Global Perspectives*, 2(1), California.

Zoia, M. G. *et al.* (2018) The determinants of Italian firms' technological competencies and capabilities, *Eurasian Business Review*, 8, pp. 453–476.

HRM Alignment and Integration in Knowledge Risk Management in South African State-Owned Enterprises

Malefetjane Phineas Phaladi
Department of Information Systems, Durban University of Technology, Durban, South Africa

malefetjanep@dut.ac.za
https://orcid.org/0000-0002-6267-5295

Abstract: Most state-owned enterprises (SOEs) in South Africa face serious challenges with tacit knowledge loss risks, largely due to a lack of alignment and integration points for human resource management (HRM) practices in knowledge management to effectively manage such knowledge loss risks. This study was interdisciplinary in nature, presenting empirical evidence of a strong connection between HRM and knowledge management (KM), especially its knowledge risk management (KRM) sub-domain. The research paper employed a qualitative research design, which involved collecting in-depth qualitative data through interviews with 20 human resource (HR) managers in 9 SOEs. The qualitative data extracted through the interviews were analyzed thematically using Atlas.ti software. The research results revealed that HRM practices are not aligned, integrated and focused on mitigating enterprise tacit knowledge loss risks in most South African SOEs. A lack of HRM alignment and integration was a serious issue across the board, irrespective of whether the participating SOEs had knowledge management structures, roles and strategies in place. However, on a positive note, HR managers acknowledged the need for the integration and alignment of HRM strategies regarding effective knowledge loss risk management. The study highlights a deficiency in HRM alignment and integration for effective knowledge loss risk management. The researcher infers that HRM alignment and integration in KRM has a critical strategic and operational role to play in the mitigation of enterprise knowledge risks, as well as in developing the required knowledge management capabilities. The study sought to close a knowledge gap in the existing body of knowledge by presenting empirical evidence identifying alignment and integration points of HRM strategies into KRM for SOEs to effectively reduce knowledge loss risks. Furthermore, the study presents a strong link between HRM and KRM in building KM capacity for the reduction of the risks associated with tacit knowledge loss.

Keywords: Tacit Knowledge Loss; Human Resource Management; Knowledge Risk Management; Knowledge-Based View; Resource-Based View; State-Owned Enterprises; South Africa.

1. Introduction

Human resources and knowledge assets are key drivers of organisational performance, innovation and sustainability in the current global knowledge economy. State-owned enterprises (SOEs) are key instruments wholly or partially owned by the state to drive the economic development agenda in many developing and developed nations across the globe. In South Africa, SOEs are considered as catalysts for economic growth, employment and the sustainability of the economy. Phaladi (2023a) observed that SOEs are facing a number of knowledge loss-related risks due to voluntary, involuntary and the absence of knowledge-driven human resource management practices (HRMPs) that are aligned and integrated to mitigate knowledge risks. The Resource-Based View Theory (RBVT) of the business considers knowledge workers as drivers of competition, organisational effectiveness, innovation and productivity (Barney 2001). Similarly, the Knowledge-Based Theory (KBT) of the firm prioritizes organisational intangible assets such as knowledge, expertise and skills as drivers of organisational performance, innovation and sustainable competitive advantage (Grant 1996). Extant research demonstrates that the role of human resource management (HRM) in knowledge management (KM) is certainly unavoidable (Gürlek 2020). SOEs across the globe, including South Africa, are experiencing some serious tacit knowledge risks as a result of a lack of high employee attrition, knowledge-driven HRMPs and retention strategies. Such tacit knowledge risks threaten the economic development, innovation capacity and sustainability of these SOEs. The situation is worse in most developing countries because their economic performance and viability are much dependent on well-run SOEs. However, it remains unknown as to whether HRMPs in South African SOEs are well-aligned and integrated in knowledge risk management (KRM) strategies. In an organisational context, knowledge, competencies and skillsets are enterprise-specific intangible assets that are strategically linked or contingent on human resources. However, the extant corpus of research observes that these organisational intangible knowledge assets could place companies at risk as and when carriers of such knowledge decide to terminate their relationships with their employers (Phaladi and Ngulube 2024). KM research characterises such potential risks as knowledge loss risks that require management interventions (Durst and Zieba 2019).

Emerging research characterizes such a required management approach as knowledge risk management (Durst, Lindvall and Bruns 2020). KRM is a novel research niche area within the broad KM field of practice that seeks to

assist companies to predict and respond to knowledge-related risk occurrences. Phaladi (2023a) opines that HRMPs could play a crucial role in mitigating such knowledge-related risks. This is largely due to the fact that the effective management of organisational knowledge-related risks are contingent on firm-specific knowledge workers (Phaladi and Ngulube 2024). Nevertheless, extant literature points to the significant role of HRMPs for organisations such as state-owned enterprises to mitigate such knowledge-related risks. The role of HRMPs in the management of enterprise-specific knowledge assets is undisputable. Phaladi, Mhlongo, Omarsaib and Mpungose (2024) point to very limited empirical research in the global literature directly linking, aligning and integrating HRM practices for the effective management of knowledge loss risks and knowledge risk management. These authors lament the dearth of literature linking HRM systems to KRM in SOEs globally. This is despite the fact that the role of HRM and its practices in the mitigation of enterprise knowledge risks is inevitable. Phaladi et al (2024) indicate that such a relationship remains blurred in the current body of KRM research and practice. Much of the extant research on tacit knowledge loss risks is silent on the alignment and integration of knowledge-driven HRM systems with the management of such risks in both private and public enterprises. The study explores the alignment and integration of HRMPs in managing organisational tacit knowledge loss in SOEs. It also explores the need for such integration, its implementation, and the effectiveness of HRMPs in managing and mitigating knowledge loss risks. The research also proffers strategies for implementing such alignment and integration in the organization.

2. Literature Review

2.1 Human Resource Management Practices

Researchers have argued that tacit knowledge is heavily dependent on firm-specific workers, and that HRMPs such as recruitment, career management, learning and development, performance management, compensation and rewards, as well as the facilitation of a knowledge-driven organisational culture and behaviours, are crucial for managing knowledge and mitigating its potential loss within organisations (Le 2024; Phaladi et al. 2024). Proponents of the RBVT argue that HRMPs are key drivers of a sustainable competitive edge, innovation capacity and superior enterprise performance in knowledge-based competition (Murali and Kumar 2014). Recruitment as an HRM practice is considered an important activity within organisations and provides a direct link between KM and HRM. Phaladi (2023a) argues that the HRM recruitment process is by nature knowledge-driven, largely because it is tasked with the responsibility of sourcing much-needed firm-specific human resources. Thus, recruitment practices serve as a facilitator for the acquisition of required knowledge, competencies and skillsets. As such, it is the genesis of the nexus between HRM and KM in organisations. Learning and development is also an important knowledge-driven HRM practice that facilitates the acquisition of knowledge and absorptive capacities in organisations (Sarfraz et al. 2023). Kianto et al (2017) assert that retention practices such as compensation, rewards and incentives could be playing an important role in ensuring that organisations retain and protect firm-specific employees and their much-needed knowledge, competencies and skillsets to survive in knowledge-based competitive markets. Scholars have established that retaining highly experienced workers who are at the top of their performance and productivity levels remains a serious problem area for the HRM establishment and executives (Allen and Vardaman 2021). Phaladi (2023b) posits that knowledge-driven retention practices help to facilitate the retention and protective capacity of company-specific knowledge assets and, as result, such practices serve to enhance knowledge sharing, retention and protective capacities. Scholars concur that HRMPs that are knowledge-driven in character will serve to facilitate and develop knowledge-driven cultures, activities and behaviours (Le 2024; Phaladi 2023a). Consequently, such knowledge-driven practices will directly or indirectly facilitate the effective mitigation of knowledge loss risks in state-owned enterprises.

2.2 Knowledge Management

The knowledge-based view of the firm argues that knowledge assets such as knowledge, skillsets and abilities to perform organisational duties will provide companies with sources of superior performance and a sustainable competitive edge over their competitors (Grant 1996). Knowledge management involves the use of resources to create an environment where knowledge is easily accessible, thereby enabling firm-specific employees to develop their own knowledge and apply it for the benefit of the organization, encouraging the sharing and utilization of knowledge (Murali and Kumar 2014). Knowledge-intensive companies such as SOEs require a strong nexus between HRM and KM, which can enhance performance and lead to its success (Phaladi 2021). Within SOEs, individual employees are sources of organisational knowledge. Ideally, in order for knowledge to be acquired, created, shared and retained, HRM establishments should develop their practices in such a way that

they help facilitate the effective management of knowledge in order to lessen the risks of losing organisational tacit knowledge to their competitors. Phaladi (2023a) opines that a majority of the SOEs in South Africa are lacking key knowledge-driven HRMPs, which adversely affects the management, sharing and retention of organisational tacit knowledge. El-Farr and Hosseingholizadeh (2019) assert that HRM plays a significant role in supporting and facilitating the management of knowledge within organisations. It is for this reason that HRMPs should be aligned and integrated into knowledge management processes. Ideally, beyond this alignment and integration point, HRMPs should be knowledge-driven and integrated enough to effectively play a meaningful role in the management of tacit knowledge loss risks in SOEs.

2.3 Knowledge Risk Management in SOEs

In relation to KRM, extant literature defines it as the application of a set of tools and techniques used to identify, measure, prevent and lessen the risks related to the creation, use, sharing and retention of enterprise knowledge (Durst and Henschel 2020). In other words, KRM presents researchers, practitioners and business executives with the strategic tactics to use knowledge as a valuable firm-specific resource so that they are in a better management position to predict, measure and mitigate the risks associated with organisational knowledge. However, scholars lament the fact that conceptual and empirical research on the topic of knowledge risk management in private and public enterprises is still very rare (Durst et al. 2023). Phaladi (2023a) further notes that this also applies to empirical papers linking HRMPs to knowledge risks and its management in SOEs. Phaladi et al. (2024), in their global systematic literature review linking and integrating the role of HRM in KRM in SOEs, illustrate the scarcity of scholarly contributions in this research strand, despite the fact that knowledge risks are considered serious enterprise risks affecting knowledge-intensive business enterprises such as SOEs (Kumar 2020). The few existing studies in this research strand, especially in SOEs, indicate that these enterprises are quite vulnerable to serious knowledge loss risks given the fact that they are resource-intensive, knowledge-intensive learning organisations (Kumar 2020; Phaladi 2023a). Internationally, SOEs are key instruments in driving and shaping the economies of the world, in both developed and developing nations. Scholars observe that they are no exception to the great resignation and knowledge exodus affecting private and public companies in the current knowledge economy (Serenko 2023). High turnover (voluntary and involuntary) and the lack of strategies to retain knowledge workers and their much-needed intangible assets (knowledge, competencies and skills) threaten SOEs' ability to deliver on their developmental mandate, especially those operating in the developing economies of the world (Phaladi and Ngulube 2024). Nevertheless, it remains unclear as to whether the HRMPs in these public enterprises can be considered to be knowledge-driven, aligned and integrated to identify, predict, measure, respond to and mitigate such tacit knowledge risks associate with resignations and retirements.

3. Methodology

The research paper deployed a qualitative research approach which involved collecting in-depth qualitative data through interviews in South African state-owned enterprises. The researcher conducted interviews with twenty managers (20) in the human resource management departments of nine SOEs that were purposively selected for the purpose of gathering answers to the research questions, as illustrated in Figure 1 below. The researcher ensured ethical considerations, including obtaining permissions, maintaining anonymity and confidentiality, obtaining informed consent, and using the interview method in selected SOEs. The sample size of 20 managers in HRM was deemed adequate for the purpose of gathering in-depth data and developing a rich picture about the phenomenon under study. According to Creswell (2014), a few cases or interviewees, ranging from 1 to 40, are considered adequate for qualitative research for scholars to formulate a rich picture of the research phenomenon. The qualitative data collected through the interviews were analyzed thematically using Atlas.ti software.

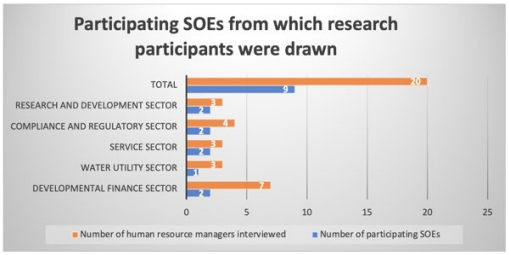


Figure 1: Participating SOEs from which research participants were drawn

4. Research Findings

Regarding the research question on whether HRMPs are aligned and focused on lessening tacit knowledge loss in SOEs, the research shows that 50% of participants think that their processes are aligned, while 50% disagree, indicating a lack of focus on managing organisational knowledge loss. Pertaining to whether there was a need for the integration of HRMPs in KRM, all the participants agreed that there was indeed such a need. Similarly, they articulated the need for a better understanding of KM vocabulary and tools in order to better reflect on their processes. Such an understanding would help HR managers to align themselves and their practices effectively in dealing with knowledge loss risks. In three cases, where KM structures and roles were well-defined, the participants postulated that they work in harmony with the KM practitioners in the SOEs to identify and mitigate knowledge-related loss risks. Nevertheless, their functions were not aligned and integrated to ensure the better management of such risks.

The issue of alignment and integration, regardless of the presence of KM roles and processes, was identified as significant. The HR manager in SOE1 put into words the lack of synergy in the following manner:

> *At the moment, the knowledge management people are there and we are here as the HR people, we still live like that, that is one of the things we need to bring together. We work together with knowledge management unit, but I cannot claim it to be an integration. It is not an integration that happens automatically (HR Manager #1).*

Regarding the follow-up research question on how such integration should be approached and implemented, HR managers in SOEs without knowledge management strategies, systems, structures and processes suggest that strategies, structures, roles or resources for knowledge management should be a starting point for the integration process, as there was no existing integration at the time of the study. One HR manager explained the state of affairs as follows:

> *What more can be done is for us to realise the value of knowledge management in an organisation, and not for our own good as individuals, but for the company good. In the same manner, that we are seeing that need to formal processes on knowledge management. We actually see the significance of strategy on that (HR Manager #17).*

Finding the gaps in one's knowledge is the first step towards developing a plan and procedures to close them. In those state-owned businesses with established KM strategies, structures, rules and procedures, the alignment scenario was different. In order to mitigate the effects of voluntary turnover and the loss of enterprise knowledge, their HR strategy places a high priority on the management and retention of mission critical skills. One participant narrated the science behind their HR strategy as follows:

> *Yes, we are implementing talent management; it was there but we are making it more formal. Therefore, that talent management is all-inclusive, including retaining critical knowledge it will include making sure that we keep our critical resources (HR Manager #1)*.

Based on the data analysis, it is evident that HRM departments were, in certain instances, re-aligning themselves to address the intricacies of knowledge in a knowledge-driven economy by using integrated people management approaches that consider talent holistically. More of such will help to reduce possible knowledge loss in these state-owned firms by promoting enterprise knowledge-driven activities and behaviours.

Regarding the overall effectiveness of HRM processes in enabling or easing the management and minimization of tacit knowledge loss in SOEs, in response to this study question, all the participants expressed concern about the gaps and areas in which their procedures for ensuring retention and minimizing organisational knowledge loss needed improvement. They articulated their opinions on this study issue as follows:

4.1 Effectiveness of HRMPs

Thirty percent of the participants indicated that their practices work well for helping their SOEs to effectively manage and retain much of their organisational tacit knowledge. Their answers did, however, also highlight shortcomings and potential areas for improvement. An SOE1 respondent, who discussed how KM is integrated into organisational life, stated the following:

> *Very effective. I think we are holding our space. However, there are areas for further development. On a scale of one is to five. I will give us four. As I said, we have systems, we have structures and we have policies that are highly effective (HR Manager #1).*

Even if, in some instances, the retention of human resources and their knowledge was achieved through deliberate acts of management and efforts aimed at minimising potential enterprise-specific tacit knowledge loss, there was also a need to continuously identify integration points for alignment and further improvements.

4.2 Partial or Average Effectiveness of HRMPs

Thirty percent of the HR managers found their practices to be neither effective nor ineffective, with some being partially effective but not very effective in reducing involuntary turnover and knowledge loss. They identified gaps and areas for further alignment and integration points between their HRMPs and KM strategies to ensure the proper management of knowledge loss risks in their SOEs.

The participant in SOE9, where the KRM and KM philosophy was not institutionalised, explained the situation as follows:

> *I think we have not been deliberate enough to be effective. In some cases, we have done well, in some cases we have not done well. Those pockets of excellence are here and there, but not necessarily calibrated well to a point where we can say we are effective. Therefore, there is still lots of gaps from one practice to the other (HR Manager #17).*

The aforementioned case highlights the lack of coordinated strategies and practices in knowledge management, and gaps in HRMPs for employee recruitment and retention. HR managers were not intentional in managing enterprise-specific knowledge, mainly because of the informal nature of how it manifested in their public enterprises. Therefore, in some instances where KM was not institutionalised as part of the organisational processes, there was a gap. On the other hand, there was also a need to perfect the science and embrace certain KM principles.

4.3 Ineffectiveness of HRMPs

This study established that 40% of HR managers found their practices in retaining and managing organisational knowledge ineffective. Even HR managers who had institutionalized knowledge management in their SOEs admitted that their processes were not yet effective. This situation was exemplified by the participant from SOE2, who stated:

> *I am tempted not to say that we are not there yet, we are not very effective, as we would like to be because of those gaps and then the loss of opportunities for those synergies for us to be able to work together. You know, they started harvesting knowledge many years ago, I think as early as 2013 or so, but we started becoming very involved and get to know what they are doing in recent times. That is why I am saying there has been that lack of working in silos, yet we are trying to achieve as a common goal (HR Manager #9).*

In certain SOEs, HR managers struggled with working in silos due to a lack of collaboration with relevant units for knowledge management. Many SOEs (67%) had not formalized knowledge management, resulting in ineffective HRMPs in managing and retaining company-specific knowledge. Their practices were not designed to support knowledge management and, therefore, the mitigation of inherent firm-specific knowledge loss risks.

5. Discussion of the Findings

This research explored the alignment and integration of HRM practices in managing and lessening tacit knowledge loss in selected SOEs in South Africa. Extant research highlights the significance of the interface, alignment and integration of HRMPs into KM for ensuring the mitigation of tacit knowledge loss (Murali and Kumar 2014; El-Farr and Hosseingholizadeh 2019; Gürlek 2020). However, the research findings point to a lack of alignment and integration as a serious issue facing a majority of South African SOEs. Regardless of whether SOEs have KM roles, functions or processes in place, this remains the case. The research suggests that streamlined HRMPs can improve knowledge absorptive capacity, KM capability and retentive capacity by supporting knowledge management. Moreover, HR recruitment and staff training practices are crucial for developing knowledge absorptive capacity in SOEs.

Furthermore, the study argues that if companies can invest in staff retention interventions such as retention strategies; rewards and recognition systems; and in other knowledge-based practices such as coaching and mentoring, job rotation and job shadowing, then knowledge protective capacity will be enhanced. The research also suggests that investing in staff retention interventions, rewards and recognition systems, as well as

knowledge-based practices like coaching, mentoring, job rotation and job shadowing, can enhance knowledge protective capacity.

All twenty HR managers in this qualitative study concurred that there was a need for the alignment and integration of HRM systems in KM for the successful mitigation of firm-specific knowledge loss. Furthermore, HR managers need to have a better understanding of knowledge management vocabulary and the tools to better use these techniques. In those SOEs where KM functions, practices, structures and resources were not institutionalised, the research found that there was nothing much to align and integrate as such. However, in order for these public enterprises to align and integrate their KM and HRM practices, the best starting point is to develop an understanding of the science behind knowledge management, strategy, function, roles and resources. A lack of awareness and education on the philosophy behind KM is a significant challenge. Hence, creating awareness of what is missing in terms of the strategies and procedures to close the gap will serve to advance the discourse. Consequent to this lack of awareness and education, the retention of critical skills and expertise will remain a challenge.

An overwhelming majority of HR managers concurred that their practices were ineffective in mitigating and managing tacit organisational knowledge loss, largely due to a lack of alignment and integration in support of KM. The majority of the HR managers concur that the loss of enterprise tacit knowledge is due to a lack of knowledge-driven retention strategies, which can decrease the survival chances of many SOEs. Recent studies have shown that knowledge loss in SOEs leads to knowledge risks negatively impacting organisational performance, innovation and sustainability (Durst and Zieba 2020; Kumar 2020; Phaladi and Ngulube 2024). Their practices were not designed to support KM, and consequently the mitigation of inherent firm-specific knowledge loss risks.

5.1 Limitations and Directions for Future Research

The study is an empirical contribution qualitatively exploring the alignment and integration points of HRM systems into KRM in South African SOEs. Future studies will benefit from quantitative surveys testing the alignment and integration of HRMPs to mitigate knowledge loss risks in organisations. On a global scale, whilst using South African SOEs as a case, the paper points to the scarcity of scholarly contributions linking, aligning and integrating HRM strategies into knowledge loss risk management. The picture of such alignment and integration points remains blurred in the extant research, both conceptually and empirically. Large portions of the current research dedicated their efforts to establishing the inevitable role of HRM and its practices broadly in facilitating KM processes and capacities, but with limited focus on KRM in research and practice. Furthermore, current research in KRM still dedicates such efforts to exploring KM practices to mitigate knowledge loss risks, not paying much attention to integrating HRM systems into KRM research. Therefore, future research will benefit the research community and practitioners by exploring this distinct area further, both in private and public enterprises. The current study also points to a need for future scientific explorations in SOEs on a global scale, investigating the role of various HRMPs in knowledge risk management for the effective mitigation of knowledge loss risks interdependently from HRM and KM standpoints.

6. Conclusion and Recommendations

Based on the findings of the study, it is apparent that there is a need to close the gaps to ensure a better alignment and integration of HRMPs to support the management of organisational knowledge and to mitigate against its potential loss. SOEs without a knowledge management strategy should develop one and implement it. The strategy should then be followed by structure. HRMPs should be streamlined to KM processes in order to enhance knowledge creation, absorptive and protective capacity, whilst reducing knowledge stickiness and knowledge loss-related incidents. HR managers and leadership within SOEs should enhance their understanding of KM vocabulary, strategies and tools to bridge gaps in knowledge management. In addition, knowledge managers in SOEs should also focus on understanding HRMPs, as this directly impacts their strategies and helps manage and mitigate tacit knowledge loss risks. Understanding the science behind these two management disciplines is crucial for their success in managing organisational knowledge loss. KM practices alone cannot create significant success in reducing and mitigating knowledge loss unless they are in alignment with and supported by HRMPs. For KRM strategies to be effective, it is important that HRMPs are integrated into KM strategies and processes. Leadership, management, HRM and KM practitioners should establish strategic partnerships; raise awareness of the importance of their relationship; and urgently address the removal of existing silos between these fields, as the success of these practices depends on their joint collaborative efforts.

A more integrated approach to management and retention is needed, with HR managers playing a central role in all KM processes. The findings suggest that KM practices can be better managed if they are structurally incorporated within HR organisational structures. Moreover, SOEs should embed KM into their organisational culture, with HR leading practices. HR managers should also reflect on their practices in the context of organisational knowledge loss, whilst knowledge managers should do the same. Collaboration between HR managers and KM is crucial to manage the knowledge risks associated with the loss of firm-specific human and knowledge resources. Regular interactions and reporting on key knowledge management issues can help avoid such loss.

References

Allen, D.G., and Vardaman, J.M. (2021) Global talent retention; understanding employee turnover around the world. In Allen, D.G. and Vardaman, J.M. eds. *Global talent retention: understanding employee turnover around the world*, Emerald Publishing. pp 1-15.

Creswell, J.W. (2014). *Research design: qualitative, quantitative and mixed methods approaches*, 4th ed. Los Angeles, CA: Sage.

Durst, S., Foli S, La Torre, M., and Borgia, M. (2023). "Knowledge risk management in banks - An area for improving organisational performance". *Heliyon*, Vol 9, pp 1-12. https://doi.org/10.1016/j.heliyon.2023.e22064

Durst, S., and Henschel, T. (2020). Knowledge risk management – state of research. In S. Durst & T. Henschel (Eds). *Knowledge risk management: from theory to praxis* (pp. 3–10). Springer.

Durst, S., and Zieba, M. (2020). "Knowledge risks inherent in business sustainability". *Journal of Cleaner Production*, Vol 251, 1-10.

Durst, S., Lindvall, B., and Bruns, G. (2020). "Knowledge risk management in the public sector: insights into a Swedish municipality". *Journal of Knowledge Management*, Vol 24, No. 4, pp 717-735.

Durst, S., & Zieba, M. (2019). Mapping knowledge risks: towards a better understanding of knowledge management. *Knowledge Management Research & Practice*, *Vol 17, No.* 1, pp 1-13.

El-Farr, H., and Hosseingholizadeh, R. (2019). "Aligning human resource management with knowledge management for better organisational performance: how human resource practices support knowledge management strategies?" in *Current Issues in Knowledge Management*. Available at: https://www.intechopen.com/books/current-issues-in-knowledge-management/aligning-human-resource-management-with-knowledge-management-for-better-organisational-performance-h

Grant, R.M. (1996) "Towards a knowledge-based theory of the firm". *Strategic Management Journal*, Winter special issue, Vol 17, pp 109-122.

Gürlek, M. (2020). *Tech development through HRM?* Emerald Publishing Limited.

Kianto, A., Sáenz, J., and Aramburu, N. (2017). "Knowledge-based human resource management practices, intellectual capital and innovation". *Journal of Business Research,* Vol 81, pp.11-20. http://dx.doi.org/10.1016/j.jbusres.2017.07.018

Kumar, S. (2020) Knowledge risk management for state-owned enterprises-Indian scenario.in Durst, S. and Henschel, T. Eds. *Knowledge risk management: from theory to praxis*. Springer. pp 89-106

Le, P.B. (2024). "Applying knowledge-based human resource management to drive innovation: the roles of knowledge sharing and competitive intensity". *Management Research Review*, Vol 47, No. 4, pp 602-621. https://doi.org/10.1108/MRR-02-2023-0154

Murali, A., and Kumar, S.K. (2014). Knowledge management and human resource management (HRM): Importance of Integration. *FIIB Business Review*. Vol 3, No. 1, pp 3-10.

Phaladi, M.P., Omarsaib, M., Mhlongo, P., and Mpungose, B. (2024). Integrating Strategic Human Resource Management Practices for Effective Knowledge Risk Management in Public Enterprises: A Systematic Review and Future Research Directions. In Mizrak, F (ed.). *Trends, Challenges, and Practices in Contemporary Strategic Management (*pp 213-235). Hershey, PA: IGI Global. https://doi.org/10.4018/979-8-3693-1155-4.ch011

Phaladi, M.P. (2023a). "Mitigating Tacit Knowledge Loss in South African State-Owned Companies: HRM Approach", *The Electronic Journal of Knowledge Management,* 21(3), pp 00-00, https://doi.org/10.34190/ejkm.21.3.3152

Phaladi, M.P. (2023b). "Developing knowledge protective capacity through retention practices in South African state-owned companies", *South African Journal of Information Management*, Vol 25, No. 1, pp 1-10. https://doi.org/10.4102/sajim.v25i1.1727

Phaladi, M.P., and Ngulube, P. (2024). "Understanding tacit knowledge loss in public enterprises of South Africa", *SA Journal of Human Resource Management*, Vol 22, pp 1-10. https://doi.org/10.4102/sajhrm.v22i0.2229

Phaladi, M.P. (2021). *Framework for integrating knowledge management and human resource management for the reduction of organisational knowledge loss in selected South African state-owned enterprises*, (PhD Thesis), University of South Africa, Pretoria, South Africa.

Sarfraz, M., Khawaja, K.S., Khalil, M., and Han, H. (2023). "Knowledge-based HRM and business process innovation in the hospitality". *Humanities & Social Sciences Communications*, Vol 10, No. 624, pp 1-13. https://doi.org/10.1057/s41599-023-02140-9

Serenko, A. (2023). "The Great Resignation: the great knowledge exodus or the onset of the Great Knowledge Revolution?" *Journal of Knowledge Management*, Vol 27, No. 4, pp 1042-1055.

Zieba, M., Durst, S., and Hinteregger, C. (2022) "The impact of knowledge risk management on sustainability", *Journal of Knowledge Management*, Vol 26, No. 11, pp 234-258. https://doi.org/10.1108/JKM-09-2021-0691

Appendix A: Interview Protocol for Collecting Data From HR Managers in the SOEs

Do you consider HRM practices to be aligned and focused on managing organisational knowledge loss?

Is there a need for such an integration of human resource management practices in knowledge risk management?

How should such integration be approached, facilitated and implemented in the organisation?

Overall, how effective are HRM practices in facilitating the management and reduction of organisational knowledge loss?

Capability Development for Within-Organization Distinctiveness in Sub-Brand Products: A Case Study in the Media Industry

Amanda Piepponen, Päivi Maijanen, Ari Jantunen and Paavo Ritala
LUT University, Business School, Lappeenranta, Finland

amanda.piepponen@lut.fi
pmaijane@lut.fi
ari.jantunen@lut.fi
ritala@lut.fi

Abstract: Digital transformation necessitates firms to continuously innovate their product and service portfolios, which drives firms to develop their capabilities accordingly. While adapting to the evolving environment, incumbent firms develop new digital offerings that both seek novelty but also build on the existing brands and capabilities. Using a single case study design with 27 interviews from a media company, this study explores the capability development in the context of an incumbent creating a new, digital sub-brand and seeking a within-organization optimal distinctiveness. This study examines how an incumbent firm develops its capabilities and what organizational factors and practices facilitate and hinder the development of the new sub-brand and its associated capabilities. The findings show that developing capabilities for internal distinctiveness is a complex, organizationally embedded challenge that requires consideration of distinctive skills, professional norms and values, and how managerial and technical structures and systems are set up.

Keywords: Capability Development, Within-Organization Distinctiveness, Sub-Brand, Case Study, Media Industry.

1. Introduction

Digital transformation often materializes toward customers in the form of new digital value propositions and value proposition elements (Piepponen et al., 2022). Often, a value proposition is communicated to customers through brands and, in the case of new digital products and services, through new sub-brands. According to Payne et al. (2017), value proposition is "a strategic tool facilitating communication of an organization's ability to share resources and offer a superior value package to targeted customers" (p. 472). A sub-brand, on the other hand, refers to a product brand that is associated with a main brand but has its own name and identity to differentiate it from the main brand (Jo, 2007). The main brand plays a primary driver role, while the sub-brand can complement or modify the associations of the main brand and provide access to new important segments (Aaker, 2004; Zelenskaya & Elkanova, 2021). While the main brand creates synergies, its heritage, assets, capabilities, people, and values can also represent an important role in the sub-brand product (Aaker, 2004).

While the literature has a great deal of understanding of brands and sub-brands, as well as of digital value proposition development, it is less clear what consequences developing a new digital sub-brand has on organizational capabilities. When an organization develops a within-organization sub-brand, the co-existence of the new and main brand creates new "variables" for the organizational transformation; in particular, to what extent are existing capabilities utilized, and when and how are new capabilities built? We portray this challenge of capability development when an organization is seeking within-organization optimal distinctiveness (Bu et al., 2022). In other words, when sub-branding, the new brand must be aligned with the main brand while being distinctive to external audiences. A similar challenge is likely to arise inside the organization as well. However, the literature has studied intraorganizational distinctiveness challenges and dynamics relatively little, which represents a challenge to our understanding of how incumbent organizations can manage new sub-brand development internally.

These issues are also relevant for the media industry, where digitalization has shaped consumption patterns and customers' value perceptions and, consequently, the way organizations innovate and manage their businesses (e.g., Lischka, 2019; Malmelin et al., 2022). This necessitates a more comprehensive and multidisciplinary understanding of the strategic transformation of media organizations, integrating insights from fields such as corporate strategy, dynamic capabilities, and firm performance (Oliver, 2018). As several empirical and conceptual papers exploring dynamic capabilities in the context of the media industry (e.g., Ellonen et al., 2011; Maijanen & Jantunen, 2016; Murschetz et al., 2020; Oliver, 2014) have demonstrated, dynamic capabilities provide a useful lens for exploring the challenges faced by media organizations and explaining how they adapt to radically changing environments.

To bridge the abovementioned research gap, this study explores how an incumbent develops its capabilities and which organizational factors and practices facilitate and hinder the development of the new sub-brand and

related capabilities. We use a single case study approach to analyze new capability development in the context of creating a new distinctive digital news media product. The new sub-brand operates under the main brand but has a differentiated value proposition and, for example, its own editorial staff and customer segments. In line with the demands of digital transformation, the development of this new sub-brand necessitated the acquisition of new resources and the adoption of new ways of working and thinking, providing a rich real-world context for exploration. The media industry offers an exemplary environment for studying innovative practices, as media organizations must continuously innovate to meet the needs of multiple stakeholders across multiple strategic dimensions. Moreover, this case is not only necessitated by digitalization, as is often the case in traditional news media, but is also driven by it, proactively seeking to build and implement practices and capabilities that reduce path dependencies and facilitate the creation of a distinctive sub-brand within the organization.

We contribute to the literature on capability development in the context of creating a sub-brand that has to be, at the same time, detached from and integrated into an existing organization and product portfolio. The company meets a need to balance old and new in order to reach within-organization optimal distinctiveness. Optimal distinctiveness has usually been studied at the industry level (Zhao et al., 2017), but we show that the concept can also be applied to a within-organizational context, which is an important driver for the company to renew its business models and value propositions. In particular, our study unbundles capability development through four dimensions that create a core capability (Leonard-Barton, 1992). It shows what kinds of capabilities are needed in a context in which an incumbent creates a within-organization sub-brand and from which elements they constitute. Moreover, the findings discuss the main brand's different roles in capability development, enlightening the dynamics of capability development and management. By doing this, the study advances our theoretical understanding of the strategic renewal of media organizations.

2. Theoretical Background and Research Objectives

In a volatile business environment, firms are continually required to renew and diversify their product and service portfolios and introduce innovations that promise something unique and distinctive within their market category. As firms adapt to the changing landscape, they must cope with the challenge of positioning their products optimally among their competitors (Zhao et al., 2017). Optimal positioning entails differentiation to secure a competitive advantage and at the same time, maintain a certain level of conformity and familiarity within the market category.

This dilemma of balancing differentiation and similarity has been explored through the concept of optimal distinctiveness, which has attracted scholarly interest in management studies in recent years (Zhao et al., 2017; McKnight & Zietsma, 2018). Optimal distinctiveness addresses one of the core managerial paradoxes of "how firms strategically manage competing pressures to be both 'like' and 'different from' their organizational peers" (Zhao et al., 2017, p. 93). Being distinctive enables firms to seize new business opportunities, while similarity ensures legitimacy among stakeholders, such as customers and investors.

While much research has focused on optimal distinctiveness between organizations, the concept can also be applied to a within-organization setting (Bu et al., 2022). Within an organization, being distinctive involves creating something that stands out from the firm's existing prototypes while remaining recognizable in terms of the firm's general design and brand. From the perspective of organizational capabilities, creating distinctive products, services, and business models necessitates the renewal and orchestration of existing resources and capabilities to develop new distinctive resources and capabilities. As companies develop their product portfolios, they have to renew their capability portfolios accordingly in order to be able to create new products: "For the firm, resources and products are two sides of the same coin" (Wernerfelt, 1984, p. 171). With "resources," Wernerfelt (1984) refers to the pool of intangible and tangible organizational assets needed to produce products. A firm's unique and non-replicable tangible and intangible resources can be seen as potential sources of competitive advantage (Barney, 1991).

In addition to possessing the resources needed for a business, firms need the ability to deploy these resources efficiently to produce desired outcomes (i.e., firms need capabilities). The concept of capability is "the ability to perform a particular task or activity" (Helfat et al., 2007, p. 1), and capabilities consist of a set of interconnected organizational elements, such as knowledge, intangible and tangible processes, and structures needed for using resources (Helfat & Peteraf, 2003; Leonard-Barton, 1992; Winter, 2000). Capabilities are a context-specific concept—what types of capabilities are needed and what are the essential building blocks of them depend on the type of company's business and other contextual factors. There is diversity of definitions in academic discussion and even wider diversity of capabilities in practice, but overall, there is a rather commonly shared

view about the nature of capabilities—they are organizational skills (Nelson & Winter, 1982) that involve necessary knowledge about how to conduct the task at hand in an efficient way.

When making significant changes to their product offerings, companies must build and further develop their capabilities to create new products and corresponding production processes. Due to the nature of capabilities as organizational skills, involving a lot of "how to" knowledge, in-house development activities play an essential role in capability development. While some ingredients of capabilities, such as technology, information systems, or special expertise, can be at least partly sourced from outside the organization, the integration and coordination of different elements—so that they function efficiently together—are fundamental activities that cannot be sourced from the markets. Procedures, routines, and processes—essential key elements of capabilities—develop especially with experience accumulation (Zollo & Winter, 2002) through learning-by-doing. Hence, in the capability development process, local learning typically plays a significant role (see Zollo and Winter [2002] for the potential roles of other types of learning processes).

Building on the evolutionary view of organizational learning (Nelson & Winter, 1982), capabilities evolve gradually through experiences of success and failure. This dynamic process is influenced by the organization's existing capabilities, which can both facilitate and impede the creation of new distinctive assets and capabilities. The learned capabilities, existing product design, and brand form a strong foundation and support for further change and learning. However, to create something genuinely new and distinctive, organizations must critically assess their existing capabilities and practices. Incumbent organizations can, on the other hand, utilize their existing capabilities in developing new ones (Cohen & Levinthal, 1990; Zahra & George, 2002), but the cumulated asset base may also be a source of organizational inertia (Gilbert, 2005; Leonard-Barton, 1992; Tripsas & Gavetti, 2000), hindering the development of capabilities that differ significantly from existing ones. Hence, when developing distinctive products and corresponding distinctive capabilities within an organization, incumbents meet the need to leverage their existing resources and capabilities while coping with the organizational rigidities and path dependencies involved in existing capabilities. From the organizational learning point of view, when developing new distinctive capabilities, incumbent companies have to support unlearning, in addition to being active in acquiring new knowledge by means of experimental learning or other learning processes (Sharma & Lenka, 2022).

When creating capabilities that are distinctive within an organization, but still based partly on existing assets and integrated as a part of the company's production system, incumbents meet the need to find ways to utilize existing assets without being too tightly bound by them. In this study, we explore how an incumbent organization builds its capabilities to create a distinctive sub-brand product. We examine how existing organizational structures, on the one hand, enable and, on the other hand, restrict and hamper the possibilities for capability development. We aim to show what issues incumbent companies meet when trying to achieve within-organization optimally distinctive positions with new products, and how tensions in capability development were managed. By doing this, we aim to open up the intertwined relationship between products and capabilities and their development.

3. Data and Methods

We adopted a single-case study design to provide an in-depth and contextual understanding of the social phenomena under inquiry (Yin, 2018). This study analyzes a Finnish media company that publishes a well-established daily newspaper (main brand). The case company's newspaper has managed to increase its subscriptions in recent years and has made significant investments in news and lifestyle content. In 2019, the newspaper initiated a development project to renew its economy and financial news. The project aimed to enhance the value of economic and financial news for the main brand and, ultimately, to create a sub-brand product to target a specific underserved customer segment, mainly young and ambitious men. The sub-brand was launched in 2021 and focuses on in-depth economic and financial content over short-term news, addressing the needs of an individualistic, goal-oriented, and even anarchistic audience. To meet their interests, the sub-brand has developed a digital multi-content product covering topics such as investing, technology and science, careers, and foreign and international politics. The sub-brand has a distinctive appearance, both in digital and print, and covers topics in a way that the main brand cannot as it reaches the entire nation. Consistent with digital transformation (Parviainen et al., 2017), the organization had to develop its capabilities and adopt novel ways of thinking and working to create this new sub-brand, including product elements and production processes.

Following the case study approach, we utilized multiple data sources (Yin, 2018) to gain an in-depth and comprehensive understanding of the case (Table 1). The primary data consisted of 27 qualitative in-depth interviews conducted in 2022 with the sub-brand's development team and editorial staff (Table 2), resulting in 268 pages of transcription. Interviewees were selected using purposive and snowball sampling methods to ensure a variety of perspectives from all key individuals involved in different stages of the process. The interview protocol covered the drivers and preconditions for the transformation, the development process, and the coexistence of the main brand and the sub-brand. The interview protocol focused on the resources and capabilities required to develop and produce the sub-brand and the different organizational roles and activities around the development. Finally, the interview protocol captured how the sub-brand was maintained and further developed after the launch and the lessons learned during the project. The protocol was supplemented with clarifying and supplementary questions, where necessary, to allow for in-depth exploration by the researcher. To broaden and corroborate the emerging findings, we used secondary data collected from 2021, 2022, and 2023. These data included researcher's notes from meetings with the case company, documents from the company's own sources and published by other media, and documents received from the case company.

Table 1: Data overview

	Primary data	**Secondary data**		
	Interviews	***Material published by case company***	***Material published by other parties***	***Researcher's or case company's internal documents***
No. of data items	27	20	5	5
Data collection period	April 2022 – August 2022	January 2022 – March 2023	January 2022	March 2022 – June 2022
Description of the data	Semi-structured interviews with 16 members of the top management and multidisciplinary development team responsible for developing and launching the new brand. Semi-structured interviews with 11 members of the editorial staff working with the new brand. In total, 11 interviews were conducted in person and 16 interviews using Teams.	News of case company's operations and podcasts published by the company itself, articles written by the company's editorial team, and product and target group information available on the company's websites.	News of the new product launch published by other media outlets.	Information about the profiles of open vacancies in the case company and notes from the meetings with the case company representatives prior to the interviews.
Role in analysis	Overview of creating a within-organization sub-brand, including the entire process across several organizational levels/silos.	Accounts of the company's actions related to digital transformation and creating the sub-brand, as well as demonstrations of the sub-brand's product elements and existing target groups.	Accounts of the company's actions related to digital transformation and creating the sub-brand.	Overview of the company's strategic and operational actions related to digital transformation and creating a sub-brand, as well as demonstrations of the company's actions to develop its resources and capabilities for such actions.

The analysis aimed to capture how capabilities were developed in the creation of a within-organization sub-brand and how the existing organizational elements influenced this development. The analysis sought to explain the relationship between product-related factors and capabilities and the issues arising from development. To develop a chronological understanding of the ongoing transformation, the analysis began with interviews with the development team. The perspectives of the multidisciplinary group of interviewees were constantly integrated. After the initial stages of open coding, different themes began to emerge regarding various aspects of capability development. At this stage, following abduction logic, we sought to find frameworks from the capabilities literature that would capture the conceptual structure of the emerging findings. We chose Leonard-Barton's (1992) model, as it fit well in describing the construction of different dimensions that form a core capability and the requirements for it. We aimed to abstract *open codes* by identifying congruent *themes* and then assigning them to the existing categories of *capability dimensions*. The analysis used secondary data to gain an initial understanding of the transformation and to validate the interview findings, specifically in identifying distinctive skills and knowledge that needed to be acquired outside the organization. To enhance the validity of the analytical process, this study employed data triangulation, utilizing insights from various data sources and cross-functional perspectives across the organization.

Table 2: List of interviewees

*ID**	*Position***	*Business Unit/Area***	*Type of interview*
Interviewee 1	Top manager	Editorial team	Online
Interviewee 2	Top manager	Business development	Online
Interviewee 3	Middle manager	Editorial team	In person
Interviewee 4	Middle manager	Sales and marketing	Online
Interviewee 5	Top manager	Editorial team	Online
Interviewee 6	Specialist	Research and analytics	Online
Interviewee 7	Journalist	Editorial team	Online
Interviewee 8	Journalist	Editorial team	In person
Interviewee 9	Middle manager	Sales and marketing	Online
Interviewee 10	Top manager	Sales and marketing	Online
Interviewee 11	Specialist	Business development	Online
Interviewee 12	Specialist	Research and analytics	Online
Interviewee 13	Middle manager	Sales and marketing	Online
Interviewee 14	Middle manager	Editorial team	In person
Interviewee 15	Journalist	Editorial team	Online
Interviewee 16	Journalist	Editorial team	In person
Interviewee 17	Journalist	Editorial team	Online
Interviewee 18	Journalist	Editorial team	In person
Interviewee 19	Journalist	Editorial team	In person
Interviewee 20	Journalist	Editorial team	In person
Interviewee 21	Journalist	Editorial team	In person
Interviewee 22	Journalist	Editorial team	In person
Interviewee 23	Journalist	Editorial team	In person
Interviewee 24	Visual designer	Editorial team	In person
Interviewee 25	Visual designer	Editorial team	Online
Interviewee 26	Top manager	Editorial team	Online
Interviewee 27	Top manager	Editorial team	Online

* To protect anonymity and confidentiality, individual interviewee's age and gender are not presented.
** To protect anonymity and confidentiality, individual interviewee's exact job tittle or business unit are not presented.

4. Findings

Following Leonard-Barton's (1992) definition, we approached the development of a core capability through four dimensions. The first dimension is skills and knowledge base, which refers to the skills, experience, and knowledge embodied in people. Second, managerial systems refer to organizational structures and processes used for creating and utilizing new knowledge and enabling employee engagement, continuous product management, and the organizational integration of different resources and other elements to work together. Third, technical systems include databases and technical systems themselves, as well as the specific technical knowledge and skills needed in production. Finally, values and norms are higher-level goals and objectives that are embedded in the organizational culture, create a shared understanding of what is considered professionally desirable, and shape the direction of the organization's development.

The findings indicate that the main brand performed two roles in the development of capabilities—facilitator and inhibitor—which can be disaggregated into different dimensions. The following sections provide a detailed description of the findings, supported by the coding structure (Figure 1).

4.1 Skills and Knowledge Base

Personal proficiency represents the central point of the skills and knowledge base and, therefore, emphasizes the importance of finding the right individuals whose expertise matches the sub-brand's content. Personal proficiency comprises an individual employee's specific expertise derived from prior experience or education, including existing networks. To maximize this, the final profiles of each editorial position in the sub-brand were matched to the research data of the target group and the recruited individuals.

Audience insight is critical to the development and production of a target group media, moving from a journalist-centric view to an audience-centric view. This required an advanced ability to interpret and integrate large amounts of detailed research and user data into daily routines. To better understand the audience and their perspectives, the editorial staff used a variety of methods to empathize with them. For example, they began content planning by creating a fictional person from the target audience.

Sub-brand fluency refers to adopting the style and tone of the sub-brand through written guidelines and experimentation. Building fluency requires creating a shared understanding of the brand among employees and, most importantly, translating this into content decisions to maintain differentiation and attract the right audience. Achieving sub-brand fluency requires an open-minded, brave, and innovative approach that reflects the desired sound and look of the sub-brand.

Journalistic development refers to maintaining and building the capacity to keep up with the sub-brand, as the product elements differ from those of the main brand. For traditional news media, this represented a new way of operating. Journalists have to question their old and personal journalistic preferences and renew their storytelling and content choices. Journalists must learn how to incorporate visually demanding outputs and include them in the planning of content while working with visualists.

Collective expertise builds on the synergies created by the co-existence of the new and main brands. For example, the sub-brand benefited from expanded in-house skills and knowledge resources. In such a large organization, there was always an expert in certain niches. Furthermore, the existing skills and resources of the main brand enabled the day-to-day operations of production, visual design, and information technology.

These aspects contributed to the development of the sub-brand's capabilities by aligning hard skills with the needs of the target group and enhancing the building of brand identity and differentiation. In terms of skills and knowledge base, the main brand was a *facilitator*. The financial investment in acquiring new staff came from the main brand, while its brand, reputation, and background helped attract, for example, candidates representing the top of the market. The main brand played an important role as an advocate, as it aimed to create a suitable environment for the sub-brand's editorial staff to learn about and maintain the sub-brand's distinctive style. Additionally, the main brand provided the established production processes on which the sub-brand was based. The culture of collegial assistance also grew out of the established roots of the organization and was directly transferred to the sub-brand. Although the main brand provided existing systems and data to support audience insight, it also hindered the adoption of the new unusual approach for traditional news media to implement a target group product due to the existing capabilities resisting the new ones.

4.2 Managerial Systems

Research, development & innovation represents the prevailing approach of the development project. A significant amount of resources was invested in finding the right focus for the sub-brand and ensuring that its implementation was separate from the main brand. The project was completed by a multidisciplinary team of people from different levels of the organization, and outsourced research activities were also used. To ensure that the right strategic direction was maintained, top management played an active role in decision-making. The case company also established long- and short-term steering groups to monitor the development of the sub-brand. As part of the innovation phase and the definition of the sub-brand manual, a printed dummy version of the new product was developed, including a lot of testing of different story types and elements.

Employee engagement supports the prevailing idea that the sub-brand equals its editorial staff and that through active engagement, it is possible to enhance the success of the brand. The editorial staff was given an active role in the final development of the sub-brand and its new final product. From that point on, the editorial staff created and developed the product mostly on the basis of their own experience, and after some trial and error, they were also involved in readjusting the goals to better suit the nature of the sub-brand. From a management perspective, unleashing the full potential of the editorial staff required the editor to act as a facilitator, which differed from one's usual role.

Organizational integration considers the issues that arise when the sub-brand's editorial team is brought under the umbrella of the main brand. Although both brands had their own journalists, many day-to-day production processes were shared, including visual design and development. Due to COVID-19 and maintaining the sub-brand's fluency, the editorial staff were initially physically isolated from the rest of the organization. This led to difficulties in learning, such as organization-specific communication habits. Eventually, the editorial staff moved to the same office space as other staff, and the editor joined the same desk as the other editors to facilitate a better exchange of information, knowledge, and ideas. Although there were benefits, management must continuously evaluate the extent to which integration and separation are necessary and how to manage two different journalistic cultures without sacrificing the focus of the sub-brand.

Adaptive product management is the driving force behind the creation of the sub-brand and supports other managerial systems. It aimed to ensure a focus on the target group. The organization employed adaptive product management, which involved actively revising the product based on trial and error and learning from the process. This approach enabled the organization to make ad hoc decisions and revise tasks among staff as necessary.

These issues emphasize the significance of ongoing learning and the use of accurate, data-based information for the development background. While seeking to achieve the appropriate level of organizational integration, the sub-brand invested in employee engagement and adaptive product management, which enhanced the development of skills and knowledge, as well as the adoption of values and norms that ensure the overall relevance and effectiveness of capability development and serving the target group.

These issues emphasize the significance of continuous learning and the use of accurate data-based information to inform development. While seeking to achieve the appropriate level of organizational integration, the sub-brand invested in employee engagement and adaptive product management, which enhanced the development of skills and knowledge, as well as the adoption of values and norms that ensure the overall relevance and effectiveness of capability development and serving the target group.

The main brand supported these actions by acting as a *facilitator*. It made all the resources and capabilities available for various development activities and was able to react quickly when the operations or the strategic direction needed to be revised. Furthermore, the main brand sought to create a conducive environment in which employee engagement could flourish. On the other hand, the main brand also acted as an *inhibitor*, as most of the processes and structures for the sub-brand were adapted from the main brand, but these often hindered the revision initiatives and hampered the implementation of the sub-brand elements. Although the prevailing atmosphere supported an adaptive and engaging approach, the existing systems hindered it. Therefore, in this case, the main brand also divided and consciously or unconsciously maintained a threshold between the brands.

4.3 Technical Systems

Clustered technical expertise originates from the main brand's existing systems. The technical skills and knowledge required by the sub-brand were clustered around specific individuals and/or departments that were separate from the sub-brand's editorial staff, such as the digital development team. Large technical development projects had to be undertaken in conjunction with the main brand, and smaller development needs tended to be prioritized based on the developers' personal views. Furthermore, creating and modifying digital layouts specific to the sub-brand's focus required coding expertise. In many ways, knowledge of the production systems was centralized, challenging the day-to-day operations of the sub-brand.

Platform specificity refers to the characteristics of the platform on which the main brand and, therefore, the sub-brand operate. In this case, the organizational culture was heavily focused on text, while the sub-brand's original goal was to provide content in a variety of formats. However, the platform was not designed for audio, both technically and in terms of branding, which presented challenges in terms of content production and reaching the target audience. The work was complicated by the fact that digital and print production were part of the same system. Therefore, it was necessary to consider the print version while maintaining a digital-oriented approach. To meet the initial objectives of the offering, the organization had invested in testing other third-party platforms and channels.

Customer-centric design and data relates to technical systems by emphasizing the user experience, particularly in comparison to competing international offerings. The sub-brand sought to be recognizable among other economic and financial news media, which required differentiation from the main brand, including, for example, the mobile app. The focus on the specific target group also revealed gaps between the operational domains and

the systems. The available data did not correspond with the defined target group, indicating that the data collected and analyzed were not completely equivalent to the defined target group and goals.

Developing the sub-brand's capabilities required leveraging technical expertise while balancing the main brand's organizational constraints, overcoming platform limitations, and prioritizing customer-centric design and data analysis. In this domain, the main brand's role as a *facilitator* and *inhibitor* created a contradiction. For example, the main brand offered significant resources and existing systems to realize the sub-brand's customer experience objectives. However, it did not bend to the sub-brand's needs and prevented the sub-brand from implementing the desired features of the sub-brand's product, such as mobile app features or audio content.

4.4 Values and Norms

Professionalism represents the established journalistic culture of the main brand, which the sub-brand has begun to follow both consciously and unconsciously. The journalistic work in the organization was driven by strong ambition and goal orientation, characterized by an artistic mindset and often leading to work being seen as a lifestyle. Interviewees even described how prevailing values encouraged the aspiration to be a heroic journalist.

Responsibility is the foundation of the main brand, which is widely recognized within the organization and in the market. The sub-brand was expected to adhere to the same ethical and quality standards as the main brand to avoid any harm. The main brand's reputation and market position gave it significant power to influence people's lives, particularly through content decisions, which needed to be taken seriously.

Specialization comes from the origin of the sub-brand, which shifts the focus from customer loyalty to loyalty for the target group. This meant keeping the promise of delivering the desired value to the specific target group and staying on the intended path of the sub-brand that best served the target group. Maintaining this required path independence and uniqueness from the main brand.

Freedom plays an essential role in ensuring sub-brand fluency. This appeared through the discussion atmosphere between the editorial team and management. This embraced the self-direction and ability of the sub-brand staff to be themselves, which finally equaled the sub-brand.

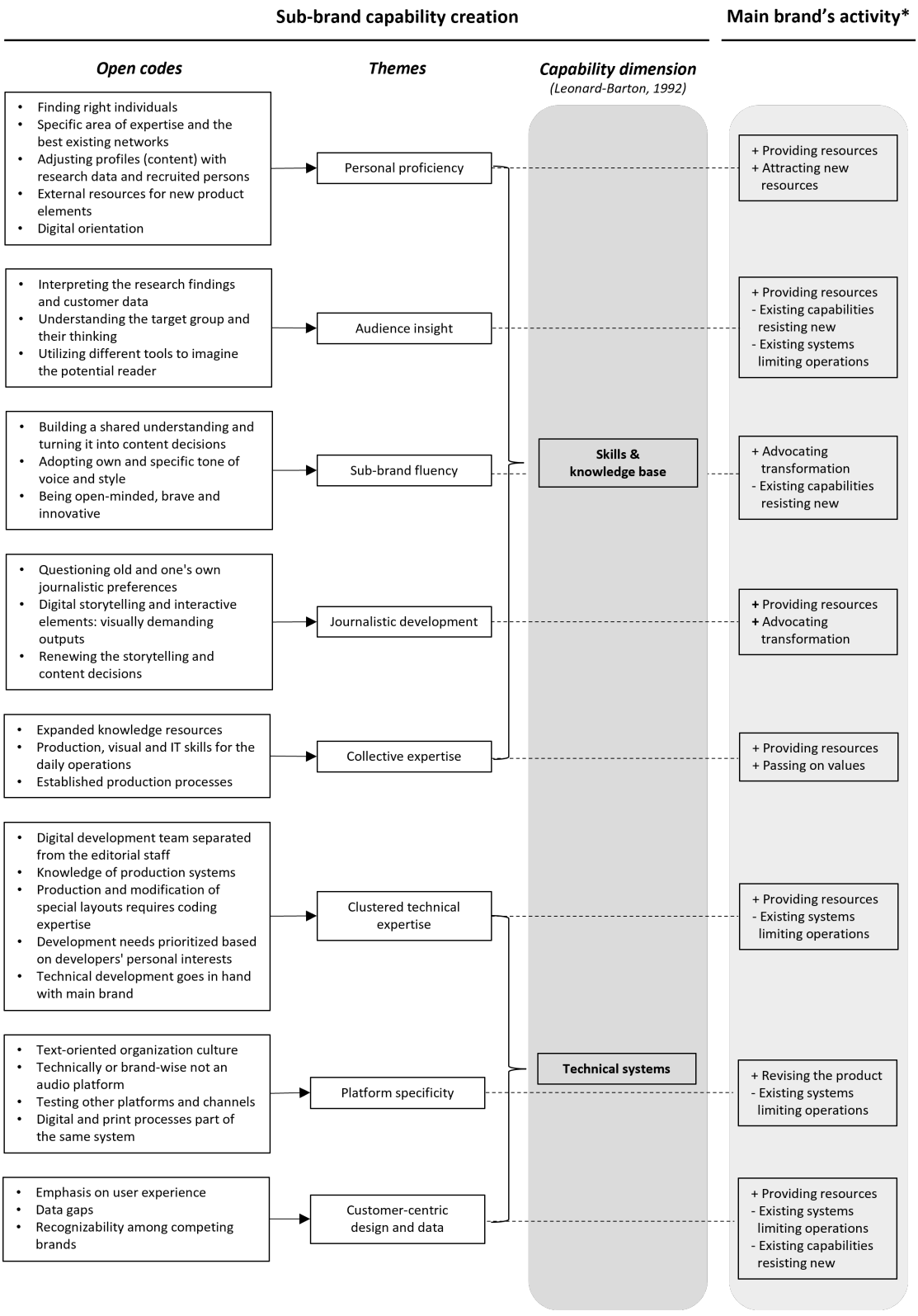
Values and norms played a critical role in ensuring the sub-brand's alignment and recognizability with the main brand. They also helped maintain favorable skills and knowledge originating from the main brand while enabling the sub-brand to differentiate itself by creating its own unique identity and ensuring the development of new capabilities.

The main brand delegated some of its values directly to the sub-brand, which, in this case, could be seen as acting as a *facilitator*. Being associated with such an established brand helped the sub-brand gain credibility and legitimacy in the market. On the other hand, the main brand acted as an *inhibitor*, as its capabilities dominated the organization and thus hampered specialization and freedom. These values relied heavily on the target group's focus and the role and expertise of individual employees, which challenged the prevailing manners of the main brand. To compensate for this, the main brand still sought to promote the right atmosphere for these values to flourish and be put into practice, paying particular attention, for example, to strengthening employees' self-confidence.

4.5 Key Events and Activities in the Capability Development Timeline

Based on our empirical analysis, the timeline in Figure 2 demonstrates capability development and the impact of the main brand on the capabilities of the sub-brand over time. The analysis shows that capability development is a dynamic and long-term process consisting of multiple overlapping events. The key events constituting the development of each capability dimension may occur at one point in a time (e.g., reorganization of tasks) or continue existing over time (e.g., balancing between legacy and freedom).

However, as illustrated in Figure 2, the relative emphasis on different capability dimensions may vary throughout the process. For example, management systems play an important role throughout the process, while the importance of skills and knowledge base increases as the focus shifts to embracing the new value proposition. In addition, as discussed earlier, the presence of the main brand in capability development can have an ambivalent and twofold impact, but the timeline indicates that this is likely to occur at different times rather than simultaneously; what is initially facilitative may later be inhibiting.



* Plus (+) refers to main brand's activities that facilitate sub-brand's capability development and minus (-) refers to main brand's activities that inhibit sub-brand's capability development.

Figure 1: Coding structure

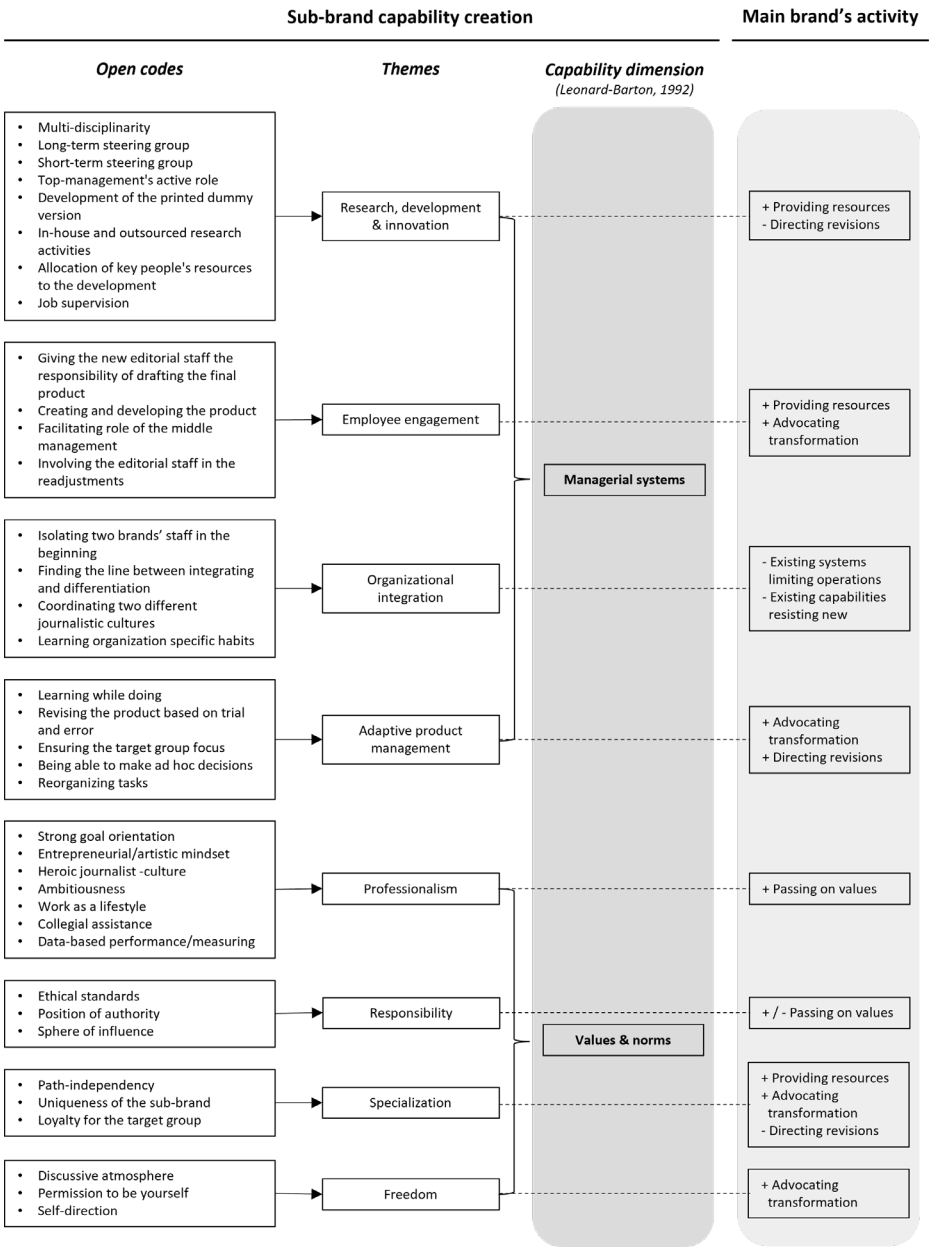


Figure 1: Coding structure (continued)

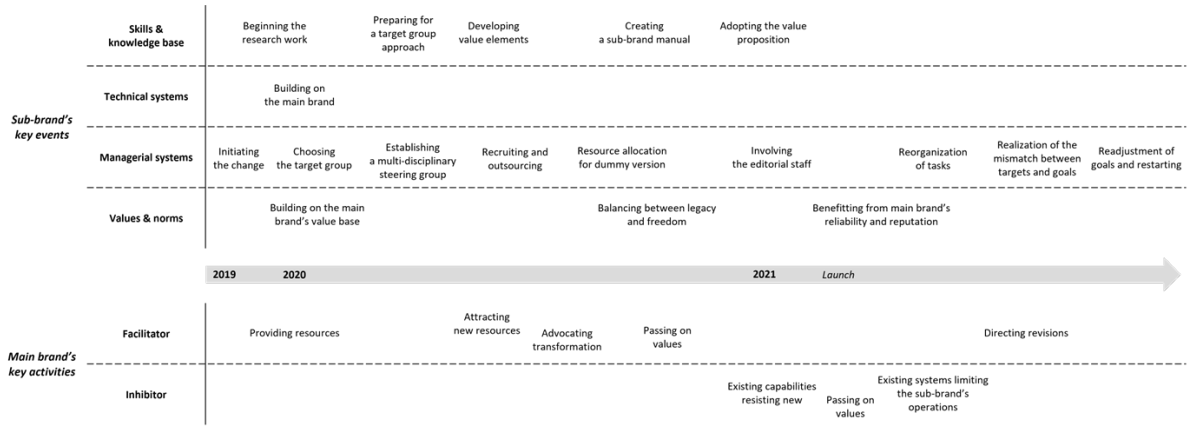


Figure 2: Timeline of the capability development

5. Discussion and Implications

Our study has demonstrated how a company that developed a novel sub-brand sought optimal distinctiveness (Zhao et al., 2017) within an organization, not only toward external audiences (Bu et al., 2018). We approached the challenge from the capability development perspective and unveiled four particular dimensions related to a core capability: skills and knowledge base, managerial systems, technical systems, and values and norms (Leonard-Barton, 1992). In addition, our study reveals how new capability development is affected by the main brand and its existing structures and capabilities.

We contribute to the academic literature on organizational strategic renewal by illustrating how organizational capabilities are developed when an organization is seeking within-organization distinctiveness by updating its product portfolio. We explore how a company builds new capabilities when it aims to create a differentiated sub-brand product and corresponding capabilities. In this capability-building context, the company operates with balancing needs to be detached from and integrated into the main brand. We found that capability development in the context of internal distinctiveness is a complex organizationally embedded challenge that requires consideration of distinctive skills, professional norms and values, and how managerial and technical structures and systems are set up. It particularly highlights the power of organizational path dependencies (Gilbert, 2005; Leonard-Barton, 1992), which continuously challenge the development of new sub-brand-related capabilities. Our analysis clearly shows that existing structures and capabilities hinder renewal processes. On the other hand, the main brand also supports the development of new capabilities. In this study, the existing resource base, values, and norms created foundations for building the new sub-brand. In fact, development requires continuous ambidextrous balancing between integrating and separating existing and new elements (Maijanen & Virta, 2017). The challenge and question for management is how to leverage existing resources and capabilities, keeping in mind the goal of creating something divergent from the existing brand.

Our study relates to the topical issue of media research, namely how media organizations need to continuously innovate and expand to new markets and customer groups to sustain competitiveness in the highly competitive digital media business (Villi & Picard, 2019). As a study, this represents research on the micro-level foundations of capability development (Helfat & Winter, 2011; Teece, 2007). The study highlights the challenges, particularly for media managers, since the development process must be managed with a clear strategy to maintain the right balance in the interplay between old and new. Due to path dependencies, the old easily hampers new initiatives. However, our study also demonstrates that achieving balance is possible but requires a systematic and constant strategic approach when building operational capabilities.

For practitioners, our study demonstrates the interdependence between product elements and capabilities and emphasizes the significance of integrating capability development into product development. Additionally, the results indicate that achieving within-organization optimal distinctiveness cannot be accomplished solely by introducing new product elements and capabilities but also by recognizing and addressing organizational issues that hamper capability development. In particular, our findings provide insights into the benefits and drawbacks of developing a sub-brand product embedded in the main brand from a capability viewpoint. The main brand can accelerate capability development, for example, by providing knowledge, resources, and credibility. Furthermore, it can promote a favorable environment for development and transfer its values to the sub-brand, supporting the delivery of the intended distinctive value proposition. However, it is important to note that the established capabilities of the main brand may dominate the new capabilities of the sub-brand, and that the existing technical or managerial systems may not be equipped to serve the sub-brand's objectives. Therefore, managers must be aware of potential pitfalls that could derail the sub-brand's capability development from its intended path and, consequently, deteriorate the desired distinctiveness of the new product.

As for the limitations, although the study uses data triangulation, the findings should be interpreted with caution, as they are mainly based on qualitative interview data and are limited to a single company operating in the Finnish media industry. However, capability building is always a context-specific activity impacted by organizational conditions. Despite these context-specific limitations, this study increases our knowledge of the dynamics of capability development and opens avenues for further research, such as a multi-level study on capability development: how different organizational levels and units (e.g., top managers, middle managers, editorial team, marketing and sales, and data and analytics) perceive, experience, and also contribute to capability development. Furthermore, a more focused study on the interplay between the main brand and the sub-brand would be interesting to better understand how sub-brand-related capabilities affect the main brand.

References

Aaker, D. A. (2004) "Leveraging the corporate brand", *California management review,* Vol. 46, No. 3, pp. 6–18.

Barney, J. B. (1991) "Firm resources and sustained competitive advantage" *Journal of Management*, Vol. 17, pp. 99–12.

Bu, J., Zhao, E. Y., Li, K. J. and Li, J. M. (2022) "Multilevel optimal distinctiveness: Examining the impact of within-and between-organization distinctiveness of product design on market performance", *Strategic Management Journal*, Vol. 43, No. 9, pp. 1793–1822.

Cohen, W. M. and Levinthal, D. A. (1990) "Absorptive capacity: A new perspective on learning and innovation", *Administrative science quarterly*, Vol. 35, No. 1, pp. 128–152.

Ellonen, H.-K., Jantunen, A. and Kuivalainen, O. (2011) "The role of dynamic capabilities in developing innovation-related capabilities", *International Journal of Innovation Management*, Vol. 15, No. 3, pp. 459–478

Gilbert, C. G. (2005) "Unbundling the structure of inertia: Resource versus routine rigidity", *Academy of management journal*, Vol. 48, No. 5, pp. 741–763.

Helfat, C. E. and Peteraf, M. A. (2003) "The dynamic resource-based view: Capability lifecycles", *Strategic management journal*, Vol. 24, No. 10, pp. 997–1010.

Helfat, C. E. and Winter, S. G. (2011) "Untangling dynamic and operational capabilities: Strategy for the (N) ever-changing world", *Strategic Management Journal*, Vol. 32, No. 11, pp. 1243–1250.

Helfat, C. E., Finkelstein, S., Mitchell, W., Peteraf, M., Singh, H., Teece, D. and Winter, S. G. (2007) *Dynamic capabilities: Understanding strategic change in organizations,* Blackwell Publishing, Malden.

Jo, M. S. (2007) "Should a quality sub-brand be located before or after the parent brand? An application of composite concept theory", *Journal of the Academy of Marketing Science,* Vol. 35, pp. 184–196.

Leonard-Barton, D. (1992) "Core capabilities and core rigidities: A paradox in managing new product development", *Strategic management journal*, Vol. 13, No. S1, 111–125.

Lischka, J. A. (2019) "Strategic renewal during technology change: Tracking the digital journey of legacy news companies", *Journal of Media Business Studies*, Vol. 16, No. 3, pp. 182–201.

Maijanen, P. and Jantunen, A. (2016) "Dynamics of dynamic capabilities: The case of public broadcasting", *International Journal of Business Excellence*, Vol. 9, No. 2, pp. 135–155.

Maijanen, P. and Virta, S. (2017) "Managing exploration and exploitation in a media organization–A capability-based approach to ambidexterity", *Journal of Media Business Studies*, Vol. 14, No. 2, pp. 146–165.

Malmelin, N., Virta, S. and Kuismin, A. (2022) "Transforming media: Reviewing the issues and contexts of change in media management research", *Journal of Media Business Studies*, Vol. 19, No. 3, pp. 203–224.

McKnight, B. and Zietsma, C. (2018) "Finding the threshold: A configurational approach to optimal distinctiveness", *Journal of Business Venturing*, Vol. 33, No. 4, pp. 493–512.

Murschetz, P. C., Omidi, A., Oliver, J. J., Kamali Saraji, M. and Javed, S. (2020) "Dynamic capabilities in media management research: A literature review", *Journal of Strategy and Management*, Vol. 13, No. 2, pp. 278–296.

Nelson, R.R. and Winter, S.G. (1982) *An evolutionary theory of economic change*, Harvard University Press, Cambridge.

Oliver, J. (2014) "Dynamic capabilities and superior firm performance in the UK media industry", *Journal of Media Business Studies*, Vol. 11, No. 2, pp. 57–78.

Parviainen, P., Tihinen, M., Kääriäinen, J. and Teppola, S. (2017) "Tackling the digitalization challenge: How to benefit from digitalization in practice", *International Journal of Information Systems and Project Management*, Vol. 5, No. 1, pp. 63–77.

Payne, A., Frow, P. and Eggert, A. (2017) "The customer value proposition: Evolution, development, and application in marketing", *Journal of the Academy of Marketing Science*, Vol. 45, No. 4, pp. 467–489.

Piepponen, A., Ritala, P., Keränen, J. and Maijanen, P. (2022) "Digital transformation of the value proposition: A single case study in the media industry", *Journal of Business* Research, Vol. 150, pp. 311–325.

Sharma, S. and Lenka, U. (2022) "On the shoulders of giants: Uncovering key themes of organizational unlearning research in mainstream management journals", *Review of Managerial Science*, Vol. 16, No. 6, pp. 1599–1695.

Teece, D. J., Pisano, G. and Shuen, A. (1997) "Dynamic capabilities and strategic management", *Strategic Management Journal*, Vol. 18, No. 7, pp. 509–533.

Tripsas, M. and Gavetti, G. (2000) "Capabilities, cognition, and inertia: Evidence from digital imaging", *Strategic Management Journal*, Vol. 21, pp. 1147–1161.

Villi, M. and Picard, R. G. (2019) *Transformation and innovation of media business models*. In M. Deuze & M. Prenger (Eds.), Making media: Production, practices, and professions (pp. 121–131), Amsterdam University Press, Amsterdam.

Wernerfelt, B. (1984) "A resource-based view of the firm", *Strategic management journal*, Vol. 5, No. 2, pp. 171–180.

Winter, S. G. (2000) "The satisfying principle in capability learning", *Strategic management journal,* Vol. 21, No. 10–11, pp. 981–996.

Yin, R. K. (2018) *Case study research and applications: Design and methods* (6th ed.), Sage, Thousand Oaks.

Zahra, S. A. and George, G. (2002) "Absorptive capacity: A review, reconceptualization, and extension", *Academy of management review*, Vol. 27, No. 2, pp. 185–203.

Zelenskaya, E. and Elkanova, E. (2021) "Designing place brand architecture: the potential of a sub-brands strategy", *Journal of Product & Brand Management*, Vol. 30, No. 1, pp. 167–179.

Zhao, E. Y., Fisher, G., Lounsbury, M. and Miller, D. (2017) "Optimal distinctiveness: Broadening the interface between institutional theory and strategic management", *Strategic Management Journal*, Vol. 38, No. 1, pp. 93–113.

Zollo, M. and Winter, S. G. (2002) “Deliberate learning and the evolution of dynamic capabilities”, *Organization science*, Vol. 13, No. 3, pp. 339–351.

Digital Technological Solutions in Knowledge Transfer in Higher Education

Luiza Piersiala
Częstochowa University of Technology, Faculty of Management, Częstochowa, Poland

luiza.piersiala@pcz.pl

Abstract: In a world of constant change and ongoing technological globalization, the challenges facing education are multidimensional. The modern generation of the academic community, especially technical universities, is increasingly demanding in terms of teaching materials: they expect dynamism, a digital approach and very good visual quality. The knowledge provided to them should be presented in an engaging way and using the latest technologies. The world in which society functions, especially young people, is described as a nanosecond culture, i.e. one in which everything is expected to be available immediately. Education has been digitized. Remote learning forced a change in the way knowledge was transferred. Classes and the method of transmitting knowledge should be adjusted to current requirements and the surrounding reality, which will be attractive, immersive and motivating for further learning for students. Traditional ways of education are no longer sufficient to meet society's complex expectations as people often change careers, seek new educational opportunities, and have difficulty coping with life, work, and competing for educational demands. The article is an attempt to answer the question: what digital methods and tools are used by students in the process of acquiring knowledge. Which of them are the most effective? The CAWI method was used for research. The respondents were full-time and part-time students of the first cycle (bachelor's/engineer's studies) and the second cycle (supplementary master's studies). The time scope of the analysis covers the period from November 2023 to December 2023. A survey was carried out with the participation of 245 student representatives.

Keywords: Education, Knowledge, Digital Approach, Digital Native, Learning Environment, Higher Education

1. Introduction

Digital learning provides greater control and autonomy over learning itself and enables learning in context, that is, in the place, time and conditions that the student finds most appropriate. The aim of the article is to examine what digital educational devices are needed and most frequently used in higher education.

In recent years, education has changed and been digitized. Remote and/or hybrid learning has been introduced. Which, in consequence, resulted in a change in the way of transmitting knowledge. Currently, it is important to remember to adapt it to the current situation and the requirements that students place on lecturers. The aim of this approach is to create attractive, interesting and motivating lectures and lessons for further learning. Technology and ongoing digitization have improved the effectiveness of learning and the process of acquiring knowledge. According to Mete, Riegel, Kozen, and Polka (2017), technology has not only transformed into a powerful tool in everyday life, but has also significantly influenced education. Currently, students are considered to be the first generation of the so-called “digital natives” They have grown up with technology all their lives, they know mobile phones, tablets, computers, playstaion and many other electronic devices from birth (Acquah & Katz, 2020).

The first part of the article presents the characteristics of the examined student. Then, the tool and the research sample were characterized. The results, conclusions of the research, their limitations, and recommendations for further research are presented.

2. Literature Review

In the 21st century, there has been an explosion in research and learning (Krawczyk, 2022). Both lecturers and students must adapt quickly to new technological developments. It is reasonable to assume that this pace of AI development will increase.

Analyzing "4 trends that will shape the future of higher education" it can be indicated that current students, are those who can learn anywhere, from wherever they want, is to do the so-called "learning from everywhere", for whom active lectures are important (placing lectures with active learning), are those for whom it is important to learn from examples of phenomena that are relevant to the environment. And finally, they are people for whom using formative assessment instead of high-stakes exams. Real learning relies on principles such as spaced learning, emotional learning, and the application of knowledge (World Economic Forum, 2022). Students are referred to as "digital natives" (Ivan, 2022) because they have grown up with digital communication technologies since birth. Digital natives born with advanced digital media technologies are acknowledged as the first

generation of the 21st century. Digital natives are different from previous generations because they are unique addicted to the Internet. They closely follow technological developments, interact and communicate regularly through various means of mobile communication, such as mobile phones and social networking sites, they can easily express their wishes and deliver them continuously and more

access to virtual environments (Azimi et al., 2021). Digital natives show a preference for using graphics to communicate and feel comfortable with multitasking, preferring to receive immediate feedback and seek gratification (Xie et.al, 2022). This is someone who is fluent in Twitter, Facebook, Instagram, WhatsApp, SnapChat, podcasts, YouTube, online news, text messaging, instant messaging (Yue et al., 2023). They are well versed in smartphones, iPads, smartwatches and more (Piersiala, 2023). The daily lives of digital natives are influenced and governed intensely by the advancements in new media technologies due to being born in the digital opportunities such as advanced technological tools like smartphones with fast and uninterrupted internet connection (Fortunati, 2022). Also referred to as the "iGeneration" or as having "digital DNA" from birth, this group is also people raised in a "nanosecond culture." They are multitaskers and switch quickly between tasks. They are capable of performing tasks at high speed. Native digital students prefer to learn visually rather than through text; they want an environment rich in images. They like information presented in the form of graphics, charts, tables and images rather than long reading tasks.

Currently, interactive boards, virtual learning environments, e.g. Moodle, videoconferencing, applications and software, games, tablets and smartphones have started to be used more often in lecture halls (Nikou and Aavakare, 2021). Lecturers started recording podcasts, tutorials, instructional videos, e-books. They began to conduct synchronous lectures and use videoconferencing. Future employees are those who, when looking for a job, will not be defined by the diploma obtained or the degree held, but by their competencies and skills (The Burning Glass Institute, 2022). It is important to remember that the next generation that will come to study at universities is the alpha generation. This is the touchscreen generation. What defines them is: immediacy, digital-first, haptic interaction, personalization, interaction (games), incidental learning.

Education has transformed over the past few decades. Since the onset of the recent pandemic, schools and universities have been forced to put a lot of their teaching online. Technology breaks up the limitation of time and improves students' learning autonomy (Liu & Li, 2020; Huang et al., 2020). The challenge posed by the Covid-19 pandemic was the transition from classroom learning to online and hybrid learning with the use of technological solutions. At the same time, universities had to develop ways to use modern learning methods while ensuring high-quality teaching (Reis et al., 2022). Currently, interactive boards, virtual learning environments, e.g. Moodle, videoconferencing, applications and software, games, tablets and smartphones have started to be used more often in lecture halls (Nikou and Aavakare, 2021). Lecturers started recording podcasts, tutorials, instructional videos, e-books. They began to conduct synchronous lectures and use videoconferencing. Such tools and such methods are certainly conducive to the positive transfer of knowledge. It can be said that students need such tools, and lecturers need to learn to use such tools. According to Riegel and Mete (2017), students and faculty should share knowledge. There is feedback. Students have a wealth of knowledge to impart to lecturers, and lecturers have a wealth of knowledge to offer to students. Mutual learning can have many positive effects. This idea of mutual learning applies to technology (Haytham, 2023, pp. 23-33). The experience of the past two years has shown that technology is conducive to bridging time and space barriers. It has turned out that it is possible to learn asynchronously and synchronously. The opportunities arising from the development of technology in learning should be exploited, adapting to the requirements of today's students. Teaching materials supported by photos, graphics, videos should be used. Given the current trend of nanoseconds, such solutions promote flexibility and mobility for both students and lecturers.

3. Research Methodology

The aim of this study, based on the above literature analysis, is to determine how students spend their time on the Internet, what devices they use and whether the use of e-books and audio recordings (podcasts) is useful for them. People were also asked about the use of educational e-learning platforms. The main research problem in this aspect was to answer the question: How do students use the Internet? What equipment do they use for this? Is it desirable for them to use educational platforms and e-books? And also determining where (in terms of equipment) they read and would they read if they could choose?

This is a pilot study conducted on a sample of 239 students. It is planned to conduct a study on a larger research sample, covering various faculties of technical universities in Poland. The questionnaire was developed by the Center for Modern Technologies of the Gdańsk University of Technology. The study used an online questionnaire

to investigate the digital birthing of Polish students. The basic research method was the CAPI method, based on a questionnaire. It consists of two parts. The first part contains basic information about students, such as gender, age, degree and field of study. The second part concerned students' answers to questions about their study habits. The participants were informed about the purpose and course of the study and their right to withdraw from the study at any time. Generally, participants completed the questionnaire for approximately 10 minutes.

4. Results

The research was carried out in the period November – December 2023 on a sample of 239 people. The characteristics of the survey participants in the research were analyzed based on the results from the metric part of the survey. The research group represented was: 126 women and 113 men. All the respondents were students of the Częstochowa University of Technology (Poland) from the Faculty of Management, full-time and part-time students of the first cycle (bachelor's/engineer's studies) and the second cycle (supplementary master's studies). This study adopted an online questionnaire to examine Polish learners' digital nativity and their intentions to acquiring knowledge. The most respondents (48%) are aged 22 to 24. Another 35% are respondents aged 19-21. The survey was also completed by 6 respondents under the age of 18, 9 respondents aged 30-40 and 2 person over 41 years of age.

After the metrics section, the student was asked if they use a computer, tablet or smartphone to access the Internet. According to Figure 1, the most responses were given to a smartphone (174 answers) and the least to a tablet (5 answers). 96% have a Windows PC/laptop. The rest use OSX (Apple). Analyzing the distribution of responses regarding the system used on a smartphone indicated Android (52%). The rest of the students use IOS.

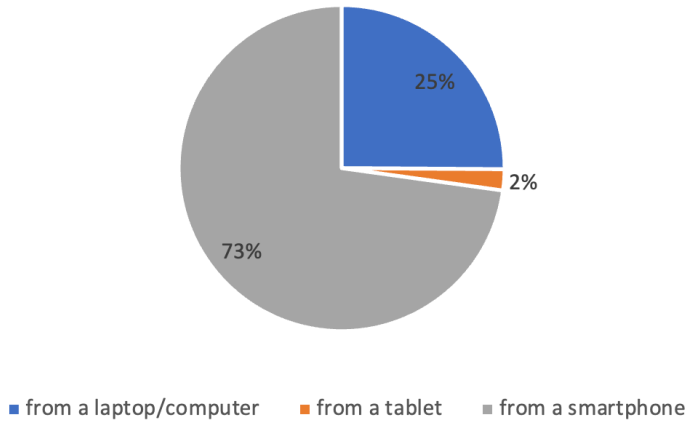


Figure 1: Preferences for spending time on the Internet

In the next question, students were asked: What is using a digital version of a textbook in the form of an ebook in the learning process for you? The distribution of responses is given in figure no.

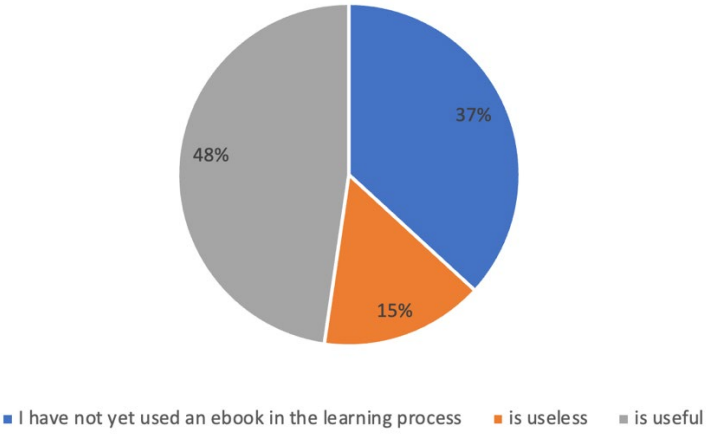


Figure 2: Preferences on using e-book in the learning process

114 respondents indicated that using an ebook (digital version of a textbook) in the learning process is useful to them. 88 respondents have not yet used ebooks in the learning process. In contrast, 37 indicated that it is a useless form of learning.

As many as 159 respondents indicated that they had not yet used an e-learning learning platform like Coursera, Doemstica, EdX or Udemy. 44 students indicated the answer "no, but I know how they work," and only 36 respondents answered in the affirmative "yes, I have used these learning platforms."

There was a similar distribution of responses to the question of what electronic equipment a student uses when watching video content, e.g. YouTube, as to the answer to the question of what device he uses when accessing Internet content. 66% then use a smartphone, 32% use a computer/laptop, the least 2% use a tablet.

In response to the question “The benefits of using audio/podcasts in learning for me are?” as many as 41% has not yet used this form of acquiring knowledge in the learning process. According to 22% of respondents, it is an unhelpful tool, while 15% more respondents indicated that it is a useful tool for them.

The next question was about reading various content, not only on the Internet, not only in the context of learning. The distribution of answers indicates that respondents are most likely to read using a smartphone (126 indications), followed by the answer: traditional books, printed press, other publications in paper form (67 indications), on a laptop/computer (28 responses) and the same number (9 indications) for the answers: on the tablet and on the e-book reader. The answers are shown in Figure 3.

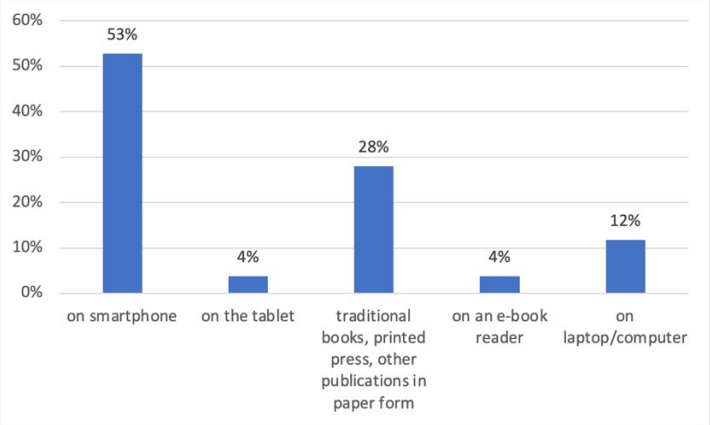


Figure 3: Answer the question “I read most often (not only in the context of learning)”.

The survey questionnaire also asked where the student would most like to read. Analyzing the distribution of answers, it can be indicated that respondents would most like to read using a smartphone (96 indications), followed by the answer: traditional books, printed press, other publications in paper form (83 indications), on a laptop/computer (43 indications). The fewest indications concerned the answers: on a tablet (9 indications) and on an e-book reader (8 indications).

The answers obtained are shown in the figure 4.

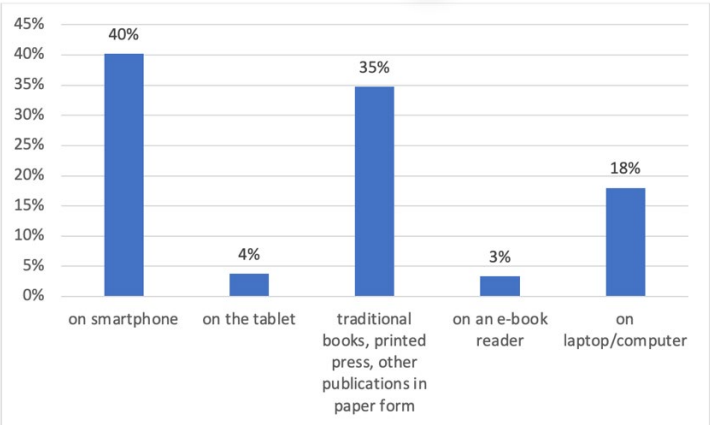


Figure 4: Answer the question "I would most like to read".

Summing up, it can be said that the person in our study is accustomed to using a smartphone on the Internet, both in terms of time spent on the Internet, as well as in terms of reading various content, not only related to science, and the willingness to read in general. The smartphone is also the most popular tool for watching video content on the Internet. The respondent does not use educational platforms used in e-learning, although he knows them. He assesses the use of the electronic version of the textbook as useful, but does not use audio recordings/podcasts in learning.

5. Summary

Analyzing the research results obtained, lecturers and students should focus on mutual learning, and lecturers should adapt their teaching methods to current challenges.

The author believe that education has been changing in recent years. Mutual teaching and learning is important. There are several opportunities to share knowledge between generations, one can learn from each other. Teachers or university lecturers need to undertake the creation of classes using a variety of technologies, adapt the topics presented to the current requirements of students. Universities need to move towards active learning and teaching skills that will survive in a changing world. Lecturers need to teach are skills that remain relevant in new, changing, and unknown contexts.

This study had some limitations. Firstly, considering the large population of Polish university students, the sample size was comparatively small, and the results of the study cannot represent all Polish university students. Further studies were suggested to enlarge the sample size. It is planned to conduct this study in other academic units in Poland and compare the results achieved between universities. It is also planned to increase the survey sample. Interestingly, when conducting the survey, many students were eager to discuss their expectations for teaching with modern technologies.

It is important to remember that the next generation that will come to study at universities is the alpha generation. Future employees are those who, when looking for a job, will not be defined by the diploma obtained or the degree held, but by their competencies and skills (The Burning Glass Institute, 2022).

References

Acquah, E. O., & Katz, H. T. (2020). Digital game-based L2 learning outcomes for primary throughhigh-school students: A systematic literature review. Computers & Education, 143, 1–19. *Measurement Invariance of Digital Native Assessment Scale Across Gender in a Sample of Nigerian Students*.

Azimi, S., Andonova, Y., & Schewe, C. (2021). Closer Together or Further Apart? Values of Hero Generations Y and Z during Crisis. Young Consumers, 23(2), 179–196. https://doi.org/10.1108/yc-03-2021-1300

Fortunati, L. (2022). The Smartphone between the Present and the Future: Five changes. Mobile Media &Communication, 1–6. https://doi.org/10.1177/20501579221131223

Haytham E. (2023). Bridging the Gap between Digital Native Students and Digital Immigrant Professors: Reciprocal Learning and Current Challenges, American Journal of Education and Technology (AJET), Volume 2 Issue 2, DOI: https://doi.org/10.54536/ajet.v2i2.1522, pp.23-22

Huang, F., Teo, T., & Zhou, M. (2020). Chinese students' intentions to use the internet-based technology for learning. Education Tech Research Dev, 68, 575–591

Ivan, L. (2022). Interpersonal Communication in the Information Age: Opportunities and Disruptions. American Behavioral Scientist, 1–13. https://doi.org/10.1177/00027642221092801

İyici, A., & Kuruç, Ü. K. (2023). Digital Natives' Academician-Student Relationships. AJIT-E: Academic Journal of Information Technology, 14(55), 377-395. https://doi.org/10.5824/ajite.2023.04.004.x

Krawczyk, P. (2022). Knowledge management and corporate social responsibility interactions in theory and practice, Proceedings of the 23rd European Conference on Knowledge Management. Vol. 23 No. 1.

Liu, Z., & Li, S. (2020). Research on multimedia assisted English teaching. Education and Teaching Forum, 44, 268-270.

Mete, R., Riegel, C., Kozen, & Polka, W. (2017). What every contemporary teacher educator needs to know about technology. . .but, didn't know about who to ask! The Journal of the Illinois Association of Teacher Educators, 26, 41–55.

Nikou, S., & Aavakare, M. (2021). An assessment of the interplay between literacy and digital Technology in Higher Education. Education and Information Technologies, 26(4), 3893–3915. https://doi.org/10.1007/s10639-021-10451-0

Piersiala, L. (2023). Digital natives and their learning habits in acquiring knowledge, Proceedings of the 24th European Conference on Knowledge Management, Vol. 24 No. 1 https://doi.org/10.34190/eckm.24.2.1611

Reis, M. A. F., Favretto, J., Favretto, N.M., Favretto, L.M. H., & Santos, R. P. (2022). Knowledge management in the classroom using Mendeley technology. Journal of Academic Librarianship, (September 2021), 102486. https://doi.org/10.1016/j.acalib.2021.102486

Riegel, C., & Mete, R. (2017). Educational Technologies for K-12 learners: What digital natives and digital immigrants can teach one another. Educational Planning, 24(4), 49–58.

Xie A., Huang F., Zhao M. (2022). Examining Chinese University Students' Digital Nativity and Its Effect on Their Intentions to Use Technology in English Learning. International Journal of Educational Research Review, 8(1), pp. 1-8

Yue, Z., Zhang, R., & Xiao, J. (2023). Social media use, perceived social support, and well-being: Evidence from two waves of surveys peri- and post-COVID-19 lockdown. Journal of Social and Personal Relationships. https://doi.org/10.1177/02654075231188185

El-Azar, A. (2022). World Economic Forum, https://www.weforum.org/agenda/2022/02/four-trends-that-will-shape-the-future-of-higher-education/

The Burning Glass Institute, https://www.burningglassinstitute.org/research/the-emerging-degree-reset.

PPP Projects Information and Methodical Support (CZ and SK Comparison)

Jan Pokorný and Marie Černá
University of West Bohemia, Plzeň, Czech Republic

pokorny@fek.zcu.cz
macerna@fek.zcu.cz

Abstract: Public goods and services administration represents an important tool supporting functioning of the state. Provision of public goods and services is closely related to the necessity to ensure relevant sources and setting the appropriate distribution channels, what in fact means, finding the suitable provider. Production of public goods can be provided by both sectors, private or public. If a public entity produces a public good, it is possible to talk about in-house production. In the opposite situation, when external private entity produces a public good, it is possible to talk about out-house production. This contribution is focused on the issue of Public Private Partnership (PPP) projects as one of the out-house production variants. The aim of the contribution is to compare the availability and complexity of information about the given projects for potential contractors in the Czech Republic and Slovak Republic (Slovakia). To be able to make this comparison, authors of the article conducted the qualitative research. Used method was document and text analysis. To identify the relevant literary sources, systematic literature review followed by the traditional literature review, were used. Authors expected that there will be solid database of information available to the potential conductors of PPP projects. Also the way of its presentation was expected to be thoughtful and complex. Provision of information and methodical support in specified area can influence the final willingness of both sides, contractors and contracting authorities, to enter this project focused on provision of public services, traditionally provided by the public sector, by the private sector. The contribution is finalized using the method of synthesis that enables the authors to describe the main differences in ways of PPP projects information presentation. It was found that currently provided information and methodical support in the area of PPP projects administered by the authorities on the central level in selected countries can be described as insufficient. This finding contradicts the original expectations of the authors.

Keywords: Information Support, Out-House Production, Public Affairs Administration, Public Sector, PPP Projects

1. Introduction

Public goods and services administration represents an important tool supporting functioning of the state, respectively of the public sector. Existence of public goods is further related to questions linked with the acquisition of resources for their provision or the production and distribution of these goods. Within the framework of the public sector system, resources are obtained by limiting the private sector (by taxation, or temporarily by a debt manner), as stated by Pavel (2013).

Production of public goods can be provided by both, the public and the private sector, or by their combination (Ferdman, 2018). In terms of production, it is possible to talk about in-house production, if a public entity produces a public good, or about the possibility of outsourcing (out-house production), which is provided by an external private entity. In the case of the use of external entities for the production of a public good, it is possible to divide it into public contracts or Public Private Partnership (PPP) projects (Ochrana et al, 2010). This contribution is focused on the second of the mentioned methods, PPP projects. In the case of combined form of production, there is cooperation between both entities, when individual advantages are used in the phases of the project (risk, know-how, financing, etc.).

Political and economic issues are closely related to the issue of production. The primary question is: "Is it possible to have selected public good or service provided by the private sector?" This seems to be a highly political issue. This option is more difficult to imagine, for example, in the area of justice or defence, however, in the case of infrastructure construction, the option of external production is almost certain. Economic questions are then asked in association with the convenience of the selected alternative. As part of this, it is possible to mention the 3E principle, where economy, efficiency and effectiveness are monitored (Jackson and Brown, 2003; Ochrana et al, 2010).

On the basis of an expert assessment of these facts, the optimal production variant should be selected, which may be related, but not necessarily, to the issue of distribution. In matters of distribution, it is also important to take into account how the public good is provided (basic education as a compulsory public good), or if there is any fee associated with the use (fee for issuing a passport).

This contribution is focused on the issue of PPP projects as one of the out-house production variants. The premise on which is the presented contribution based is the importance of information and methodical support prepared by central state administration bodies, primarily relevant ministries. The mentioned thesis has its justification in studies dealing with this issue, as political risk represents an important aspect in legislative support, but also in the possibilities of further support and its stability (Abd Karim, 2011; Hai et al, 2022).

The aim of the contribution is to compare the availability and complexity of information about the given projects for potential contractors in the Czech Republic and Slovak Republic (Slovakia).

2. Methods

In order to be able to reach the set aim, authors of the article conducted the qualitative research. Used method was document and text analysis. To identify the relevant literary sources, systematic literature review followed by the traditional literature review, were used.

Authors analysed the level of information and methodical support in the area of PPP projects provided by the authorities on the central level in selected countries, namely the Czech Republic and the Slovak Republic (Slovakia). The reason for selecting these two countries is their closeness to each other, which is caused by the fact that until 1992 they were a joint state entity. This significantly influenced the legislative environment despite the fact that they have been developing separately for almost three decades.

Authors expected that there will be solid database of information available to the potential conductors of PPP projects. Also the way of its presentation was expected to be thoughtful and complex. Provision of information and methodical support in specified area can influence the final willingness of both sides, contractors and contracting authorities, to enter this project focused on provision of public services, traditionally provided by the public sector, by the private sector.

Therefore, in the next part of this contribution, with respect to the defined aim, PPP projects are first presented, taking into account the production possibilities in a broader level. This overview is compiled on the basis of a literature research of professional publications. Similar approach is used also in the chapter, where the practice of PPP projects in the Czech Republic and Slovakia is historically defined.

The contribution further includes the analysis of information and methodical support compiled to this issue by the state authorities on the central level of both countries. Information base for contracting authorities and contractors (suppliers), websites of the ministries of finance in the Czech Republic and Slovakia, are used. This chapter is compiled based on the analysis of websites of Ministry of Finance of the Czech Republic and Ministry of Finance of the Slovak Republic where information about PPP projects is provided. To assess the outputs of both countries, the method of comparison is used.

At the end of the contribution, authors used the method of synthesis that enabled them to describe the main differences in ways of PPP projects information presentation.

2.1 PPP Projects

External production (out-house production) within the provision of public goods represents one of two possible production methods mentioned in the text above, internal and external production. Pavel (2013) names among the possibilities of internal production municipal office employees, budgetary organizations and funded organizations, as well as commercial companies within public sector entities. On the other hand, in addition to public contracts and PPP projects, external production includes commercial companies with majority or minority ownership of public sector entities. The authors do not fully agree with this division, because commercial companies, especially with minority ownership within the public sector, represent also the coordination of the second mentioned side (the private sector). Therefore, it would be better to classify it as a combined (mixed) form of production.

As part of external production, public contracts and PPP projects are significantly important. Public contracts represent a "classic" form of relationship between a public entity (contracting authority) and a private entity (supplier, contractor). The basic difference between PPP projects and public contracts is in their time layout and complexity. Even if also the PPP projects themselves can differ. PPP projects are usually announced as complex, in contrast to public contracts, where different parts (project, construction, operation, etc.) are competed. This is related to their mentioned time layout. Due to their complexity, PPP projects take longer time period (even in

the order of tens of years). This has implications for the form of financing and ownership (Sajko, 2008; Villani et al, 2017).

At the beginning, the implemented project is usually financed by a private entity and then after the start of the use of the given project (e.g. construction), payments are made by the contracting authority to suppliers (quasi-concessions), or fees are collected from users (concessions), which can replace payments from the public sector. If the fees flow to the contracting authority, then the contracting authority makes the payments to the supplier, and this is again a quasi-concession. During the concession or quasi-concession, the project is normally owned by the contractor, and after its end is ownership transferred to the contracting authority (Pavlík et al, 2007).

Related to this, it is possible to identify also other effects in the area of responsibility (supplier side) and control (contracting authority side). If the supplier does not meet the requirements with regard to the quality or quantity of the project, then payments may be suspended. All these matters are dependent on the contractual form of the project. The same applies to the sharing of PPP project risks. According to Abd Karim (2011), these include the following risks: political, economic, market, operational and other. In the case of a concession, the effects of business risk (non-use of project outputs) may occur on the supplier's side. In the case of a quasi-concession, this risk lies on the side of the contracting authority.

Among the significant risks on the side of the contracting authority is the long-term nature of the contract, when the supplier may go bankrupt. It also influences a burden on public budgets for the next several years, which can be decades, and therefore the possibility of handling public funds is affected and prevented by other elected officials (Willems et al, 2017). In this context, Delmon (2017) summarizes important principles related to this type of decision-making: prudent principle, good preparedness and selection, ability to be a partner and respond.

3. Comparison of Development of the use of PPP Projects

The use of PPP projects in the Czech Republic and Slovakia is illustrated in this chapter. This is further used as a starting point to analyse the results of a comparison of the practical form of information support for the given projects. It therefore serves to qualitatively assess the results of the analysis of the information and methodical support provided to the users of the given information by the ministries of finance in both countries.

3.1 The Czech Republic

The question of the use of PPP projects as part of external production began to appear in the Czech Republic in the 1990s. The issue of the use of PPP projects was primarily related to the lack of public resources to finance investments. The first attempts, however, were not successful. This was related, for example, with the bypass of the city of Pilsen in the framework of the completion of the “D5” highway (Pavel, 2007).

In the Czech Republic, more attention was given to PPP projects in the first decade of the 21st century. Pavel (2007) adds to this that: “...also the Czech Republic did not avoid the PPP fashion wave...” Among the projects that were created in this period are the “D3” highway, hospitals in “Pardubice” and “Na Homolce”, court premises and prisons, etc. (Pavel, 2007). The main subject of PPP projects was primarily material infrastructure such as roads, highways and buildings.

Popularization of PPP projects during this period was influenced by the approach of Mirek Topolánek's government, which tried to introduce the principles of the *New public management concept*. This ultimately did not happen in practice (Kroupa et al, 2015). This concept is closely related to the 3E principle and the aim is the efficient use of resources with high quality services for customers (citizens). To do so, the competitive environment between the public and private sectors is used, i.e. market principles, which also influence high level of responsibility in the public sector (Ostřížek, 2011).

As part of the support, in 2004, the Ministry of Finance established the PPP Centrum Inc. In 2013, the name was changed to CENTRUM-F, Inc. Two years later, the company was in liquidation, which was officially terminated, and therefore this centre was deleted from the commercial register, on January 21, 2016 (Justice CZ, 2024). The aim of this centre was to satisfy tasks associated with the coordination of the preparation of the legislative environment, to create information and methodical support, to share experiences within the framework of PPP projects, etc. The model for the establishment of this organization was practice from foreign countries (Šíp, 2005).

Currently, an important PPP project is the completion of the "D4" highway in the section between two cities, "Příbram" and "Písek". The government's intention for this project was approved in 2016. Two years later a tender was launched, and on February 15, 2021, a contract between the contracting authority and the concessionaire, who should complete the construction of the highway by the end of 2024, was signed (PPP D4, 2024). However, the idea of the "D4" completion project using a PPP project appeared before 2016, as in 2015 an *Analysis of the Feasibility and Advantage of Securing the R4 Project in the form of PPP compared to classic public contracts* was prepared (PwC, 2015).

The project thus represents a current example of a PPP project at the central level, which can subsequently influence the future direction in this area. As mentioned, PPP Centrum Inc., which was supposed to provide information and methodical support, went out of business. Within the framework of the contribution, attention is therefore paid to the Ministry of Finance of the Czech Republic, as also stated in the Introduction.

3.2 The Slovak Republic (Slovakia)

In 2005, in Slovakia was created a document called *Administration on the creation of conditions for the implementation of projects with private partnership*, which was created by the Ministry of Finance of the Slovak Republic (MF SK, 2005). Four years later, a document focusing on the analysis of the legal environment and its modification with regard to the possibility of using PPP projects was created (MF SK, 2009).

The effort to create an infrastructure construction project in the form of a PPP project in Slovakia dates back to 2007, although the debate had already started several years before during the era of Dzurinda's government. The infrastructure construction was divided into three packages, while the first package failed to be implemented. Although a concession agreement was signed in 2009, it lapsed in 2010. Originally, it was supposed to be a complex project with a duration of 30 years (Slovincová, 2021).

The second package was already more successful and in 2012 it was possible to open all its parts. The concession period was set to be 30 years (Via Pribina, 2024). The third package started to be implemented later. In 2015 the contract was signed and a year later the construction under this package started. The concession in this case should be terminated in 2048 (Slovincová, 2021).

Another three-decade-long project is a concession focused on the operation and maintenance of the "*Žilina Intermodal Transport Terminal*". The contract was signed in 2018 (Terminál Žilina, 2024).

From the above mentioned cases, it is clear that these projects had been considered in Slovakia in a similar period as in the Czech Republic. On a practical level, three more significant projects were implemented in Slovakia, which demonstrate the success of PPP projects in Slovakia.

4. Results and Discussion

As the first step leading to compilation of previous and following parts of this article was provided a systematic literary review. This review was focused on searching the literary sources dealing with PPP projects issue relevant for the Czech Republic and Slovakia in the Web of Science database. Authors tried to search for articles dealing with public private partnership projects or PPP projects. They search for the articles with this terms in their content and then in their titles. The results were limited by the years of publication (2004 – 2024) and by the countries/regions (Czech Republic and Slovakia). The results were 343 documents including 232 articles in journals. Results of this review are visible in the following figure 1.

Figure 1: Results of systematic literary review

Source: own processing, 2024

The results were further limited by the next requirement – articles should be focused also on methodical support of these projects. After adding this limitation, there were 273 relevant sources available. This was still quite wide range of articles. Therefore, the research was done focusing just on the articles with the terms public private partnership projects or PPP projects in the title. Further limits were used similarly as described above. This way 13 results were obtained, see figure 2. The results included 2 articles in journals, 9 articles in conference proceedings and 2 editorial materials.

Figure 2: Results of systematic literary review - shortlist

Source: own processing, 2024

Selected sources were then used as the background for compilation of introductory parts of this article. Then the authors decided to use also other sources (web pages) focused on this issue. Therefore, the traditional literature review was done.

From the previous chapter (compiled using the document and text analysis), it is evident that consideration of PPP projects occurred in the Czech Republic earlier than in Slovakia. However, important aspects in terms of practical implementation did not begin until about the mid of the first decade of the 21st century. Implementation of PPP projects was then unfortunately disrupted by the economic crisis at that time.

In terms of the practical implementation of PPP projects, the success of Slovakia is evident compared to the Czech Republic. Three important PPP projects were implemented in Slovakia, despite the failure of the first transport infrastructure package. In the case of the Czech Republic, there was a delay of almost ten years, which has not yet ended with success (with the commissioning of the affected infrastructure).

As part of a traditional literature review, the authors found that monitoring the availability of information about the given area is useful to monitor the websites of the Ministry of Finance of the Czech Republic (MF CR, 2024) and the Slovak Republic (MF SK, 2024). Table 1 points out the basic requirements of both websites with regard to what is traceable and graspable as information support within the framework of PPP projects. In the case of the Czech Republic, the term *public-private sector partnership* is used, in contrast, *PPP projects* are used in Slovakia. Within the sorting, it is clear that on the Czech website, you have to click on *public sector* and then *support from national sources*. On the Slovak website, it is possible to access *PPP projects* directly through the intermediate step of the *finance* item.

Table 1: Ministry of finance websites comparison in the area of PPP projects (CZ and SK)

Category	Czech Republic	Slovak Republic
Terminology	*public-private sector partnership*	*PPP projects*
Category (placement)	*public sector, support from national sources*	*finance*
Basic information	*yes*	*yes*
Phases (process)	*no*	*yes*
Methodical documents	*yes (the latest from 2013)*	*yes (the latest from 2020)*
Project examples	*no*	*yes (3 examples, the newest from 2018)*
Statistical information	*no*	*described*

Source: own processing according to MF CR (2024) and MF SK (2024), 2024

The main difference can be found in the content of the methodical support to PPP projects. Although both websites offer basic information, in the case of Slovakia, there is also a description of the process of the phases of PPP projects.

Another difference is the difference in the timeliness of the documents. In the case of the Czech Republic, there are documents from the period of 2007 to 2013. In the case of Slovakia, it is also possible to find older documents from 2008, but also more recent materials, or updated materials that relate to, for example, the preparation process, feasibility studies or the code for the preparation and implementation of PPP projects.

Another difference is visible in the presentation of project examples. Slovakia can offer and share information gathered during implementation of its three successful projects. Due to the current situation within the framework of PPP projects, no such information is listed on the relevant website of the Ministry of Finance of the Czech Republic.

The disadvantage of both websites can be seen in the fact that they do not provide statistical information of sufficient quality and quantity. In the case of Slovakia, there is at least a brief description of the development of the value of PPP projects. In both cases, the addition of such data would be beneficial, especially in the case of the Czech Republic. It can be stated that relevant information on the analysed area was also in the past provided on the websites of Czech institutions (Hejduková and Pokorný, 2020). It would be advisable to restore this state, because with sufficient support and economic efficiency, under certain circumstances, preference for the PPP project variant can be expected from the contracting authority, which can be a region or municipality in addition to central authorities. If such a support is not provided, then PPP projects are not preferred, as there are concerns on the side of the contracting authorities about insufficient use of this variant by the contractors.

5. In Conclusion

PPP projects represent specific alternative of provision of public goods and services by external private entities (out-house production alternative). Even if it seems that both analysed countries, the Czech Republic and the Slovak Republic, have currently more experience in the area of provision of public goods and services using the out-house production in the form of public contracts, PPP projects remain the realisable alternative which has its place in both mentioned economies.

It is necessary to write again that in both cases, the addition of more detailed and relevant data would be beneficial and may increase the public knowledge about this issue what may finally lead to greater acceptance of this type of public goods and services provision. This in fact means that with sufficient support (information and methodical) and economic efficiency, under certain circumstances, PPP project variant preference can be expected. Low level of information and methodical support, amongst other things, will lead to situation in which PPP projects will not belong to the preferred alternative for public goods and services provision.

During the conducted research was also found that currently provided information and methodical support in the area of PPP projects administered by the authorities on the central level in selected countries can be described as insufficient. This finding contradicts the original expectations of the authors.

Acknowledgements

This paper was created within the project SGS-2023-007 “Current Challenges and Problems of Modern Society from the Perspective of Finances and Accounting” at the University of West Bohemia, Faculty of Economics.

References

Abd Karim, N.A. (2011) “Risk allocation in public private partnership (PPP) project: a review on risk factors”, International Journal of Sustainable Construction Engineering and Technology, Vol 2, No. 2, pp 18–16.

Delmon, J. (2017) Public-Private Partnership Projects in Infrastructure: An Essential Guide for Policy Makers, Cambridge University Press, New York.

Ferdman, A. (2018) “Why the intrinsic value of public goods matters”, Critical Review of International Social and Political Philosophy, Vol 21, No. 4, pp 661–676.

Hai, D.T. et al. (2022) “Critical success factors for implementing PPP infrastructure projects in developing countries: the case of Vietnam”, Innovative Infrastructure Solutions, Vol 7, No. 89, pp 1–13.

Hejduková, P. and Pokorný, J. (2020) Veřejný sector pro ekonomické a regionální geography (Public sector for economic and regional geographies), Západočeská univerzita v Plzni, Plzeň.

Jackson, P.M. and Brown, C.V. (2003) Ekonomie veřejného sektoru (Economics of the public sector), Eurolex Bohemia, Praha.
Justice CZ. (2024) "Veřejný rejstřík a sbírka listin (Public register and collection of documents)", [online], Justice CZ, https://or.justice.cz/ias/ui/rejstrik-firma.vysledky?subjektId=699503&typ.=UPLNY
Kroupa, A. et al (2015) Working Conditions and Industrial Relations in the Central Public Administration: Conducting in-depth case studies in Member States which have joined the EU since 2004, VÚPSV, Praha.
Ministry of Finance of the Czech Republic (MF CR). (2024) "Rozpočtová politika (Budgetary policy)", [online], Ministry of Finance of the Czech Republic, https://www.mfcr.cz/cs/rozpoctova-politika/podpora-z-narodnich-zdroju/partnerstvi-verejneho-a-soukromeho-sekto
Ministry of Finance of the Slovak Republic (MF SK). (2024) "ppp-projekty (ppp-projects)", [online], Ministry of Finance of the Slovak Republic, https://www.mfsr.sk/sk/financie/ppp-projekty/ppp-projekty/
Ministry of Finance of the Slovak Republic (MF SK). (2009) Analýza právnych predpisov vo vzťahu k realizovateľnosti projektov verejno-súkromného partnerstva (PPP) v Slovenskej republike a návrh legislatívnych opatrení v oblasti PPP (Analysis of legal regulations in relation to the feasibility of public-private partnership (PPP) projects in the Slovak Republic and draft legislative measures in the field of PPP), MF SK, Bratislava.
Ministry of Finance of the Slovak Republic (MF SK). (2005) Správa o vytváraní podmienok na realizáciu projektov s privátnym partnerstvím (Administration on the creation of conditions for the implementation of projects with private partnership), MF SK, Bratislava.
Ochrana et al. (2010) Veřejný sektor a veřejné finance: financování nepodnikatelských a podnikatelských aktivit (Public sector and public finance: financing of non-business and business activities), Grada, Praha.
Ostřížek, J. (2011) "PPP z pohledu teorie veřejného investování (PPP from the perspective of public investment theory)", Acta Academica Karviniensia, Vol 11, No. 3, pp 66–77.
Pavel, J. (2013) Veřejné zakázky a efektivnost (Public contracts and efficiency), Ekopress, Praha.
Pavel, J. (2007) PPP projekty v České republice – šance nebo riziko? (PPP projects in the Czech Republic – chance or risk?), Transparency International, CZ.
Pavlík et al. (2007) Facility management a Public Private Partnership, Professional Publishing, Praha.
PPP D4. (2024) "Dálnice D4 projekt PPP (Highway D4 PPP project)", [online], PPP D4, https://pppd4.cz/cs
PwC. (2015) Analýza proveditelnosti a výhodnosti zajištění projektu R4 formou PPP ve srovnání s klasickými veřejnými zakázkami (Analysis of the feasibility and profitability of securing the R4 project in the form of PPP compared to classic public contracts), PwC, Praha.
Sajko, L. (2008) "Financial aspects of Public-Private Partnership", Central European Public Administration Review, Vol 6, No. 1, pp 81–102.
Slovincová, L. (2021) PPP projekty príležitosť, alebo hrozba (PPP projects an opportunity or a threat), Ambis, Brno.
Šíp, E. (2005) Projekty PPP v oblasti Fondu soudržnosti (PPP projects in the Cohesion Fund area), MMR ČR, Praha.
TIP Žilina, s.r.o. (2024) "Terminál Žilina (Žilina terminal)", [online], TIP Žilina, s.r.o., https://www.terminalzilina.sk/o-nas
Via Pribina. (2024) "Projekt PPP – rýchlostná cesta R1 (The PPP project – the R1 expressway)", [online], Via Pribina, https://viapribina.sk/sk/koncesia-a-prevadzka/
Villani et al. (2017) "Understanding Value Creation in Public-Private Partnerships: A Comparative Case Study", Journal of Management Studies, Vol 54, No. 6, pp 876–905.
Willems et al. (2017) "Ten lessons from ten years PPP experience in Belgium", Australian Journal of Public Administration, Vol 76, No. 3, pp 316–329.

Navigating Organizational Success: Knowledge Management Capabilities in Public Healthcare

Paula Pusenius and Harri Laihonen
University of Eastern Finland, Kuopio, Finland

paula.pusenius@uef.fi
harri.laihonen@uef.fi

Abstract: Knowledge Management (KM) has been studied in healthcare for over two decades and has an established role in healthcare management. By leveraging KM, healthcare organizations aim to enhance organizational performance, facilitate informed decision-making, and elevate service quality. However, KM faces specific challenges in healthcare, including siloed service provision and effective management of growing volumes of data and evidence. Public healthcare organizations encounter additional challenges due to the complex environment, conflicting values, wicked problems, and resource constraints. While research on KM in the public sector has increased recently, it remains relatively scarce. Notably, the capabilities of effective KM and its significance for organizations' survival have received limited attention. Finland has recently implemented a massive healthcare reform, which shifted the responsibility for organizing healthcare, social welfare and rescue services to new autonomous regional-level organizations, wellbeing services counties. This study explores how KM can support the success of public healthcare organizations after such a fundamental change. The central research question is: What are the critical KM capabilities when rebuilding KM function after a major public reform? To address this question, we employ a qualitative case study approach. Through the interviews of KM specialists from the newly established wellbeing services county, we gain valuable insights into the practical aspects of KM within an integrated public healthcare organization. Our key findings shed light on challenges related to diverse stakeholders and values, emphasize the importance of internal and external relationships, underscore the significance of specialist diversity, and highlight the value of KM to the healthcare organization.

Keywords: Knowledge Management, Healthcare Management, Public Sector, Reform, Capabilities

1. Introduction

The healthcare industry is characterized by its knowledge-intensive nature, as the economic activities within healthcare are intricately tied to the creation, accumulation, and dissemination of knowledge (cf. Miles, Kastrinos & Flanagan, 1995). In healthcare, knowledge in its different modes supports decision-making and is a source of value creation (cf. Grant, 1996). The value of health services emerges largely from the expertise and skills of healthcare professionals, knowledge shared through relationships, codified and tacit knowledge, and organizational culture (Evans, Brown & Baker, 2015; Grant, 1996). Digitalization, the fast-growing volume of healthcare data and national and international regulation of medical records have underlined the relevance of codified knowledge-related development. At the same time, in recent years, we have seen an increase in diversity within our societies, and the trade-offs between values (Bracci et al., 2021) also affect decision-making, especially in the public sector.

Knowledge Management (KM) has a long research history and a stable role in healthcare management (Lunden et al., 2017; Nicolini et al., 2008). However, the public sector is the least examined area (Massaro, Dumay & Garlatti, 2015) despite its significant societal role and the vital context the public sector serves for KM research. While research on KM in the public sector has increased recently, it remains relatively scarce. Moreover, KM has focused more on the context of information management (cf. Choo, 2002), and more attention needs to be paid to KM capabilities (Laihonen & Saranto, 2021).

The healthcare sector is under pressure worldwide due to economic recession, population ageing, workforce shortfall (e.g. Liu et al., 2017), digitalization and societal changes. These global trends drive, in particular, public sector healthcare for renewal to retain the ability to provide services and meet the users' growing expectations. To respond to these pressures, Finland has recently implemented a massive healthcare reform, which shifted the responsibility for organizing healthcare, social welfare, and rescue services from over 300 municipalities to 21 newly established wellbeing services counties. The reform aims to improve the availability and quality of basic public services and curb the continued cost growth (Ministry of Social Affairs and Health, 2023).

This article aims to elaborate on the role of KM as the critical component of organizational renewal and performance. It explores the practical aspects and role of KM in supporting the success of public healthcare organizations after a fundamental reform. The study aims to contribute to the knowledge gap regarding critical KM capabilities when rebuilding KM function. The central research question is:

What are the critical KM capabilities when rebuilding KM function after a major public reform?

Based on the literature and empirical data gathered through thematic interviews of KM specialists from one wellbeing services county in Finland, this article addresses the importance of KM in the public healthcare sector. Through the interviews, we gain valuable insights into the practical aspects of KM within an integrated public healthcare organization, especially for four key themes: (1) KM in practice, (2) the value of KM, (3) KM capabilities and (4) the future of KM.

The rest of the paper is organized as follows: The next section reviews the theoretical background of KM in public healthcare and briefly discusses the recent literature. Section three presents the study's context and methods, and section four presents the empirical results. Section five makes concluding remarks.

2. Theoretical Background – KM and KM Capabilities in Public Healthcare

The field of KM traces its origins to the knowledge-based view, which posits that knowledge plays a pivotal role as both a critical input in production processes and a primary source of organizational value (Grant, 1996). KM systematically identifies and strategically leverages an organization's knowledge resources (Von Krogh, 1998). KM encompasses various processes, including knowledge creation, storage, transfer, and application (Alavi & Leidner, 2001). Central to KM is enhancing an organization's overall performance (Kalling, 2003).

KM in healthcare has been studied for over 20 years (Lunden et al., 2017; Nicolini et al., 2008). By leveraging KM, healthcare organizations aim to enhance organizational performance, facilitate informed decision-making, and elevate service quality (Hujala & Laihonen, 2021). Studies examine KM in healthcare from different perspectives. For example, the processes and tools of KM (El-Jardali et al., 2023; Nicolini et al, 2008), barriers and enablers of knowledge sharing (Kim et al., 2011; Lin & Lo, 2015), KM´s impact on the effectiveness of healthcare (e.g. Laihonen & Sillanpää, 2014), and KM related to performance (for review, see Kosklin, Lammintakanen & Kivinen, 2023). However, the healthcare and public contexts should be considered when examining KM in *public sector* healthcare. In particular, the public sector presents a unique environment characterized by distinct organizational features, effectiveness concerns, and levels of representativeness, accountability, and responsiveness (Massaro, Dumay & Garlatti, 2015). KM in the public sector has a broad range of goals seeking to strengthen societal capabilities, cultivate a competitive workforce, and facilitate the participation of citizens in public decision-making (Wiig, 2002). A comprehensive literature review of KM in the public sector (Massaro, Dumay & Garlatti, 2015) underscores the need for tailored approaches recognizing the organizational idiosyncrasies inherent to the public sector.

Scholarly literature has acknowledged various impediments to implementing KM within the public sector. These challenges encompass both technological and cultural dimensions. For example, a strong emphasis on technology-driven approaches in KM initiatives (e.g. Tseng, 2007) may hinder the successful adoption and utilization of KM approaches. The public sector often grapples with incompatible information systems, leading to the lack of accessible managerial information (Behn, 2003), which poses hurdles to the effective utilization of KM practices. The hierarchical and bureaucratic nature typical for public sector organizations can impede knowledge sharing and even lead to knowledge hoarding (Evans, Hendron & Oldroyd, 2015; Amber et al., 2019). In addition to technological and cultural dimensions, the public sector must consider the convergence with political orientations. Public healthcare organizations encounter challenges due to the complex environment, conflicting values (Bracci et al., 2021), wicked societal problems (Jacobs & Cuganesan, 2014) and resource constraints. Recently, value-based healthcare (VBHC), aiming to optimize health system performance in population health, patient experience, and cost of care (e.g. Nuño-Solinís, 2019), has set new requirements for KM in public healthcare. Integration of care is one central principle of VBHC (Nuño-Solinís, 2019), directly impacting KM by calling for knowledge integration.

Previous research has demonstrated that organizational Knowledge Management Systems (KMS) play a pivotal role in an organization´s strategy and structure (e.g. Starns & Odom, 2006). A robust foundation in people, technology, and processes, beginning with strategic integration, is essential for successful KM implementation (Robu & Lazar, 2021). While technology facilitates KM, the organizational KM culture wields even more significant influence (Ghosh & Scott, 2006; Hujala & Laihonen, 2021). Within integrated healthcare organizations, a significant paradigm shift from isolated organizational and information structures to vertical and horizontal arrangements presents new challenges (cf. Laihonen & Huhtamäki, 2020). In public healthcare, KM also involves coordination of collaboration across multiple professions and sectors, bringing diverse objectives and regulatory mechanisms (Laihonen & Kokko, 2020).

KM capabilities are typically approached from the organizational perspective (Laihonen & Huhtamäki, 2020). Gold, Malhotra & Segars (2001) proposed an organizational capabilities perspective aiming to evaluate the essential capabilities of KM. These capabilities are classified into knowledge infrastructure capability, consisting of technology, structure and culture, and knowledge process capability, consisting of acquisition, conversion, application and protection of knowledge (Gold, Malhotra & Segars, 2001). This perspective, however, largely excludes individual experts' skills and competence. Alavi & Leidner (2001) view capability as one perspective on knowledge, which implies that KM is focused on developing core competencies, understanding the strategic advantage, and creating intellectual capital (Alavi & Leidner, 2001). Watson (1999) expands on capability, proposing that knowledge is not a specific ability for action but rather the capacity to utilize information. The capabilities of KM can also be interpreted through the lens of knowledge assets or Intellectual Capital (IC) traditionally categorized into structural, relational and human capital (Petty & Guthrie, 2000). Laihonen & Saranto (2021) concluded in their study that little attention has been paid to KM capabilities and competencies despite significant changes in the operating environment and technology after the above-mentioned seminal articles.

In the next sections, we look at the empirical results for the integrated public healthcare organizations' KM unit to understand better how KM helps an organization succeed. We focus on KM's practical work, the value it adds to the healthcare organization, the KM capabilities needed, and its future.

3. Context and Methods of the Empirical Study

3.1 Context of the Empirical Study

In Finland's recently implemented healthcare reform, the responsibility for organizing healthcare, social welfare and rescue services was shifted from 309 municipalities to 21 new autonomous regional-level organizations, wellbeing services counties in the beginning of 2023. Larger organizational structures aim to achieve more consistent and equal public services and savings, especially in administration. In addition, the Ministry of Social Affairs and Health is strongly advocating the shift towards value-based healthcare through various steering mechanisms. Therefore, the considerably increased size of the organizations, the integration of functions and the objective of moving towards VBHC bring new opportunities and challenges for KM. In addition, the wellbeing services counties have a dual leadership model with civil servant and political leadership. (Pirha 2024a)

The research was conducted within the Pirkanmaa Wellbeing Services County (Pirha), an administrative region encompassing 23 municipalities. Pirha boasts a population of approximately 500,000 inhabitants and serves as the largest wellbeing services county in Finland. Pirha assumes responsibility for social welfare, healthcare, and rescue services within this administrative framework. A workforce of approximately 19,000 employees manages these critical functions. (Pirha 2024a)

The case study was conducted in a newly established KM unit of Pirha. In Pirha's organization, the KM is organized as an independent unit, part of the strategic guidance and organization function with other vital divisions such as procurement, communication, finance, and human resources (Pirha, 2024b). The KM function was rebuilt on a previous organizational and technological basis. The KM unit members were recruited from previous organizations whose healthcare functions were merged during the reform. The KM unit consists of two teams, one focusing more on data quality and the other on reporting. In spring 2023, the unit employed 17 people.

3.2 Methods and Empirical Data

We chose a case study as a research method to gain an in-depth understanding of KM in public healthcare (cf. Yin, 2009). Thematic interviews were conducted remotely in April 2023, and 11 KM specialists from the Pirha KM unit participated. The interviews were recorded and transcribed, followed by a content analysis of the data (Drisko & Maschi, 2016). In addition, Pirha's Strategy and Strategy Implementation Programme, Pirha's Knowledge Management Programme and the KM unit's Data Quality Improvement Management Model were used as background material.

4. Results

The interview data provided a coherent picture of KM in Pirha. The interviewees answered many questions similarly, highlighting the importance of culture, diversity, networking and exemplary implementation. The

objectives of the KM unit are clear and shared. Also, interviewees stressed the role of systematic identity building. The main difference in tone emerged between the two teams – data quality and reporting. In October 2023, preliminary results were validated by presenting and discussing them at the monthly meeting of the KM unit. Based on feedback from specialists, the results provided a truthful picture of the unit's function.

4.1 KM in Practice – What is KM in Pirha?

Pirha's KM programme defines KM as *"a set of policies and technical solutions that make the right information available to the right people at the right time and in the right format"*. During the interviews, the experts were asked "*What is KM in Pirha*?". The specialists described the unit's key task as providing adequate and reliable information to support service delivery and other core activities of wellbeing services county. The support is provided by establishing relationships and networks and coordinating cooperation at different levels of the organization and with external actors (e.g. national steering of health information management). As one interviewee summarized:

"The key point is that enough information must be available for a wellbeing services county [of Pirha] to succeed."

Interviewees described that KM is currently being implemented in a situation where Pirha has several patient information systems in place after merging 23 municipalities and a hospital district to launch the wellbeing services county. There are also differences in patient record keeping practices. Thus, an essential and ongoing role of the KM unit is to ensure consistency and maintenance of data quality by supporting the development of service delivery competencies through record-keeping networks. In addition, the KM unit's tasks include combining data from different data sources, validating the data and producing visualized reporting coherently across a large and variable wellbeing services county, especially for the needs of senior management.

4.2 Value of KM – Why is the KM Unit Important?

Pirha's KM programme defines the value of KM to wellbeing services county as follows: "*KM enables high-quality and strategy-driven decision-making, management and operations*". The specialists were asked: "*Why is KM unit important to Pirha*?". KM unit was seen as an enabler; KM unit doesn't participate in management decision-making but enables it by providing a coherent and consistent view on the operations of the wellbeing services county for decision-makers, as interviewees put it:

"*If there was no central coordination [of KM], everyone would be doing their own thing and knowledge management would be fragmented*."

"*It's this size, which definitely requires it [the KM unit], but then there's also the role of national reporting obligations, which raises the importance of this information to even different levels because it's linked to funding*."

The KM specialists saw that the KM unit's robust reporting and advocacy role enables service providers to concentrate on their expertise. Meeting national reporting obligations was also seen as a critical benefit of the KM unit. As the funding of the wellbeing services counties is based on the operational information reported to national bodies, the role of the KM unit in ensuring the quality of data and implementing data collection and reporting is crucial in financial terms. The responsibility for harmonising data quality highlights the developmental function of the KM unit. In addition, interviewees saw the KM unit playing an essential role in translating KM's needs into the service delivery language to motivate health professionals to improve data quality. From a public service perspective, the interviewees identified the KM unit's activities as increasing openness and transparency and thus value for money for citizens.

4.3 KM Capabilities - What are the Key Capabilities of the KM Unit?

Pirha's KM programme defines that in Pirha "*KM is decentralised and centrally coordinated [...] competence and skills are needed both close to service operations and centralised in the KM unit*". This capability topic is broad, and we categorised the responses according to the Intellectual Capital tripartite framework to human capital (HC), relational capital (RC) and structural capital (SC). The lens of IC enables organizational and individual capabilities, competencies and skills to be considered equally.

In terms of human capital, respondents highlighted the role of broad substantive skills. The KM unit has expertise in primary healthcare, specialised healthcare, social care as well as in technical skills such as data modelling and

reporting. In addition to hard skills, soft skills such as change management skills, communication skills, and leadership skills were highlighted. Among the personality traits, motivation, curiosity, and willingness to develop were considered particularly important. A deep understanding of the operational environment is vital for the KM unit:

"It's extremely important that we understand the services, the issues involved, and how the organization works. What legalities exist in the public sector, what cultures exist in healthcare, and what cultures exist in social care in relation to record-keeping."

The role of relational capital emerged as particularly important in the interviews. The KM specialists identified the strategic role of KM in supporting the core activities of the organization. As one of the respondents pointed out:

"We are nothing alone."

KM specialists' diverse knowledge and work experience in previous organizations enable them to build relationships across the entire organization. This is essential for the "decentralized and centrally coordinated" concept; the KM unit is a small area of responsibility in a large and multifunctional ecosystem. The role of networks was highlighted, with the KM unit functioning at the hub of a wide range of networks horizontally, vertically, and at the regional and national levels.

Two key elements emerged from the structural capital describing an organization's intangibles: The systematic building of policies and processes and the role of culture. Building policies and processes was seen as exceptionally important due to the role of KM unit whose task is to form a coherent picture of all the data from the multifunctional and multi-professional organization. As interviewees stated:

"[KM's] job is to frame; the content comes from service operations."

"In Data Quality Improvement Management Model all these different roles are considered […] the aim is that every single professional understands the chain of reliable information formation."

When interviewees spoke about KM units' culture, they mentioned repeatedly openness, trust, and low hierarchy. Good culture was seen as a competitive advantage for KM unit to succeed and has been systematically developed:

"We are a brand-new unit and a very heterogenic team, so it is essential to have a good culture and be a unified team, and we have done much work for that."

4.4 The Future of KM

In the interviews, the specialists were asked, "*How do you see the future of KM?*" At the time of the interviews, the KM unit and the Pirha Wellbeing Services County had only been in operation for a few months, and many of the answers about the future were related to stabilisation and clarification of the role of the KM unit in the near future. This involved consolidating several patient information systems and expanding the data volume of the data pool to enable efficient knowledge processing. As one interviewee put it:

"Hopefully, in a year, we have clarified the situation regarding the data sources and the data pool. [...] the work will then be more about developing new reports than about trying to hunt down the different municipal systems and how to connect them to the data pool."

In addition, the expansion of networks and the growth of KM capabilities and competencies in Pirha were seen as areas of future development.

"We should focus on building [KM] capability and on the fact that if we build that capability, then we will have the resources in the future through it [...] As we need more [KM] resources for our lines [of operational activity]."

As regards external factors, respondents highlighted national KM development; at the time of the interviews, national information production and national requirements for reporting were partly unclear and cumbersome. This was seen to be linked to the reform and would be addressed in the future. Regarding general technological developments, several respondents identified the growing role of AI as an exciting opportunity to develop KM. In addition, respondents considered using various health technology data (including smart watches and intelligent rings) as possible future data sources for KM. Forecasting and prediction also emerged as a prominent

feature of the longer-term future. The answers were not limited to KM, but the role of KM in facing the wicked problems of social and healthcare was considered:

"[...] that we have found, with the support of knowledge, a solution to the fact that people want to work in this sector, as in the social and health sector, and that it makes sense to work and also to use these services [of Pirha]. But there are so many other things in it than this KM, but yes, it also has its role to play."

5. Discussion and Concluding Remarks

The study aimed to better understand the critical KM capabilities when rebuilding KM function after a major public reform. To answer this question, we highlight three areas of KM capabilities. Each of these three perspectives offers a wealth of opportunities for future research. The recognized capabilities are not KM capabilities per se (cf. Gold, Malhotra & Segars, 2001; Alavi & Leidner, 2001) but especially during the change, these upper-level capability areas seem to be stressed. It seems that the KM unit in Pirha can handle operational tasks well; thus, it can be concluded that operative capabilities are in place. However, without a legitimate organizational position, a certain kind of renewal capability, and an ability to recognize "the right things", KM will not be able to meet the growing expectations.

First, KM needs to have sufficient legitimacy to act. Positioning KM at a strategic level enables KM to support effective organizational renewal in change and thus act as a *dynamic capability of an organization*. The case organization Pirha explicitly positions KM as an independent organizational entity, which does not imply that the KM unit operates in isolation. On the contrary, KM is considered an integral part of the organization, aligned with its fundamental mission: promoting the well-being of the area's inhabitants by supporting the core functions of the organization. This alignment with organizational strategies has been stressed in KM literature previously (e.g. Starns, & Odom, 2006).

Second, major changes in the operational environment necessitate continuous renewal of KM capabilities. The previous literature provides various frameworks to study KM capabilities, but what our data adds to these existing models is the importance of resilience and inter-organizational and inter-sectoral collaboration – KM capability should not be considered only as an independent and static reporting function but maybe more as the capacity to utilize information as Watson (1999) phrased it. In terms of relational capital, there is a need for the active building of networks and connections both inside and outside an organization. From the human capital perspective, diversity and continuous learning are essential. Also, organizational structures and technological solutions must be flexible enough to enable basic activity and renewal. The role of culture in encouraging and supporting change cannot be overemphasised. Indeed, it seems that the IC framework may help to conceptualize and better understand KM as an organizational capability.

Third, KM must have a capability to raise the level of abstraction from efficient KM to effective KM (cf. Hujala & Laihonen, 2021). This means that KM must be able to exploit the existing data. However, on the other hand, it is essential to explore novel ways to acquire, use and process data for forecasting and prediction and to ask different kinds of questions (cf. Laihonen & Huhtamäki, 2020). This may help collaboration across multiple professions and sectors, bringing together diverse objectives, values and legislative and regulatory mechanisms (cf. Laihonen & Kokko, 2020), which further allows KM to focus more on wicked problems in the future (cf. Dumay, 2020).

References

Alavi, M. & Leidner, D.E. (2001) "Knowledge Management and Knowledge Management Systems: Conceptual Foundations and Research Issues", *MIS Quarterly*, Vol. 25, No. 1, pp 107-136.

Amber, Q., Ahmad, M., Khan, I.A., Hashmi, F.A. (2019) "Knowledge sharing and social dilemma in bureaucratic organizations: Evidence from public sector in Pakistan", *Cogent Business & Management* 6, 1685445.

Behn, R. D. (2003) "Why measure performance? Different purposes require different measures", *Public Administration Review*, 63(5), 586–606.

Bracci, E., Saliterer, I., Sicilia, M., & Steccolini, I. (2021) "Accounting for (public) value(s): Reconsidering publicness in accounting research and practice", *Accounting, Auditing & Accountability Journal*, 34(7), 1513–1526.

Choo, C.W. (2002) "Information Management for the Intelligent Organization", The art of Scanning the Environment. USA, Information Today.

Drisko, J. W., & Maschi, T. (2016) *Content analysis*, Oxford University Press, USA.

Dumay, J. (2020) "Using critical KM to address wicked problems", Knowledge Management Research & Practice, 20(5), 767-775.

El-Jardali, F., Bou-Karroum, L., Hilal, N., Hammoud, M., Hemadi, N., Assal, M., ... & Novillo-Ortiz, D. (2023) "Knowledge management tools and mechanisms for evidence-informed decision-making in the WHO European Region: a scoping review", *Health Research Policy and Systems*, 21(1), 113.

Evans, J.M., Hendron, M.G., Oldroyd, J.B. (2015) "Withholding the Ace: The Individual- and Unit-Level Performance Effects of Self-Reported and Perceived Knowledge Hoarding", *Organization Science,* 26, 494–510.

Evans, J. M., Brown, A., & Baker, G. R. (2015) "Intellectual capital in the healthcare sector: A systematic review and critique of the literature", *BMC Health Services Research*, 15(1).

Ghosh, B. & Scott, J. (2006) "Effective knowledge management system for a clinical nursing setting", *Information System Management*, Vol. 24, No. 1, pp 73-84

Gold, H., Malhotra, A. & Segars, A.H. (2001) "Knowledge management: An organizational capabilities perspective", *Journal of Management Information Systems*, Vol. 18, No. 1, pp 185-214.

Grant, R. (1996) "Toward a knowledge-based theory of the firm", *Strategic Management Journal*, 17(S2), 109–122.

Hujala, T., Laihonen, H. (2021) "Effects of knowledge management on the management of health and social care: a systematic literature review", *Journal of Knowledge Management*, 25, 203–221.

Jacobs, K., & Cuganesan, S. (2014) "Interdisciplinary accounting research in the public sector: Dissolving boundaries to tackle wicked problems", *Accounting, Auditing & Accountability Journal*, 27(8), 1250-1256.

Kalling, T. (2003) "Organization-Internal transfer of knowledge and the role of motivation: A qualitative case study", *Knowledge and Process Management*, 10(2), 115–126.

Kim, Y.M., Newby-Bennett, D. and Song, H.J. (2011) "Knowledge sharing and institutionalism in the healthcare industry", *Journal of Knowledge Management*, Vol. 16 No. 3, pp. 480-494.

Kosklin, R., Lammintakanen, J., Kivinen, T. (2023) "Knowledge management effects and performance in health care: a systematic literature review", *Knowledge Management Research & Practice*, 21, 738–748.

Laihonen, H. & Huhtamäki, J. (2020) "Organisational hybridity and fluidity: deriving new strategies for dynamic knowledge management", *Knowledge Management Research & Practice*, 21:2, 216-228.

Laihonen, H. & Kokko, P. (2020) "Knowledge Management and Hybridity of Institution-al Logics in Public Sector", *Knowledge Management Research & Practice*, 21:1, 14-28.

Laihonen, H. & Saranto, K. (2022) "Knowledge Management Competencies in Health and Social Care", *Proceedings of the 23rd European Conference on Knowledge Management*, ECKM 2022.

Laihonen, H., Sillanpää, V. (2014) "What is the Role of Knowledge Management in Establishing the Effectiveness of Public Welfare Services?", *Knowledge and Process Management,* 21, 112–121.

Lin, S.W. and Lo, L. (2015) "Mechanism to motivate knowledge sharing: integrating the reward system and social networks perspectives", Journal of Knowledge Management, Vol. 19 No. 2, pp. 212-235.

Liu, J.X., Goryakin, Y., Maeda, A., Bruckner, T., Scheffler, R. (2017) "Global Health Workforce Labor Market Projections for 2030", *Human Resource for Health* 15, 11.

Lunden, A., Teräs, M., Kvist, T., Häggman-Laitila, A. (2017) "A systematic review of factors influencing knowledge management and the nurse leaders' role", *Journal of Nursing Management*, 25, 407–420.

Massaro, M., Dumay, J., Garlatti, A. (2015) "Public sector knowledge management: a structured literature review", *Journal of Knowledge Management*, 19, 530–558.

Miles, I., Kastrinos, N., Flanagan, K., Bilderbeek, R., Den Hertog, P., Huntink, W., & Bouman, M. (1995) *Knowledge-Intensive Business Services Users, Carriers and Sources of Innovation A report to DG13 SPRINT-EIMS*.

Ministry of Social Affairs and Health (2023) Wellbeing services counties - Ministry of Social Affairs and Health (stm.fi) [3.4.2024]

Nicolini, D., Powell, J., Conville, P., Martinez-Solano, L. (2008) "Managing knowledge in the healthcare sector. A review", *International Journal of Management Reviews* 10, 245–263.

Nuño-Solinís, R. (2019) "Advancing towards value-based integrated care for individuals and populations", *International Journal of Integrated Care*, 19(4).

Petty, R., Guthrie, J. (2000) "Intellectual capital literature review: Measurement, reporting and management", *Journal of Intellectual Capital*, 1, 155–176.

Pirha (2024a) About the Wellbeing Services County of Pirkanmaa - Pirha in English - pirha.fi [13.3.2024]

Pirha (2024b). Strateginen ohjaus ja järjestäminen - pirha.fi [27.3.2024]

Robu, A. & Lazar, J.B. (2021) "Digital transformation designed to succeed – Fit change into the business strategy and people", *Electronic Journal of Knowledge Management*, Vol. 19, No. 2, pp 133-149.

Starns, J. & Odom, C. (2006) "Using knowledge management principles to solve organizational performance problems", VINE: The Journal of Information and Knowledge Management Systems, Vol. 36, No. 2, pp 186–198.

Tseng, S. (2007) "The effects of information technology on knowledge management systems", *Expert Systems with Applications*, 35, 150-16.

Van Beveren, J. (2003) "Does health care for knowledge management?", *Journal of Knowledge Management* 7, 90–95.

Watson, R. T. (1999) *Data Management: Databases and Organizations* (2nd ed.), John Wiley, New York

Wiig, K.M. (2002) "Knowledge management in public administration", *Journal of Knowledge Management*, Vol. 6, No. 3, pp 224-239.

Von Krogh, G. (1998) *Care in knowledge creation*. California Management Review, 40(3), 133–153.

Yin, R. (2009) *Case Study Research - Design and Methods*, SAGE, Thousand Oaks, CA.

Knowledge-Based Approach to Sustainable City Management: An Example of European Smart Cities

Aleksandra Radziszewska
Czestochowa University of Technology, Czestochowa, Poland

aleksandra.radziszewska@pcz.pl

Abstract: This study aims to examine the relationships between the use of knowledge-based approach in key areas of sustainable city management (urban planning, mobility and transportation management, and environment protection) and city's position in the global smart cities ranking (the IESE Cities in Motion Index). A case study methodology is adopted to examine and compare the possibilities of implementing knowledge-based approach in sustainable city management, in order to gain a better understanding of this new urban phenomenon. Data and information about knowledge-based smart city initiatives have been collected from secondary sources. The presented case studies were explored through desk research using online resources, such as the web pages of smart city initiatives. Smart Cities were selected based on their rankings in the IESE Cities in Motion Index. In addition, multiple regressions were used to identify the relationship between the independent variables (environment protection, mobility and transportation management, urban planning) and dependent variable-value of city's ranking in the IESE Cities in Motion Index . The results illustrate that the majority of cities use smart-city solutions in all categories to improve city management, efficiency and achieve sustainability goals. All research hypotheses have been accepted, therefore knowledge-based smart city solutions implemented in all key areas of sustainable city management (urban planning, mobility and transportation management, and environment protection) positively influence performance of achieving sustainability goals. The selection of a limited number of case studies is a limitation of this research. It is therefore important to explore the potential of knowledge-based approach in urban development and city management in more detail by considering more cases. Future research should explore the impacts of other variables related to sustainability, which can determinate performance of sustainable city management. A future study should try to validate the result by using a wider sample. The research combines quantitative and quantitative analysis in order to identify the determinants of effective achievement of sustainable development goals in city management. This study provides a form of grounding for further discussion to debate over of the operational functioning, planning, design, development, and governance of smart sustainable cities in the future.

Keywords: Sustainability, Sustainable Urban Development, Knowledge-Based Approach, Sustainable City Management, Sustainable Smart Cities, the IESE Cities in Motion Index

1. Introduction

Knowledge-based development is a vision of development that considers knowledge as the central structuring element of a development strategy. The smart city must be able to exploit knowledge that result from data management. This knowledge will result in better decisions in order for the modern city to address its main challenges. Smart cities are exposed to technological issues tied to the huge mass of data which pass within them. These data can carry knowledge and, by the way, the city authorities aware of the existence and of the potential of this knowledge, can exploit and use them.

The basis for efficient sustainable city management are effective information flows and ability of knowledge extraction from the fast growing data resources.

The most important challenge for cities authorities now and in the future, in the context of development of sustainable city management, is to integrate the data resources and to deliver valuable information flows for the efficient knowledge management processes for urban development.

The literature does not pay much attention to the organizational and managerial solutions during the transition from a classic city to a smart city, therefore the paper try to explore the potential of the knowledge-based managing of urban development.

The motivation for this study is to identify the main dimensions of the sustainable city management and their influence on a city's position in the global smart cities ranking.

This study aims to examine the relationships between the use of knowledge-based approach in key areas of sustainable city management (urban planning, mobility and transportation management, and environment protection) and city's position in the global smart cities ranking (the IESE Cities in Motion Index).

A case study methodology is adopted to examine and compare the possibilities of implementing knowledge-based approach in sustainable city management, in order to gain a better understanding of this new urban phenomenon. Data and information about knowledge-based smart city initiatives have been collected from

secondary sources. The presented case studies were explored through desk research using online resources, such as the web pages of smart city initiatives. Smart Cities were selected based on their rankings in the IESE Cities in Motion Index. In addition, multiple regressions were used to identify the relationship between the independent variables (environment protection, mobility and transportation management, urban planning) and dependent variable-value of city's ranking in the IESE Cities in Motion Index .

The paper will enable researchers and scholars to direct their future work to the emerging paradigm of knowledge-based smart sustainable urbanism, and practitioners and experts to identify common problems and potential ways to solve them, all as part of future research and practical endeavours. It give also an opportunity to identify areas for further improvement while leveraging areas of strength with regard to the future form of such urbanism.

The paper is structured as follows: After this introduction the next section presents the literature review with discussions of the research model and hypotheses development. Then research methodology is presented in detail. Finally, research findings are outlined and discussed, implications are explored, limitation and futures research are described.

2. Literature Review and Hypotheses Development

Concepts linked to environmental protection to characterise cities have given rise to initiatives and experiments such as green city, eco-city, low carbon city, smart city, evolving towards more integrated approaches to sustainability (Yigitcanlar and Kamruzzaman 2015; Trindade et al. 2017). Mori and Yamashita (2015) view a sustainable city as the one that can generate the maximum socioeconomic benefits for its population without losing the environmental and equity parameters, measured by appropriate indicators.

A smart city, for instance, will seek the goal of achieving its sustainability with the support of modern technologies. In fact, information and communication technologies (ICTs) can bring numerous benefits to cities, but its implementation as an end in itself is not enough to make it a sustainable city (Ahvenniemi et al. 2017).

Knowledge-based development (KBD) is a vision of development that considers knowledge as the central structuring element of a development strategy for cities and regions (Lönnqvist et al. 2014).

Knight (1995) envisioned knowledge-based development of cities as basis for sustainable development, emphasising the relevance of the process of transforming know ledge resources into local development. Following this view, cities should build their own unique knowledge stock by identifying their own particular strengths. This statement on knowledge-based urban development (KBUD) seems very adequate to describe actual challenges. The increasing importance and complexity of the city and the requirement that development is sustainable calls for a new integrative framework for thinking about the development of cities. Urban planners are facing new issues and need new approaches in order to facilitate new forms of development (Knight, 1995).

To construct a knowledge-based social structure, urban planning also needs to incorporate knowledge creation (May and Perry, 2011). Knowledge has become critical to social and economic development, while promoting economic growth and increasing competitiveness.

The integration of technology into urban infrastructure is a significant aspect of a Smart City. This involves the use of Information and Communication Technology (ICT) and other innovative technologies to manage the city's assets, including transportation systems, power plants, water supply networks, waste management, and other community services. The aim of technological integration is to improve the quality of services, reduce costs, optimize resource consumption, and enhance interaction between citizens and the government.

The concept of Smart City seeks to make maximum use of modern technologies, mainly information technologies with the aim of achieving sustainable development goals. Social and environmental sustainability is a major strategic component of smart cities (Lee et al., 2023).

The concept of a Smart City extends beyond mere technological integration. It also encompasses sustainable practices Sustainable practices involve the implementation of strategies aimed at improving environmental sustainability, including the promotion of renewable energy sources, waste management, water conservation, and sustainable urban planning. The goal is to create a city that is not only technologically advanced but also environmentally friendly (Rahmat et al. 2023).

Improving environmental sustainability through anti-pollution plans, support for green buildings and alternative energies, efficient water and waste management, and policies that help counteract the effects of climate change

are essential to ensure the sustainability of cities over time (Su, Hu and Yu, 2023). In light of the aforementioned evidence, the initial hypothesis of this study can be formulated as follows:

H1: Knowledge-based solutions in area of environmental protection positively influence sustainable city management

The application of data-driven solutions within the domain of transport and traffic management is a particularly prevalent phenomenon in the context of both smart cities and sustainable smart cities (Savastano et al., 2023).

The future of urban mobility and transportation is confronted with two significant challenges: facilitating travel over vast territories and ensuring access to public services. The quality of life of a city's inhabitants is affected by mobility and transportation, which encompasses road and route infrastructure, the vehicle fleet, public transit and air transport. These factors can be key to a city's sustainability over time (da Silva, Santos and Setti, 2022).

Artificial intelligence (AI) is now playing a pivotal role in the advancement of urban development. Furthermore, it is assisting local authorities in the collection of data regarding the inhabitants of a given city, thereby facilitating the efficient management of resources. To illustrate, a city that employs AI to mitigate traffic congestion is well-positioned to address its mobility challenges. The utilisation of AI tools facilitates the real-time collection of traffic data, enables the prediction of traffic congestion, enhances mobility and alleviates congestion in key areas (Singh et al., 2022; Cruz and Paulino, 2022). In light of the aforementioned evidence, the second hypothesis of this study is thus proposed:

H2: Knowledge-based solutions in area of mobility and transportation management positively influence sustainable city management

The field of urban planning has historically been regarded as a key driver of sustainable development in urban areas. Consequently, urban planning is inextricably linked to the concept of sustainability. In order to enhance the liveability of any given territory, it is essential to consider local master plans and the design of green areas and spaces intended for public use, while also prioritising smart growth strategies. The objective of new urban planning methods should be the creation of compact, well-connected cities with accessible public services (Son et al., 2023). The management of urban infrastructure represents a significant application of the Internet of Things (IoT) and big data analytics, facilitating monitoring, control, automation, and optimization. This encompasses the operation of roads, railway tracks, bridges, and tunnels (Sanchez et al., 2023). This is pertinent to the occurrences and alterations pertaining to the structural characteristics of urban infrastructure, which have the potential to elevate risk and expenditure, and ultimately compromise safety and service quality. In this regard, the Internet of Things (IoT) devices can be employed to enhance incident management, optimise emergency response coordination and service quality, and reduce operational costs across all infrastructure-related domains (Wang and Yin, 2023). In light of the above, the third hypothesis of this study is as follows:

H3: Knowledge-based solutions in area of urban planning positively influence sustainable city management

Knowledge-based, smart and sustainable city is a conceptual framework that displays a knowledge- based urban development strategy aimed to promote smart and sustainable cities through the operationalisation of a knowledge management integrated approach (Yigitcanlar and Lönnqvist, 2013).

3. Research Methodology

The presented study was conducted in June 2024. Its purpose was to determine the relationship between datafication and a city's position in the global smart cities ranking (IESE Cities in Motion Index 2024).

The IESE Cities in Motion Index is a study published annually by the business school of the University of Navarra (IESE) that aims to evaluate the development of the world's cities. It assesses several socioeconomic aspects of development, including human capital, social cohesion (which includes employment, female participation in the work force, etc.), governance, sustainable development, mobility and transportation, urban planning, international outreach, and technology. IESE Cities in Motion Index offers a platform for a comprehensive initial diagnosis of the cities and, through comparative analysis, aims to serve as the first point of reference. The index compares 183 cities globally, looking at 114 criteria grouped into nine dimensions: human capital, social cohesion, economy, governance, environment, mobility and transportation, urban planning, international profile, and technology (Lai and Cole, 2023).

IESE Cities in Motion Index defines smart city as a way of city governance to maintain future sustainability and the quality of life of inhabitants, which generate business opportunities for collaboration between public and private sectors. (Berrone & Ricart, 2020).

A case study methodology is adopted to examine and compare the possibilities of implementing knowledge-based approaches in sustainable city management, in order to gain a better understanding of this new urban phenomenon. Data and information about city initiatives have been collected from secondary sources. The presented case studies were explored through desk research using online resources, such as the web pages of smart city initiatives. Smart Cities were selected based on their rankings in the IESE Cities in Motion Index 2024.

In addition, multiple regressions were used to identify the relationship between the independent variables (environment protection, mobility and transportation management, urban planning) and dependent variable - value of city's ranking in the IESE Cities in Motion Index. The IESE Index were selected on the basis of temporal and thematic relevance, as it reflects the current results in several indicators, which are the priority indicators of city's technological development and sustainability.

The table below (Table 1) presents the values of dimensions related to sustainability according to IESE Cities in Motion Index 2024.

Table 1: The results from the IESE Cities in Motion Index 2024- the value of dependent and independent variables

City	Value of IESE Cities in Motion Index (dependent variable)	Value of independent variables according to IESE Cities in Motion Index indicators		
		Environment protection	Mobility and transportation management	Urban planning
Amsterdam-Netherlands	72.21	21	28	5
Barcelona - Spain	64.17	68	11	15
Berlin-Germany	75.66	10	9	4
Bilbao - Spain	47.66	61	55	93
Brussels-Belgium	56.04	72	23	33
Copenhagen-Denmark	70.68	3	19	39
London - United Kingdom	100.00	24	4	1
Paris- France	84.29	53	6	13
Stockholm - Sweden	66.64	6	14	60
Turin - Italy	48.49	81	36	40
Vienna - Austria	65.86	17	12	10

Source: The IESE Cities in Motion Index 2024

Environment protection refers directly to the notion of sustainable urban development. Green technologies, green buildings, renewable energy, efficient waste management, reliable water supply, and methods to counter climate change are essential. These measures determine the long-term sustainability of smart cities. It is also essential to consider elements such as the promotion of environmental sustainability through anti-pollution strategies, measures to support green buildings and alternative energy sources, adequate water and waste management, and the implementation of policies that mitigate the impacts of climate change to ensure the long-term resilience of cities.

Urban planning means the design process that determines the components required for the construction of a city. Planning enables the efficient construction of a city while ensuring a high standard of quality of life. Currently, urban planning is inextricably linked with sustainability. To enhance the quality of life in any urban area, it is crucial to consider local master plans and the design of green spaces and public areas, and to promote sustainable and intelligent urban development, with convenient access to essential public services.

Transportation management and smart mobility are core elements of sustainable city management. Smart mobility is also one of the main areas of the smart city concept. Mobility represents, in a narrower sense, the movement of inhabitants. In a broader sense, it refers to access to services, health, and social care, but also, for example, the ability to commute for education, work, family, recreation and so on. The difference between mobility and smart mobility lies in the public's access to different information in real time. In the short term, the goal of smart mobility is to manage and monitor the transport of the population in real time. As for the long-term goal, it is about developing innovative and sustainable transport systems and making the transport and logistics solution of a given smart city more efficient. Smart mobility priorities include, for example, reducing environmental pollution, reducing traffic congestion, making citizens' mobility more efficient or reducing noise in the city (Simonofski, A., et al. 2023).

4. Results and Discussion

This section presents data obtained through secondary analysis of best practice strategies from selected sustainable smart cities. A case-study approach was used to explore the role of knowledge-based solutions in sustainable city management.

A sample of 11 case studies that use knowledge- based solutions (in form of data-driven applications) deployed in real-world settings were identified from secondary sources. All analyzed cities are included in the IESE Cities in Motion Index 2024 and they have been also included in the regression analysis. The results are presented in the Table 2.

Table 2: Knowledge-based smart city solutions (in form of data-driven applications) related to sustainable city management – results of case study analysis

City	Examples of knowledge-based solutions (in the form of data-driven applications) related to sustainable city management
Amsterdam- Netherlands	• Smart lighting controls for energy efficiency and saving • Traffic reduction
Barcelona - Spain	• Communication and green technologies • Smart water efficiency • Smart public transportation • Smart noise control solutions
Berlin-Germany	• Smart metering • Smart transport systems
Bilbao - Spain	• Smart parking systems
Brussels-Belgium	• Energy efficiency through smart sensors • Smart mobility systems • Real-time transportation information • Waste management • Environmental monitoring
Copenhagen- Denmark	• Smart energy incubators and energy labs smart transport systems • Smart noise control solutions
London - United Kingdom	• Green and smart technology application in transport and parking -pollution and congestion control • Smart noise control solutions
Paris- France	• Smart applications for lighting, road circulation, waste management and environment monitoring • Online transportation control system
Stockholm - Sweden	• Fiber optic communication network • Smart noise control solutions
Turin - Italy	• Smart meters
Vienna - Austria	• Energy efficiency via smart sensors • Smart mobility systems

Source: own study

The results demonstrate that the majority of smart cities employ knowledge-based solutions in the form of data-driven applications across all categories with the objective of enhancing city management efficiency and achieving sustainability goals. The most prevalent data-driven solutions identified include transport and traffic, mobility, energy, power grid, environment, buildings, infrastructure and urban planning.

A variety of data-driven traffic control systems have been implemented with the objective of optimising the performance of city services. These include systems which provide interactive notifications of parking availability and distribution, as well as bike and car sharing, digital public transit payment, predictive maintenance of transportation infrastructure, real-time public transit information, and road navigation. These applications facilitate agent-based simulations of transport systems and the myriad of scenarios they may encounter. This enables the development of sophisticated systems capable of integrating and responding to a multitude of entities, including the shortest routes, minimal waiting times, and diversions that are aware of traffic congestion, thereby providing optimal traffic solutions.

Cities employ data-driven technology for the management of transport and traffic. This encompasses the administration of transport services based on the data received, as well as the automated control of traffic signals based on data collected on traffic congestion using sensors embedded in the traffic lights.

The utilisation of advanced technologies, facilitated by the city's Wi-Fi network, enables the real-time monitoring of air quality in terms of the presence of various substances. This allows for the implementation of timely preventive measures and the monitoring of the condition and composition of green space in urban areas. The real-time data collected about the air quality in the city are subjected to analysis in order to determine the impact of the solutions that have been adopted in terms of improving environmental conditions, as well as to identify the areas where further actions are needed. The deployment of low-cost sensors in urban areas enables the detection of noise levels and pollution, facilitating the identification and mitigation of violations pertaining to municipal policies on these matters. The implementation of smart noise control solutions in urban environments facilitates the optimisation and centralisation of data collection, integration, processing, analysis, and dissemination by unifying the information obtained from noise sensors produced by different suppliers and sound level meters distributed throughout the city.

The application of a knowledge-based approach to urban planning, coupled with an analysis of data pertaining to the population, enables the consideration of emerging demands for the development of various venues. In other words, the utilisation of data-driven technology in planning is associated with the planning of districts, streets, and urban infrastructure based on the collection of information on the movement of residents and their activities.

In addition, multiple regressions were used to identify the relationship between the independent variables (environment protection, mobility and transportation management, urban planning) and dependent variable - value of the IESE Cities in Motion Index 2024 .The results of regression analysis have been shown in the table 3.

Table 3: The results of regression analysis

Independent variables	Standardized coefficients	t	Significance level
	Beta		
Environment protection	0,386	4,367	0,000
Mobility and transportation management	0,369	3,841	0,000
Urban planning	0,391	4,673	0,000
Dependent variable: value of the IESE Cities in Motion Index 2024 . R^2 = 0,827, F = 28, 394, significance level = 0,01.			

Source: own study

The result shows that R-square was 0,827, which demonstrates that independent variables explain 82,7 % of the variance in value of the IESE Cities in Motion Index. The linear relationship between independent variables (environment protection, mobility and transport management and urban planning) with value of the IESE Cities in Motion Index is significant with an F-value of 28,394 at the 0,01 significance level. Therefore, the model fits this study.

The significance level of environment protection with value of IESE Cities in Motion Index was 0,000, which is less than 0,05. Therefore Hypothesis 1 is accepted. Environment protection was the second highest coefficient (beta = 0,386), hence, higher level of data-driven solutions related to sustainability positively influences the value of the IESE Cities in Motion Index and a city's position in the global smart cities ranking.

The significance level of mobility and transportation management with in value of IESE Cities in Motion Index was 0,000, hence, Hypothesis 2 is accepted. The beta value for this variable was 0,369. Therefore, higher level of level of data-driven solutions related to mobility and transportation management has a significant positive effect on the value of the IESE Cities in Motion Index and a city's position in the global smart cities ranking.

The significance level of urban planning with the value of the IESE Cities in Motion Index was 0,000, therefore, Hypothesis 3 is accepted. The test also showed that urban planning had the highest coefficient (beta = 0,391) compared to others independent variables. In other words, sustainable urban planning has the highest positive impact on city's position in IESE Cities in Motion Index.

This study demonstrates that the cities exhibit a high level of advancement in knowledge-based solutions, manifested in the form of applied data-driven technologies. However, there is a slight discrepancy in the implementation of such technologies across different city systems and domains with respect to sustainability areas. Furthermore, there is a moderate discrepancy in the level of preparedness with regard to the availability and advancement of the competencies and infrastructure required to generate, transmit, process, and analyse vast quantities of data in order to extract valuable insights for improved decision-making and a deeper understanding of urban operational functioning, management, and planning in relation to sustainability.

5. Conclusion

The potential of knowledge-based solutions lies in their capacity to facilitate the development of smart sustainable cities. By leveraging their informational landscape, these solutions can enable cities to understand, monitor, probe, and plan their systems and environments in ways that facilitate the achievement of optimal sustainability. Furthermore, they are providing novel avenues for more judicious decision-making with regard to the knowledge required to monitor, comprehend, and plan the development of cities in a more effective manner.
A considerable number of smart cities around the world have initiated investigations into the potential of knowledge-based solutions for addressing and overcoming the significant issues and complex challenges associated with sustainability and urbanisation.

In terms of the value of this work, the outcome will assist strategic city stakeholders in understanding the potential actions and investments that could be made to advance smart sustainable urbanism on the basis of knowledge-based solutions and approaches. Furthermore, it will provide an opportunity to identify areas for further improvement while leveraging areas of strength with regard to the future form of such urbanism. Furthermore, it will facilitate the direction of future research and practical endeavours by scholars and practitioners towards the emerging paradigm of knowledge-based sustainable urbanism.

Finally, this paper provides a foundation for further discussion and debate regarding the operational functioning, planning, design, development, and governance of smart sustainable cities in the future. Furthermore, it provides a foundation for further research, including both qualitative and quantitative studies, on the relevance of knowledge-based solutions and their role in accelerating sustainable development.

The research presented here combines quantitative and qualitative analysis in order to identify the factors that contribute to the effective achievement of sustainable development goals in city management.

It is evident that the choice of a restricted number of case studies represents a limitation of this research. It is therefore important to explore the potential of knowledge-based smart city solutions in urban development and city management in greater depth, with a view to considering a larger number of cases. Nevertheless, an analysis of the best practices identified in the selected case studies can provide valuable insights and practical guidelines for the development of a smart city model.

Further research is required to investigate the influence of additional variables associated with sustainability, which can be used to assess the efficacy of sustainable city management practices. A subsequent study should endeavour to corroborate the findings by utilising a more extensive sample.

Moreover, as this study has demonstrated that applied technological solutions already exist in many cities, it would be highly beneficial to conduct a more expansive and diverse comparison involving a greater number of cities with the aim of elucidating the most pervasive trends in knowledge-based sustainable city management.

References

Ahvenniemi, H., Huovila, A., Pinto-Seppä, I. and Airaksinen, M. (2017) "What are the differences between sustainable and smart cities? ", *Cities*, Vol. 60, pp. 234–245.

Berrone, P. and Ricart, J. E. (2019), IESE cities in motion index. *IESE Business School,* University of Navara*,* Available from: https://media. iese. edu/research/pdfs/ST-0509-E. pdf, doi, 10, 018.

Cruz, S. and Paulino, S. (2022) "Experiences of innovation in public services for sustainable urban mobility", *Journal of Urban Management*, Vol. 11, No. 1, pp. 108-122.

da Silva, R., Santos, G. and Setti, D. (2022) "A multi-criteria approach for urban mobility project selection in medium-sized cities", *Sustainable Cities and Society*, Vol. 86, 104096.

Evidence from the Indonesian Government," *Smart Cities and Regional Development (SCRD) Journal,*

Knight, R. V. (1995) "Knowledge-based development: Policy and planning implications for cities", *Urban Studies*, Vol. 32, No. 2, pp. 225–260.

Lee, J., Babcock, J., Pham, T., Bui, T. and Kang, M. (2023) "Smart city as a social transition towards inclusive development through technology: a tale of four smart cities" *International Journal of Urban Sciences*, Vol. 27, pp. 75-100.

Lönnqvist, A., Käpylä, J., Salonius, H. and Yigitcanlar, T. (2014) "Knowledge that matters: Identifying regional knowledge assets of the Tampere region", *European Planning Studies*, Vol. 22, No.10, pp. 2011–2029.

May, T. and Perry, B. (2011) "Urban research in the knowledge economy: Content, context and outlook", *Built Environment*, Vol. 37, No. 3, pp. 352-367.

Mori, K. and Yamashita, T. (2015) "Methodological framework of sustainability assessment in city sustainability index (CSI): A concept of constraint and maximisation indicators", *Habitat International*, Vol. 45, pp. 10–14.

Rahmat, A., Vrabie, C. and Soesilo, G. (2023) "Exploring the Cybercrime Prevention Campaign on Twitter:

Sanchez, T., Shumway, H., Gordner, T. and Lim, T. (2023) "The prospects of artificial intelligence in urban planning", *International Journal of Urban Sciences*, Vol. 27, No. 2, 179-194.

Savastano, M., Suciu, M., Gorelova, I. and Stativă, G. (2023) "How smart is mobility in smart cities? An analysis of citizens' value perceptions through ICT applications", *Cities*, Vol. 132, 104071.

Simonofski, A., Handekyn, P., Vandennieuwenborg, C., Wautelet, Y. and Snoeck, M. (2023) "Smart mobility projects: Towards the formalization of a policy-making lifecycle", *Land Use Policy*, Vol. 125, 106474.

Singh, J., Sajid, M., Gupta, S. and Haidri, R. (2022) "Artificial Intelligence and Blockchain Technologies for Smart City", *Intelligent Green Technologies for Sustainable Smart Cities*, Vol. 17, No. 4, pp. 317-330.

Son, T., Weedon, Z., Yigitcanlar, T., Sanchez, T., Corchado, J. and Mehmood, R. (2023) "Algorithmic urban planning for smart and sustainable development: Systematic review of the literature", *Sustainable Cities and Society*, Vol. 94, 104562.

Su, Y., Hu, M. and Yu, X. (2023) "Does the development of smart cities help protect the environment?", *Journal of Environmental Planning and Management*, Vol. 66, No. 3, pp. 572-589.

Trindade, E., Hinnig, M., Costa, E., Sabatini-Marques, J., Bastos, R. and Yigitcanlar, T. (2017) "Sustainable development of smart cities: A systematic review of the literature*", Journal of Open Innovation: Technology, Market, and Complexity*, Vol. 3, No. 3, pp. 1-14.

Vol. 7, No. 2, pp. 9-24.

Wang, C. and Yin, L. (2023) "Defining Urban Big Data in Urban Planning: Literature Review", *Journal of Urban Planning and Development*, Vol. 149, No. 1, 04022044.

Yigitcanlar, T. and Kamruzzaman, M. (2015) "Planning, development and management of sustainable cities: A commentary from the guest editors", *Sustainability*, Vol. 7, No. 11, pp. 14677–14688.

Yigitcanlar, T. and Lönnqvist, A. (2013) "Benchmarking knowledge-based urban development performance: Results from the international comparison of Helsinki", *Cities*, Vol. 31, pp. 357–369.

Using Agent-Based Simulation to Investigate the Dynamics of Knowledge-Exchange in Organisations

Aleksandra Rudawska[1] and Fred J. Ingram[2]
[1]Institute of Management, University of Szczecin, Szczecin, Poland
[2]Department of Management, Huddersfield Business School, University of Huddersfield, Huddersfield, UK

aleksandra.rudawska@usz.edu.pl
f.j.ingram@hud.ac.uk

Abstract: Knowledge-sharing between employees is a complex and dynamic interpersonal process that we investigate using a system thinking approach. Individuals make their knowledge-related decisions (seeking, sharing, hiding knowledge) based on various factors (their traits, experiences, perception of others and the context). Overall, organizational knowledge-sharing is a product of behavioural dependencies and changes in the behavioural patterns of individuals as well as the interactions between individuals and groups. In this paper, our goal is to investigate how employees' reactions to the behaviours of others in the organization, due to disruption or individual behavioural strategy, affect the extent of knowledge-sharing over time. To do this we identify several feedback loops in solicited knowledge-sharing interactions and build an agent-based simulation model of knowledge-sharing in 40-person organization. We perform two 'in silico' experiments. The first investigates the organizational consequences of a local disruption that immediately reduces the inclination to seek and share knowledge of a group of individuals. The second experiment compares the organizational consequences of four strategies for deselecting individuals who have previously declined to share knowledge. The results of the first experiment show that the local event causing higher likelihood of knowledge-rejection affects the overall organizational knowledge exchange due to disruptions in knowledge-seeking attempts. The second experiment indicates that knowledge source selecting strategy reduces not only rejection rates, protecting emotion resources of the seeker, but also reduces knowledge seeking attempts and knowledge-sharing. Empirical studies are needed to obtain more data to enhance the model's realism and to verify or refute the modelling assumptions.

Keywords: Knowledge-Sharing, Knowledge-Hiding, Knowledge-Seeking, Agent-Based Simulation

1. Introduction

Knowledge-sharing among employees enables knowledge possessed by one individual to be spread throughout an organization to other employees who can subsequently apply it, improve upon it or use it as a source in the creativity process (Anand, Muskat, et al., 2020). With that, knowledge-sharing encourages organizational knowledge flow and consequently improves performance (Sung and Choi, 2018). However, knowledge-sharing is based on discretional behaviours that need to be well-understood to be governed in alignment with organizational needs (Foss et al., 2010).

Numerous studies have reported lists of antecedents of asking and providing information and knowledge (cf. Lim et al., 2020; Witherspoon et al., 2013). However, comprehending intraorganizational knowledge-sharing is difficult because organizations are complex social systems comprising diverse interacting individuals who are themselves sub-systems, constantly adapting to changes in their environment, including the behaviours of other individuals (Wang et al., 2009). For example, Borgatti and Cross (2003), who analysed knowledge-seeking and Anand and Walsh (2022), who studied knowledge hiding, emphasised that previous knowledge exchange experiences affect individuals' later behaviours (asking for and providing knowledge), signalling the need to study knowledge-sharing dynamics. Also, disruptive events in one part of the organization affect individuals not only in that part but also in other areas.

The complexity of knowledge-based interactions in organizations makes their study challenging using standard methods, such as regressions, that apply a linear, open-loop approach (Wang et al., 2009). Very few studies investigate the dynamics and spatial contexts in knowledge-exchange interactions while considering individual attributes, their previous behaviours and changes in the organizational environment. One of the few examples is Pires et al. (2024), who used an agent-based simulation that included both spatial and temporal factors and behavioural rules that individuals followed. They found that knowledge-sharing in the simulated hospital depended on individuals' physical movement and changed over time.

In this paper, we adopt a system thinking approach and identify the feedback loops in solicited knowledge-sharing to investigate how employees' reactions to the behaviours of other employees affect the extent of knowledge-sharing in the organization. Specifically, we use an agent-based simulation model (Bonabeau, 2002)

to conduct 'in silico' experiments of knowledge-sharing in a 40-person organization over 20 working days. In the first experiment, we analyse how a disturbance within a group decreases the whole group's positive responses to knowledge requests and, hence, overall organizational knowledge-sharing. In the second experiment, we investigate the effect on overall knowledge-sharing of a range of rejection-response criteria, from never asking the rejector again to no limitations.

Our agent-based simulation model itself has a specific novelty, aiming to represent some of the day-to-day behaviours of office staff, for example, their locations in the office, the locations of people they work with, and their impromptu encounters while walking past or taking a break. This methodological approach enables us to investigate various knowledge-exchange behaviours, including knowledge-seeking, knowledge-sharing and knowledge-hiding between heterogeneous individuals interacting in an organization under different conditions (Macy and Willer, 2002). The results of each interaction influence the individuals involved in a knowledge exchange event and others in the organization. Among the primary simulation outputs are the time spent on knowledge-sharing and the count of individuals' attempts to request knowledge, receive it or be rejected.

2. Theoretical Background

2.1 Solicited Knowledge-Sharing

When knowledge-sharing between individuals occurs as a result of a knowledge request and knowledge response, it is termed *solicited* knowledge-sharing (Teng and Song, 2011). Solicited knowledge-sharing covers the behaviours of knowledge-seeking (Haas and Cummings, 2015), reactive knowledge-giving (Zhang and Jiang, 2015) and knowledge-hiding (Oliveira et al., 2021). The nature of these behaviours depends on the individual's traits, including attitudes, motives and abilities (e.g., Anand et al., 2022; Lim et al., 2020; Witherspoon et al., 2013), the characteristics of the context they are acting in (Cummings and Teng, 2006), and the interpersonal ties and social capital between knowledge-seeker and knowledge-giver/hider (Reinholt et al., 2011).

2.2 Feedback Loops in Solicited Knowledge-Sharing

We use a system theoretic (Senge, 1990) approach to analyse interpersonal knowledge-sharing because this approach offers a holistic perspective to the phenomena usually studied linearly. This approach enables understanding complex, dynamic processes over time and within a specific context (Rubenstein-Montano et al., 2001). In this approach, people are viewed as sub-systems of the organization system. On the individual level, the results (outputs) of individual behaviours (e.g., rejecting a request for knowledge) alter the attributes of all individuals involved in the interaction (e.g., those who asked for knowledge and those who decided to hide it). These changes in individuals' attributes are now inputs to their future behaviours, either reinforcing or reducing the inclination for such behaviours. These are feedback loops that "alter the state of the world, causing changes in nature and triggering others to act, thus giving rise to a new situation which then influences our next decisions" (Sterman, 2001, p. 12).

In the case of solicited knowledge-sharing, our analysis focuses on five key feedback loops (depicted in Figure 1). These loops illustrate how the outcomes of behaviours (such as knowledge-seeking, giving, or hiding) influence (feed back) an individuals' future willingness to engage in these behaviours and their preferences for selecting knowledge-exchange partners (Zhang and Jiang, 2015). For instance, Loop 1 represents the feedback loop for a knowledge seeker (A) when a suitable person to ask for knowledge was not found (nobody met A's selection criteria). This feedback loop could lead to a change in the knowledge seeker's search strategy (Lim et al., 2020), such as shifting from asking others to self-study, perhaps using an organizational repository or an internet source.

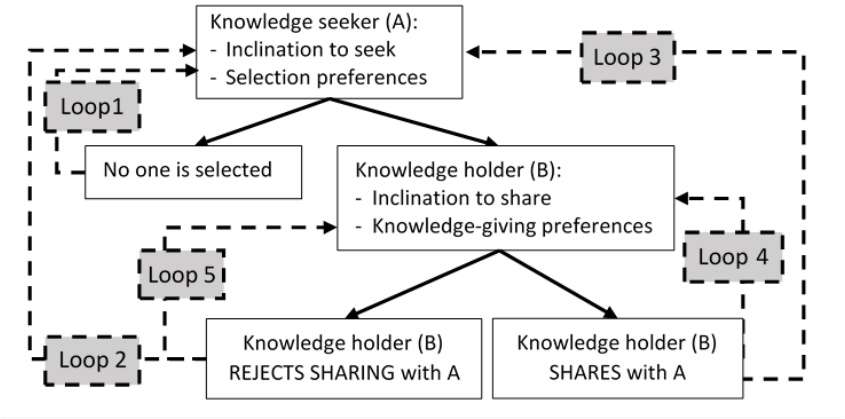


Figure 1: Dynamic model of solicited knowledge sharing

From the perspective of a knowledge seeker (A), the rejection of a knowledge request (Loop 2) initiates negative reciprocity feedback (Černe et al., 2014). The rejection can lead to negative emotions and distrust towards the person who hid knowledge and, to some extent, towards others in the organization. This can increase the likelihood of A hiding knowledge from others in the future (Anand, Centobelli, et al., 2020). Rejection can also increase the social cost of asking for knowledge, leading the rejected knowledge-seeker (A) to reduce their willingness to ask others in the future to conserve their emotional resources (Lim et al., 2020).

From the perspective of the knowledge-holder (B), rejecting sharing (Loop 5) could affect their future inclination to seek and share knowledge as it reduces their perception of psychological safety (Jiang et al., 2019), weakens workplace relationships, and decreases organizational citizenship behaviour (Kaur and Kang, 2023). It will also affect B's future selection preferences when requesting knowledge (decreased inclination to ask a person they previously rejected) - assuming negative reciprocity (Anand, Centobelli, et al., 2020).

When a knowledge request is accepted and knowledge shared, a knowledge-seeker (Loop 3) becomes more likely to ask for knowledge in the future (Leiß and Rausch, 2023). Furthermore, it increases the chances of knowledge providers being approached again, as their effective previous interaction would, among other things, increase the benevolence trust between the two (Mohammed and Kamalanabhan, 2019). Also, A's willingness to share knowledge with B or other organizational members would grow as a result of the need to reciprocate the receipt of knowledge (Lim et al., 2020). Loop 4, which represents feedback for the knowledge provider (B), represents the increase in their willingness to share knowledge due to positive feelings and satisfaction associated with helping. Providing knowledge also increases a person's inclination to ask for knowledge. It affects knowledge-holder selection preferences due to reciprocation expectations from the person to whom they gave knowledge (Lim et al., 2020).

2.3 An Agent-Based Model of Knowledge-Exchange in Organizations

The current agent-based simulation is capable of representing a wide variety of organization layouts and individuals. People are represented as autonomous, heterogeneous agents, each with their own attributes, which change during a simulation. They have a limited number of mutually-exclusive activity states available, with the main activities being solicited knowledge-exchange, simple working together (without a knowledge exchange incentive), and working alone. Agents have designated desks but can choose to walk to their designated break-place (e.g., kitchen/coffee station). They can choose to walk to another person's desk to interact or just communicate with them electronically. Taking breaks and going to others' desks provides individuals with opportunities for impromptu encounters, which increase tie-strengths between individuals. An example office layout is shown in Figure 3a. People are assigned to teams, and team members' desks are grouped together. We assume people work a 7.5-hour workday, but currently we make the simplification that the time of day does not affect people.

An individual agent's behaviour depends on the following main factors: their current attributes (e.g., knowledge level, organizational identification, psychological safety, familiarity with other people, location, current inclinations for each activity state option), their current activity state (e.g., taking a break), what others are doing, and what has happened in the past (e.g., knowledge exchange history, knowledge request rejection history). Agent attributes are initialised at the start of a simulation run and their values change dynamically

during the simulation. Everyone is initialized with one of three state preference profiles: an average person, a highly self-sufficient person who does not seek knowledge so often, or a frequent knowledge seeker. These profiles contain the agent's relative state choice 'probabilities', and they are altered dynamically in response to the agent's experiences. This means that an individual's inclinations, and hence decisions and behaviour, alter according to their experiences – which depend on the others in the organization. Records of past interactions are dynamic cumulative totals and could be considered 'memories' of past situations. The simulation output metrics include state frequency counts and durations for each agent (and hence for the organization) as well as overall interaction totals (such as total knowledge-sharing time), knowledge level, rejection counts, etc.

We took 1 second as our unit of simulation time because this enabled us to incorporate the impromptu encounters mentioned in the introduction. Hence, simulating one office day involved 27,000 simulation time steps (7.5 hours equals 27,000 seconds). At the start of each simulation time step, each person must decide what activity to do. They decide this by using their (dynamic) state preference profile. One of the simplifications we made is that when a person enters a state, the duration in that state is sampled from a plausible distribution of times and the agent stays in that state until that time has elapsed (there are no interruptions, no interactions within interactions).

The logic involved in a solicited knowledge-sharing interaction is shown in Figure 2.

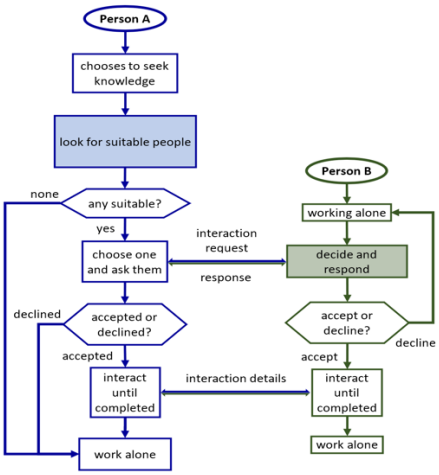


Figure 2: The procedure of arranging solicited knowledge-sharing

When a knowledge seeker (Person A) decides to ask around for some knowledge, they first need to look for suitable people who could be asked. This depends on what others are doing, A's characteristics, the others' characteristics, and what has happened in the past. Person A applies various (configurable) criteria that filter out unsuitable people and produce a set of potential candidates. For example, A would look for someone who:

- is not currently interacting with someone, and has not rejected A before, or has rejected A less than a certain number of times before (accessibility; e.g., Borgatti and Cross, 2003)
- is similar to A in various selectable ways (e.g., similar organizational identification, psychological safety) (similarity; cf. Lim et al., 2020)
- has a greater knowledge level than A (expertise; e.g., Borgatti and Cross, 2003)
- is someone A has some social relationships with (they have met before, preferably many times) (familiarity; e.g., van der Rijt et al., 2013)
- is someone A has exchanged knowledge with before (either direction), preferably many times (trustfulness; e.g., Mohammed and Kamalanabhan, 2019).

The second stage is that Person B has to decide whether to accept the request or reject it (a basic form of knowledge-hiding). This again depends on both agents' characteristics and the past. B also applies various (configurable) criteria, such as:

- B has organizational identification above a certain threshold (motivation; e.g., Phookan and Sharma, 2021)
- B perceives that the context is psychologically safe above a certain threshold (safety; e.g., Škerlavaj et al., 2023)

- B has some social relationships with A – they interacted before above a certain threshold (familiarity; e.g., Zhang and Jiang, 2015)
- B has exchanged knowledge with A before, above a certain threshold (trustfulness; e.g., Le and Lei, 2018).

If all the conditions are met, A's request is accepted otherwise it is rejected (a knowledge-hiding situation).

The simulation records counts of all the results of wanting to interact and all the reaction results. Each of the results of a solicited knowledge-exchange interaction (not finding a suitable person available, rejection of sharing, and sharing knowledge) has consequences for both the knowledge seeker and the knowledge holder. One of the results of interaction is the change in individual knowledge levels. Naturally, when Person A receives knowledge, A experiences an increase in knowledge level. In addition, we assumed that Person B, while explaining knowledge to A, also experiences a slight increase in their understanding. These rates of increase are set by model parameters. When Person A tries and fails in an attempt to seek knowledge from someone, then A's inclination to seek knowledge in the future is reduced (a model parameter sets the rate of reduction). On the other hand, when A's knowledge request is fulfilled, we assume that this would cause a slight increase in A's inclination to seek knowledge in the future (there is a model parameter for the rate of increase).

The model is controlled by twelve main parameters. At present, we do not have much relevant empirical data (e.g., distributions for the frequency of knowledge requesting or duration of knowledge-sharing sessions). For our initial experiments, we fixed some of these parameters at values that produced plausible results. We then conducted a coarse grid search of the resulting parameter space, using 'categorical calibration' (Thiele *et al.*, 2014) to filter out parameter sets that failed acceptability criteria. The most important parameter is the initial state preference profiles, which represent the individuals' activity preferences. Another parameter, *Minimum-Person-Match*, specifies a threshold for how close the match must be (0: 'anyone will do' to 1: 'must be identical') when an agent selects a person to interact with or decides how to respond to a request. When selecting a person based on an attribute value, a parameter *Positive-Response-Threshold* specifies a minimum threshold.

The number of replications was chosen such that the cumulative mean of the total knowledge-sharing time stabilized to within 5% (an arbitrary tolerance of typically less than 2 minutes) (Robinson, 2014). We found that 50 replications provided convergent cumulative outputs.

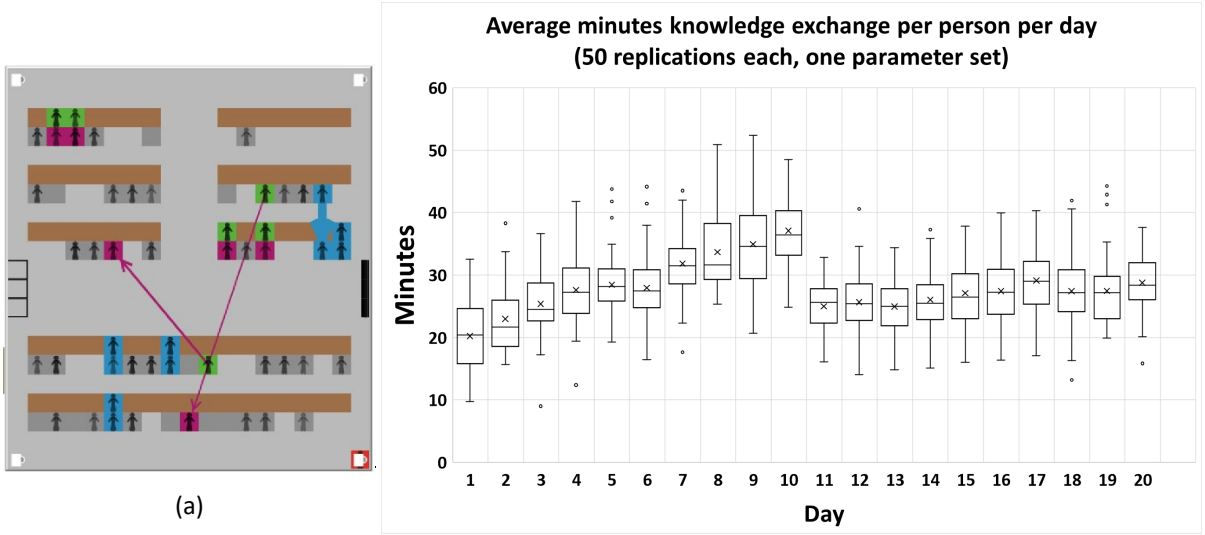
Regarding model verification, the simulation model was developed using conventional software engineering standards (such as error-trapping, meaningful variable names, unit testing). The model is implemented in NetLogo (Wilensky, 1999). Since there were no empirical data to validate the simulation model, all we could do was check that the model produced reasonable results, and sensitivity analyses were conducted to check that the simulation responded sensibly to changes in model parameters and agent characteristics.

3. Experiments and Results

We have conducted two preliminary experiments to investigate knowledge-sharing dynamics over 20 work days (i.e., four weeks). Both experiments were conducted with 40 staff members and used the same set of model parameters. Each scenario was replicated 50 times. The experiments' results cover the average time of knowledge-sharing and average counts of knowledge requests, rejection and acceptance attempts. Every result is reported per person per day.

3.1 Experiment 1 and Discussion

Our aim in Experiment 1 was to analyse the effect of a sudden increase in the likelihood of knowledge rejections in one group on knowledge-sharing in the whole organization. The scenario was that after ten days of normal working, an event occurred that drastically increased the likelihood of knowledge rejections in one of the four groups (Group 4, top-left corner Figure 3(a)). The disruptive event (perhaps some counterproductive, unethical behaviour of the team leader) caused a drastic drop (to 10%) in the group members' organizational identification and psychological safety. The simulation was run for ten more days after disruption.



(a)

(b)

Figure 3: (a) The office layout used in both experiments; (b) Average time spent on knowledge-sharing before and after the disruptive event in Experiment 1.

Figure 3(b) shows boxplots for the resulting distributions of minutes of knowledge sharing per person for each day. They show that the average time spent on knowledge sharing per person per day was increasing during the first ten days of ordinary work. The sudden negative event in Group 4 led to an observable drop in knowledge-sharing, from an average of around 37 minutes after the first ten days to approximately 25 minutes over the next ten days. The upward day-to-day trend from weeks one and two continued but at a lower rate. Analysis of agents' behaviour frequencies revealed that, as expected, average rejection attempts increased significantly in week 3 (11-15th day) and continued in week 4 (16-20th day), see Table 1. Also, in week 4, the variability of rejections between workdays increased. Moreover, while in week 3, the growth rate of knowledge request attempts revealed the same (around 20%), in week 4, the week average growth rate dropped (to 4%) but with higher day-to-day variability. After the disruption, the number of knowledge-seeking attempts when no one was available and suitable (failed search) started to increase (from 3% in week 2 to 11% in week 4).

Table 1: Differences between work weeks in individual behaviour frequencies (day average)

	#knowledge-seeking attempts	#failed searches	Failed searches per knowledge-seeking attempt	#rejected requests	Rejections per request
Week 1 (day 1-5)	1.30	0.13	10%	1.49	68%
Week 2 (day 6-10)	1.62	0.05	3%	1.77	64%
Week 3 (day 11-15)	1.98	0.17	9%	2.45	77%
Week 4 (day 16-20)	2.06	0.22	11%	2.68	76%

Note: All figures are averages per person per day

Experiment 1 examines the consequences of feedback Loops 2 and 5 depicted in Figure 1. The results show that the disruptive event immediately affected the decisions of a few organizational members, but the consequences affected overall knowledge-sharing shortly after, and this stayed at a lower level until the end of the experiment. This decreased overall knowledge-sharing was associated with a higher rejection rate. This increase in rejection attempts exacerbated the growth rate of knowledge-seeking attempts (Lim *et al.*, 2020). It can be explained by the increase in the social costs of requesting (Tidwell and Sias, 2005) and the individuals' intention to reduce them by generally decreasing their request attempts (Flynn and Lake, 2008). Knowledge hiding also deteriorated the relationships between individuals (Škerlavaj *et al.*, 2023), making it harder to find a trusted individual.

3.2 Experiment 2 and Discussion

In Experiment 2, we compared the consequences of four strategies to follow when experiencing a knowledge request rejection. This experiment refers mainly to feedback Loop 2 in Figure 1. Agents remember all rejections

(and acceptances) and can choose to never ask a rejector again. We compared the amount of overall knowledge-sharing during a 20-work-day period when an agent tolerates 1, 2, 3 or unlimited rejections before excluding the rejector completely. However, in all strategies, the inclination to ask others for knowledge declines after every rejection (at a rate set by a model parameter). To make the simulation more plausible, we catered for scenarios where rejection could be a result of factors not explicitly modelled, such as being busy on a deadline. For this, we introduced a random 1 in 5 chance of rejection due to other circumstances.

Table 2: Differences between strategies for responding to knowledge rejections

Maximum Rejections Allowed	Work Alone (mins)	Self-Study (mins)	Knowledge-sharing (mins)	#knowledge-seeking attempts	#accepted knowledge requests	#rejected knowledge requests	Failed searches per knowledge-seeking attempt
1	260	141	6	1.25	0.12	0.08	85%
2	220	116	19	1.44	0.45	0.28	55%
3	203	94	30	1.57	0.75	0.54	31%
unlimited	197	82	35	1.60	0.91	1.65	3%

Note: All figures are averages per person per day

The different strategies caused some differences in the 20-day behaviours and knowledge-sharing outcomes, as depicted in Table 2. It seems that continuing to consider a person suitable - irrespective of the number of times they have rejected you - results in increased knowledge-sharing overall. Although one might experience less rejections by never asking previous rejectors again (0.08 vs 1.65 times per person per day), because people have been excluded one is less likely to find some suitable (85% search failure compared to 3%).

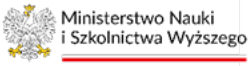
These results suggest that severer strategies for selecting knowledge-holders protect the knowledge seeker from the social and emotional costs of rejections but at the expense of significantly lower knowledge exchange with others. It indicates the trade-offs an individual approaching other for knowledge needs to make based on cost-gain concept and conservation of resources theory (Lim *et al.*, 2020). Also, the experiment suggests a mechanism whereby knowledge hiding can hinder the flow of knowledge in an organization by decreasing knowledge inquiries and limiting the number of knowledge holders who can be approached for knowledge (Borgatti and Cross, 2003).

4. Conclusions

Our study emphasises the importance of investigating the behavioural and relational feedback loops in knowledge requesting, sharing and hiding. Identifying the consequences of knowledge-based behaviours affecting every actor involved in the exchange interaction is informative for theory and practice. We built an agent-based simulation model that performs as a platform for testing consequences of feedback loops in knowledge-exchange behaviours. We believe that our simulation model can usefully model the dynamic, spatial interactions between individuals engaged in knowledge exchange activities, and potentially provide a micro-level explanation of macro-level effects, such as the change in the extent of knowledge-exchange. Specifically, our “in silico” simulation-based experiments show that some consequences of rejecting to share knowledge have individual and organizational level consequences that manifest over time.

However, the simulation model currently has several limitations. For example, the model has not been thoroughly parameterized – only a limited grid search has been conducted. Empirical data are needed to increase confidence in the relative weights of the factors involved. There have been many simplifications that could be addressed, such as taking into account the type of knowledge exchanged, the time of day, the time taken to negotiate an exchange or a rejection (all of which currently take just one simulation time interval). Further models could include individual attributes such as employee tenure, hierarchical position in the organization, and age (Burmeister and Fasbender, 2018). There is a need for longitudinal empirical case studies to identify the feedback involved in knowledge exchange experiences, to find out the delayed effect of some decisions, and to identify the strategies that employees adopt.

Acknowledgements



Co-financed by the Minister of Science under the "Regional Excellence Initiative", Poland.

References

Anand, A., Centobelli, P. and Cerchione, R. (2020) "Why should I share knowledge with others? A review-based framework on events leading to knowledge hiding", *Journal of Organizational Change Management*, Vol. 33, No. 2, pp 379–399.

Anand, A., Muskat, B., Creed, A., Zutshi, A. and Csepregi, A. (2020) "Knowledge sharing, knowledge transfer and SMEs: evolution, antecedents, outcomes and directions", *Personnel Review*, Vol. 50, No. 9, pp 1873–1893.

Anand, A., Offergelt, F. and Anand, P. (2022) "Knowledge hiding – a systematic review and research agenda", *Journal of Knowledge Management*, Vol. 26, No. 6, pp 1438–1457.

Bonabeau, E. (2002) "Agent-based modeling: Methods and techniques for simulating human systems", *Proceedings of the National Academy of Sciences of the United States of America*, Vol. 99, No. SUPPL. 3, pp 7280–7287.

Borgatti, S.P. and Cross, R. (2003) "A relational view of information seeking and learning in social networks", *Management Science*, Vol. 49, No. 4, pp 432–445.

Burmeister, A. and Fasbender, U. (2018) "Being perceived as a knowledge sender or knowledge receiver: A multistudy investigation of the effect of age on knowledge transfer", pp 518–545.

Černe, M., Nerstad, C.G.L., Dysvik, A. and Škerlavaj, M. (2014) "What goes around comes around: knowledge hiding, perceived motivational climate, and creativity", *Academy of Management Journal*, Vol. 57, No. 1, pp 172–192.

Cummings, J.L. and Teng, B.-S. (2006) "The Keys to Successful Knowledge-Sharing", *Journal of General Management*, Vol. 31, No. 4, pp 1–18.

Flynn, F.J. and Lake, V.K.B. (2008) "If you need help, just ask: Underestimating compliance with direct requests for help", *Journal of Personality and Social Psychology*, Vol. 95, No. 1, pp 128–143.

Foss, N.J., Husted, K. and Michailova, S. (2010) "Governing knowledge sharing in organizations: Levels of analysis, governance mechanisms, and research directions", *Journal of Management Studies*, Vol. 47, No. 3, pp 455–482.

Haas, M.R. and Cummings, J.N. (2015) "Barriers to knowledge seeking within MNC teams: which differences matter most", *Journal of International Business Studies*, Nature Publishing Group, Vol. 46, No. 1, pp 36–62.

Jiang, Z., Hu, X., Wang, Z. and Jiang, X. (2019) "Knowledge hiding as a barrier to thriving: The mediating role of psychological safety and moderating role of organizational cynicism", *Journal of Organizational Behavior*, Vol. 40, No. 7, pp 800–818.

Kaur, N. and Kang, L.S. (2023) "Perception of organizational politics, knowledge hiding and organizational citizenship behavior: the moderating effect of political skill", *Personnel Review*, Vol. 52, No. 3, pp 649–670.

Le, P.B. and Lei, H. (2018) "The mediating role of trust in stimulating the relationship between transformational leadership and knowledge sharing processes", *Journal of Knowledge Management*, Vol. 22, No. 3, pp 521–537.

Leiß, T.V. and Rausch, A. (2023) "Informal learning from dealing with software-related problems in the digital workplace", *Journal of Workplace Learning*, Vol. 35, No. 9, pp 291–310.

Lim, J.H., Tai, K., Bamberger, P.A. and Morrison, E.W. (2020) "Soliciting resources from others: an integrative review", *Academy of Management Annals*, Vol. 14, No. 1, pp 122–159.

Macy, M.W. and Willer, R. (2002) "From Factors to Actors: Computational Sociology and Agent-Based Modeling", *Source: Annual Review of Sociology*, Vol. 28, pp 143–166.

Mohammed, N. and Kamalanabhan, T.J. (2019) "Tacit knowledge seeking from teammates: unravelling the role of social capital", *International Journal of Organizational Analysis*, Vol. 28, No. 3, pp 765–790.

Oliveira, M., Curado, C. and de Garcia, P.S. (2021) "Knowledge hiding and knowledge hoarding: A systematic literature review", *Knowledge and Process Management*, Vol. 28, No. 3, pp 277–294.

Phookan, H. and Sharma, R.R. (2021) "Subsidiary power, cultural intelligence and interpersonal knowledge transfer between subsidiaries within the multinational enterprise", *Journal of International Management*, Elsevier Inc., Vol. 27, No. 4, p. 100859.

Pires, B., Goldstein, J., Molfino, E., Ziemer, K., Orr, M. and Jiménez, J. (2024) "Knowledge sharing in a dynamic, multi-level organization: an agent-based modeling approach", *Computational and Mathematical Organization Theory*, Vol. 30, No. 1, pp 75–100.

Reinholt, M., Pedersen, T. and Foss, N.J. (2011) "Why a central network position isn't enough: The role of motivation and ability for knowledge sharing in employee networks", *Academy of Management Journal*, Vol. 54, No. 6, pp 1277–1297.

van der Rijt, J., van den Bossche, P., van de Wiel, M.W.J., de Maeyer, S., Gijselaers, W.H. and Segers, M.S.R. (2013) "Asking for help: a relational perspective on help seeking in the workplace", *Vocations and Learning*, Vol. 6, No. 2, pp 259–279.

Rubenstein-Montano, B., Liebowitz, J., Buchwalter, J., McCaw, D., Newman, B. and Rebeck, K. (2001) "A systems thinking framework for knowledge management", *Decision Support Systems*, Vol. 31, No. 1, pp 5–16.

Senge, P. (1990) *The Fifth Discipline:The Art and Practice of the Learning Organization*, Doubleday, New york.

Škerlavaj, M., Černe, M. and Batistič, S. (2023) "Knowledge Hiding in Organizations: Meta-Analysis 10 Years Later", *Economic and Business Review*, Vol. 25, No. 2, pp 79–102.

Sterman, J.D. (2001) "System dynamics modeling: Tools for learning in a complex world", *California Management Review*, Vol. 43, No. 4, pp 8–25.

Sung, S.Y. and Choi, J.N. (2018) "Building knowledge stock and facilitating knowledge flow through human resource management practices toward firm innovation", *Human Resource Management*, Vol. 57, No. 6, pp 1429–1442.

Teng, J.T.C. and Song, S. (2011) "An exploratory examination of knowledge- sharing behaviors: solicited and voluntary", *Journal of Knowledge Management*, Vol. 15, No. 1, pp 104–117.

Thiele, J.C., Kurth, W. and Grimm, V. (2014) "Facilitating Parameter Estimation and Sensitivity Analysis of Agent-Based Models: A Cookbook Using NetLogo and 'R'", *Journal of Artificial Societies and Social Simulation*, Vol. 17, No. 3, p. 11.

Tidwell, M. and Sias, P. (2005) "Personality and information seeking: Understanding how traits influence information-seeking behaviors", *Journal of Business Communication*, Vol. 42, No. 1, pp 51–77.

Wang, J., Gwebu, K., Shanker, M. and Troutt, M.D. (2009) "An application of agent-based simulation to knowledge sharing", *Decision Support Systems*, Vol. 46, No. 2, pp 532–541.

Wilensky, U. (1999) "NetLogo", Center for Connected Learning and Computer-Based Modeling, Northwestern University, available at: http://ccl.northwestern.edu/netlogo/.

Witherspoon, C.L., Bergner, J., Cockrell, C. and Stone, D.N. (2013) "Antecedents of organizational knowledge sharing: a meta-analysis and critique", *Journal of Knowledge Management*, Vol. 17, No. 2, pp 250–277.

Zhang, X. and Jiang, J.Y. (2015) "With whom shall I share my knowledge? A recipient perspective of knowledge sharing", *Journal of Knowledge Management*, Vol. 19, No. 2, pp 277–295.

Collaborative Policy Development for Effective, Flexible Working

Linzi Ryan
Maynooth University, Maynooth, Ireland

Linzi.ryan@mu.ie

Abstract: In the post-COVID environment, work flexibility is an increasingly important factor in employee attraction and retention. This new way of working is particularly challenging in the public sector as it is bound by high levels of rules, regulations and bureaucracy. Academic literature on the post-Covid ways of working is limited as the research takes time to catch up to current practices and does not fully capture or address the novel issues currently faced by public sector managers. With the increasing demand for flexible working, it is vital to explore how public sector organisations exploit opportunities and avoid potential risks in this new way of working. Through our empirical study with a public sector organisation, it is argued that the rapid shift to flexible working was possible as it leveraged off the pre-COVID organisational culture. High levels of organic tacit knowledge exchange were possible through staff's physical proximity in the workplace. Under new flexible work practices, this is often no longer the case. For sustainable, effective knowledge exchange, operational policies must capture, consider and support operant knowledge exchange in this new geographically dispersed work environment. Drawing on service design theory and public sector management literature, this study generates managerial and policy learnings, practices, and methodologies for collaborative work policy development. Firstly, we demonstrate that, as traditional operational policies focus on quantifiable, explicit knowledge and communication, a new user-centred approach to policy development is required. It demonstrates the managerial need for *collaborative* policy development, which engages staff in capturing both explicit and tacit knowledge for effective operations. Secondly, it identifies the implications of the loss of tacit knowledge exchange, particularly for staff new to the organisation. It highlights the implications of moving to online forms of engagement and collaboration and the impact on knowledge development and exchange. Thirdly, we show the importance of critical reflection within co-creative policy development. Critical reflection provides staff with opportunities and resources to question old practices, reflect on new practices and construct knowledge collaboratively.

Key words: Flexible Working, Policy Development, Use-Centred Design

1. Introduction

Although COVID initially forced remote working, for many organisations, it also revealed both a capacity to deliver services remotely and the need for a new user-centred approach (Williamson et al., 2022; Gavin, Poorhosseinzadeh, Mahan Arrowsmith., 2022; Palumbo et al., 2022). In the new post-COVID environment, it is becoming increasingly evident that the 9-5 office structure is no longer fit for purpose. Instead, hybrid ways of working - where employees divide their time between work and home - is increasingly becoming the norm in many sectors. While this empowers staff to do their best work and deliver better performance for employers, it presents some knowledge management challenges. Appropriate management practices with supporting workplace policies are required to fully exploit opportunities and avoid potential risks of this new way of working (AlMazrouei and Zacca, 2021; Hammer, 2021). This study focuses on the development of a workplace policy in an Irish public sector organisation, operating in a geographically dispersed hybrid work format. A qualitative research approach provides insight into the changes and challenges of knowledge management in this developing context, through the case study of the development of a workplace policy.

Hybrid working is a particularly difficult task for the public sector as it operates in a complex policy and political environment, with direct political oversight, and high levels of scrutiny and accountability (Hartley and Skelcher, 2008). More recently, the emergence of the 'New Public Governance' model puts emphasis on inter-organisational relationships, networks, collaborative partnerships, participatory governance and multi-actor relations (Krogh and Triantafillou, 2024; Bannink et al., 2024; Huxham and Vangen, 2013; Wu, Ramesh, and Howlett, 2017). This has placed greater emphasis on knowledge generation, sharing and management, within public sector organisations and the development of an organisational culture in which knowledge is valued, shared and utilised for public sector improvement (Karim and Majid, 2022). However, due to the complexity of public sector network, knowledge management has received limited attention (Haque and Turner, 2013; Chen and Hsieh, 2015; Puppim De Oliveira et al., 2015; Abdul et al., 2020).

This research presents an empirical project with an Irish national public sector organisation. Prior to Covid, the organisation operated a traditional 9am-5pm office format for the majority of staff. Due to its national remit, some roles required high levels of travel, but all staff had a base office as their primary base of operation. Covid restrictions – where all staff were required to work from home – demonstrated the organisations ability to work remotely and staff expressed their desire for more flexible work environments as restrictions were lifted. Having previously worked with the researcher on complex organisational issues, HR wanted to take a similar, human-

centred approach to a new workplace policy that was both innovative and flexible in its approach to work parameters. Due to industry-sensitive information, the case study organisation cannot be identified. To provide context, Ireland has eighteen State Agencies or public sector bodies that have a statutory obligation to perform specific tasks on behalf of the Government of Ireland. Each department employs a large number of public sector staff who remain in their positions regardless of changes in Government. State Agency activities include the implementation of national, regional, and local plans and policies, as well as EU plans and policies on the island of Ireland. Of the State Agencies, four - one of which is the focus on this study - are national economic development agencies. Their primary role is to support the long-term sustainable growth of the economic, social, cultural and environmental contributions of Ireland.

This paper details the qualitative methodology taken for the case study. The organisation was chosen for its innovative and flexible approach to work parameters. Data collection was through interviews with managers, and a series of interactive workshops which produced field notes and completed templates. The data was examined through thematic analysis to identify reoccurring patterns and themes related to knowledge management in collaborative policy development and used to generate recommendations for managerial practice.

2. Literature Review

The hybrid work model combines remote working from home and in-person working from an office-based location (Beno, 2021). While it existed before COVID, the pandemic expedited the use of remote work practices for both the private and public sector (Yang et al., 2021). This led many organisations to recognise that employees can work as productively at home as in the office (Lodovici et al., 2021). Hybrid work can be advantageous as it combines the benefits associated with remote work with those of the traditional office. For home-based work, it offers time flexibility, a better work-life balance and reduced commuting time. For office-based work, there is the ease of collaborating and coordinating, building of organisational culture, and greater innovation and creativity (Mortensen and Haas, 2021; Bloom, 2021). For these benefits to be reaped, adopting hybrid work practices requires substantial change across all levels of an organisation. Systems and structures must be adjusted or created entirely to support hybrid work, and policies must be created to ensure all necessary legal requirements are met while utilising the potential benefits of this new way of working (Shepherd, 2022).

To develop effective and appropriate hybrid workplace policies, organisations must understand the necessary changes in staff working behaviour (Harsch and Festing, 2020). Changes in communication - for example an increased reliance on Information Communication Technologies (ICT) - require clear processes and expected norms among team members (Kaiser et al., 2022). Interdependencies between virtual teams must be strengthened to enhance feelings of belongingness of members (Spitzmuller et al., 2023) and processes must be created to effectively manage knowledge across these new communication channels (Li et al., 2022). Organisational culture plays an important role in this change process. By collaborating with staff in the development of goals, organisations can develop holistic strategies and structures that support the changes needed for effective hybrid work (Silvestre, Marques, and Gomes, 2018). Fosterign collaboration is recommended as it can build trust between staff and management (Ansell and Gash, 2008; Chugh et al., 2015); promote resources sharing (Purdy, 2012); and reduce potential staff resistance to change (Abrell-Vogel and Rowold, 2014).

With its human-centred approach, governments have increasingly turned to DT as a way of reframing policy issues and generating and testing new solutions to organisational and public problems (Kimbell, 2016; Blomkamp, 2018). DT is suitable for *complex* problems as it offers a broad range of strategies to address open-ended challenges (Dorst, 2011). It enhances innovation, participation, and responsiveness (Parker and Heapy, 2006) by combining various sources of information, constructing it into readily understandable and usable formats, testing and refining solutions, collaborating with multiple actors, and integrating human factors and values into the development process (Olejniczak et al., 2020; Van Buuren et al., 2020). Accordingly, DT has been used as a human-centred approach to shape public policies and knowledge management.

“Knowledge” itself can be roughly divided into two categories, explicit and tacit (Nonaka, 1998). Explicit knowledge comprises numbers and words which can be readily shared. In contrast, tacit knowledge is highly personal and difficult to formalise and communicate (Gamble, 2020). As public sector organisations come under increasing pressure to continually learn and improve (Mc Evoy, Ragab and Mohamed, 2019), processes which utilise and maintain *all* accumulated knowledge within staff are becoming increasingly important (North and Kumta, 2018; Aladwan, Al-Yakoub and Adaileh, 2022). DT is an appropriate approach to this challenge as,

according to most policy scholars, through its collaborative process, it embodies the lessons learned from previous experiences in the development of new or reforming of old policies (Howlett 2019; Hermus et al., 2020; Lewis et al., 2020; Van Buuren et al., 2020). As a result, DT utilises *both* implicit and explicit knowledge to prevent the repetition of past errors and failures. It emphasises the value of understanding participant views and experiences to create a *holistic* approach to knowledge management.

3. Methodology

A qualitative research methodology was used to explore collaborative hybrid work policy development within a public sector organisation and, in particular, the impact of this new way of working on knowledge management. A case study approach was taken as it enabled the researcher to focus on the knowledge dynamics within a single setting and investigate contemporary real-life phenomena through contextual analysis of an environment (Creswell, 2007). This provided a rich context for investigating the knowledge transfer process(es) across multiple staff within a singular team, between teams and across departments working in a hybrid organisation. The limitations of a single case study are acknowledged, with multiple case studies creating more robust insights in a wider context (Yin, 2016). However, theoretical explanations of the data observed within this paper are applicable across similar organisations.

First, primary data was collected through managerial interviews with high-level management and the HR team. This was coupled with secondary data collected in the form of operational documentation. The initial data collection was to provide organisational and sectoral contextual information, and to capture managerial perspectives on current knowledge management practices. This was used to develop a collaborative workshop utilising a DT approach which has been shown to be effective in driving innovative operations, gathering key insights, and as a responsive framework to identify emerging challenges (Mutanen, 2008). The DT process is roughly categorised into two 'diamonds' consisting of two phases each (British Design Council, 2019): Diamond 1: Discover and define; Diamond 2: Develop and deliver. For this exploratory study, the developed framework focused on Diamond 1 to gain an understanding of current knowledge management practices and emerging barriers in a hybrid workplace. Though depicted as linear, the process integrates feedback loops as participants learn and evolve their knowledge.

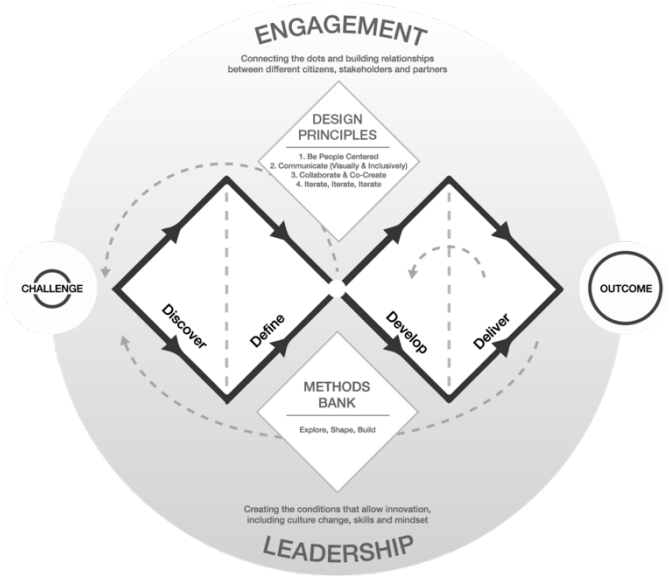


Figure 1: UK Design Council Double Diamond Framework

Secondly, nine workshops were then held with 142 staff, focussing on current knowledge processes (both formal and informal), knowledge transfer gaps and knowledge transfer awareness between new and established members of staff. Each workshop was 4 hours long and was held online to optimise attendance and collaboration in geographically dispersed teams. Participants were asked to complete a variety of tools (detailed in Results) and to provide additional insight/information through open discussion. Feedback loops were used to reflect on the information captured and the inclusion of additional information gained during discussion. Specific time was allocated at the end of each workshop to allow staff to provide feedback, highlight any key issues/considerations not captured in the tools, and ask additional questions. Detailed field notes of the

discussion between participants were taken, and supplementary notes were created immediately after the workshops in a 'debrief' to capture additional perspectives, observations, and thoughts.

Thirdly, the collected data underwent a rigorous analysis process to identify key themes and patterns related to knowledge transfer and management in the organisation. Following Creswell's methodology (2005), field notes and the completed workshop tools were systematically coded using qualitative data analysis software (Nvivo) (Creswell, 2015). Progressive data coding was used by first identifying broad-based codes to avoid premature interpretations. This was then progressively narrowed down to context-specific information, before organising information into themes. Themes were reviewed and refined to ensure their coherence and relevance to the research objective. Finally, themes were interpreted and synthesised to generate a comprehensive understanding of the organisation's knowledge transfer and management processes. This allowed connections, relationships and conversions of one form of knowledge to another to be mapped.

4. Results

This section examines the outcomes of the workshop in relation to knowledge management within the public sector organisation. It identifies key insights of knowledge transfer within this new hybrid way of working such as the impact of lost tacit knowledge transfer on operational flexibility; a link between activity objectives, communication platforms used and the knowledge generated and exchanged; and the impact of hybrid working on informal knowledge exchange within the wider organisational network.

The first phase of the DT framework required staff to document their primary activities. Several key themes emerged from the data analysis of this stage. Firstly, there was a strong relationship between tacit knowledge, conceptual knowledge and procedural flexibility which was overlooked in the transition to a hybrid model. Procedural knowledge – the knowledge of procedures, such as a series of steps or actions to accomplish a goal - and conceptual knowledge – knowledge of general principles, such as *why* each step is part of the process (Rittle-Johnson et al., 2015) - were easily captured by participants. Tacit knowledge - things that are "understood" without necessarily being said - allowed experienced members of staff to utilise procedural flexibility to circumvent barriers or address arising problems. Prior to hybrid working, the transfer of tacit knowledge occurred organically through informal discussion in a shared office space. If faced with a barrier, staff could simply ask colleagues for assistance and/or guidance. When geographically dispersed, informal discussions were significantly reduced. Contacting colleagues through an online platform such as Microsoft Teams had formal discussion connotations and staff were more reluctant to contact colleagues for help through these channels. This was particularly evident for new staff who were heedful of calls as they felt they were disrupting their colleague's work.

The second phase of the DT framework required participants to reflect on and capture the type of engagement most effective for each activity (e.g. face-to-face, online, blended or independent) and, most importantly, *why* this engagement was considered the most productive format. The emerging theme highlighted a link between the activity objective, communication platform and knowledge generation and exchange. Initially, staff believed most tasks could be completed in an online format. On reflection, activities could roughly be divided into three categories: Operational, strategic and independent. Staff believed planning activities that required knowledge generation, such as strategy development, ideation and insight development, required in-person collaboration. For these activities, the importance of ongoing tacit knowledge exchange during informal discussions such as during lunch or coffee breaks; and the impact of 'flowing discussion' for idea generation vs. the more stilted online discussion was recognised. This collaborative form of exchange facilitated analysis of the organisation's internal and external environment; identifying strategic issues based on these analyses; and formulating strategies, goals, and plans to address these issues. In contrast, operational activities focused on the exchange of explicit knowledge, such as project action updates, report generation etc. As information was easily captured and communicated, online delivery was considered appropriate. Similarly, activities completed independently, such as report generation/review and administration activities, could be effectively delivered from a remote location.

The third phase of the DT framework required participants to cross-share insights on their own work practices. This revealed the final theme: the importance of managing knowledge exchange across the full organisational network. The organisation consisted of nine geographically dispersed offices. Staff within a single team could be dispersed between locations, and multiple teams were frequently required to collaborate on projects. This resulted in a complex collaboration and communication network. As discussed in theme one, the increase in remote working impacted the informal knowledge exchange within this already complex organisational

network. During cross-share, the loss of tacit knowledge between teams became apparent. Collaboration between some teams was limited and frequently in a formal format for specific activities. As a result, staff were unaware of some interdependencies between teams outside the scope of their current projects. While this is a relatively new impact caused by hybrid working, in the long-term it has the potential to affect the wider organisational culture as informal exchanges between the employees can create trust, commitment and goodwill for the organisation as a whole (Gooderham *et al.*, 2011).

Overall, the thematic analysis revealed the importance of adapting knowledge management practices for this new way of working within the public sector. The findings emphasised the importance of capturing and facilitating both tacit and conceptual knowledge for organisational efficiency and culture management.

5. Discussion

This contribution provides valuable insights into the dynamics of knowledge management in the public sector hybrid way of working. As this is a relatively new change, there is a gap in the academic literature. These findings assist in addressing this gap by offering practical recommendations for knowledge management in a hybrid organisation for managers and policymakers.

Our first contribution is the identification of the need for human-centred, collaborative policy development. While organisational collaboration has proven difficult in the public sector (Kivleniece and Quelin, 2012), this project demonstrated that a comprehensive understanding of the organisational and staff needs can be established by engaging with the wider body of staff. The collaborative tools and open discussions created a shared organisational vision, and a holistic account of operational and knowledge requirements, both tacit and explicit. From a staff perspective, the process provided a structure for critical reflection on pre- and post-COVID operations, cross-sharing of experiences from different perspectives (e.g. new versus established staff), and a platform to voice their opinions to high-level management. From a managerial perspective, it provided a systemic and holistic understanding of the organisational operations, and how staff, knowledge and resources were integrated within the organisational system. In addition, it provided insight into the cultural impact of this new way of working, which is considered one of the most crucial factors in successful knowledge management (Robinson et al., 2005), highlighting the need for support structures to strengthen the relationship between teams and to instil a positive approach to knowledge sharing and recognition.

Our second contribution is the identification of reduced access to tacit knowledge and its impact on organisational conceptual knowledge and procedural flexibility. Procedures are clearly documented, conveying procedural information, e.g. facts and details. In practice, there were a diverse range of projects within the organisation requiring collaboration across multiple teams, resulting in a degree of variability within these procedures. Prior to hybrid working, tacit knowledge on how to utilise procedure flexibility for project variations was done organically through discussions in a shared workspace. The impact of hybrid working on this tacit knowledge exchange was underestimated and highlighted the potential for long-term impact on organisational output, e.g. a lack of understanding of procedural flexibility resulted in process delays. Put simply, it is not sufficient to assume that tacit knowledge is accessible and free-flowing in this new way of working. Organisations must proactively support tacit knowledge exchange to fully exploit this valuable asset for organisational efficiency, and innovative workplace solutions. *Tacit learning* must become a key organisational staff activity - consisting of dialogue and structured reflection (Bohm, 2012; Fahrenbach, 2023) – which is interwoven into staff activities, and is communicated and actively supported as a key organisational output.

Our third contribution highlights the impact of ICT on tacit knowledge transfer and knowledge generation. While research highlights the importance of adopting ICT technologies to develop adaptable, efficient and effective business operations (Chatterjee et al., 2022), ICT also impacts staff's collaborative actions and outputs. Within the organisation studied, staff initially believed that all activities could be completed online, as activities continued throughout the COVID lockdown when in-person meetings were not permitted. On reflection, staff recognised that this was facilitated by the knowledge and relationships established prior to COVID. Organisations must recognise the value of tacit knowledge exchange in collaborative activities and provide guidance and support for *adaptive* collaborative practices. Categorising activities based on their levels of discussion, tacit knowledge exchange and knowledge generation would provide guidance on appropriate collaborative formats and highlight the need to manage both explicit and tacit knowledge within the organisation.

Finally, the insights gained from the case study highlight the need for a new deliberate knowledge transfer strategy that accounts for the changing communication dynamics and channels across the wider organisational

network. Within the case study, the organisation had a complex communication network with projects crossing multiple teams and departments. This was further complicated by geographically dispersed departments and teams, typical of an Irish public sector organisation implementing and managing nationwide projects. Online communication platforms have the potential to effectively capture, organise, store, and share explicit knowledge across the service network (Igbinovia and Ikenwe, 2018). With the changing communication dynamic of the hybrid workplace, effective management of these platforms can streamline the transfer of explicit and operational knowledge across the service network, thereby freeing up time for in-person tacit knowledge exchange and generation.

Based on these findings, we recommend several practical managerial practices for hybrid organisations to optimise their knowledge management. The research highlights the importance of a culture of knowledge-sharing with multiple channels of knowledge exchange and generation. Knowledge transfer processes should be provided on the operational (explicit) and strategic (tacit) level. Operational guidelines based on the activity requirement can provide guidance on the appropriate communication format. In addition, as organisations frequently rely on their managers to ensure that a hybrid work model is successfully implemented, leadership competency training should be provided to support and reinforce the communication and collaboration channels in this new way of working.

6. Conclusion

By working with a public sector organisation on an empirical piece of research, this project provides valuable insights into the impact of hybrid work practices on knowledge management. The findings contribute to the literature by expanding the understanding of hybrid organisational communications, and provide practical recommendations for managers and policymakers in similar situations. Ultimately, knowledge is a key contributing factor in the development of effective, efficient and innovative operational solutions. The recommendations present a holistic approach for knowledge management in the post-COVID hybrid workplace.

There are some limitations to the case study. It adds to the limited body of empirical research within the public sector, but it is based on a single case study. Additional work is required to extrapolate the findings across multiple contexts. Regardless, the findings contribute to the existing literature on knowledge management in hybrid organisations and offer valuable, practical recommendations for public sector managers in this new environment. Similarly, public sector organisations are increasingly engaging with external stakeholders in collaborative governance. Similar research is required on the impact of hybrid work on the external communication and knowledge management with these third parties, and how best to operate in this new dynamic.

To conclude, knowledge management is a critical activity for hybrid public sector organisations for effective, and efficient operations. By understanding the nature of knowledge generation and transfer, both formal and informal, tailored strategies, processes and supports can be developed to ensure it is exploited to its full potential.

References

Bannink, D., Sancino, A., & Sorrentino, M. (2024). Governance without we. Wicked problems and collaborative governance. *Public Policy and Administration*, 36(3), pp 397-413.

Creswell, J. W. (2007) *Qualitative inquiry and research design: Choosing among five approaches*, 2nd ed, Thousand Oaks, CA, US, Sage Publications, Inc.

Chugh, R., Wibowo, S. & Grandhi, S. (2015). Mandating the Transfer of Tacit Knowledge in Australian Universities. *Journal of Organizational Knowledge Management*, 2015(1), pp 1-10.

Devaney, S. A. (2016) Yin, R.K. (2016). Qualitative Research from Start to Finish, Second Edition. New York: The Guilford Press. ISBN: 978-1-4625-1797-8. 386 pp. *Family and Consumer Sciences Research Journal,* 44**,** pp 324-325.

Dorst, K. (2011) The core of 'design thinking' and its application. *Design Studies,* 32(1)**,** pp 521-532.

Fahrenbach, F. (2023) How the validation of prior learning can be used to assess entrepreneurial human capital investments and outcomes. *European Journal of Training and Development,* 47(1)**,** pp 1-14.

Gavin, M., Poorhosseinzadeh, M., & Arrowsmith, J. (2022). The transformation of work and employment relations: COVID-19 and beyond. *Labour and Industry*, 32(1), pp 1–9.

Gooderham, P., Minbaeva, D. & Pedersen, T. (2010) Governance Mechanisms for the Promotion of Social Capital for Knowledge Transfer in Multinational Corporations: Promotion of Social Capital. *Journal of Management Studies,* 48(1)**,** pp 123-150.

Hammer, L. B. (2021) The Interplay of Workplace Redesign and Public Policy in the 21st Century. *American Journal of Public Health,* 111(1)**,** pp 1784-1786.

Haque, M. S. & Turner, M. (2013) Knowledge-Building In Asian Public Administration: An Introductory Overview. *Public Administration and Development,* 33(4)**, pp** 243-248.

Harsch, K. & Festing, M. (2020) Dynamic talent management capabilities and organizational agility—A qualitative exploration. *Human Resource Management,* 59(1)**,** pp 43-61.

Hartley, Jean and Skelcher, Chris (2008). The agenda for public service improvement. In: Hartley, Jean; Donaldson, Cam; Skelcher, Chris and Wallace, Mike eds. *Managing to Improve Public Services. Cambridge*: Cambridge University Press, pp 1–24.

Hermus, M., van Buuren, A. and Bekkers, V., 2020. Applying design in public administration: a literature review to explore the state of the art. *Policy & Politics*, 48(1), pp 21-48.

Howlett, M. (2019) *Designing public policies: Principles and instruments*, Routledge.

Huxham, C. & Vangen, S. (2013) *Managing to collaborate: The theory and practice of collaborative advantage*, Routledge.

Igbinovia, M. & Ikenwe, I. (2018) Knowledge management: processes and systems. *Information Impact: Journal of Information and Knowledge Management,* 8(3), 26-38,.

Kaiser, S., SÜß, S., Cohen, R., Mikkelsen, E. N. & Pedersen, A. (2022) Working from home: Findings and prospects for further research. *German Journal of Human Resource Management Zeitschrift für Personalforschung,* 36(3), pp 205-212.

Karim, D. & Majid, A. (2022) Opportunity-enhancing HRM practices and knowledge sharing behaviour: the mediating role of public service motivation. International Journal of Knowledge Management Studies, 13(4), pp 359-383.

Kimbell, L. (2016) Design in the Time of Policy Problems.. *Design and Research and Society: Future-Focused Thinking.* Brighton UK.

Kivleniece, I. & Quelin, B. V. (2012) Creating and capturing value in public-private ties: A private actor's perspective. Academy of management review, 37(2), pp 272-299.

Krogh, A. H., & Triantafillou, P. (2024). Developing New Public Governance as a public management reform model. *Public Management Review*, pp 1–17.

Lewis, J.M., McGann, M. and Blomkamp, E., 2020. When design meets power: Design thinking, public sector innovation and the politics of policymaking. *Policy & Politics*, 48(1), pp111-130.

Li, Y., Wang, Y., Wang, L. & Xie, J. (2022) Investigating the effects of stakeholder collaboration strategies on risk prevention performance in a digital innovation ecosystem. *Industrial Management & Data Systems,* 122(9)**,** pp 2045-2071.

Lodovici, M. S., Ferrari, E., Paladino, E., Pesce, F., Frecassetti, P. & Aram, E. (2021) The impact of teleworking and digital work on workers and society. *Study Requested by the EMPL Committee*.

Mc Evoy, P. J., Ragab, M. A. F. & Arisha, A. (2019) The effectiveness of knowledge management in the public sector. *Knowledge Management Research & Practice,* 17(2)**,** pp 39-51.

Mortensen, M. & Haas, M. (2021) Making the hybrid workplace fair. *Harvard Business Review,* 24(1).

Mutanen, U.-M. (2008) Developing organisational design capability in a Finland-based engineering corporation: the case of Metso. *Design Studies - Design Stud,* 29(5)**,** pp 500-520.

Nonaka, I. (1998) A Dynamic Theory of Organizational Knowledge Creation. *Organization Science,* 5(1)**,** pp 14-37.

North, K. & Kumta, G. (2018) Context Specific Knowledge Management Strategies, In: *Knowledge Management*, 2(6), pp 201-242.

Olejniczak, K., Borkowska-Waszak, S., Domaradzka-Widła, A. & Park, Y. (2020) Policy labs: the next frontier of policy design and evaluation? *Policy & Politics,* 48(1)**,** pp 89-110.

Palumbo, R., Fakhar Manesh, M. & Petrolo, D. (2022) What makes work smart in the public sector? Insights from a bibliometric analysis and interpretive literature review. *Public Management Review***,** pp 1-26.

Parker, S. & Heapy, J. (2006) The journey to the interface. *London: Demos*.

Puppim De Oliveira, J. A., Jing, Y. & Collins, P. (2015) Public Administration for Development: Trends and the Way Forward. *Public Administration and Development,* 35(1), pp 65-72.

Purdy, J. M. (2012) A framework for assessing power in collaborative governance processes. *Public administration review,* 72(3)**,** pp 409-417.

Rittle-Johnson, B. & Schneider, M. (2015) Not a One-Way Street: Bidirectional Relations Between Procedural and Conceptual Knowledge of Mathematics. *Educational Psychology Review,* 27(1), pp 587–597.

Robinson, H. S., Carrillo, P. M., Anumba, C. J. & Al-Ghassani, A. M. (2005) Knowledge management practices in large construction organisations. Engineering, *Construction and Architectural Management*, 12(5), pp 431-445.

Shepherd, L. (2022) Be aware of legal challenges with hybrid work. Available from: https://www.shrm.org/resourcesandtools/legal-and-compliance/employmentlaw/pages/hybrid-work-legal-challenges.aspx [Accessed 3rd April 2024 2024].

Silvestre, H. C., Marques, R. C. & Gomes, R. C. (2018) Joined-up Government of utilities: a meta-review on a public–public partnership and inter-municipal cooperation in the water and wastewater industries. *Public Management Review,* 20(4)**,** pp 607-631.

Spitzmuller, M., Xiao, C. & Woznowski, M. (2023) Managing team interdependence to address the Great Resignation. *Personnel Review,* 52(2), pp 425-433.

Van Buuren, A., Lewis, J. M., Guy Peters, B. & Voorberg, W. (2020) Improving public policy and administration: exploring the potential of design. *Policy & Politics,* 48(1), pp 3-19.

Williamson, S., Pearce, A., Connor, J., Weeratunga, V. & Dickinson, H. (2022) The future of working from home in the public sector: What does the evidence tell us? *Australian Journal of Public Administration,* 81(1)**,** 640-648.

Wu, X., Howlett, M. & Ramesh, M. (2017) *Policy capacity and governance: Assessing governmental competences and capabilities in theory and practice*, Springer.

Yang, L., Holtz, D., Jaffe, S., Suri, S., Sinha, S., Weston, J., Joyce, C., Shah, N., Sherman, K. & Hecht, B. (2021) The effects of remote work on collaboration among information workers. Nature Human Behaviour, 6(1), pp 43-54.

Yin, R. K. (2015) *Qualitative research from start to finish*, Guilford publications.

The Impact of Relationships on Knowledge and Leadership in Family Firms in the 21st Century

Agnieszka Rzepka and Magdalena Czerwińska
Department of Economics and Economic Management, Management Faculty, Lublin University of Technology, Lublin, Poland

a.rzepka@pollub.pl
m.czerwinska@pollub.pl

Abstract: Intellectual capital reflects the knowledge and thinking capacity that a particular company can use to achieve benefits (Muslih, 2021). It is often identified with organizational capital (Beltramino, 2020). At the same time, the significance of a human is to intellectual capital resources is often emphasized (Dessein & Pratt, 2022; Ozgun, 2022). Interactions between employees within an organization, as well as between employees and the environment, are of significant importance. Relations of this kind are even considered relational capital (Zhang, 2022). Family firms are pervasive organizations (Calabrò, et al.,2019) in all economies worldwide, and evidence shows that the presence of family in a business impacts the firm under wide range of circumstances. Innovation is a prominent one of them, and this study examines the way families affect innovation antecedents, activities, and outcomes. Research has shown that even though organizations expect leaders to have new skills, they still largely promote traditional models and mindsets. The authors draw on their study conducted over the last five years. The study is part of a larger research project. The research comprised four stages, with the number of enterprises surveyed in stage 1 being N=605. The results demonstrate the significant potential of this type of work and the numerous research gaps that remain for future exploration. Organizations should develop their leaders' skills and evaluate leadership in a way that allows them to successfully navigate ambiguity, take responsibility for handling rapid change, and engage with external and internal stakeholders. There is therefore an obvious gap between what organizations should do to support 21st-century leaders and what is currently happening. Today, 21st century leaders of the must adopt an agile approach to leadership and management, be proactive, and look for opportunities that will allow them and their teams to grow and develop.

Keywords: Leadership, Family Firm, Knowledge, Intellectual Capital, Inter-Organization Relations

1. Introduction

Inter-organizational relations between independent entities are now considered one of the key development trends in modern mechanisms for creating the competitiveness of enterprises (Arzubiaga, et al., 2018).

Management science and organizational theory contain a variety of concepts that underline the growing importance of inter-organizational cooperation (including, for instance, coopetition, network governance, and project management). There are also articles devoted to new organisational structures such as clusters, partnerships, networks, and alliances.

When examining the concept of interorganizational relations (Rzepka, 2023), it is imperative to emphasize the necessity of shaping connections between individual links according to the principles of trust and the division of risk and benefits. Relationships of this nature lead to additional synergistic effects and, as a result, a competitive advantage (Witkowski 2003).

At present, interorganizational relations are considered an increasingly important source of competitive advantages and profitable results (Grandor, 2012; Dyer et al., 1998). In this regard, interorganizational relations can be interpreted as a multi-subject action that is designed to achieve mutually consistent goals (Möller & Svahn, 2003).

1.1 The Role of Human Capital in Relationships Among Companies

Not only do properly shaped inter-organizational relationships provide access to valuable resources in the form of human capital, but they are also conducive to the creation, connection, and sharing of resources, as well as the acquisition of values for those involved in the arrangement. According to some managers, "as long as the value is being generated, everything in the relationship remains satisfactory" (Ritter, 2008).

Undoubtedly, the success of any modern enterprise depends largely on how its relationships with others are handled (Skalik, 2006). Hence, enormous importance is placed on the role and activity of the executive team, employees, and teams that are willing to collaborate with external entities. A significant role in the company's development is assigned to human capital that uses its own competence, intellectual ability, motivation, and

abilities to perform certain organizational roles, including the development of inter-organizational relationships (Vesperi, et al, 2023). Relationships (Bouazzaoui, et al., 2020) with customers, suppliers, competitors, and other stakeholders are built by the company's employees. It should be kept in mind that structural capital is formed through human capital, among other elements. It includes new products, patents, licenses, software, technologies, and relational capital (i.e., reputation, customer loyalty, and strong relationships with stakeholders) (Jackson & Dunn-Jensen, 2021).

Ability and competence, especially relational competencies associated with the use of knowledge, skills, abilities, and attitudes in the area of cooperation, are particularly important in the evolution of relationships (Rzepka, 2017). The creation of relational capital is supported by direct and personal contacts (links) of employees and executives with stakeholders, which are based on the ability to collaborate, on the capacity trust others, and on one's own credibility and one's core competencies. It is created on the basis of relational (Daghar et al., 2021) resources that are formed between the company and external stakeholders. It is a consequence of establishing appropriate relationships with customers, distributors, suppliers, and other entities that the company interacts with.

Relational capital could determine the efficacy of the company's affairs and its market success, both from a static perspective (seen as a resource associated with interpersonal relations) and from a dynamic perspective (seen as the ability to create and maintain close and lasting relationships based on trust and collaboration). Relational capital is created on the basis of inter-organizational relationships that involve employees as well as management (Versiani et al., 2021). It cannot function as a separate phenomenon, but it exists only in relation to human and structural capital, both of which create intellectual capital. In contrast to structural capital that remains the company’s property, relational capital is described as difficult to manage and control. This belief stems mostly from the particular characteristics of this kind of capital as ittakes an intangible form that is hard to describe, quantify, and measure.

The relationsships between the collaborating entities are unique and unrepeatable. This is attributable to the specific arrangements between the parties. Hence, a possible acquisition or replication of such relationships by other rival entities may lead to a number of hindrances.

As strong bonds between the entities involved in the relationship form and develop, they result in a flow of knowledge and information (Kellermanns et al. 2012). And this, in turn, results in the creation of a new range of products or innovations that foster the development of value.

The relations between the parties are fortified by dynamic changes in the environment as they lead to greater flexibility in the organization's activities in the area of problem-solving and decision-making byh involving the organization’s own competences and those of other entities’ . The transfer of knowledge is carried out through the means of human and relational capital, whereas the acquisition, maintenance, and renewal of resources necessary to create structural capital are carried out through the means of relationships.

Those involved in a relationship must identify variables prior to, during, and at the end of the relationship. These variables tend to be found in the areas associated with benefits and costs that arise as a result of the collaboration. Such values as trust and honesty, respect, openness, and clear rules of communication play an important role in the formation of inter-organizational relationships pertaining to human capital. Moreover, the evolution of the criteria for determining value indicates that the non-material criteria are becoming increasingly important, which stems from the growing complexity of economic interactions. Therefore, the determination of value is burdened with a constantly growing level of subjectivity and uncertainty.

1.2 Family Business

Family firms are the most predominant form of business organization and account for a large proportion of employment, business turnover, and gross domestic product (Bjuggren, Johansson, & Sjögren, 2011). The involvement of families in firms’ ownership, management, and governance is a key driver of organizational attitudes (Bennedsen & Foss, 2015), behaviors, and performances, especially those related to innovation. Since the beginning of the 21st century, academic interest in innovation within family companies has bloomed. This body of research has mostly emerged from family firm scholars, while mainstream innovation scholars have often overlooked family-related variables in their studies. Indeed, innovation is one of the main components of research on family firms that integrates family and business aspects and leads to a plethora of occasionally contradictory findings.

Family firms serve ast a unique setting for research because of the simultaneous existence of two fundamental sociological systems: the family and the business (Holt et al., 2018). Family ownership is the most prevalent type of business ownership worldwide (La Porta et al., 1999). Not only are the vast majority of small- and medium-sized firms family owned and managed, but large public firms are often controlled by families. Conceptually, what constitutes a family business is the subject of great debate in research on family businesses Daspit et al., 2021).

For the purpose of this study, a family firm is conceived according to the most comprehensive and reputable definition by Chua, Chrisman, and Sharma (1999), where the family business is a business governed and/or managed with the intention to shape and pursue the vision of the business held by a dominant coalition that is controlled by members of the same family or a small number of families in a manner that is potentially sustainable across generations of the family or familie.This definition helps distinguish family from nonfamily firms. Research on family businesses seeks to understand family firms in order to provide recommendations and/or frameworks to guide professionals to improve their performance, accelerate their development, and ensure their business' sustainability in the long run (Miller & Le Breton-Miller, 2005). Innovation is a means to stay relevant and competitive in the market. Thus, developing knowledge about family firm-generated innovation can help family firms thrive, thereby contributing to global economic prosperity.

2. Methods

The empirical aspect of this study is founded upon a structured investigation that forms part of an international project entitled *Teal Organizations in Economy 4.0*. The project was conducted across countries such as Poland, England, Hungary, Ukraine, the Czech Republic, Spain, Georgia, and the USA, focusing on the management personnel. The procedure for conducting research encompassed three stages: a pilot study in 2020, a foundational study in 2021, and subsequent follow-up studies in 2022 and 2023. The study included management personnel from a variety of small and medium-sized enterprises (SMEs) of varying size and spanning various geographical scopes. The selection of companies was based on the availability of SMEs, and the research was carried out by using a certified research platform.

This article focuses specifically on the 2022 study, which collected a total of 620 surveys (two rounds of 310 surveys) through a nationwide research platform. The primary data collection tool was a proprietary questionnaire, which was distributed in accordance with CAWI (Computer-Assisted Web Interviewing) technology standards. The survey was broken down into topics related to organizational leadership, innovation, and technologies implemented by the businesses participating in the study. These included existing relationships, agility and creativity, social capital, knowledge and information, trust, structure, and organizational culture. The research was and will continue to be conducted in accordance with the OECD-DAL (Organization for Economic Co-operation and Development: Definition and Selection of Competencies) recommendations.

A variety of methods, including data analysis, in-depth individual interviews, and a questionnaire, were used to gain a comprehensive understanding of the subject matter under investigation. This three-dimensional approach facilitated a comprehensive study of the phenomenon. The questionnaire was divided into five sections, each with 5 to 7 questions addressing a different topic.

The study's primary goal was to determine whether a family-owned organization is not only innovative but also capable of generating, implementing, and disseminating innovation. Furthermore, the study's hypothesis posited that the ability of a family-owned innovative organization to create an atmosphere that encourages learning and idea generation influences how well the organization functions. The study also aimed to show that a leader's role in creating and managing an organization is to cultivate a suitable organizational culture, with knowledge, transparency, and good communication between staff members and the outside world being essential components. Ultimately, the study aimed to ascertain the traits and elements—such as courage, honesty, and intuition—that impact the preservation of sustainability within companies.

The chosen method of statistical analysis was the use of the $\chi 2$ test, Pearson's Chi-square test for independence. The statistical analysis of the data obtained from the surveys was performed by means of SPSS STATISTICS 21 computer software.

The range of activities carried out by study participants is displayed in Table 1, along with information about the study's geographical reach, workforce size, and industry representation.

Table 1: Characteristics of enterprises

Dominant modus operandi of the company (%)		Geographic scope of activity (%)		Number of employees (%)		Industry (%)	
Commercial	16.6	Local	9.4	0-9	3.3	Aircraft	5.3
Production	28.0	Regional	27.3	10-49	55.1	Fuel market	4.0
Service	55.4	National	22.0	50-249	16.6	Car industry	3.8
		International	41.3	250-999	16.6	IT	11.4
				1000 -and over	8.4	Education	3.8
						Research and development	4.0
						Gastronomy	5.2
						Construction industry	5.3
						Trade	3.4
						Banking sector	10.0
						Other	43.8

Source: own study based on research by A. Rzepka

The table indicates that the majority of the study's participants were men who held managerial positions (57.9%) in service businesses (62.7 and 75.8%), with a workforce consisting of 50–249 workers (28.3%) and a global reach (42.5%). The respondents were predominantly from the banking, construction, and aviation industries (column 4, table 1). It can be demonstrated, based on the study's hypotheses, that the research's base model (Rzepka A.) includes variables influencing every dependency.

3. Results

The study's results shed light on the complex dynamics within family businesses as they endeavor to make well-informed and sustainable decisions while balancing the need for intuition in their strategic choices. It becomes obvious that family firms seeking to integrate sustainability into their strategies often confront various challenges that result from the interplay between tradition and innovation. These challenges encompass generational disparities in values and perspectives, resistance to change within the family, and the crucial necessity of establishing effective communication channels that span both personal and professional spheres.

Table 2: Statements regarding a company leader

	I strongly disagree	I disagree	Hard to say	I agree	I strongly agree
In relations with subordinates, a good leader should strive to shape their independent thinking and responsibility for their actions	1.0	2.1	18.0	44.2	34.7
Vision is a characteristic of a good leader that unites and inspires the team to act	0.6	3.4	19.1	38.9	37.9
Humility is a characteristic of a good leader, thanks to which they have the ability to acknowledge they have been wrong	0.3	3.2	18.6	42.9	34.9

Source: a study based on Agnieszka Rzepka's research

As shown in Table 1, over 70% of respondents agree with the qualities of a good leader, i.e., vision, inspiring teams to act (38.9% and 37.9%, respectively). Similarly, regarding humility (i.e., good leaders should admit when they are wrong), more than 76% of respondents agreed with the statement (columns 4 and 5). Good leaders know, appreciate, and respect their colleagues; they motivate them to do fruitful work, show support during times of difficulty, and have all the prerequisites needed to manage a team effectively. Leaders have specialist skills such as knowledge and professional qualifications, innovative skills, creativity, and analytical thinking (Rzepka 2023). However, the most important characteristics are interpersonal skills related to team building. A leader with all the qualifications to manage but who cannot communicate with the group will not succeed. According to my research, the effectiveness of a leader also depends on having skills that can be learned and constantly improved, regardless of one's predispositions. The leader should master social skills in effective team building and leading, i.e., the ability to communicate effectively, listen actively, provide feedback, motivate to achieve goals, have a positive self-presentation, solve problems, and exhibit assertive behavior. An effective leader should also be a visionary, an entrepreneur, an initiator, and a person open to spontaneous changes.

The research revealed that the integration of familial and commercial interests in these businesses can present complex difficulties. The management of personal biases and conflicts of interest, accountability and

transparency issues, and other factors were identified as potential obstacles to the effective integration of sustainability into strategic decision-making processes. This underscores the need for a holistic and forward-thinking approach by leaders in family businesses, that respects the past while harnessing the power of sustainability to ensure the enduring success of both the family and the business.

The research findings also align with the global trend of leadership in the 21st century, moving towards sustainability as a central imperative. Successful leaders understand that, although crucial, their responsibilities cannot be limited to generating profits. Sustainable leadership demands a deep commitment to environmental stewardship and ethical governance. Those advocating for sustainability concentrate on the long-term financial health of their companies as well as achieving a lasting and beneficial effect on the environment and society. They understand that environmentally responsible business practices are not only ethically justifiable but also a source of innovation, resilience, and competitive advantage. Consequently, sustainability emerges as a guiding principle to inform decision-making in family businesses and compels them to approach the matter from a forward-thinking and eco-conscious perspective.

4. Conclusion and Discussion

Today, organizational change refers to the transition of an organization from one state of affairs to another. Every company must embrace organizational change if it wants to remain competitive. If done correctly, organizational change can turn any company into a more competitive, efficient, and better place to work. However, organizational change is not easy.

The study points out the evolving nature of decision-making within family businesses in response to advancing technology and changing business landscapes. While data-driven decision-making remains essential, there is a growing acceptance of intuition-based decision-making approaches. These instinct-driven approaches correspond to the importance of agility and flexibility in today's fast-paced business world. The findings suggest that intuition, which is often based on experience and industry knowledge, should complement empirical data in decision-making processes. In their pursuit of sustainability, family businesses should adopt a hybrid approach, leveraging both intuition and data to respond to evolving consumer preferences for environmentally responsible products.

Understanding the fundamentals of relationships and capital, as well as how businesses use them (Rzepka, 2017), can help businesses manage their resources more effectively and control how appealing they are to investors. In particular, the obtained results make it necessary to construct a measurement model to assess the use of these relationships and capital, for example, by companies of various sizes, various sectors, managers, and rank-and-file employees. When making this kind of research model, it is important to make sure that it can be changed to fit a smaller group of indicators that show how these interorganizational relationships and intellectual capital work in order to give a true picture of how much of each is present in businesses.

The collaboration of enterprises in creating interorganizational relationships and their impact on their ability to innovate is a phenomenon that is becoming more and more apparent in the area of shaping intellectual capital in changing environments.

As technology continues to advance and the business environment continues to undergo transformation, there is a growing willingness within family businesses to make decisions based on instinct. As observed in contemporary management practices, instinct-driven approaches to decision-making have been gaining scientific ground for some time now. This change is a turn toward more agility and flexibility, which fits better with the needs of today's fast-paced business world. While data-driven decisions undeniably offer advantages, the intrinsic value of intuition and experience should not be underestimated. Conversely, it is important to recognize that instinct should not supplant data and analytics entirely. Instead, family businesses should take a complementary approach when seeking to be sustainable, using both intuition and empirical data to answer changing consumer preferences for environmentally responsible products.

Family firms are pervasive organizations in all economies worldwide, and evidence shows that the presence of the family in the business affects the firm in a wide range of circumstances. Innovation is a prominent one, and this study has examined how the family influences innovation antecedents, activities, and outcomes. The purpose of the framework is to synthesize the current understanding of family firm innovation and leadership and identify future directions that require further academic attention to deepen and extend knowledge about this crucial phenomenon.

References

Arzubiaga, U., Iturralde, T., Maseda, A., & Kotlar, J. (2018). Entrepreneurial orientation and firm performance in family SMEs: The moderating effects of family, women, and strategic involvement in the board of directors. *International Entrepreneurship and Management Journal*, *14*(1), 217–244.

Beltramino, N.S., García-Perez-de-Lema, D., & Valdez-Juárez, L.E. (2020). The structural capital, the innovation and the performance of the industrial SMES. *Journal of Intellectual Capital*, Vol. 21 No. 6, 913–945. Doi:10.1108/JIC-01-2019-0020.

Bennedsen, M., & Foss, N. (2015). Family assets and liabilities in the innovation process. *California Management Review*, *58*(1), 65–81.

Bjuggren, C., Johansson, D.,& Sjögren,H. (2011). A Note on Employment and Gross Domestic Product in Swedish Family-Owned Businesses: A Descriptive Analysis, *Family Business Review, 24*(4), 362–371.

Calabrò, A., M. Torchia, M, D.G. Jimenez, and S. Kraus. (2021). The role of human capital on family firm innovativeness: The strategic leadership role of family board members. *International Entrepreneurship and Management Journal* 17(1): 261-287.

Calabrò, A., Vecchiarini, M., Gast, J., Campopiano, G., De Massis, A., & Kraus, S. (2019). Innovation in family firms: A systematic literature review and guidance for future research. *International Journal of Management Reviews*, *21*(3), 317–355.

Chua, J. H., Chrisman, J. J., & Sharma, P. (1999). Defining the family business by behavior. *Entrepreneurship Theory and Practice*, *23*(4)*, 19–39.*

Daspit, J. J., Chrisman, J. J., Ashton, T., & Evangelopoulos, N. (2021). Family firm heterogeneity: A definition, common themes, scholarly progress, and directions forward. *Family Business Review*, *34* (3), 296–322*.*

Dessein, W., & Prat, A. (2022). Organizational Capital, Corporate Leadership, and Business Dynamics. *Journal of Political Economy, Vol. 6*, 1477–1536. Doi: 10.1086/718985.

Dyer, J. H. & Singh, H. (1998). *The relational view: Cooperative strategy and sources of interorganizational competitive advantage, Academy of Management Review 23*(4), .

Grandor, A. (2012) Interfirm Networks: *Organization and Industrial Competitiveness*, New York: Routledge.

Holt, D. T., Pearson, A. W., Payne, G. T., & Sharma, P. (2018). Family business research as a boundary-spanning platform. *Family Business Review*, *31* (1), 14–31.

Jackson, N. C., & Dunn-Jensen, L. M. (2021). Leadership succession planning for today's digital transformation economy: Key factors to build competency and innovation. *Business Horizons*, *64*(2), 273-284. Doi: 10.1016/j.bushor.2020.11.008.

Kellermanns, F. W., Eddleston, K. A., Sarathy, R., & Murphy, F. (2012). Innovativeness in family firms: A family influence perspective. *Small Business Economics*, *38 (1), 85–101.*

La Porta, R., Lopez-de-Silanes, F., & Shleifer, A. (1999). Corporate ownership around the world. *Journal of Finance*, *54(*2), 471–517.

Miller, D., & Le Breton-Miller, I. (2005). *Managing for the long run: Lessons in competitive advantage from great family businesses*. Harvard Business Press.

Möller, K. & Svahn, S. (2003). *Managing Strategic Nets: A Capability Perspective*, *Marketing Theory, 2*(3)/2003, .

Muslih, M., Wati, T., Agustin, R., & Lestari, A. F. R. (2021). Intellectual Capital Disclosure. *International Journal of Multidisciplinary Research*, *4*(6), 1–8http://ijmrap.com/wp-content/uploads/2021/11/IJMRAP-V4N5P112Y21.pdf.

Ozgun, A. H., Tarim, M., Delen, D., & Zaim, S. (2022). Social capital and organizational performance: The mediating role of innovation activities and intellectual capital. *Healthcare Analytics*, 2, 100046, Doi: 10.1016/j.health.2022.100046.

Rzepka, A. (2017). *Inter-organizational relations as a one of sources of competitive ad-vantage of contemporary enterprises in the era of globalization*, *Procedia Engineering, 174,*

Rzepka, A., & Sabat, A. (2022). Knowledge Creation in Teal Organizations. In: Rzepka, A., Olesiński Z., & Jędrych, E. (Eds.). *Self-Management, Entrepreneurial Culture, and Economy 4.0 : A Contemporary Approach to Organizational Theory Development,* 184–196, New York: Routledge. Doi: 10.4324/9781003213048-15

Rzepka, A. (2023). *Innovation in the Digital Economy: New Approaches to Management for Industry 5.0*, New York: Routledge.

Versiani, A.F., Cruz, M.A., Rezende, S.F.L., & Castro, J.M. (2021). Absorptive Capacity, Innovation, and External Sources of Knowledge: The Brazilian Power Sector. *Revista de Administracião Mackenzie*, *22*(5), eRAMR.210083. Doi: 10.1590/1678-6971/eRAMR.210083.

Witkowski, J. (2003). *Zarządzanie łańcuchem dostaw. Koncepcje, procedury, doświadczenia.* Warszawa: PWE.

Vesperi, W., & Coppolino, R. (2023). Inter-organizational relationships in agri-food sector: a bibliometric review and future directions. *British Food Journal, 125*(1), 82–95.

Daghar, A., Alinaghian, L., & Turner, N. (2021). The role of collaborative interorganizational relationships in supply chain risks: a systematic review using a social capital perspective. *Supply Chain Management: An International Journal, 26*(2), 279–296, 279–296.

Bouazzaoui, M., Wu, H. J., Roehrich, J. K., Squire, B., & Roath, A. S. (2020). Justice in inter-organizational relationships: A literature review and future research agenda. *Industrial Marketing Management*, 87, 128–137.

The Role of the Freight Exchange in Knowledge Management of A Logistics Company

Robert Sałek and Anna Wiśniewska-Sałek
Czestochowa University of Technology, Poland

robert.salek@pcz.pl
a.wisniewska-salek@pcz.pl

Abstract: The growing importance of digitization of economic processes forces logistics companies to use modern technologies. This is a trend visible throughout the economy which has a significant impact on the logistics industry. The amount of processed information is constantly increasing and managing it is becoming a growing challenge. Freight exchanges are an integral component of the functioning of transport companies dealing with transportation of goods. This primarily applies to road transport, which constitutes the largest share in European transport. The use and role of freight exchanges are constantly growing. These are tools that enable obtaining information about cargo and transport services which is used in planning transport processes of logistics companies. The activities of logistics companies involve constantly acquiring information about potential customers. Transport processes require careful preparation and detailed planning of all activities performed during the transport of cargo. The dynamics of the logistics market do not always allow the full use of cargo space in vehicles, which is associated with a decrease in transport efficiency and thus a reduction in companies' profits. Therefore, the knowledge about additional loads, due to which companies will be able to fill empty cargo spaces or entire empty runs, is necessary. This is of great importance for companies from the SME sector, which often must compete on the market with large entities. Transport exchanges are, by definition, a valuable source of information on the basis of which the internal knowledge base is created, which also requires appropriate management. The authors conducted the research among small and medium-sized transport companies both nationwide and with international reach in Poland. This research was aimed at identifying the features and demonstrating the role of freight exchanges as a source of knowledge for enterprises. The process of planning the transport process was analyzed for the variant with and without the use of the freight exchange. A decision-making algorithm was defined, the task of which is to structure and organize knowledge in the field of the transport process preparation. The importance of digital tools in knowledge management was also emphasized.

Keywords: Transport, Management, Electronic Freight Exchanges, Road Transport, Knowledge Management

1. Introduction

Road transport plays a key role in ensuring the smooth running of logistics processes and the movement of goods and people in the economy. Due to continuous improvements and adaptations to the increasingly demanding market needs, it constitutes a strategic service sector with high popularity. Its significance for enterprises in satisfying transport needs is irreplaceable, which makes it one of the most important branches of transport in the economy (Miller and Nie, 2018). Due to the availability and the most developed infrastructure, it enables direct deliveries. Moreover, it can be used in combination with other branches of transport, which allows for comprehensive and effective supply chain management. Therefore, diverse logistics needs can be satisfied, and better operational results can be achieved (Pyza, 2010). Versatility and flexibility in transport are crucial for the effectiveness of many enterprises. Due to the possibility of delivering goods directly to customers, the company may offer a fast and effective service, which translates into increased competitiveness on the market (Nowakowska-Grunt and Strzelczyk, 2019). The use of freight exchanges is becoming more and more popular among companies since they help effectively manage logistics processes in today's digital world. They enable companies to optimize their transport operations, improve performance and costs, and increase visibility and control over their shipments (Palczewska, Barwiński and Borowiecki, 2015).

2. Literature Overview

2.1 Electronic Freight Exchanges

Information technology-based solutions in the transport industry, such as freight exchanges, have existed for years, but there are still challenges to automate and optimize processes. Electronic platforms provide an opportunity to transmit information about loads and obtain orders, but the process of adaptation of loads to vehicles and transaction finalization still requires the intervention of managers or brokers. There is still potential for further development and improvement in these solutions to ensure more efficient and automated functioning (Miller, Nie and Liu, 2020). Electronic transport platforms allow transport companies to flexibly adapt to changes in demand and provide quick access to offers from all over Europe (Wu, Huang and Chen, 2024).

Cabotage is becoming more and more popular among Polish transport companies, which allows them to generate profits without having to incur costs related to road infrastructure in Poland (Kisielewski and Leśniakiewicz, 2016). It is therefore crucial to use effective and developed transport platforms to maximize benefits for the country's economy (Ajith *et al.*, 2023). Electronic transport platforms, despite their great development in the last decade, remain relatively unknown to many employees of companies in the TSL industry (Grabowska, 2018). However, freight exchanges are gaining popularity among people who want to develop their careers in this industry, which may contribute to increasing the awareness of the possibilities and operating procedures of these platforms (Jenkins, 2024). The implementation of modern information technologies in the transport industry is crucial for the operational efficiency and competitiveness of companies (Norman-López *et al.*, 2023). The possibility of fast and efficient transaction and exchange of transport services contributes to the optimization of logistics processes, cost reduction and an increase in competitiveness on the market. Therefore, enterprises can dynamically respond to changing market conditions and take advantage of new development opportunities (Leończuk, 2013). Freight exchanges are an important component for the effective functioning of the logistics industry, enabling companies to access a variety of carriers and loads and streamlining the exchange of information between transport market participants (Choudary, Van Alstyne and Parker, 2019). Thanks to them, companies can quickly find the best transport solutions, which contributes to the optimization of logistics processes and reduction in transport costs (Witkowski, 2019).

2.2 Knowledge Management in the Transport Company.

Knowledge has become a key component for the organization, enabling it to develop and gain a competitive advantage on the market. Due to proper knowledge management, organizations can quickly respond to changes, innovation, and new challenges, which translates into their success and leadership in the industry. This is especially important in the era of globalization and dynamic changes, where the ability to effectively use knowledge may be decisive for the survival and development of the organization (Asrar-ul-Haq and Anwar, 2016). Modern enterprises increasingly recognize logistics as a key component of creating the company’s value, primarily through flexibility, integration, comprehensiveness, and coordination of processes (Budzik and Cichoń, 2023). Knowledge management (KM) is a key component for organizations due to the possibility of using their knowledge resources to improve strategy, decisions, and effectiveness. Through effective knowledge management, organizations may achieve sustainable commercial benefits, as evidenced by numerous studies and authors in the field of knowledge management. This is important for improving knowledge practices, organizational behavior and achieving better performance (Ngah and Bontis, 2016).

The development of the Transport-Shipping-Logistics (TSL) sector covers a wide range of assets, including knowledge, skills, and organizational processes. The key role in gaining a competitive advantage is played by the appropriate and effective management and use of these resources, such as employee competences, infrastructure, training, knowledge, brand, technologies, and customer service skills. The market success of transport companies depends on a comprehensive approach to the management of available resources and accumulated knowledge, as well as on the improvement in operational processes (Kowalska, 2021).

The use of appropriate IT tools such as telematics systems, logistics project management and knowledge management software is crucial for the efficiency and competitiveness of the company. Thanks to them, it is possible to improve business processes, optimize activities and use resources better, which translates into the company's success and development on the market (Pisz and Łapuńka, 2014). The implementation of modern IT systems, especially integrated logistics systems, plays a key role in the long-term development of enterprises. These tools enable the optimization of both internal and external communication through effective data exchange between various departments of the organization and with contractors. The development of these technologies is a consequence of changes in the approach to economic processes and increased significance of information and knowledge, which allows enterprises to improve their strategies and business models (Misztal and Fajczak-Kowalska, 2020). The approach to practical origins of knowledge indicates that knowledge in organizations has its roots in practices and is closely related to them. Since this knowledge cannot stand alone, there is a need to transfer it through sharing practices. Where practices are shared, knowledge flows, and where they are not, knowledge sticks to the context. Such a model confirms the integral relationship between knowledge and practices in organizations (Chen, 2022). Nowadays, in order to operate effectively, companies from the TSL industry should include the aspect of knowledge management in their business model. A complex knowledge management system (KMS) includes the processes of acquiring, selecting, processing, codifying, transferring, and creating knowledge, as well as sharing it and updating the knowledge base. The concept of knowledge management as a key company resource is based on the resource approach, which treats knowledge

as an important component of the organization's success. This requires the cooperation of five key components, such as importing knowledge from the environment, implementing new tools and technologies, experimenting, joint problem solving and developing key skills of employees. This is a key component that should be considered in the development strategy of companies from the TSL industry (Janczewska, 2018).

3. Research Methodology

The methodology developed for the purposes of this study concerns activities the research objective of which is to determine the share and importance of electronic freight exchanges in enterprise knowledge management. The subsequent stages of the research work are presented in Figure 1.

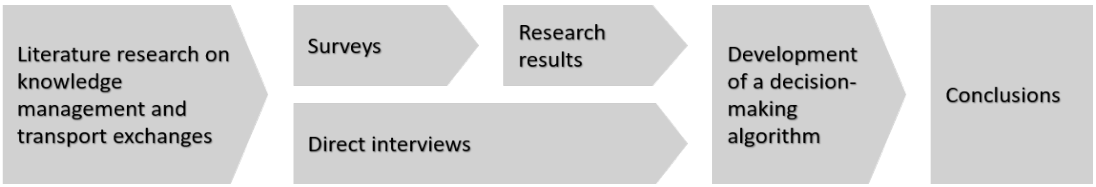


Figure 1: Research methodology diagram

Source: Own study

In order to determine the role of electronic freight exchanges in the activities of enterprises, the survey research method was applied (Nowak, 2024). The research addressed to logistics companies was conducted using a survey questionnaire. The survey form was constructed based on the knowledge of the selected topic and observations of individual practices in this area. The first part of the survey concerned determining the type of the enterprise participating in the study. The aspects considered included the duration of the company's operations on the market, the company's size in terms of employment and the scope of the company's operations. This allowed for specifying what types of enterprises use (or do not use) freight exchanges. The second part of the survey related to only freight exchanges. This part of the survey was completed only by the companies that support their activities using this tool. The issues raised in this part were to specify whether the freight exchange in the company is a relatively new tool and when they started to gain popularity among the respondents. The study was also to determine which freight exchange is the most popular, what purpose they are used for and how high, within the percentage range, companies rate their utility. When considering the results obtained using the survey, an attempt was made to determine the significance of freight exchanges and the following questions were answered:

- What types of companies are most likely to use freight exchanges and which ones prefer other methods of supporting transport?
- When did the freight exchange gain popularity among the respondents?
- Which freight exchange is the most popular among the surveyed enterprises?
- What role do freight exchanges play in individual enterprises?
- To what extent do they support transport processes?
- Is the freight exchange a basic or auxiliary tool?
- Will the activities of freight exchanges be expanded in the future?

Additionally, a decision-making algorithm was developed to structure the transport process. The objective of the actions taken was to isolate individual activities in the process of planning and organizing transport using the freight exchange to support the process. The algorithm was used to isolate the activities carried out, decision-making problems arising in the process and the expected consequences of the activities. The information resources of a medium-sized transport company providing domestic and international transport of goods in the form of full-truck loads and general cargo was used as the research subject.

The examined company is a family company carrying out transport orders in Poland and abroad. It obtains transport orders primarily through constant cooperation with regular customers and those acquired through participation in fairs and trade meetings. Based on the company's transport orders, the research was undertaken in the form of a direct interview, which was aimed at obtaining information for creating a decision-making algorithm for planning and organizing transport using the freight exchange. The following questions were answered:

- What activities does the process of planning and organizing transport consist of?

- What decisions are made during the process?
- What are the consequences of the decisions and actions taken?
- What is the course of the process of acquiring a customer in the execution of a standard order?
- At what stage does the company use the freight exchange in the transport process?
- What is the course of the process of acquiring a customer in the execution of an order using the freight exchange?
- What activities and decisions are made in the transport process using the freight exchange?
- What role does the freight exchange play?

The results of the first part of the research are presented in the form of charts illustrating the structure of the responses along with descriptions. The second part concerns the development of the decision-making algorithm in graphical terms and the characteristics of the role played by freight exchanges in the context of management of planning and organizing transport processes.

4. Research Results

4.1 The Survey

The survey consisted of ten questions, all of which were closed-ended questions. In the set of closed-ended questions, two of them were conjunctive questions in which the respondents could select several options. Completing the survey took approximately 3 minutes. The questionnaire was delivered to the respondents in 100% in an electronic form. The research was conducted for approximately 30 days, and as a result, 108 responses were received. The survey results and the distribution of responses are presented at Figure 2.

The analysis of the data for the first question indicates that most of the surveyed companies have been operating on the market for a relatively short time, from 1 to 5 years, constituting exactly half of the respondents. Only 26.9% of the enterprises have been operating on the market for over 10 years, and the group of companies with operation from 6 to 10 years amounts to 15.7%. The companies operating for less than a year constitute a small group, amounting to only 7.4%. The operations of companies in various scopes of time on the market are diverse and may affect their strategies and experience.

In terms of the analysis of the number of employees in the surveyed enterprises, the largest group was large enterprises hiring 250 or more employees (33.3%), followed by medium-sized logistics companies employing from 50 to 249 people (27.8%), small companies employing from 10 to 49 people (22.2%), and micro-enterprises hiring less than 10 employees (16.7%). Such distributions indicate the diversity of the employment structure in the surveyed companies.

The results of the survey indicate that most companies, since as much as 66.7%, operate internationally, while the remaining ones only domestically. It can be noticed that there is a significant difference between the companies operating locally and those with global presence, which may be related to various business strategies and the scope of activities of these companies.

The next question was to determine what percentage of the respondents use electronic freight exchanges. The confirmatory result was 77.8%, which leads to the conclusion that these tools are commonly used in logistics companies. This is the evidence that demonstrates their significant share in the logistics market and confirms that they are an important solution for the effective management of transportation of goods.

Another issue was to determine how long enterprises have been using electronic freight exchanges.
The dominant group turned out to be the companies that have been using freight exchanges for 1 to 5 years, accounting for 60.2% of all the respondents. 20.4% of the surveyed logistics companies have been using freight exchanges for less than 1 year. The companies that have been using freight exchanges for 6-10 years constitute a slightly smaller group, their percentage share is 13%. Only 6.5% of the respondents declared the use of freight exchanges for more than 10 years. This proves the increasing significance of freight exchanges in the logistics of enterprises and their growing popularity.

In terms of the question regarding the use of specific electronic freight exchanges, the respondents indicated that they most often use the Trans (60.2%) and TimoCom (46.3%) exchanges, which suggests their great popularity among users resulting from the reach and access to contractors. Less popular platforms are CargoGlob (20.4%) and Teleroute (13%). Only 6.5% of the respondents use the Wtransnet exchange and other

unnamed exchanges. When analyzing the answers to the above question, it can be noticed that the Trans and TimoCom exchanges are very popular.

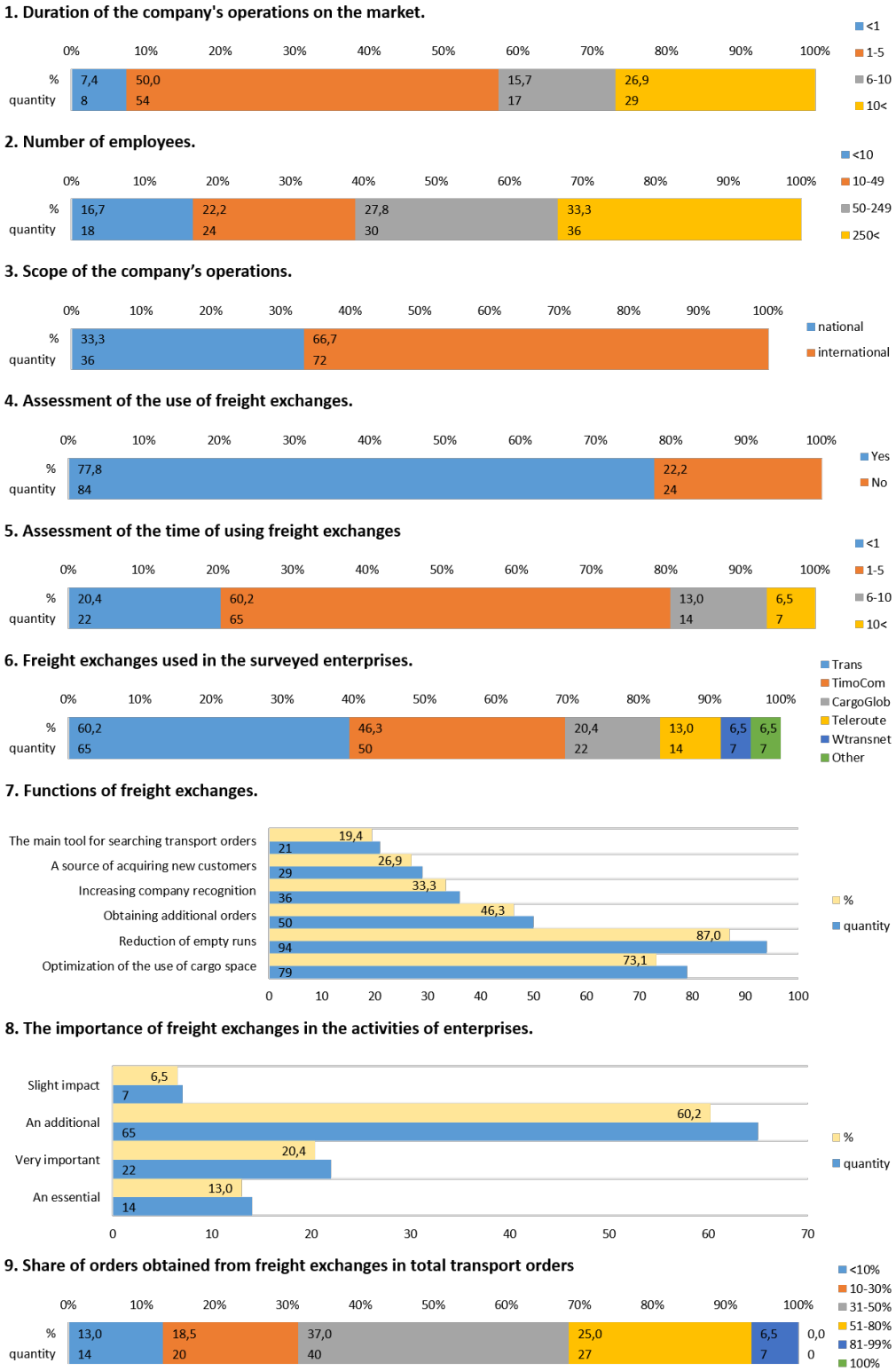


Figure 2: Distribution of responses from a survey conducted in transport companies

Source: Own study

Another important issue concerned the role of the freight exchange in the surveyed logistics companies. In this case, the respondents also had an opportunity to select several possible options. The vast majority of those

questioned (87%) described the role of the freight exchange as a way to reduce empty runs. For 73.1% of the respondents, freight exchanges are used to optimize the use of vehicle cargo space.

Additionally, about half of the respondents (46.3%) obtain additional orders during their runs thanks to freight exchanges. Increasing the company's recognition was declared by 33.3% of those questioned. 26.9% of the respondents describe the role of electronic freight exchanges as a source of acquiring new customers. The smallest group is the companies for which the freight exchange is the main tool for searching for orders - 19.4%.

Another issue was to determine the percentage share of orders obtained from freight exchanges in the total transport performed. Most respondents (37%) declared a percentage share in the range of 31-50% of orders. A quarter of the respondents indicated the range of 51-80%. For 18.5% of those questioned, the percentage of orders obtained from freight exchanges is 10-30%. On the other hand, 13% of the surveyed enterprises marked the range below 10%. Only 6.5% of the companies stated that the percentage of orders was 81-99%, while none of the respondents answered that they obtained 100% of orders from freight exchanges. The use of freight exchanges in searching for orders can be described as effective.

The last question was to determine whether the surveyed companies plan to expand their activities by using freight exchanges in the future. Among the respondents, no one declared this type of activities in the future, which is puzzling due to the increasing digitization of economies.

4.2 Decision-Making Algorithm and Knowledge Management System

The presented decision-making algorithm (Fig.3) illustrates the process of planning and organizing transport in the company specializing in road transport. It also shows the position of the company's knowledge management system in terms of the resources needed to implement the process.

The first stage of the process is to acquire customers. The following methods of acquiring customers in the surveyed company were considered: permanent cooperation; the customer present in the company's database, but not cooperating with the company on a permanent basis; customers acquired by participating in fairs and sales meetings. These are the three main ways of acquiring customers by the surveyed company. In the case of regular customers, the activities aimed at determining their credibility and possibilities of providing transport are omitted during the planning process, since they were inspected when establishing the cooperation. The following activities are not omitted in the case of customers acquired through sales meetings and customers appearing in the company's database. The surveyed company controls the credibility of contractors present in the databases using interviews and previous experience related to the fulfillment of transport orders. The company inspects the following aspects:

- did the customer pay for transportation?
- were they behind on payment?
- did the cooperation go smoothly?

If the answers to the above questions are positive, the company determines the potential contractor as suitable for cooperation. The credibility of customers acquired through sales meetings is determined by examining whether the company actually exists, through searching for customer opinions and conducting an initial interview. Based on the type and weight of the load, the loading location and the target unloading location, it is assessed whether the transport order can be completed for the company. If the customer is assessed as unreliable and/or it is impossible to fulfill the transport order, the offer is rejected. If the potential customer meets the above conditions, the details of the offer are discussed in more detail during the interview. It specifies potential means of transport, the exact route by the carrier, the method of securing goods and the formalities related to the contract and transport documentation. The initial quote for the order, methods and payment date are also determined. If the customer agrees to the transport conditions specified in the contract, the order is accepted and then generated in the system. In the absence of full agreement, the parties will attempt to negotiate a valuation. If, during negotiations the parties fail to find a solution, cooperation is not undertaken. The next stage is the analysis of the exact route by the examined company. It is determined whether the route will require supplementation. If there are no empty runs, the transport documentation is completed. If it is necessary to supplement the route, the company looks for customers using the Trans.eu freight exchange.

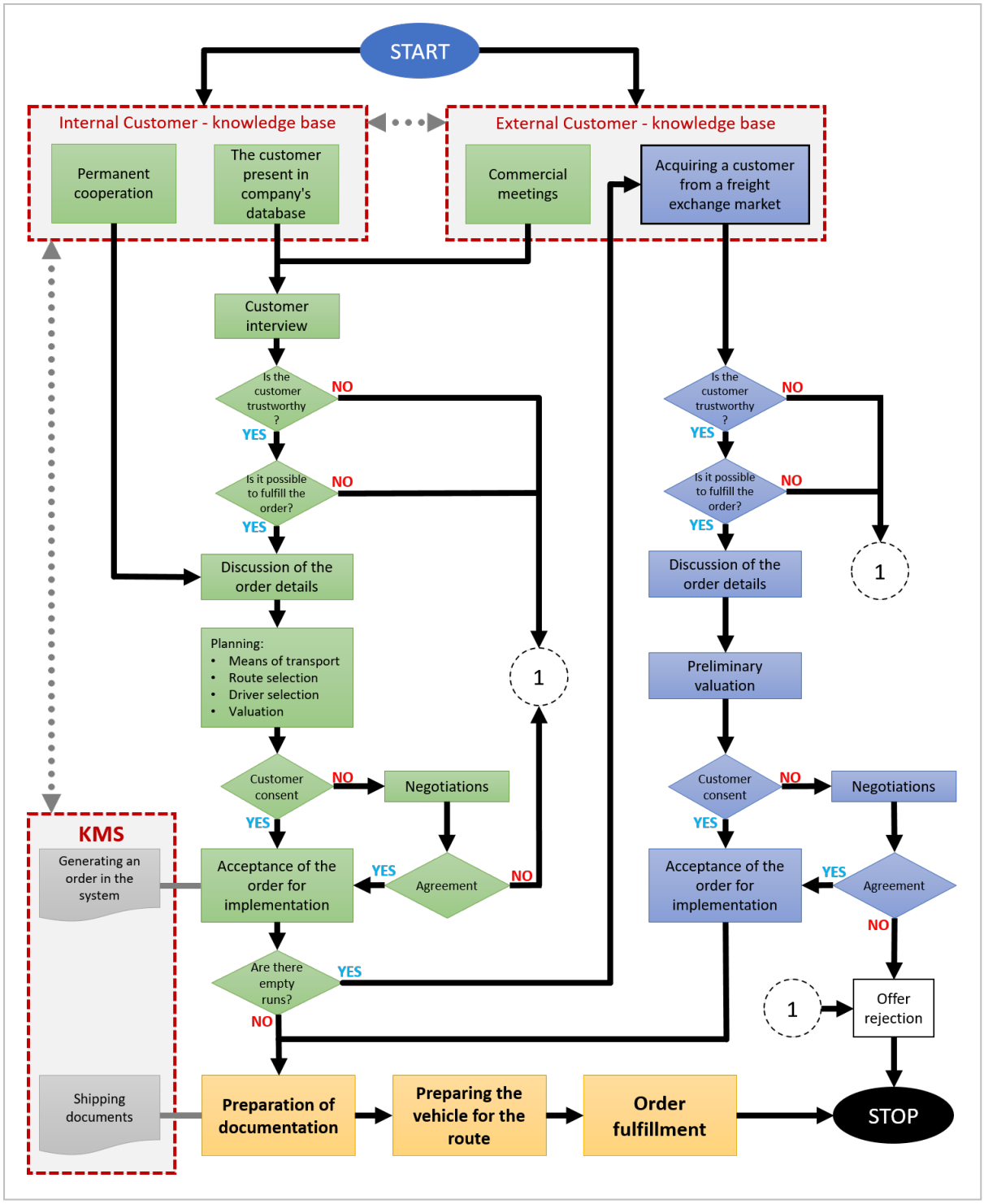


Figure 3:Algorithm for planning and organizing transport and KMS approach.

Source: Own study

The company searches for available goods and publishes its own advertisements. The credibility of the customer acquired by the company through the freight exchange is assessed based on the opinions provided by the freight exchange users who have cooperated with the potential contractor. Through the Trans.eu chat, the parties determine the type and quantity of goods and the date of transport. After obtaining the necessary information, the company determines whether the transport order is feasible. If it is not possible to fulfill the order, the company rejects the offer. If transport is undertaken, its details are discussed, and the rate is proposed. Like in other cases, the order is accepted if the customer agrees to the price, if not - the companies negotiate with each

other. If the negotiations are successful and the companies reach an agreement, transport documentation is prepared. The final stage of the planning and organization process is preparing the vehicle to set off on the road. This activity takes place in a workshop belonging to the company. At this stage, the transport process begins. The role of the freight exchange in the surveyed enterprise is primarily to reduce empty runs. With its help, the company minimizes the costs of providing services and obtains additional earnings resulting from obtaining a new order. The freight exchange improves the transport of goods, both domestically and abroad, and completes the transport process of the surveyed enterprise.

5. Conclusions

The development of the transport industry may not only increase the level of employment and stimulate economic growth, but also correct the economic and industrial structure and contribute to the constant acceleration of the process of integration of the city with the regions. Knowledge management in transport companies is a key component on the way to increasing competitiveness. The research indicated that the use of freight exchanges is a very important part of the company's knowledge management system. The key aspect is the proper placement of electronic exchange systems in the overall knowledge management system to make its use as effective as possible. The study showed that the freight exchange is a tool that plays an important role in planning and organizing transport. They are used to a greater extent by experienced and large enterprises, but they also play an important role in smaller entities. The study indicated that a small group treats them as basic tools. Electronic freight exchanges are primarily an additional tool supporting management and organizational processes. They act as an auxiliary tool that allows companies to minimize their costs by reducing empty runs and optimal use of vehicle cargo space. It also allows for increasing the availability of new orders during transport, which increases their profitability. It is less often used for marketing purposes. Enterprises rely more on direct contracts, which is why freight exchanges will be used on a smaller scale, but their importance in streamlining the company's operations is visible.

References

Ajith, P.J., Raju, T.B., Gupta, R., Kulshrestha, N. (2023) "Volatility in tanker freight markets", Case Studies on Transport Policy, 12, p. 100993. Available at: https://doi.org/10.1016/j.cstp.2023.100993.

Asrar-ul-Haq, M. and Anwar, S. (2016) "A systematic review of knowledge management and knowledge sharing: Trends, issues, and challenges", *Cogent Business & Management*, Vol 3, No. 1, pp. 1-17. doi.org/10.1080/23311975.2015.1127744.

Budzik, A. and Cichoń, S. (2023) „Innowacyjność logistycznych systemów transportowych w zarządzaniu organizacją", *Management and Quality – Zarządzanie i Jakość*, Vol 5, No. 4, pp. 18–33.

Chen, A. (2022) "The Impact of "Real life" Working Environment on Knowledge Management in Transport Organizations", *Transportation Research Procedia*, Vol. 63, pp. 2421–2433. doi.org/10.1016/j.trpro.2022.06.278.

Choudary, S.P., Van Alstyne, M.W. and Parker, G.G. (2019) "Platforms and blockchain will transform logistics.", *Harvard Business Review*, [online], https://hbr.org/2019/06/platforms-and-blockchain-will-transform-logistics

Grabowska, M. (2018) "Business models in Polish and Brazilian logistics joint-stock companies", in I. Otola, M. Grabowska, and M.T. Okano (eds) *Logistics and Organizations – Brazilian and Polish experience*. São Paulo Centro Paula Souza, pp. 8–24.

Janczewska, D. (2018) „Rola zarządzania wiedzą w usługowych procesach transportowych MŚP w ujęciu modeli biznesowych", in Z. Ślusarczyk and J. Janczewski (eds) *Zarządzanie Innowacyjnego w Gospodarce i Biznesie*. Wydawnictwo Akademii Humanistyczno-Ekonomicznej w Łodzi, pp. 180-193.

Jenkins, A. (2024) "What is Logistics? Importance, Benefits, and Examples", [online] access: April 2nd, 2024. www.netsuite.com/portal/resource/articles/ erp/logistics.shtml

Kisielewski, P. and Leśniakiewicz, M. (2016) „Charakterystyka i analiza porównawcza europejskich elektronicznych giełd transportowych", *Autobusy : technika, eksploatacja, systemy transportowe*, Vol. 17, No. 6, pp. 1368–1377.

Kowalska, M. (2021) Egzogeniczne determinanty zrównoważonego rozwoju przedsiębiorstw transportowych gospodarek wschodzących Unii Europejskiej. Poznań: Wyd. Rys. DOI 10.48226/978-83-66666-63-4.

Leończuk, D. (2013) „Giełdy transportowe i platformy przetargowe - elektroniczne narzędzia wspomagające wybór przewoźnika w transporcie samochodowym", *Gospodarka Materiałów i Logistyka*, Vol. 10, pp. 18–26.

Miller, J. and Nie, Y. (2018) "Dynamic trucking equilibrium through a freight exchange", *Transportation Research Procedia*, Vol. 38, pp. 320–340. doi.org/10.1016/j.trpro.2019.05.018.

Miller, J., Nie, Y.M. and Liu, X. (2020) "Hyperpath Truck Routing in an Platform", *Transportation Science*, Vol. 54, No 6, pp. 1676–1696. doi.org/10.1287/trsc.2020.0989.

Misztal, A. and Fajczak-Kowalska, A. (2020) „Systemy informatyczne wspomagające realizację strategii logistycznych przedsiębiorstw", in A. Fajczak-Kowalska (ed.) *Technologie i nowe trendy w zarządzaniu a rozwój przedsiębiorstw sektora TSL*. Monografie. Wydawnictwo Politechniki Łódzkiej, p. 91. DOI: 10.34658/9788366287617.

Ngah, R. and Bontis, N. (2016) "Knowledge Management Capabilities and Organizational Performance in Roads and Transport Authority of Dubai: The mediating role of Learning Organization", *Knowledge and Process Management*, Vol. 23, No. 3, pp. 184–193. doi.org/10.1002/kpm.

Norman-López, A., Garaffa, R., Wojtowicz, K., Tamba, M. (2023) "Building a baseline to better integrate air passenger and air freight transport into a global Computable General Equilibrium (CGE) model", *Economic Systems Research*, pp. 1–24. doi.org/doi: 10.1080/09535314.2023.2230653.

Nowak, S. (2024) *Metodologia badań społecznych*. PWN.

Nowakowska-Grunt, J. and Strzelczyk, M. (2019) "The current situation and the directions of changes in road freight transport in the European Union", *Transportation Research Procedia*, Vol. 39, pp. 350–359. doi.org/10.1016/j.trpro.2019.06.037.

Palczewska, A., Barwiński, S. and Borowiecki, Ł. (2015) „Znaczenie giełdy transportowej dla współczesnych przedsiębiorstw produkcyjnych , transportowych i spedycyjnych na przykładzie giełdy Trans.eu", in M. Czajkowska and M. Malarski (eds) *Funkcjonowanie e-biznesu. Zasoby, procesy, technologie*. Wydawnictwo Uniwersytetu Łódzkiego, pp. 121–133. dx.doi.org/10.18778/8088-106-8.12.

Pisz, I. and Łapuńka, I. (2014) „Zarządzanie wiedzą w przedsiębiorstwie z branży TSL wspomagane systemami telematycznymi transportu", *Logistyka - nauka*, 4, pp. 4024–4036.

Pyza, D. (2010) „System transportowy i jego ukształtowanie w systemie logistycznym Polski", *Transport, Prace Naukowe Politechniki Warszawskiej*, Vol. 76, pp. 113–129.

Witkowski, J. (2019) „Elektroniczne giełdy transportowe i platformy logistyczne w budowaniu łańcuchów dostaw", in K. Witkowski, K. Huk, and Z. Patora-Wysocka (eds) *Systemy logistyczne w gospodarowaniu: nowe trendy i kierunki zmian*, pp. 205–215. www.wir.ue.wroc.pl/info/article/WUT2ee8d8ae70fb47c2bdda2b1ddb19eab5/

Wu, Y., Huang, J. and Chen, X. (2024) "The information value of logistics platforms in a freight matching market", *European Journal of Operational Research*, Vol. 312, No. 1, pp. 227–239. doi.org/10.1016/j.ejor.2023.06.043.

Using T2-Capability Profile Modelling to Anticipate Change and Development: Bridging the Industry and Higher Education Views

Juha Saukkonen and Sanna Nieminen
JAMK University of Applied Sciences, Finland

juha.saukkonen@jamk.fi
sanna.nieminen@jamk.fi

Abstract: Organizations depend on the capabilities their members possess to survive and succeed in the highly competitive operating environment. Typically, capability or competence profiles have been created cross-sectionally, serving the current needs of the organization, whilst the Knowledge (KM) and Human Resource Management (HRM) also need to be future-oriented, addressing the emerging needs for new capabilities in an anticipatory manner. The development of capability profiles has moved from I-shaped models stressing the need for deep professional special knowledge to T-shaped models where the emphasis is adding horizontal knowledge capabilities (about business processes and additional knowledge areas) to balance the deep vertical specialization to specific occupational areas. In an ECKM (European Conference on Knowledge Management) conference paper in 2022, a new model called T^2-model was introduced on a conceptual level (Saukkonen & Kreus, 2022). The development step to earlier T-shaped capability models was the addition of a second horizontal layer on top of combinatory capabilities – thus the name of T^2. The lower horizontal layer contains business-specific items (like supply chain management, quality, or project management) where advanced knowledge is needed. The higher horizontal layer contains items of phenomena where a basic level of knowledge is needed (e.g., financial literacy, AI principles, sustainability). In the experimental research design, capability profiles were created for selected professional positions. The capability profiles were created by both business professionals (individuals currently having or managing the profession in question) and higher education professionals (who educate undergraduates and graduates to the industry and function studied). The respondents filled into the visualized T^2-model the skills preselected from earlier literature to relevant and were also able to add the skills they felt were missing in the original list of skills for the profession in question. The results give early proof-of-concept of the viability of T^2-model as a method of bridging both HRM and KM within organizations as well as University-Industry views on the knowledge items and levels needed for the future. Furthermore, the results give a basis for the knowledge anticipation process. The paper elaborates on a new model for anticipation of knowledge and offers a process that organizations can use in designing their HRM and Knowledge Management. Using T^2-model may offer an improved integration to other areas of planning such as technology development and strategic change.

Keywords: Knowledge, Capability, Skills, Career, Competence

1. Introduction

1.1 The Scope and Aim of the Study

The research project aimed at pilot implementation of the T^2-profiling, which had been earlier presented in academia only on the conceptual level. The primary aim was to test and assess the profiling framework in itself but also to shed light on the capabilities demanded for professional success in what comes to areas of Purchasing Management and Digital Marketing Management. The results and conclusions were planned to be usable both for the guidance of lifelong learning and professional development in business as well as for the development of educational approaches in the fields leading students to the two professions under study.

1.2 Research Approach, Method and Sampling

The approach was exploratory and experimental. Via convenience sampling, the following respondent pools were created to do the categorizing of the capabilities.

Professional Title 1: Purchasing Manager

- 2 respondents from HEI (Higher Education Institution) – educators teaching and researching purchasing management
- 3 respondents from industry (2 from the manufacturing industry, 1 from wholesale)

Professional title 2: Digital Marketing Manager

- 2 respondents from HEI – educators teaching and researching digital marketing management
- 3 respondents from industry (2 from the manufacturing industry, 1 from retail)

The three categories of capability ”ranking” were:

EXPERT LEVEL = VERTICAL (DEPTH) LAYER capabilities are rather unique in the organization, crucial for success in the job, and present all the time when performing in the job

ADVANCED LEVEL = FIRST HORIZONTAL LAYER capabilities where someone else in the organization has expert level knowledge, capabilities needed continuously in the job and cooperate with others

BASIC LEVEL = SECOND HORIZONTAL LAYER capabilities not directly included in the job but knowledge of which support the work done in the job and acting in the work community.

The respondents to the study were chosen via purposeful convenience sampling, The respondents contacted were alumni from the HEI (Higher Education Institution) were the researchers work. When constructing the respondent pool, the researchers sought heterogeneity of company types and sizes in what comes to representatives from industry. The respondent pool consisted of professionals from industrial, wholesale and retail organizations. The company sizes varied from 100 people to 2000+ people organizations. The educators invited to the study were educators/researchers responsible for digital marketing and purchasing management courses and research .

The respondents were introduced (via LinkedIn message or e-mail) the aim of the study and expected workload for them. Once they reacted positively to the invitation to join, they were sent a slide with the T^2- structure and the preselected set of skills. The respondents' task (independently of each other) was to place the preselected capability areas to the T^2-model layers of expert/advanced/base level of capabilities demanded – *currently* -in the job in question. The sources of capability areas were:

- The future of jobs – report by Word Economic Forum (WEF, 2023)
- The final report of FUDIX (Future Digi Expert)-project (JAMK, 2022)
- Purchasing and supply management (PSM) competencies: Current and future requirements. (Bals et al., 2019)
- In addition, the respondents could add the capabilities needed in the profession but not listed by the researchers

The respondents worked by rearranging the capability text boxes on a MS PowerPoint slide that was coded by the sphere (purchasing or marketing & industry or education + the name initials) so that the researchers could have contacted the respondents and asked individualized further questions if needed. Also, the opportunity to act on the responses was kept alive with the informant coding – e.g. the next stage of further research could be the capability needs *for the future,* and looking at that, the ability to backtrack the responses to the person answering was maintained.

In the data analysis of the individual T^2-profiles depicted by the informants, the researchers aimed at pattern recognition (repetition of lines of thought by informants) but also in the issues where no pattern emerged, thus proposing a discrepancy of views that may, in turn, motivate further study and discussion. In the analysis, the researcher triangulation method was used i.e. two researchers performed their analysis independently, and then their findings were merged into a joint view. The approach was a quantitative one the researchers made their conclusions on pattern emergence based on the frequency of capabilities based on specific layers. The areas of interest were: 1) Within one profession: Which skills are typically based on certain layers i.e. what is the agreed core of a capability profile for that profession 2) Which capabilities are lacking a pattern i.e. in which issues the professional community agrees on a capability importance, and 3) Which capabilities form a pattern between the two distinct professions studied: What are the generic, interdisciplinary capabilities.

1.3 Research Gap, Objectives and Questions

The research gap identified links to the lack of practical instantiations of the capability profiles. Multiple studies have addressed the evolution of capability profiles and discussed the alternative models on a conceptual level. Empirical research on the feasibility of the capability profiles has been scarce. The role of business practitioners has been minor in testing the models and developing them further. In addition, higher education's role has been weak in impacting the contents of capability profiles and designing their processes.

The research objectives were:

- to test the practical feasibility of T^2- capability profiling with business and education professionals
- to find if the small samples of the professionals can agree on the capabilities and levels of expertise needed for the 2 professions in focus.

- to see how the educators' view corresponds to those of business professionals.
- to see if there are overlapping/shared capability areas and levels between the two professions (generic capabilities)

From the research objectives, the following research questions (RQs) could be created:

RQ1: What and on what level are the demanded current capabilities for the Purchasing Manager?

RQ2: What and on what level are the demanded capabilities for Digital Marketing Manager?

RQ3: Can some overlapping (=generic) capability areas be identified between the two professions?

RQ4: How well does the T^2-capability profile suit the quest to act as a framework for the improvement of professional capabilities in industries and education?

2. Literature Review

2.1 Skills, Competencies, Abilities, and Capabilities

The literature on capability-related research uses terminology and a range of conceptualizations that overlap. The related terms are often used interchangeably. For example, skill can be defined as the method for outcome connected with knowledge. And knowledge includes creativity, power of practice, communication skills, and technical skills (Takeda, 1999). Skills and competencies are used as the same concept but have distinct differences. Skills are learned abilities while competencies are inherent qualities that combine skills, knowledge, and abilities. Competencies are a set of integrated knowledge, abilities, and attributes that define what is needed to successfully perform a job. Competencies can be specific to a job or vary based on job content, performance situations, and performance criteria. Lee (2022) discusses the definitions and conceptual relationships of ability, competence, and skill. It concludes that "ability" is an individual and independent concept, while "competency" is a set or bundle of factors that includes both ability and non-ability factors.

The paper by Ruitenberg (2019) highlights that skills are specific and transferable capacities that can be perfected through practice, while competencies are broader attributes that involve one or more skills. Ruitenberg emphasizes that many human attributes exceed the concept of skill.

Lastly, capabilities, the focus of study in this paper, can be coined as a combination of knowledge, skills, experience, and competencies that enable individuals or organizations to perform certain activities or achieve desired outcomes (Whitfield et al., 2022). Capability involves the integration of prior knowledge, skills, resources, judgment, and experience to solve problems (Zvradkovic et al., 2014). Capability is seen as a complex, organizationally embedded, and firm-specific knowledge resource that supports competitive advantage (Keeley, 2014). The concept of capability can be used as a baseline for business planning, service specification, and design. It allows organizations to deliver their services in various business contexts with sustainable quality.

2.2 Capability Profiling

Capability profiling is a term used both for human and technology-driven performance evaluations. Capability profiling refers to the process of evaluating the capabilities or qualities of a system, process, or person on specific criteria or variables. The goal of capability profiling is to determine the extent to which a system or process meets customer expectations or specifications. It can be used to identify soft skills requirements in job descriptions, evaluate the process capability of IoT devices within self-organized ecosystems, or assess the process capability of a product or process in quality control applications. (Ajayi et al., 2019; Liu et al. 2018; Charki et al., 2016).

In the sphere of human capability assessments and enhancement, capability profiles are depictions of capability requirements/targets for a successful action in a professional role. Capability profiling contributes to organizational development and performance improvement by identifying and leveraging the various competencies and capabilities of a company. Through capability profiling, organizations can identify the skills and resources needed to implement their business strategies effectively (Liu, 2022). The shape, size, and contents of capability profiles are used in HRM processes from recruitment to training as well as to performance and compensation management. Originally, a wide range of archetypal profiles were established, namely those of specialist, generalist, and Phi-shaped (Macaulay et al. 2010, pp. 728–729). A specialist or in other terms an I-shaped (from the shape of the letter i in the uppercase font) professional profile describes a person who has a very deep understanding of his/her area of expertise but a limited width in other areas of expertise. The

generalist profiles can be described with the symbol "-" or as a hyphen-shaped profile, where there is width in various expertise areas but a limited depth in all of them. This profile might work for the general management or development manager positions within an organization. Phi- (π) shaped profile suggests that two distinctive areas of knowledge go deep, and the width is provided by the capacity to understand their interplay.

2.3 The Models of T- And T2 -Shaped Capability Profiles

The knowledge era in which companies currently operate, calls for new capabilities in both technological and behavioral dimensions and in combining these (Haapasalo and Kess, 2001). Yet, at the same time technological development requires people to gain a deeper and deeper understanding of their own field to provide their employers a true competitive advantage. So, there is the vertical depth required as in the original I-shaped capability profiling. However, combinatory capabilities are needed as the tendency is towards holistic, non-siloed, and interdisciplinary approaches, so also horizontal capabilities are of need. To accommodate these demands, capacity profiling moved towards talk and research on T-shaped capability profiles. As the symbolic letter T proposes, there is a need for a domain- and/or function-specific expertise (the vertical line in the letter) but in addition to that, individuals should possess width in their knowledge. This horizontal width offers the individual and organization flexibility via "empathy, breadth of knowledge, skills, experience, and complex communication abilities" (Demirkan and Spohrer, 2018). T-shaped models have been described to be fundamental for corporate knowledge management (Barile et al., 2012), innovation (Oskam, 2009), project management (Martinez et al., 2016) and service design and delivery (Saviano and Simone, 2015).

Some papers published in 2010s proposed that both vertical and horizontal dimensions should multiply in content. So there would potentially be more than one area of deep expertise but also various layers in the horizontal dimension (e.g. Heikkinen, 2018). To comply with the notions made on the multitude of contents for both the vertical and horizontal dimensions of capability profiles, Saukkonen and Kreus (2022) introduced a T2-model for capabilities based on the analytical assessment of the prior-art models and discussions with and observations of modern organizations (2022). In the T2-model there are altogether 3 layers, 2 of which are horizontal (width) and one vertical (depth).

The T^{2-}capability profile (the basic form of it shown in Figure 1) is built on the following pre-assumptions:

- despite the expressed needs for interchangeability of information and flexibility of the workforce, deep expertise skills possessed by an individual are still a valid demand for competitiveness 10
- the number of skills and competencies with deep expert-level knowledge cannot be many since the time and other resources of an individual and organization are constrained
- the interdependent nature of business functions in a modern organization set demands for the experts to understand the context-dependent (on the industry- and company-level) processes beyond one´s expertise
- in addition to deep expertise and context-dependent capabilities, there is a layer of context-independent competencies, which are needed across domains and industries

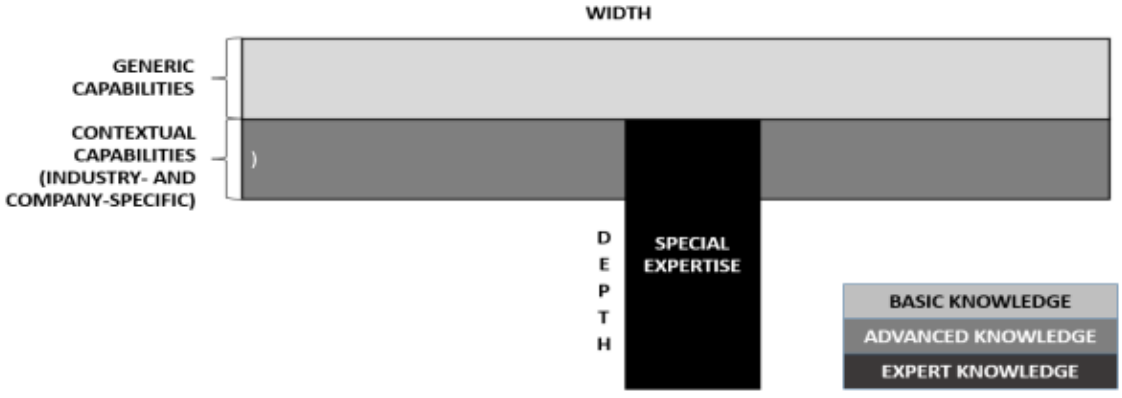


Figure 1: The format of the T^2-capability profile (Saukkonen, 2022)

3. Results

Altogether 10 different capability profiles were obtained from the respondents, to be analyzed based on the frequency of capabilities placed to specific layers, i.e.the data analysis was quantitative in nature. The overall

view was thus created by superimposing the 10 different profiles and looking for patterns that emerge from the data. In Figure 2 an exemplary T^2-profile depiction by a Purchasing Manager practitioner and in Figure 3 the depiction by a Purchasing Management educator is shown.

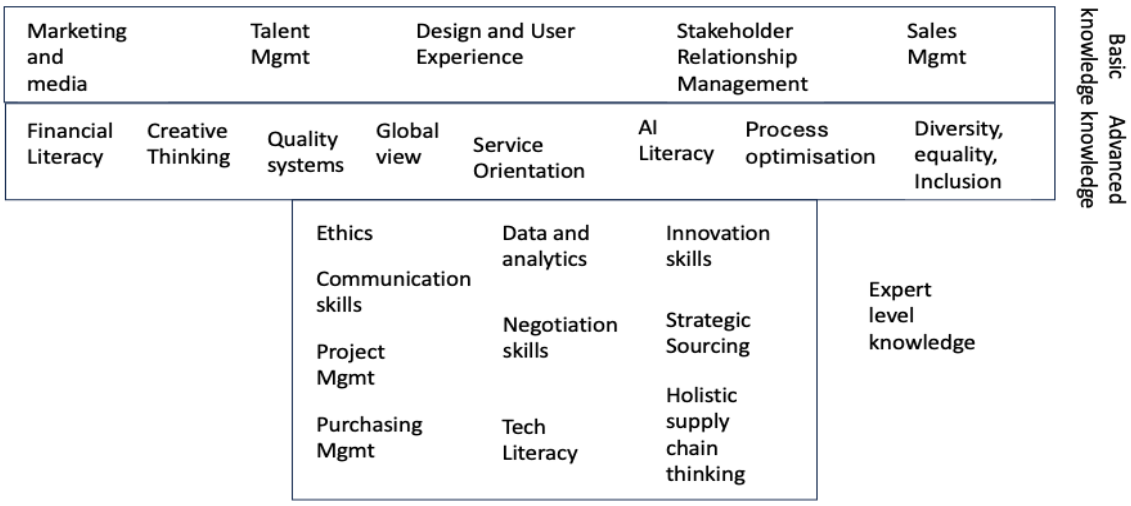


Figure 2: An example of the capability profiling by a Purchasing Management practitioner

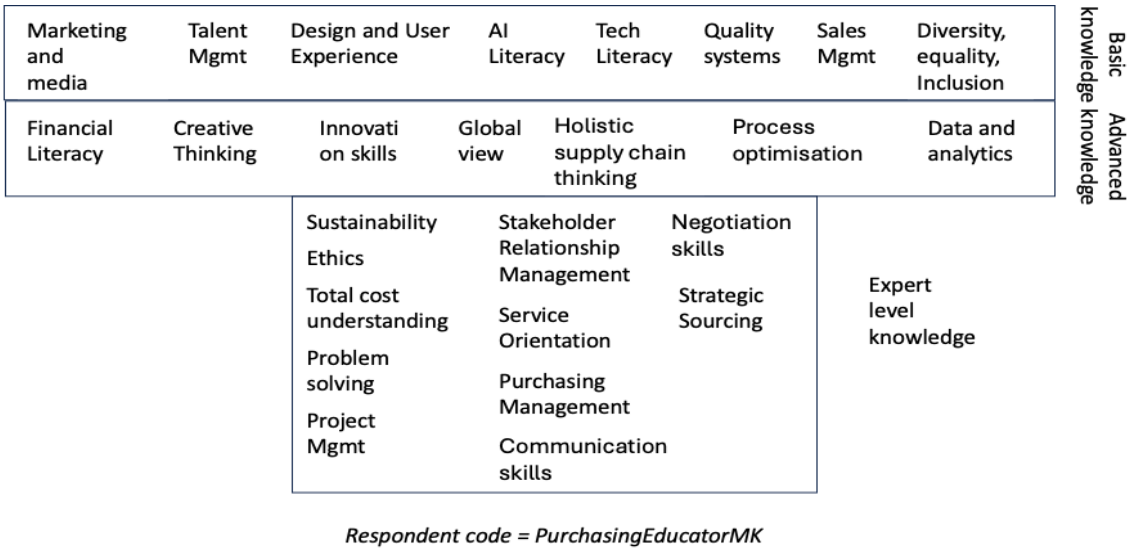


Figure 3: An example of the capability profiling by a Purchasing Management educator

When superimposing (placing on top of each other) the T^2-profiles depicted by the informants, the following patterns were identified.

- In the T2 model for a purchasing manager (PM) a greater agreement was reached than in what comes to the Digital Marketing Manager DMM case– especially on the depth dimension (Expert-level skills) may be partly due to some skills/competencies offered were taken from a sector-specific source=> conclusion: a sector-specific tailoring of competence listings needed when applying T2
- In the Digital Marketing Manager -case the informants added various and very specific skills to the expert level => conclusions: 1) the lack of sector-specific "vocabulary" (see above) may be the reason to that, and 2) the question of the difference between competence/capability and skills that prevails in academic literature is present also on the practitioner level. Educators used more broad concepts both when selecting from the given list and in adding new competencies.

- Soft skills of communication and negotiation were most often placed to expert level in PM sphere, whereas in DMM the opinion on that differed. Is DMM action currently more tech-laden than PM so transactions and communications happen online thus leading to a lower level of skill needs?
- Data and analytics are crucial for success in both professions – whereas the wider concepts of Tech and AI literacies were placed in the layers with a lot of variation.
- Financial literacy was placed clearly on the layer of advanced capabilities as well as project management was either expert or advanced competence required – across both cases.
- Ethical considerations are more present and capability-demanding in PM than DMM case
- Overall, the advanced level (first horizontal layer of combinatory capabilities) was very "crowded," giving a hint that modern business requires capabilities across organizational silos and functions.
- in the DMM -case the informants mentioned "customer journey"(expert level) and "customer relationship management"(basic level) in the category "other. The customer-related competencies were not in the pre-selected capability list and should be included in future work on the issue.

4. Conclusions

Based on the results displayed in Chapter 3, the following answers to the RQs can be presented.

RQ1: What and on what level are the current capabilities demanded of a Purchasing Manager?

The core capabilities of strategic sourcing, purchasing management, communication, and negotiation skills as well as stakeholder relationship management were commonly agreed upon by the informants and were placed on the expert level. Data and Analytics were also highly ranked among purchasing management informants - either expert or advanced knowledge level. The remaining capability areas based on the literature were placed on advanced or basic levels. Creative thinking and sales-related capabilities were ignored by some purchasing management informants.

RQ2: What and on what level are the capabilities demanded of a Digital Marketing Manager?

The core capabilities that most informants agreed upon to be demanded at the expert or advanced level were Marketing and Media, Data & Analytics, Financial Literacy, Negotiation skills, Creative Thinking, and Project Management. In what comes to the remaining 22 capability areas surged from the literature the opinions on the level of capability demanded varied between basic/advanced level skills. For example, the role of Ethics, the understanding of Purchasing management, and AI literacy varied a lot between informants. Interestingly, Data and Analytics were on average ranked higher than Creative thinking in what comes to managing digital marketing.

RQ3: Can some overlapping (=generic) capability areas be identified between the two professions?

Capability areas that were shared between the two professional communities were Data&Analytics, Negotiation skills, and Financial literacy. These areas can be seen to reflect the development tendencies of technological and organizational development across industries. Of the capability areas not shortlisted by the researchers, the additions by the informants were mostly related to Sustainability (PM case) and Search engine optimization (SEO) capabilities (DMM case).

RQ4: How well does the T^2-capability profile suit the quest to function as a framework for the improvement of professional capabilities in industries and in education?

The informants described the approach and "exercise" built on it as interesting and no negative reports were made on the usability of the T^2-tool. On average, informants placed 7 capabilities in the category of deep expertise level (8 in the PM case and 6 in the DMM case), 8 capabilities in the layer of advanced skills (9 in the PM case and 7 in the DMM case) and 6 capabilities to the level of basic skills (in both PM and DMM case). This finding highlights the complexity of the current world of work and the need for cross-disciplinary learning and practice. One informant commented that the size of the organization - how many people share the responsibilities in e.g. purchasing department – affects individual capability profiles.

For future purposes, a mode context/sector-specific "capability library" would add to the specificity of the findings and better guide the usage of the model in educational and learning purposes in both academic as well as in professional environments. The dilemma of whether the capabilities offered are too generic vs. too specific was prevalent. In addition, in a large corporation, the studies could be done on a company level with their specific structure and more focused set of organizational capabilities in mind.

As the study results propose, there are contrasting views on the importance (level required) of competencies within the professional (practitioners and educators together) communities in purchasing and digital marketing spheres. Those discrepancies may result from 1) the destructive features of emerging technologies reshaping professions, or 2) the contextual differences (like company size, the field of business, and geographical/cultural operating environment.) The study by Liu et al. (2018) shows that the capabilities requirements change as employees transition from one position to the other. Also, the capability requirements change as organizations transform from one focus area to another. The idea of dynamic capabilities, i.e., proactivity and reactivity to changes in the operating environment by the transformation of capabilities (Helfat et al., 2007) is likely to prevail as a core tool for competitive advantage, survival, and success of organizations.

5. Discussion

The results and the study's process highlighted the potential opportunities but also challenges in applying capability profile models into practice. The small sample of the respondents does not suffice for statistical proof of which capabilities belong to which layer of skills. However, the results indicate that the method chosen was actionable and understood by the respondents who represented experts on the areas studied. The sourcing of the skills from just three previous publications can cause bias. Even though respondents were encouraged to leave out of their T^{2-}model the proposed skills that they did not find relevant and /or add skills that were missing from the proposed list, the pre-selection of skills strongly directed the choices made by the informants. Furthermore, the skills were not described to respondents beyond the name of the skill, and that may have led to differing understandings of the content/meaning of the skills. Multiple roads ahead for academic advancement, as well as practical development of the T^2-model, can be identified: Firstly, via quantitative study the claims of the contents for the more tightly connected to a particular context a joint view can be reached for professions with statistical proofs. A quantitative study would also shed light on the effect of context to the views. SME (Small and Midsize Enterprise) companies were missing from the sample, and there the perceived capability demands might be different as delegation of tasks to a wider purchasing or marketing team is not a viable option. Secondly, via qualitative study the true meaning and contents of somewhat vague names of capabilities like “Tech literacy” (sourced from the World Economic Forum –publication “Future of jobs”) can be studied. Thirdly, by shifting the focus to capability profiling into *future* demands for professions, the tension between the current vs. future view (“as is” vs. “to be”) can be identified. That tension can then act as a guideline to educational institutions in designing and delivering learning paths for future professionals as well as upskilling the current employees in the profession. Finally, the intrusion of Artificial Intelligence and Machine Learning into human capital management will enable the creation of capability profiles with the means of technology (Weichselbraun et al., 2024), using job advertisements, job descriptions and performance assessments as datasets needed.

References

Ajayi, O. J., Rafferty, J., Morrow, P., Abu-Tair, M., Ducatel, G., & Cui, Z. (2019). Internet of Things Device Capability Profiling Using Blockchain. In *2019 IEEE 10th Annual Information Technology, Electronics and Mobile Communication Conference (IEMCON)* (pp. 0367-0374). IEEE.

Bals, L., Schulze, H., Kelly, S., & Stek, K. (2019). Purchasing and supply management (PSM) competencies: Current and future requirements. *Journal of purchasing and supply management, 25*(5), 100572. https://doi.org/10.1016/j.pursup.2019.100572

Barile, S., Franco, G., Nota, G., & Saviano, M. (2012). Structure and dynamics of a “T-Shaped” knowledge: From individuals to cooperating communities of practice. *Service Science*, *4*(2), 161-180.

Barile, S., Saviano, M., & Simone, C. (2015). Service economy, knowledge, and the need for T-shaped innovators. *World Wide Web*, *18*, 1177-1197.

Charkhi, M.R.A., Aminnayeri, M., & Amiri, A. (2016). Process capability indices for logistic regression profile. *Quality and Reliability Engineering International*, *32*(5), 1655-1661.

Demirkan, H., & Spohrer, J. (2015). T-shaped innovators: Identifying the right talent to support service innovation. *Research-Technology Management*, *58*(5), 12-15.

Haapasalo, H., & Kess, P. (2001). In search of organisational creativity: The role of knowledge management. *Creativity and innovation management*, 10(2), 110-118.

Heikkinen, K.-P. (2018). Exploring studio-based higher education for T-shaped knowledge workers, case LAB studio model. (Doctoral dissertation). University of Oulu, Oulu, Finland.

Helfat, C. E., Finkelstein, S., Mitchell, W., Peteraf, M., Singh, H., Teece, D., & Winter, S. G. (2009). Dynamic capabilities: Understanding strategic change in organizations. John Wiley & Sons.

JAMK (2023): FUDIX – Future Digiexperts. Developing Insightful Digital Marketing Education. Accessible at: https://www.jamk.fi/en/project/fudix-future-digiexperts. Retrieved 10th March, 2024.

Keeley, T. (2014). Capability as an outcome measure in randomised controlled trials.

Lee, C. (2022). What are the Difference Among Ability, Competence and Skill?. Injeog jawon gae'bal yeon'gu, doi: 10.24991/kjhrd.2022.03.25.1.

Liu, W. (2022). Methodology and Case Studies of Organizational Capability-based Performance Evaluation System. *International Journal of Frontiers in Sociology*, *4*(13).

Liu R., Agrawal B., Vempaty A., Sherchan W., Sin S., Tan M. (2018). Data-Driven Job Capability Profiling. doi: 10.1007/97

Macaulay L., Moxham C., Jones B., Miles I. (2010) Innovation and skills: Future service science education. Maglio PP, Kieliszewski CA, Spohrer JC, eds. Handbook of Service Science (Springer, New York), 717–736.

Martinez, M., Di Nauta, P., & Merola, B. (2016). Dynamic Capabilities and T-Shaped Knowledge in Project Management. A Viable Systems perspective. Governing Business Systems. Theories and Challenges for Systems Thinking in Practice, 41.

Oskam, I. F. (2009, July). T-shaped engineers for interdisciplinary innovation: an attractive perspective for young people as well as a must for innovative organisations. In *37th Annual Conference–Attracting students in Engineering, Rotterdam, The Netherlands* (Vol. 14, pp. 1-10).

Ruitenberg, C.W. (2019). Plus Ça Change: The Persistence of 'Skill Talk' in Competency Discourse. Philosophical Inquiry in Education.

Saukkonen, J. (2022). Developing future engineers with broad views and deep skills-the emergence of a new T2-capability profile. In *Towards a new future in engineering education, new scenarios that European alliances of tech universities open up* (pp. 1556-1563). Universitat Politècnica de Catalunya.

Saukkonen, J., & Kreus, P. (2022, August). T-shaped Capabilities of the next Generation: Prospecting for an Improved Model. In *European Conference on Knowledge Management* (Vol. 23, No. 2, pp. 1032-1041).

Takeda, K. (1999). Concept of "Skill" in the Field of Engineering Education and its Educational System. Journal of Jsee, doi: 10.4307/JSEE.47.2_7

Weichselbraun, A., Süsstrunk, N., Waldvogel, R., Glatzl, A., Braşoveanu, A.M., & Scharl, A. (2024). Anticipating Job Market Demands—A Deep Learning Approach to Determining the Future Readiness of Professional Skills. *Future Internet*.

WEF (2023) Future of Jobs Report 2023. Accessible at: https://www3.weforum.org/docs/WEF_Future_of_Jobs_2023.pdf. Retrieved: 10th March, 2024

Whitfield, M. M., Bleah, P., Bachynski, J. C., Macdonald, D., Klein, T., Ross-White, A., & Wilson, R. (2022). Capability as a concept in advanced practice nursing and education: a scoping review protocol. *JBI Evidence Synthesis*, *20*(8), 2079-2086.

Zdravkovic, J. , Pastor, O., Loucopouls, P.. (2014). On the Capability Notion in Business Informatics.

Anticipating Change and Development With Systematic Build-up of Critical Knowledge Assets: Blueprint for a Knowledge Roadmapping Framework

Juha Saukkonen, Anastasiia Mikhlina and Sanna Nieminen
JAMK University of Applied Sciences, Finland

juha.saukkonen@jamk.fi
anastasiia.mikhlina@jamk.fi
sanna.nieminen@jamk.fi

Abstract: Organizations of today act in a volatile operating environment that 1) implies challenges for firms in adapting to the new conditions but also 2) creates opportunities that new areas of knowledge and technology offer. To succeed, companies need to embark on the journey of visionary and strategic management also concerning knowledge management (KM). They also need to simultaneously link the change and development to make a continuum with the current offerings and operations. Technology Roadmapping (TRM) by e.g., Robert Phaal et al. (2004) has been introduced as a solution to describe the process of understanding and combining what is needed (external and internal business drivers) and what is possible (technologies available). In their meta-analysis of the knowledge roadmapping literature Letaba et al. (2015) conclude that technology roadmaps have supported the process of operationalizing strategies by mapping details of future R&D programs, technology and manufacturing capability development . However, technologies *per se* do not offer a competitive advantage if they are not paired with knowledge of how (and when and where) to use the technology and how to resource the build-up of the knowledge that will be relevant for the future. Competence mapping is a common tool that links jobs and skill needs to succeed in them. Competence maps act as inventories that sum up the knowledge possessions of departments and individuals in the organization. These mappings are however cross-sectional – focusing on current needs vs. current knowledge possessions – and do not link seamlessly to the overall vision and strategy of the organization. This conceptual paper introduces aims at creation of a blueprint for a new framework and process for Knowledge Roadmapping by integrating the findings of earlier research across the fields of technology, competence and knowledge mapping. The framework is built on Technology Roadmapping structure by Phaal et al. (ibid)., adding to it the layers of Critical Knowledge Assets (CKA) and Business Process Excellence (BPEx). E.g., new CKAs such as “data-drivenness” and “resource wisdom” directly affect the Product and Service offerings (PSOs) of a firm but also the effectiveness of the firm´s business processes and technologies that an organization can deploy. The framework is built by synthesizing the findings of extant literature on technology, competence, and knowledge roadmapping The theoretical contributions of the paper add to the knowledge pool of the nascent area of knowledge roadmapping and practical contributions serve organizations by offering a planning tool that ties KM to their overall strategic foresight.

Keywords: Knowledge, Capability, Anticipation, Career, HRM Strategy

1. Introduction

1.1 The Objectives and Research Question

The operational environment of organizations is knowledge-intensive, up to the point where the current tide across industries and societies can be called the knowledge economy (Powell and Snellman, 2004). To succeed, companies must be capable of creating, acquiring, protecting, and sharing knowledge.

Recently, advancements in technologies such as the Internet of Things (IoT), machine learning, and predictive and generative artificial intelligence have presented new opportunities for companies to to gather, analyze, and convert data into useful information. This information can help businesses make informed decisions that can lead to short- and long-term success. *Knowledge* is an essential resource that companies need to succeed in the foreseeable future. An environment that values knowledge as an asset also means that new knowledge brings with it destructive capacity since adjusting to the new “settings” of the operational environment can cause organizational crises (Freeman and Perez, 1988). Knowledge intensity—if well mastered—has the potential to help avoid the worst impacts of those crises and create new entrepreneurial opportunities via knowledge creation and resulting differentiated offer advantage (Moore, 2000). As a result, it can be claimed that modern KM needs to be dynamic in two senses of the word: It needs to contain the (future) time element as well as depict the dynamism of KM between an organization and its business partners (Saukkonen, 2020).

Organizations have applied many ways to keep up to date with the knowledge that they possess. The need for this type of inventory or deposit –approach of knowledge is well reflected in an often-quoted expression of the

need and difficulty of mastering knowledge by then-CEO of Hewlett-Packard Lewis E. Platt: "If only HP knew what HP knows we would be three times more productive" (Atwood, 2009). On top of mapping the current competencies, educational institutions and companies have engaged in efforts to anticipate the capabilities likely needed in the changing operational landscape. Anticipation as action and mindset is close to the foresight process, a joint effort of stakeholders to explore futures and interpret them to justify the present actions (Dufva and Ahlqvist, 2014) - e.g., in knowledge management. As Poli (2014) stated, anticipation brings in both calculable risks and incalculable uncertainties. Organizations vary in their capability to utilize futures in their decision-making (ibid.).

Companies aim to cope with and anticipate the change with their long-term plans for corporate strategy and their technology and product roadmaps. From the outputs of those efforts, different corporate functions - such as Human Resource Management (HRM) and Knowledge Management (KM) - get inputs in their function-specific visions and strategic plans. As Mintzberg (1987) coins the term, strategies are made purposefully and consciously before the action they will apply.

This paper aims to synthesize the existing models of roadmapping and the aims and scope of strategic knowledge management into a new framework to facilitate change management and strategic alignment of KM efforts. The research question i.e. the quest for new knowledge set at the start of the research journey is: *"How can the current tools of science, technology, competency and product roadmapping be further improved to better facilitate strategic and dynamic knowledge management?"*

This research aligns with the practical needs of the industry, echoing the remark of (technology) roadmapping by Letaba et al. (2015): "Practitioners and scholars alike are seeking new ways on integration of this technology market planning tool with other business processes while on the other hand, there are efforts for their customisation according to the needs of managers or policy makers."

1.2 The Approach and Method of the Study

The research approach and method of this paper is conceptual. The authors aim to understand and structurize the phenomena under study, combine the related concepts, and derive and propose a new framework for further study. Young (1995) proposed that an essential parameter of conceptual research is an attempt to give clarity to concepts systematically. Conceptual research can be used to develop new concepts and reinterpret existing ones (Leuzinger-Bohleber & Fischmann, 2006). Conceptual researchers investigate, e.g., the meanings and usage of concepts. The outcome of this study is built on existing concepts that have been combined into a proposal for a new integrative framework, "Knowledge roadmap", and a proposal for a roadmapping process that organizations can apply. In this research, the authors reviewed selected papers using Semantic Scholar, SciSpace and Google Scholar tools. The findings of the most relevant prior art studies are displayed in the literature review (Chapter 2), and elements identified in those papers as well as the elements found to be missing from current frameworks get integrated into the new framework. As is typical for conceptual research, the study also fulfils many criteria of exploratory research. Exploratory research is typically an initial investigation to clarify a problem and provide understanding and background information. It has the role of preparing for more conclusive future studies with limited prior knowledge. (Manerikar and Manerikar, 2014).

2. Literature Review

2.1 Competency and Knowledge Mapping

Competency mapping identifies and evaluates the skills and competencies required for different organizational job roles (Jaskiran et al., 2023). It may be used as a tool that supports understanding the strengths and weaknesses of individuals and directing their career development. It can also be used in talent acquisition, induction, training and development, and assessment processes in HR. Competency mapping can be visualized using knowledge or competence maps, which provide an overview of prevailing competencies in an organization. *Skill mapping* is a related concept that involves analyzing the skills and competencies required for a job position. Creating skill mapping involves analyzing the skills and competencies required for the job position, evaluating the employee's current skills and competencies, and creating skill mapping and learning activity plans based on their level (Komkrit, 2023). Competency and skill maps are cross-sectional; they are created for the current needs of competencies for job roles and map the skills (what, who, where) possessed at the time of analysis.. As Carvalho et al. (2013) commented, roadmaps that depict one or more possible routes to reach the destination have found their way into the planning in business and non-profit organizations over the recent decades.

According to Dönitz (2023), roadmapping is a flexible and practice-oriented tool for assisted strategic planning and can be used in various fields of expertise. Roadmapping has been claimed to have many affordances and claimed benefits for strategy development and innovation (Phaal & Muller, 2009). Roadmapping is a process that involves many stakeholders and is constantly evolving (Tang et al., 2011). Knowledge and competency roadmapping is a strategic approach that yields structured plans to guide organizations and individuals in assessing the needs and means of acquiring knowledge to achieve relevant competencies in a particular field of activity. The output of the process – roadmaps – serves as pathways that outline steps and milestones in time needed to reach the contents and levels of knowledge portfolio to reach a desired level of proficiency.

Numerous studies have shown the importance of knowledge roadmapping. Siebelink et al. (2021) reported that firms worldwide face challenges and need help with strategic and long-term development plans. Creating coherent plans and efficiently communicating them with employees is difficult, leading to the search for strategic development tools such as roadmapping (ibid.).

On a pragmatic level, knowledge roadmapping is a workshop-based tool that utilizes diverse knowledge from individuals to create shared knowledge in the form of a roadmap for navigating a strategic landscape (Pan, Liao & Zhang, 2023). It involves drawing on individual knowledge and transforming it into collective outcomes through shared meanings and commitment to act (Krull, Smith, & Husted, 2022). The aim is to improve knowledge sharing and ultimately achieve better strategic outcomes. Roadmapping facilitates face-to-face interactions between individuals in a neutral space, fostering knowledge sharing. Additionally, a positive disposition of individuals to share knowledge and imperatives to trigger knowledge contributions are essential factors in knowledge sharing during roadmapping. The role of the facilitator is also highlighted as crucial in promoting knowledge sharing. This multilevel approach to knowledge sharing in roadmapping provides insights into the relationship between individual knowledge and organizational-level outcomes.

2.2 Science, Technology, and Product Roadmapping

The process of roadmapping serves various purposes and helps in strategic planning, competence mapping, and knowledge asset planning. The study conducted by Siebelink et al. (2021) reviewed the roadmap as a strategic tool that helps companies surpass critical strategic challenges. Previous studies have shown that significant corporations such as Motorola and Philips have used roadmapping for decades to navigate product direction, anticipate potential risks, and make long-term plans. Adopting roadmapping has allowed firms to gain a competitive edge and improve their long-term planning capabilities.

Effective knowledge management is a challenge that most companies face, regardless of their industry or size. Qualitative research conducted by Sareminia et al. in 2018 shows that roadmapping for knowledge management can be a powerful solution to this challenge. The study developed a framework that offers a structural approach for organizations to efficiently manage their knowledge through visual roadmaps, opening new possibilities for effective knowledge management.

In 2015, Yee and Teoh conducted structured action research to create a unified roadmapping system that any organization could adopt. The system was designed to enhance a company's strategic capability. Unlike other studies focusing solely on technology roadmapping (TRM), this research explored knowledge management's "soft" aspects. Meanwhile, Phaal et al.'s 2009 study looked at technology roadmapping and their T-plan framework as a tool for navigating disruptive markets. Similarly, Moehrle et al. (2013) argued that technology roadmapping is an approach that can help companies address future challenges. These studies show that technology roadmapping is a valuable method for navigating change. Companies of different sizes and industries have widely used technology roadmapping to ensure their technologies align with their strategic objectives.

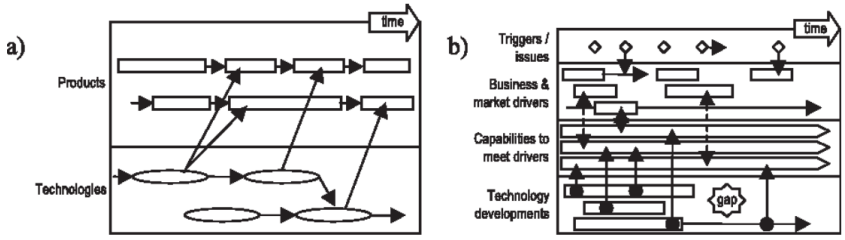


Figure 1: Examples of technology roadmapping process interim outputs in the T-plan model (Phaal et al., 2004)

Product-technology roadmapping is an effective method to ensure that current plans align with long-term objectives and specific steps. This approach creates a visual framework that consolidates knowledge across different structures within a company. According to Raymond et al. (2007), several crucial factors must be considered when creating a roadmap. These include the scope of the roadmap, the level of detail required, and the importance of data privacy throughout the process. Involving stakeholders from different company functions as well as technology and data analysis tools can enhance roadmapping.

2.3 Strategic Alignment of Knowledge Management

"Competitive strategy is about being different" (Porter, 1996). It means, for example, choosing a different set of activities to deliver a unique mix of values. Today, it more and more also includes the choices of knowledge and technology. The organization can be conceptualized as an institution for integrating knowledge (Grant, 1996). The simplified production task in an organization is transforming inputs into outputs. In this organizational context, the fundamental activities include creating, acquiring, storing, and deploying knowledge. Grant (1996) studied the coordination mechanisms through which organizations integrate the specialist knowledge of their members. The emphasis was primarily on the application of knowledge and the role of the individual.

Strategic thinking can and should lead to new options in the evolution of the business. Bolisani and Bratianu (2018) emphasize the importance of aligning knowledge when creating organizational value. The scarcity of tangible assets can be balanced with the availability of intangible resources. They see "knowledge strategy planning as a continuous effort of learning and adaptation to needs and opportunities that dynamically emerge from daily practices."

Aligning strategy with a knowledge management system improves innovation and business performance (Lai et al., 2022). Strategic knowledge management system alignment (SKMSA) has a significant positive impact on knowledge management (KM) and knowledge management system (KMS) performance (Figure 2.). SKMSA was defined in this study as the degree to which a firm's business objectives are supported by crucial KM entities such as processes (e.g. knowledge codification), skills, tools (e.g. knowledge map), and motivation (e.g. trust, rewards). It was concluded that "firms achieve their performance goals through SKMSA instead of developing a standalone KMS or business strategy." The study by Yoshikuni and Albertin (2020) demonstrated findings that knowledge management strategy (KMS) has significant, positive effects on IT strategic alignment, benefits of IT use, business process performance, and firm performance (Figure 2).

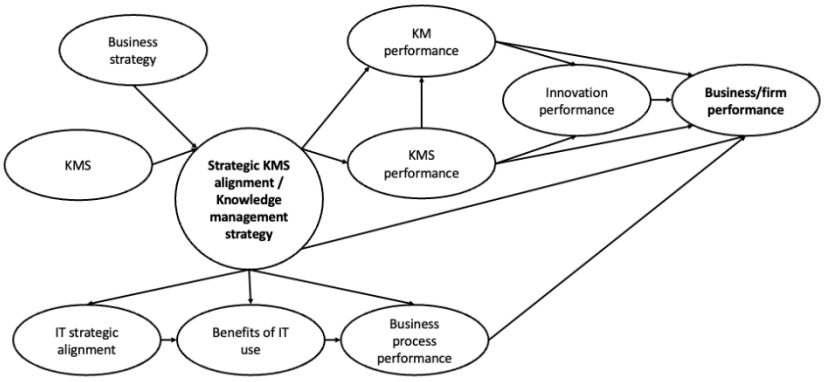


Figure 2: The strategic knowledge management system (KMS) alignment / knowledge management strategy has a positive effect on business/firm performance (Lai et al., 2022; Yoshikuni & Albertin, 2020)

Jami Pour et al. (2018) have suggested implementing KM strategic planning in practice. The main phases of KM strategic planning are review, orientation, implementation, and evaluation. The KM strategic review includes external environment analysis and internal environment. KM's strategic orientation consists of setting KM's vision, identifying the strategic knowledge gap, and prioritizing knowledge-oriented processes. KM strategy implementation includes allocating the KM resources, identifying appropriate KM mechanisms, identifying KM processes, and developing a detailed action plan. KM Strategic evaluation involves identifying key performance indicators (KPIs) and reviewing strategic priorities regarding emerging changes.

All in all, strategic alignment of knowledge management is essential, and as Prahald (1990) put it: "Unlike physical assets, competencies do not deteriorate as they are applied and shared. They grow."

2.4 Research and Tool Gap for Strategic and Dynamic Knowledge Management

The study got its motivation from the identified gaps of knowledge. Firstly, strategic knowledge alignment with other areas of planning (technologies, product, and service offerings, and resourcing both tangible and intangible resources). Secondly, the commonly deployed process of knowledge roadmapping does not specify the knowledge areas and their acquisition that need to be paired with technologies and business processes for the organization to reach its aims. Thirdly, the current knowledge mapping process is not dynamic but cross-sectional; it creates a knowledge inventory of the firm and its stakeholder network but not the evolution needed for future knowledge inventory. Finally, doing the roadmpapping by tying it into the firm´s strategies and visions (Internal drivers) and changes in operative environment (external drivers) would make the choices made in knowledge roadmapping easier to justify.

The prior-art literature in the topic area is not vast: In a Google Scholar Boolean search for academic papers about the roadmapping philosophy, close to 1000 papers had "technology roadmapping", “technology roadmapping” or “technology roadmaps” in the research title. In the case of “knowledge roadmapping”/” knowledge roadmapping”/” knowledge roadmaps” in the paper title only 3 papers were identified. Thus, knowledge roadmapping is an emerging but understudied area that requires increased interest, as well as the tools and frameworks that the technology roadmapping approach already has. Combining the vast prior-art knowledge of technology roadmapping and findings of the nascent area of knowledge of roadmapping, a new framework with theoretical and practical contributions would advance roadmapping research and practice. As proposed, knowledge roadmapping -approach can enlarge the current technology-focused roadmapping approach with “soft” issues and information systems. Despite the recognized need, effort in framework development has been scarce.

3. Results - A Blueprint for a Knowledge Roadmapping Framework and Process

3.1 The Structure of a Knowledge Roadmap

This paper's evolutionary step is the proposal to expand the product and technology roadmapping process. The new model below (Figure 3) would cover the knowledge needed to meet the operating environment and strategy changes more widely and deeply, emphasizing the crucial role of knowledge and knowledge planning in achieving organizations' goals.

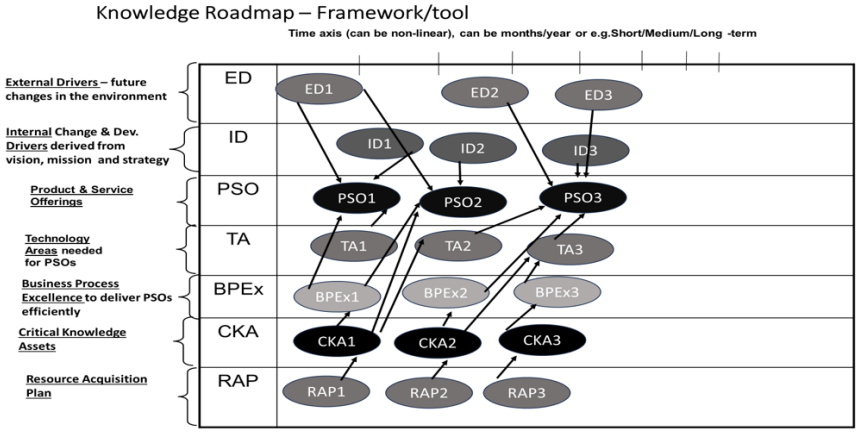


Figure 3: The elements and some hypothetical interconnections of the Knowledge Roadmapping framework.

External Drivers (ED): Changes in the operating environment that are foreseen, independent of the existence and action of the company doing the roadmapping. These drivers can be sourced from, e.g. Megatrend reports by institutes of futures research (e.g. SITRA in Finland, Fraunhofer Institute in Germany) and top-tier consultancy companies (Deloitte, Nielsen, etc.). The drivers can be sourced and arranged using e.g. the PESTEL framework: Political, Economic, Social, Technological, Ecological, and Legal drivers.

Internal Drivers (ID): The firm's strategic choices and development in the long run towards new business opportunities. The firm's vision, mission, and strategy are the main sources for the drivers. These may include targets for e.g. new marketentries, growth, market shares, profitability etc.

Product and Service Offerings (PSO): Resembling the layer of Product Feature Concepts (PFCs) in the T-plan approach by Phaal et al. (2004) , this layer depicts future offerings to chosen target market segments. The PSOs can be entirely new or development versions of existing offerings. They can be related to physical products or services offered—or a combination of the two.

Technology Areas (TA): On this layer, the organization maps the technology areas that have potential or are needed to bring about the PSOs mapped in the layer above. Mapping can also be done on a robust level ("location technology") or on a specific level, naming the technology like "Global Positioning System GPS."

Business Process Excellence (BPEx): The areas of operational excellence where the organization must be genuinely competitive to deliver PSOs efficiently and take the identified TAs into use. The business processes can be named according to the organizational divisions (marketing, purchasing, customer service, R&D, etc.) or on a more conceptual level (customer care, co-creation).

Critical Knowledge Assets (CKA): The areas of capability that the company must possess or have access to (if CKAs held, e.g. by a business network partners) to be able to excel in TAs and BPExs. Knowledge assets refer to the valuable resources and capabilities that an organization possesses in the form of knowledge. These assets can include internal knowledge developed within the organization and external knowledge acquired from outside sources. Knowledge assets can be categorized into different types, such as structural capital, relational capital, and human capital, each of which can contribute to firm performance. In today´s technology-laden operating environment, Improvement methods for knowledge acquisition include using advanced technologies like artificial intelligence and machine learning to automate knowledge extraction and analysis via "intelligent agents".

Resource Acquisition Plan (RAP): This layer focuses on how and when knowledge assets are acquired or created. Ways to secure knowledge availability range from own R&D projects and strategic hiring to license acquisitions and partnerships with other organizations.

3.2 Blueprint for a Process that Yields the Roadmap

The framework for knowledge roadmapping, proposed in section 3.1, can be developed through a series of workshops. The workshops will produce content for the different layers of the framework, connect the items across different layers, and put them into a timeline. The table presented below organizes the steps of the process into the order and themes of the workshops, desired outcome layers, and the stakeholders involved in each step. Overall, it provides a structured overview of the roadmap development process.

Table 2: Workshop-based process of creating a knowledge roadmap

Workshop order and theme	Desired Outcome Layers	Stakeholders in charge
1. Driver recognition	External Drivers (ED), Internal Drivers (ID)	R&D, Business Intelligence, all functions' representatives
2. Offering and techs	Product and Service Offerings (PSO), Technology Areas (TA)	R&D, Technology/ Product Development team, Sales&Marketing
3. Business processes and knowledge assets	Business Process Excellence (BPEx), Critical Knowledge Assets (CKA)	R&D, Functional Managers (= business process owners)
4. Resourcing and charting	Resource Acquisition Plan (RAP)	R&D, Business Intelligence; HRM

During workshops, charts and diagrams can be created using whiteboards, flipcharts, or specific ICT tools for roadmapping, such as Fibery, Productboard, Miro, and more. These exercises help better understand both internal and external markets, business drivers, and knowledge management. To ensure transparency and avoid frustration, guiding all participants throughout the workshop process is essential. The first driver recognition workshop may involve outside stakeholders like business consultants or strategic advisors. The structured approach presented in the table helps companies to navigate the complexities of strategic planning systematically. This approach allows them to create a roadmap that aligns with their objectives and goals while fostering agility and adaptability in response to internal and external dynamics that may change over time. This approach enables companies to plan strategically and respond to changes effectively.

4. Conclusions

The research question set in the beginning of the study was: *"How can the current tools of science, technology, competency and product roadmapping be further improved to better facilitate strategic and dynamic knowledge management?"*

With the exploratory research approach that aimed at creating a new framework to be tested and implemented later, this paper offers an enlargement of the pre-existing frameworks of technology roadmapping, competence and knowledge mapping. The framework is the theoretical contribution of the study. Certain elements and principles of the earlier frameworks, such as the time-boundness of the framework elements, layered structure, and the role of technologies (enablers) and internal/external drivers (change agents) and resourcing layer, were kept intact. In addition to these, the model introduced layers of Business Process Excellence and Critical Knowledge Assets. On top of the framework, the paper introduces a proposal for a process consisting of a series of workshops that will yield the framework content and a full-scale knowledge roadmap to fit the company strategy and changing operation environment. The process consisting of workshops that will yield company-level understanding of the "big picture" of knowledge management needs connected with other areas of planning is the practical contribution of the paper.

5. Discussion

Operational excellence and strategy are essential for the firm's long-term success. The Knowledge roadmapping framework helps to consider all the essential diverse elements systematically. Systematic and dynamic knowledge management can be spread across a firm's business functions and stakeholders via roadmapping. Operational excellence can be supported and developed via a systematic knowledge roadmapping process and parallel the strategic alignment of knowledge management can be established. The proposed Knowledge roadmapping framework and the process can be reflected against Zack's (1999) framework which discusses the areas of knowledge presented in Table n. With the Knowledge roadmapping framework, we can better consider the questions "knowing why, what, when, where, how, and who?".

Table 3: Knowledge roadmapping framework in reflection to Zack's knowledge framework

Knowing is made of…	Layers involved in the Knowledge Roadmap framework
Knowing WHY	External Drivers (ED), Internal Drivers (ID)
Knowing WHAT	Product and Service Offerings (PSO), Critical Knowledge Assets (CKA)
Knowing WHEN	External Drivers (ED), Internal Drivers (ID), (Resource Acquisition Plan (RAP))
Knowing WHERE	External Drivers (ED), Internal Drivers (ID), Product and Service Offerings (PSO)
Knowing HOW	Technology Areas (TA), Business Process Excellence (BPE), Critical Knowledge Assets (CKA)
Knowing WHO	Critical Knowledge Assets (CKA) and Resource Acquisition Plan (RAP)

Our conceptual paper introduces a blueprint for a new framework and process for Knowledge Roadmapping. Future research could study the implementation of the Knowledge roadmapping framework in different business contexts. A longitudinal, in-depth analysis of the outcomes of a knowledge roadmapping process would illuminate the actual outcomes.

References

Atwood, C. G. (2009). Knowledge Management Basics. Alexandria: ASTD Press

Bolisani, E., & Bratianu, C. (2017). Knowledge strategy planning: An integrated approach to manage uncertainty, turbulence, and dynamics. *Journal of knowledge management, 21*(2), 233-253. https://doi.org/10.1108/JKM-02-2016-0071

Dufva, M., and Ahlqvist. T. (2014) Knowledge creation dynamics in foresight: A knowledge typology and exploratory method to analyze foresight workshops. Technological Forecasting and Social Change, 94. pp. 251-268.

Freeman, C., Perez, C., (1988). Structural crisis of adjustment, business cycles and investment behaviour. In: Dosi, G., Freeman, C., Nelson, R., Silverberg, G., Soete, L. (Eds.), Technical Change and Economic Theory, pp. 38–66. London: Pinter

Grant, R. M. (1996). Toward a Knowledge-Based Theory of the Firm. *Strategic management journal, 17*(S2), 109-122. https://doi.org/10.1002/smj.4250171110

Meydanli, I., I., Polat, M. (2022). Roadmapping Process Implementation> Challenges for a Large-Scale Company. IEEE Transactions on Engineering Managmeent, 69(1): 34-43

Jami Pour, M., Kouchak Zadeh, Z., & Ahmad Zadeh, N. (2018). Designing an integrated methodology for knowledge management strategic planning: The roadmap toward strategic alignment. *VINE journal of information and knowledge management systems, 48*(3), 373-387. https://doi.org/10.1108/VJIKMS-10-2017-0071

Jaskiran, Kaur., G., Madaan., Sayeeduzzafar, Qazi., Pretty, Bhalla. (2023). An Explorative Factor Analysis of Competency Mapping for IT Professionals. Administrative Sciences, doi: 10.3390/admsci13040098

Komkrit, C. (2023). Work in Progress: Design and Development of Skill Mapping Focusing on Skills and Competencies Improvement for Factory Electricians: A Case Study in Glass Bottle Beverage Factory. doi: 10.1109/EDUCON54358.2023.10125226

Krull E., Smith P., Husted K. (2022). Knowledge Sharing in Roadmapping: Toward a Multilevel Explanation. *IEEE Transactions on Engineering Management,* doi: 10.1109/TEM.2021.3052974

Lai, J., Wang, J., Ulhas, K. R., & Chang, C. (2022). Aligning strategy with knowledge management system for improving innovation and business performance. *Technology analysis & strategic management, 34*(4), 474-487. https://doi.org/10.1080/09537325.2021.1907328

Letaba, P.T., Pretorius, M.W., & Pretorius, L. (2015). Analysis of the intellectual structure and evolution of technology roadmapping literature. *2015 Portland International Conference on Management of Engineering and Technology (PICMET)*, pp. 2248-2254.

Leuzinger-Bohleber, M. & Fischmann, T. (2006). What is conceptual research in psychoanalysis? International Journal of Psycho-analysis, 87 (5), pp. 1355-1386

Manerikar, V., & Manerikar, S. (2014). A Note on Exploratory Research. *Aweshkar Research Journal*, *17*(1).

Mintzberg, H. (1987). The strategy concept I: Five Ps for strategy. *California management review*, *30*(1), 11-24.

Moore, G. A. (2000.) Living on the Fault Line: Managing for Shareholder Value in the Age of the Internet. New York: Harper-Collins.

Moehrle, Martin & Isenmann, Ralf & Phaal, Rob. (2013). Technology Roadmapping for Strategy and Innovation. Charting the Route to Success. 10.1007/978-3-642-33923-3.

Pan C., Liao H-T., Zhang Y. (2023). Knowledge mapping of resilience and human rights in supply chains: A roadmapping taxonomy for twin green and digital transition design. *Frontiers in Environmental Science*, doi: 10.3389/fenvs.2023.1152345

Phaal, R., Farrukh, C. J., & Probert, D. R. (2004). Technology roadmapping—A planning framework for evolution and revolution. *Technological forecasting and social change*, *71*(1-2), 5-26.

Phaal, R., Muller, G. (2009). An architectural framework for roadmapping: Towards visual strategy, Technological Forecasting and Social Change, Volume 76, Issue 1, Pages 39-49, ISSN 0040-1625

Prahalad C. K., Hamel G. (1990). The Core Competence of the Corporation. *Harvard Business Review* 68(3): 79-91

Poli, R. (2014) Anticipation: a new thread for the human and social sciences? Cadmus 2 (3), pp. 23-36

Porter, M. E. (1996). What is strategy? *Harvard business review, 74*(6), 61-78.

Powell, W. W., & Snellman, K. (2004). The knowledge economy. Annu. Rev. Sociol., (30), pp. 199-220.

Raymond, R., Cosner., E., Jefferson, Hynds., Alan, R., Fusfeld., Carl, V., Loweth., Charles, Scouten., Richard, E., Albright. (2007). Integrating Roadmapping into Technical Planning. Research-technology Management, 50(6):31-48. doi: 10.1080/08956308.2007.11657471

Sareminia, S., Hasanzadeh, A., Elahi, S., Montazer, G. 2018. (2018). Developing a framework for organisational Knowledge Management Roadmapping: A Content Analysis. Iranian Journal of Information Processing & Management, 34(1): 171-204

Saukkonen, J. (2020). Towards dynamic knowledge management in technology-based SMEs. *JYU dissertations*. Accessible at: https://jyx.jyu.fi/handle/123456789/71621 Retrieved 1st February 2024.

Siebelink,, R., Hofman, E., Halman, J., Nee, I. Roadmapping: (Missed) opportunities to overcome strategic challenges, Business Horizons, Volume 64, Issue 4, 2021, Pages 501-512, ISSN 0007-6813

Tang, Antony & Boer, Taco & Vliet, Hans. (2011). Building roadmaps: A knowledge sharing perspective. 10.1145/1988676.1988681.

Yoshikuni, A. C., & Albertin, A. L. (2020). Leveraging firm performance through information technology strategic alignment and knowledge management strategy: an empirical study of IT-Business Value. *International Journal of Research-GRANTHAALAYAH*, *8*(10), 304–318.

Young, R (1995) Conceptual research. Changes: An International Journal of Psychology and Psychotherapy, 13, pp. 145-148

Yee, Choy Leong & Teoh, Kenny. (2015). Developing a roadmapping system for knowledge management in an organisation. *Pertanika Journal of Social Science and Humanities*. 23. 83-100.

Zack, M. H. (1999). Managing codified knowledge. Sloan management review, 40(4), pp. 45-58.

Interplay Between Knowledge Management and Digital Transformation: Designing Solutions

Šarūnas Savickas and Lina Užienė
Kaunas University of Technology, Kaunas, Lithuania

sarunas.savickas@ktu.edu
lina.uziene@ktu.lt

Abstract: This paper explores the overlap between Knowledge Management and Digital Transformation, emphasizing their complementary nature and the necessity of integrated frameworks to maximize their synergistic potential. By reviewing various models and frameworks of the Knowledge Management and Digital Transformation interplay, it highlights gaps in current research, particularly in addressing the complex nature of the interplay, and proposes a comprehensive and novel conceptual framework to fill these gaps. The proposed framework includes core foundations of technology, people, culture and organization, a comprehensive list of risks and challenges, as well as actionable collection of synergistic solutions, offering both theoretical contributions and practical guidelines for organizations. The goal of the framework is to create a comprehensive approach to fully integrate Knowledge Management and Digital Transformation, aiming to maximize their synergistic impact. By bridging the gaps identified in current literature, levering overlap of both concepts and their unique dimensions, the novelty of the developed conceptual framework derives from the solution-focused approach, and it acts both as a foundation for future academic research and provides practical guidelines for organizations, which would enable a more strategic and holistic Digital Transformation and Knowledge Management integration and transformational journey towards Industry 5.0.

Keywords: Knowledge Management, Digital Transformation, Interplay, Framework

1. Introduction

As industries begin shifting from Industry 4.0 to Industry 5.0, Artificial Intelligence and other digital technologies are becoming more accessible and rapidly evolving, the synergy between Knowledge Management and Digital Transformation becomes a critical capability, that can drive synergistic value creation, innovation, and competitive advantage. Therefore, it is critical to review and understand areas of overlap and how these two concepts support each other, so that maximum synergy and value can be achieved.

Digital Transformation (DT) is a radical, continuous change, on all levels of an organization, which is triggered and supported by digital technologies, with the goal of creating new efficiencies, customer, and stakeholder value, across the whole value chain (Vial, 2019; Ahlskog et al 2022). The organizational change covers more than just the processes of the organization, according to Vial (2019), it can also be broken down into four main categories, and specific focus areas in each of them:

- Organizational structure – enable cross-functional collaboration, organizational agility, and ambidexterity.
- Organizational culture – embrace agile practices, innovation, entrepreneurship, to increase the value generation of DT.
- Leadership – cultivate a DT mindset and respond effectively to disruptions.
- Employee roles and skills – adapt to new roles and responsibilities brought by DT, focus on upskilling or reskilling to succeed in the evolving environment.

DT, creates a highly dynamic environment for organizations, making knowledge creation and efficient processing crucial (Nonaka, 1994), which necessitates efficient management of all knowledge processes within the organization.

Knowledge Management (KM), similarly to DT, is a continuous process, involving all organizational activities and dimensions, used to capture, store, manage and apply knowledge assets of the organization, with the goal of creating new organizational value and reach the objectives of an organization (Quintas, Lefrere, & Jones, 1997; Hilger & Wahl, 2022). In academic literature, there are usually four main KM processes identified (Alavi & Leidner, 2001; Ode & Ayavoo, 2020):

- Knowledge Creation – Involves identifying, creating, and acquiring internal and external knowledge.
- Knowledge Storage – Encompasses effective categorization, enhancement, storage, and continuous maintenance of knowledge.
- Knowledge Transfer or Sharing – Disseminates collected knowledge internally and externally.

- Knowledge Application – using knowledge to gain a competitive advantage, solve challenges, boost innovation, and create business value.

One of the main interaction points between KM and DT, are Knowledge Management Systems (KMS), which are systems and technologies, that support KM processes through coding and sharing of knowledge, creation of organizational knowledge directory and creation of both internal and external knowledge networks (Alavi & Leidner, 2001). Implementation of these systems, according to Purwadi & Sardjono (2024), requires organizations to focus on more than just the technology itself, but also on other key elements:

- Organizational agility – engage and motivate employees, enable decentralized decision-making, ensure leadership support, and foster a collaborative culture.
- Knowledge infrastructure – develop a flexible and reliable IT infrastructure that will support KMS.
- Knowledge empowerment – Align KMS strategy with business goals, onboard or empower talent, provide incentives for KMS use, offer upskilling and training, and create a trust-based environment.

These focus areas are closely connected to the organizational shifts occurring in DT, as summarized by Vial (2019), therefore KMS acts as a mediator between KM and DT, strengthening the relationship and improving the innovation capabilities of the organization (Sánchez Ramírez et al, 2022). DT provides tools and platforms, while KM ensures that the right information is effectively utilized to drive innovation, collaboration, and overall organizational success. More specifically, the changes that I4.0, and by extension DT, adoption brings, enhances the potential of KM, promoting both process and product innovation through knowledge acquisition from internal and external partners (Tortorella et al., 2022). Moreover, successful DT cannot be achieved without proper KM, as it is essential for identifying the needs, basis, and priorities of DT (Erceg & Zoranović, 2022). Synergy between DT and KM directly and indirectly enhances organizational performance, leading to sustainable competitive advantage and increased innovation. The competitive advantage of an organization is directly influenced by the usage of digital technology, as well as the overall commitment to DT and KM (Cardoso et al., 2023). Committing to KM, also facilitates Organizational Learning (OL), which further boosts long-term, sustainable, people-focused, competitive advantage (Anshari & Hamdan, 2022). This integration of digital technology, KM and OL practices, not only boosts competitiveness, but also helps drive DT by improving the innovation performance of an organization and enabling the creation of new products and services (Cheng et al., 2023).

Therefore, researching and understanding the interactions between the processes of KM and DT is highly valuable, offering both practical and academic benefits. Advancing research in this field prepares it for the inevitable and continuous impact of modern technologies, such as Generative AI, and the overall shift towards Industry 5.0, while also provides practical applicability – developing integrated synergetic implementation frameworks can aid leaders in making better decisions when driving DT and KM initiatives.

2. Theoretical Background

The following chapter examines various selected studies that attempt to either build new KM and DT frameworks, or compare already existing ones, the research type, findings, and limitations identified by the authors are summarized in Table 1.

A comparative analysis of different KM models, in the context of DT was done by Tinz, Tinz, & Zander (2019), who found that new challenges introduced by I4.0, are not widely addressed by the current models. Conceptual framework by Seng Cheong & Cheng Ling (2020), only focused on external knowledge, knowledge protection and mobility, and innovation capability and manufacturing performance as the outcomes, missing other potential interactions and solutions. Evans & Price (2020), based on their interviews with 72 C level executives, about information and knowledge asset management supported by DT, created a conceptual Holistic Information Asset Management model, that also supports DT, but it solely focuses on knowledge asset management, and validation of the model in practice is needed. Another conceptual, not empirically evaluated, model was developed by Dovleac, Ionica, & Leba (2021), that integrates Agile processes, together with the concept of Quality 4.0, enabled by I4.0 and in synergy with KM processes. Silvia, Santos & Souza (2021), integrated the knowledge conversion model of Nonaka (1994), together with I4.0 principles, to develop both a theoretical relationship and diagnostic model, though it also needs to be evaluated in practice and expanded with more KM and I4.0 practices and dimensions. Framework by Anshari & Hamdan (2022) focused on the skills and competencies required in the context of KM, Organizational Learning (OL) and I4.0, but is also missing empirical validation, and requires more thorough analysis.

Table 1: Research papers conceptualizing or analysing KM and DT integration frameworks.

Authors, Year	Research type, context	Findings	Limitations, future research
Tinz, Tinz, & Zander, 2019	Comparative analysis of KM models in the context of DT and I4.0.	I4.0 introduces new challenges such as human-machine, machine-machine interactions, and data protection. Current KM models do not widely address these challenges.	Future KM models need to include the new challenges and interactions in I4.0.
Seng Cheong & Cheng Ling, 2020	Conceptual paper that builds a conceptual framework of interplay between KM, innovation capability and manufacturing performance in the context of I4.0.	Conceptual framework, which connects external knowledge sourcing, knowledge mobility, knowledge protection, innovation capability and manufacturing performance.	Requires empirical validation.
Evans & Price, 2020	Longitudinal qualitative research - interviews with 72 C level executives and board members on information asset management and how it supports DT.	A conceptual Holistic Information Asset Management model, which supports DT by focusing on benefits, environment, leadership, information systems, behaviour, attributes, quality, performance, and justification.	Validation of the model is needed in practice.
Dovleac, Ionica, & Leba, 2021	Conceptual paper that integrates I4.0, KM, Agile and Quality management practices into a single framework.	Developed an Agile based framework, to implement Quality 4.0, an I4.0 based approach to quality management, in synergy with KM processes.	Models needs to be empirically tested, using knowledge graphs.
Silvia, Santos & Souza, 2021	Systematic literature review to identify how SECI model applies to DT and principles of I4.0.	Developed a theoretical relationship and diagnostic model between I4.0 principles, tacit and explicit knowledge, as well as the SECI modes of knowledge conversion.	Needs deeper understanding of other I4.0 principles, KM dimensions and its impact on management practices during DT. Model lacks empirical testing.
Anshari & Hamdan, 2022	Literature review and focus group to identify critical new skills and capabilities that KM can build for success in I4.0.	KM can improve organizations learning strategy, allow to build a sustainable competitive advantage quicker, upskill and re-skill employees, and in the context of I4.0, focuses on three dimensions – people, process, and technology.	Larger scope for literature analysis, test proposed models to develop KM strategies, use a case study approach

The selected papers reveal that, despite active research in the field of KM and DT interplay, there is a lack of in-depth frameworks that fully explore the interplay between these processes, including the foundations, risks, and possible synergistic solutions. KM should be studied as an overarching organizational concept, but such studies, especially those focusing on practical applications, are currently scarce (Wolf & Erfurth, 2019). Tinz, Tinz, & Zander (2019) reviewed five different knowledge management frameworks, in the context of KM challenges that can be found in smart factories – knowledge identification, development, exchange, use, preservation, evaluation, data protection and human-machine and machine-machine interactions. They found that existing models only partially address these challenges, particularly human-machine interactions, and data privacy, while future models should incorporate OL culture and address the challenges of I4.0. OL is critical in the KM and DT research field, as evident from studies on upskilling and reskilling, ignoring this integral aspect creates significant research gaps. Model developed by Anshari & Hamdan (2022) includes the human-machine and machine-machine interactions and OL, though focuses strictly on employee upskilling, missing other KM and DT interplay aspects, such as organizational strategy, culture, and specific technology dimensions. The SECI-based model by

Silvia, Santos & Souza (2021) specifically addresses tacit knowledge integration but lacks a deeper understanding of other I4.0 principles and the application of technology or KMS dimensions.

The selected research papers, highlight significant gaps in the current research on the interplay between KM and DT, emphasizing the need for comprehensive frameworks that address foundational aspects, risks, and synergistic solutions. Available models are only partially addressing challenges and interactions between KM and DT, miss critical elements such as OL (Tinz, Tinz, & Zander, 2019) or application of technology (Silvia, Santos & Souza, 2021) are highly focused on a specific element of the interaction (Anshari & Hamdan, 2022). This creates a need to develop a conceptual framework, which would fully explore the interplay between KM and DT, incorporate broad aspects of the interaction, including organizational, cultural, technological, and people-related aspects, and provide a comprehensive list of actionable solutions stemming from the interplay.

3. Conceptual Model

The conceptual model presented in the following chapter is founded on the premise that KM and DT are complementary processes – both are continuous and encompass all organizational levels, activities, and dimensions, with a common objective to generate new organizational value in accordance with the specific goals of the organization. This cyclical and complimentary relationship is the first element of the conceptual model. Due to the identified research gaps, the model also incorporates the common core foundations, shared challenges, and risks, as well as the possible synergistic solutions. The risks and synergistic solutions are not depicted having a one-to-one relationship, due to the processes being closely interconnected, and one solution can potentially affect multiple risks or dimensions of the KM and DT synergy. This creates an integrated, cyclical, conceptual model, which reviews multiple dimensions of interaction between KM and DT, their impact on an organization, and suggests a concrete list of possible synergistic solutions that would drive the interplay of KM and DT forward.

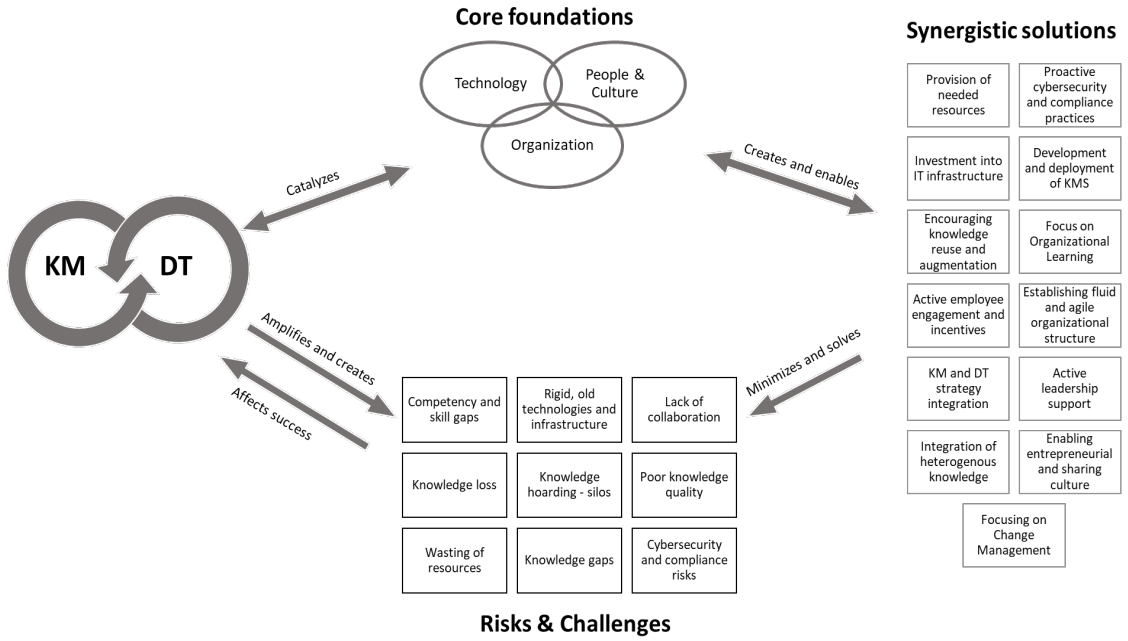


Figure 1: Conceptual model of KM and DT interplay

3.1 Core Foundations

Second group of elements in the conceptual model, are the core foundations that are common between KM and DT processes, and in their intersection become even more critical – Technology, People & Culture and Organization.

Technology is a key element of DT as evident from the various definitions presented in the literature – it can be both a trigger for DT, and its enabler (Vial, 2019; Warner & Wäger, 2019). In the context of KM, the key technological enablers can be summarized under the term KMS, which can be viewed as an extension of other various technologies used in DT, it can also help transform gathered information into knowledge. Implementing

a KMS, similarly, to implementing any other digital technology, becomes a DT project and requires focus on the key areas of implementation of the actual technology, leadership and strategy alignment, cultural and process changes, as well as organizational context, needs and available resources (Maramba & Smuts, 2020). Therefore, Technology becomes a core concept in both DT and KM fields, which can be a trigger and an enabler at the same time.

Second required core foundation are the People and Culture, namely – the culture of knowledge sharing, entrepreneurship, and human centricity. DT requires a culture, which embraces change, takes on risks, allows learning through failures and pilot projects (Abdallah, Shehab, & Al-Ashaab, 2021; Vogelsang et al, 2018). This constant innovation and experimentation, creates a knowledge-rich environment, in order to reap all its benefits and use the generated knowledge effectively, a knowledge friendly culture of sharing and trust is also required, which will in turn empower more learning, pilot projects and technology adoption (Gupta et al, 2022). People, their skills and knowledge, are the critical resource in the success of DT initiatives, and organizations should start their transformation from the changes of the people, culture, and organization, instead of technology (Kane, 2019). This creates a human-centric approach, and companies that can combine human resource management with KM, through diversity, inclusion and people empowerment policies can improve their organizational performance as well (Cillo et al, 2021).

The third overarching foundation is the Organization, which includes its strategy, processes, leadership, structure, and the environment it operates in. DT must be recognized as an integral part of the overall business strategy, closely integrating DT strategy with the business's broader strategy (Ubiparipović et al., 2020), which requires alignment with the organization's unique situation, environment, and capabilities. A similar approach is needed for KM, where its strategy should also align with business goals and fit the unique internal and external environment (Gupta et al., 2022). Due to the complexity of technologies and the new dependencies and relationships DT creates, organizations need a common KM and DT strategy to maintain control over these processes (Wolf & Erfurth, 2019). It is primarily the role of senior management or leadership to develop these strategies, provide resources, engage and empower employees to use them, and enhance the flexibility of organizational structures (Gupta et al., 2022). Another crucial element of the Organization foundation is how well it adapts to the changes of the environment. Organizations that integrate KM strategically, can leverage dynamic capabilities to anticipate and adapt to market shifts, build effective relationships with suppliers and customers, and efficiently allocate resources (Wessam & Nermin, 2023). In summary, the Organization foundation encompasses strategy, structure, leadership, processes, and adaptability to the internal and external environment, serving as a critical enabler in both KM and DT, and it becomes critically important in its intersection.

3.2 Risk & Challenges

Third group of elements are the various risks and challenges, which are either common to KM and DT, or is more pronounced in one of the processes, but their interplay amplifies and highlights these issues.

These risks affect the success of the interplay between KM and DT, as well as the implementation of the required capabilities and their efficiency. Most of the risks have a stronger or lesser impact on all the core foundations, yet certain risks are more pronounced than the others. Challenges were identified in the conceptual model are summarized in Table 2:

Table 2: Risks and challenges of KM and DT interplay.

Risks & Challenges	Description
Competency and skill gaps	Covers the risks of not having required training, competencies, or skills to effectively participate in KM and DT activities. Having employees who have the required skills and competencies is a critical success factor for DT (Ubiparipović et al, 2020) and for KM.
Rigid, outdated technology and IT infrastructure	One of the critical barriers of modern technology integration and DT, which can also stop development of effective KMS (Gupta et al, 2022; Ubiparipović et al, 2020). Heterogenous systems are also found to be a major barrier for Industry 5.0 implementation (Leng et al., 2022).
Lack of collaboration	DT is a knowledge-intensive process requiring collaboration among employees with diverse expertise across complex projects (Vogelsang et al., 2018). Extending collaboration

Risks & Challenges	Description
	beyond organizational boundaries allows partners to work as experts, focusing more effectively on specific areas of innovation and DT (Ubiparipović et al., 2020).
Knowledge loss	Retention of critical knowledge is a focus area in KM research – loss of such, mostly tacit, knowledge, can lead to business continuity risks (Nakash & Bouhnik, 2020). Knowledge loss happens due to multiple distinct reasons – employee attrition, intentional and unintentional forgetting, or unlearning.
Knowledge hoarding or silos	Closely related to the risk of knowledge loss is the creation of knowledge silos, as attempts to prevent loss can lead to dependency on a few employees who hoard knowledge (Nakash & Bouhnik, 2020). Additionally, the lack of collaboration and cross-functional cooperation can foster a competitive and mistrustful culture, posing significant challenges to DT efforts (Brink, Packmohr, & Paul, 2022).
Poor data, information, and knowledge quality	For a successful DT, correct data needs to be provided to the right user, available real-time and cover many different aspects and alternatives (Vogelsang et al, 2018), knowledge that comes from a variety of sources, is structured, mapped, and high quality, are some of the KM Critical Success Factors (CSF) (Onofre & Teixeira, 2022).
Wasting of resources	Inefficient usage of knowledge, technology, or knowledge gaps, can lead to duplication of work, and thus – wastage of resources, such as labour, machine, time, or monetary resources (Gupta et al, 2022).
Knowledge gaps	Because DT transforms the entire organization, it demands extensive organizational knowledge. If the IT department understands digitization but lacks insight into other functions' processes and needs, it creates a knowledge gap that hinders effective DT implementation (Brink, Packmohr, & Paul, 2022). Additionally, Industry 5.0 requires diverse technological knowledge to reorganize the manufacturing value chain (Leng et al., 2022).
Poor cybersecurity and compliance	Due to the integration of modern technologies, external partnerships, intentional and unintentional knowledge loss risks, cybersecurity and overall compliance to standards and policies becomes a critical organizational risk (Hammoda & Durst, 2022; Schnasse, Menzefricke, & Dumitrescu, 2021). Additionally, human-centric approach of Industry 5.0, generates vast amounts of sensitive, human-related information, security of which, becomes even more critical (Leng et al., 2022).

3.3 Synergistic Solutions

The main goal of this article is to provide a comprehensive list of synergistic solutions that arise from the interplay of KM and DT and helps minimize or completely remove the identified challenges. These are the more specific solutions and focus areas, which can also be a part of or enable the needed capabilities, and in the interplay of KM and DT, these solutions can gain even more importance, thereby simplifying the decisions to implement them. The identified synergistic solutions are summarized in Table 3:

Table 3: Synergistic solutions of KM and DT interplay.

Synergistic solutions	Description
Provision of needed resources	Identify and provide necessary time, material, and human resources for KM and DT, ensuring employee engagement through rewards and appropriate allocations.
Proactive cybersecurity and compliance requirements	Implement concrete cybersecurity policies and address emerging risks to control and minimize knowledge loss and leaks (Ubiparipović, et al 2020)
Investment into IT infrastructure	Invest in IT infrastructure and update outdated systems to create a solid technological foundation for DT and KM (Gupta et al, 2022).

Synergistic solutions	Description
Development and deployment of KMS	KMS enhance KM processes with advanced digital technologies like AI and automation, improving knowledge creation, sharing, application, and reuse (Gupta et al, 2022). While KMS can support every KM process, its success in knowledge application, reuse, and augmentation depends on employee engagement (Shrestha & Saratchandra, 2023). Specifically, AI-enabled KMS can simplify knowledge delivery, improve personalization and reach, and make knowledge available in real-time for quicker decision-making (Taherdoost & Madanchian, 2023).
Encouraging knowledge reuse and augmentation	Prevent duplication by improving knowledge quality and encouraging reuse and active augmentation (Nakash & Bouhnik, 2020).
Facilitating OL	Promote a culture of learning and knowledge sharing to address skill gaps and enhance organizational effectiveness, particularly with I4.0 technologies (Tortorella et al., 2022). Life-long learning of employees, is also a critical requirement to achieve the human-centric and sustainable goals of Industry 5.0 transition (Leng et al., 2022).
Fluid and agile organizational structure	Organizations cannot successfully manage DT with the old, static hierarchical structures, and should become more flexible, open, and quickly adapt to changes by adapting their organizational model as well (Smith & Beretta, 2020).
Active leadership promotion	Leaders should inspire, support, and promote KM and DT initiatives, fostering a culture of trust and learning, create more robust, integrated strategies and lay the required foundations for organizational and cultural changes required (Inkinen, 2016; Mazorodze & Buckley, 2019).
KM and DT strategy integration	Concrete steps must be taken to integrate the KM and DT together and into the organizational strategy, then cascade it down to functional leaders and strategies, to make sure there is a common vison in the organization (Mathew & Rodrigues, 2019; Mielli & Bulanda, 2019).
Active employee engagement and incentives	A properly motivated employee, through incentives or gamification of KMS, can help ensure a high quality of knowledge within the KMS, and help build the knowledge sharing culture (Friedrich et al, 2020).
Enabling entrepreneurial and sharing culture	Foster collaboration, trust, and experimentation to support an entrepreneurial and knowledge-sharing culture (Vogelsang et al, 2018; Gupta et al, 2022)
Integration of heterogeneous knowledge	DT increases the heterogeneity of knowledge that is required for a successful transformation, and at the same time, it creates a highly heterogenous knowledge (Yoo et al, 2012). Develop methods and strategies to manage diverse knowledge assets, addressing collaboration, knowledge loss, and hoarding challenges.
Focusing on Change Management	Lack of change management can lead to DT project failures (Brink, Packmohr, & Paul, 2022). KM strategies like personalization, codification, and organizational learning (OL) can boost readiness for change and reduce organizational cynicism, aiding project implementation (Imran et al, 2016).

4. Discussion

The proposed conceptual framework of KM and DT interplay addresses multiple limitations and future research directions identified by other models, frameworks, and research of KM and DT interplay. First, as suggested by Wolf & Erfurth (2019), it addresses both KM and DT as overarching organizational concepts with a focus on practical solutions of the interplay. The suggested framework also incorporates OL, knowledge sharing, upskilling and reskilling challenges raising from the human-machine interactions, data security and privacy risks, all of which were suggested by Tinz, Tinz, & Zander (2019) as critical missing elements of the current frameworks. The technological and strategy dimensions not considered in the frameworks developed by Anshari & Hamdan (2022) and Silvia, Santos & Souza (2021), are included as the core foundations, and their specific elements are identified as both the risks and synergistic solutions.

Every organization has a unique set of variables – internal and external environment, set of strategies, weaknesses and opportunities, which also creates a unique environment for both KM and DT (Gupta et al 2022; Ubiparipović et al 2020), the size of the company, maturity, industry and organization type, all have an impact on the technology adoption and KM activities of the company as well (Wessam & Nermin, 2023). This complexity and uniqueness of every organization, suggests that the KM and DT integration frameworks, also need to be flexible and address the complexities of different industries and organizations, by addressing the specific solutions and risks in the context of organizations of different sizes, maturity levels, industries, and geographical locations.

To advance the integration of KM and DT, it is essential to link these findings with broader academic research and practical implications. The proposed framework highlights the synergy between KM and DT, focusing on specific solutions from this interplay and acknowledging the challenges in diverse organizational settings. This is crucial as it reflects the difficulties highlighted in the literature concerning DT efforts, especially in aligning technological advancements with human-centric approaches (Kane, 2019; Vial, 2019). As KM and DT are dynamic and continually evolving, the framework must also adapt to ongoing technological changes and align with dynamic capabilities theory (Warner & Wäger, 2019). It should ensure efficient use of technologies in KM processes, remain relevant in guiding organizations to Industry 5.0, and address the associated technological and socio-economic challenges (Leng et al., 2022).

Filling in the theoretical gaps of academic research is a strong foundation for the proposed conceptual model, but to gain more in-depth, nuanced knowledge, and for the model to stay both academically and practically relevant, it needs to be empirically validated, remain flexible and change together with the KM and DT concepts.

5. Conclusion

This paper explores the relationship between Knowledge Management (KM) and Digital Transformation (DT), emphasizing how their integration can drive innovation and competitive advantage from Industry 4.0 to Industry 5.0. By examining various frameworks, the study highlights gaps in the current literature and models, particularly in fully integrating KM and DT. These gaps underscore the fragmented approach to tackling the challenges and opportunities of KM and DT interaction.

Theoretically, this paper contributes to the literature by proposing a novel, conceptual, framework that connects the risks, challenges, foundations, and synergistic solutions stemming from the interplay between KM and DT. Because there is a lack of similar frameworks, it can serve as a foundation for future academic research and help build more integrated, cross-functional, and solution-oriented frameworks.

In practice, the developed framework serves as a guide to help practitioners understand the risks and potential synergistic solutions created by the interplay of KM and DT. The framework's foundational elements offer general guidance, while the risks and challenges section provides a detailed list of obstacles that could prevent organizations from realizing the full value of KM and DT, necessitating leadership attention. The synergistic solutions section offers a comprehensive set of focus areas and actionable strategies that, with sufficient resources and support, can help mitigate risks and guide organizations more effectively through their transformational journeys.

Despite its contributions, this study has limitations, primarily because it designs and examines a conceptual framework. Future research should empirically validate and adapt this framework across various industries, organizational and DT maturity levels, and cultural contexts. Such research could tailor the framework to unique environments and deepen understanding of specific parameters that organizations need to address. This would enhance the framework's practical applicability and its ability to create synergistic value from the interplay between KM and DT.

In conclusion, as businesses continue to evolve in a digitally interconnected environment of constant change, understanding the nuanced relationship between KM and DT becomes critical. This paper sets the stage for further research and practical implementations that could potentially reshape how organizations leverage knowledge to achieve sustained innovation and competitive advantage.

References

Abdallah, Y. O., Shehab, E., & Al-Ashaab, A. (2021). Understanding digital transformation in the manufacturing industry: a systematic literature review and future trends. Product Management & Development, 19(1), e20200021. https://doi.org/10.4322/pmd.2021.001

Ahlskog, M., Badasjane, V., Granlund, A., Bruch, J., & Sauter, B. (2022). Differing Views of the Meaning of Digital Transformation in Manufacturing Industry. Advances in Transdisciplinary Engineering. https://doi.org/10.3233/atde220152

Alavi, M., & Leidner, D. (1999). Knowledge Management Systems: Issues, Challenges, and Benefits. Communications of the Association for Information Systems, 1. https://doi.org/10.17705/1cais.00107

Anshari, M., & Hamdan, M. (2022). Understanding knowledge management and upskilling in Fourth Industrial Revolution: transformational shift and SECI model. VINE Journal of Information and Knowledge Management Systems. https://doi.org/10.1108/vjikms-09-2021-0203

Brink, H., Packmohr, S., & Paul, F. H. (2022). Extending a Socio-Technical Model of the Barriers to Digital Transformation through Data Triangulation. 2022 8th International Conference on Information Management (ICIM). https://doi.org/10.1109/icim56520.2022.00020

Cardoso, A., Pereira, M. S., Sá, J. C., Powell, D. J., Faria, S., & Magalhães, M. (2023). Digital Culture, Knowledge, and Commitment to Digital Transformation and Its Impact on the Competitiveness of Portuguese Organizations. Administrative Sciences, 14(1), 8. https://doi.org/10.3390/admsci14010008

Cheng, Q., Liu, Y., Peng, C., He, X., Qu, Z., & Dong, Q. (2023). Knowledge digitization: Characteristics, knowledge advantage and innovation performance. Journal of Business Research, 163, 113915. https://doi.org/10.1016/j.jbusres.2023.113915

Cillo, V., Gregori, G. L., Daniele, L. M., Caputo, F., & Bitbol-Saba, N. (2021). Rethinking companies' culture through knowledge management lens during Industry 5.0 transition. Journal of Knowledge Management, 26(10), 2485–2498. https://doi.org/10.1108/jkm-09-2021-0718

Dovleac, R., Ionica, A., & Leba, M. (2021). Knowledge Management Embedded in Agile Methodology for Quality 4.0. 2021 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM). https://doi.org/10.1109/ieem50564.2021.9673045

Erceg, V., & Zoranović, T. (2022). Knowledge management and digital business transformation. Strategic Management, 27(2), 57–63. https://doi.org/10.5937/straman2200007e

Evans, N., & Price, J. (2020). Development of a holistic model for the management of an enterprise's information assets. International Journal of Information Management, 54, 102193. https://doi.org/10.1016/j.ijinfomgt.2020.102193

Friedrich, J., Becker, M., Kramer, F., Wirth, M., & Schneider, M. (2020). Incentive design and gamification for knowledge management. Journal of Business Research, 106, 341–352. https://doi.org/10.1016/j.jbusres.2019.02.009

Gupta, A., Kr Singh, R., Kamble, S., & Mishra, R. (2022). Knowledge management in industry 4.0 environment for sustainable competitive advantage: a strategic framework. Knowledge Management Research & Practice, 20(6), 878–892. https://doi.org/10.1080/14778238.2022.2144512

Hammoda, B., & Durst, S. (2022). A taxonomy of knowledge risks for healthcare organizations. VINE Journal of Information and Knowledge Management Systems. https://doi.org/10.1108/vjikms-07-2021-0114

Hilger, J., & Wahl, Z. (2022). Making Knowledge Management Clickable: Knowledge Management Systems Strategy, Design, and Implementation. Springer. https://doi.org/10.1007/978-3-030-92385-3

Imran, M. K., Rehman, C. A., Aslam, U., & Bilal, A. R. (2016). What's organization knowledge management strategy for successful change implementation? Journal of Organizational Change Management, 29(7), 1097–1117. https://doi.org/10.1108/jocm-07-2015-0130

Inkinen, H. (2016). Review of empirical research on knowledge management practices and firm performance. Journal of Knowledge Management, 20(2), 230–257. https://doi.org/10.1108/jkm-09-2015-0336

Yoo, Y., Boland, R. J., Lyytinen, K., & Majchrzak, A. (2012). Organizing for Innovation in the Digitized World. Organization Science, 23(5), 1398–1408. https://doi.org/10.1287/orsc.1120.0771

Kane, G. (2019). The Technology Fallacy. Research-Technology Management, 62(6), 44–49. https://doi.org/10.1080/08956308.2019.1661079

Leng, J., Sha, W., Wang, B., Zheng, P., Zhuang, C., Liu, Q., Wuest, T., Mourtzis, D., & Wang, L. (2022). Industry 5.0: Prospect and retrospect. Journal of Manufacturing Systems, 65, 279–295. https://doi.org/10.1016/j.jmsy.2022.09.017

Maramba, G., & Smuts, H. (2020). Guidelines for Selecting Appropriate Knowledge Management System Implementation Frameworks. International Journal of Knowledge Management, 16(4), 81–108. https://doi.org/10.4018/ijkm.2020100105

Mathew, A. O., & Rodrigues, L. L. (2019). Critical success factors of knowledge management: a review. World Review of Entrepreneurship, Management and Sustainable Development, 15(4), 409. https://doi.org/10.1504/wremsd.2019.102338

Mazorodze, A. H., & Buckley, S. (2019). Knowledge management in knowledge-intensive organisations: Understanding its benefits, processes, infrastructure and barriers. SA Journal of Information Management, 21(1). https://doi.org/10.4102/sajim.v21i1.990

Mielli, F., & Bulanda, N. (2019). Digital Transformation: Why Projects Fail, Potential Best Practices and Successful Initiatives. 2019 IEEE-IAS/PCA Cement Industry Conference (IAS/PCA). https://doi.org/10.1109/citcon.2019.8729105

Nakash, M., & Bouhnik, D. (2020). Risks in the absence of optimal knowledge management in knowledge-intensive organizations. VINE Journal of Information and Knowledge Management Systems, 52(1), 87–101. https://doi.org/10.1108/vjikms-05-2020-0081

Nonaka, I. (1994). A Dynamic Theory of Organizational Knowledge Creation. Organization Science, 5(1), 14–37. https://doi.org/10.1287/orsc.5.1.14

Ode, E., & Ayavoo, R. (2020). The mediating role of knowledge application in the relationship between knowledge management practices and firm innovation. Journal of Innovation & Knowledge, 5(3), 210–218. https://doi.org/10.1016/j.jik.2019.08.002

Onofre, I., & Teixeira, L. (2022). Critical Factors for a Successful Knowledge Management Implementation. Electronic Journal of Knowledge Management, 20(2). https://doi.org/10.34190/ejkm.20.2.2357

Purwadi, I. K. B., & Sardjono, W.. (2024). Developing Strategies to Improve Organizational Readiness for Knowledge Management System Implementation. Journal of System and Management Sciences, 14(2), 372–384. https://doi.org/10.33168/jsms.2024.0223

Quintas, P., Lefrere, P., & Jones, G. (1997). Knowledge management: A strategic agenda. Long Range Planning, 30(3), 385–391. https://doi.org/10.1016/s0024-6301(97)90252-1

Sánchez Ramírez, S., Guadamillas Gómez, F., González Ramos, M. I., & Grieva, O. (2022). The Effect of Digitalization on Innovation Capabilities through the Lenses of the Knowledge Management Strategy. Administrative Sciences, 12(4), 144. https://doi.org/10.3390/admsci12040144

Seng Cheong, C., & Cheng Ling, T. (2020). KNOWLEDGE MANAGEMENT, ORGANIZATIONAL AMBIDEXTERITY, AND MANUFACTURING PERFORMANCE IN THE ERA OF INDUSTRY 4.0: A PROPOSED MODEL. International Journal of Industrial Management, 5, 10–19. https://doi.org/10.15282/ijim.5.0.2020.5691

Shrestha, A., & Saratchandra, M. (2023). A Conceptual Framework toward Knowledge Ambidexterity Using Information Systems and Knowledge Management. Journal of Information Systems, 37(1), 143–167. https://doi.org/10.2308/isys-2021-013

Silva Junior, D., Santos, R., & Souza, J. (2021). The relationship between Ikujiro Nonaka's knowledge spiral and the six industry principles 4.0 in the context of digital transformation. Revista Gestão & Tecnologia, 21(4), 135-161. https://doi.org/10.20397/2177-6652/2021.v21i4.2145

Smith, P., & Beretta, M. (2020). The Gordian Knot of Practicing Digital Transformation: Coping with Emergent Paradoxes in Ambidextrous Organizing Structures. Journal of Product Innovation Management, 38(1), 166–191. https://doi.org/10.1111/jpim.12548

Taherdoost, H., & Madanchian, M. (2023). Artificial Intelligence and Knowledge Management: Impacts, Benefits, and Implementation. Computers, 12(4), 72. https://doi.org/10.3390/computers12040072

Tinz, P., Tinz, J., & Zander, S. (2019). Knowledge Management Models for the Smart Factory: A Comparative Analysis of Current Approaches. Proceedings of the 11th International Joint Conference on Knowledge Discovery, Knowledge Engineering and Knowledge Management. https://doi.org/10.5220/0008348803980404

Tortorella, G., Prashar, A., Vassolo, R., Cawley Vergara, A. M., Godinho Filho, M., & Samson, D. (2022). Boosting the impact of knowledge management on innovation performance through industry 4.0 adoption. Knowledge Management Research & Practice, 1–17. https://doi.org/10.1080/14778238.2022.2108737

Ubiparipović, B., Matković, P., Marić, M., & Tumbas, P. (2020). Critical factors of digital transformation success: A literature review. Ekonomika Preduzeca, 68(5–6), 400–415. https://doi.org/10.5937/ekopre2006400u

Vial, G. (2019). Understanding digital transformation: A review and a research agenda. The Journal of Strategic Information Systems, 28(2), 118–144. https://doi.org/10.1016/j.jsis.2019.01.003

Vogelsang, K., Liere-Netheler, K., Packmohr, S., & Hoppe, U. (2018). Success factors for fostering a digital transformation in manufacturing companies. Journal of Enterprise Transformation, 8(1–2), 121–142. https://doi.org/10.1080/19488289.2019.1578839

Warner, K. S., & Wäger, M. (2019). Building dynamic capabilities for digital transformation: An ongoing process of strategic renewal. Long Range Planning, 52(3), 326–349. https://doi.org/10.1016/j.lrp.2018.12.001

Wessam M. K., & Nermin M. G. (2023). The Role of Knowledge Management in Adopting Industry 4 Technology: The Mediating Role of Market Orientation. Arab Journal of Administration, 43(3), 1–30. https://doi.org/10.21608/aja.2023.214705.1462

Wolf, M., & Erfurth, C. (2019). Knowledge Management for the Digital Transformation of Enterprises – Literature Based Trend Analysis. Innovations for Community Services, 142–155. https://doi.org/10.1007/978-3-030-22482-0_11

Balancing Trust and Surveillance in Hybrid Work: Insights from a Pilot Study on Workplace Monitoring

Veronica Sbalzer, Gayatri Sudarshan Shetty and Kathrin Kirchner
Technical University of Denmark, Ballerup, Denmark

sbalzer.veronica@gmail.com
gayatrishetty99@gmail.com
kakir@dtu.dk

Abstract: Many knowledge workers have shifted to work hybrid by being partly in the office and partly at remote locations. This brings freedom for knowledge workers, but managers are concerned about the performance of their workforce when they are not working from the office. One means to check performance constantly is by collecting and analyzing performance and behavior data to monitor employees, which is a form of algorithmic control. On the one hand, this can lead to conflicts between employees and managers as employees feel that managers mistrust them. On the other hand, employees might trust transparent monitoring that helps them focus on core tasks. To learn more about balancing trust and surveillance, this pilot study surveyed 45 knowledge workers in an engineering company in Denmark, a country with high levels of trust in society. We developed an online survey to investigate managers' and employees' opinions about workplace monitoring. We found that all participants had a negative to neutral attitude toward monitoring, although managers were slightly more favorable. Furthermore, data collection for work-related purposes to improve the work situation might be appropriate, although a trustful relationship between managers and employees is the most important. Thus, if a form of monitoring is going to be introduced at the workplace, it is essential that all stakeholders – managers, employees, HR, and union representatives – are involved and that complete transparency is achieved in terms of which data is collected and for which purposes. Only then can a balance between trust and surveillance be achieved, including maintaining a positive working climate.

Keywords: Hybrid Knowledge Work; Workplace Monitoring, Algorithmic Control, Trust

1. Introduction

In recent years, a transformation of work practices has been underway, where knowledge workers work partly from the office and partly from anywhere, allowing greater flexibility but continuing the collaboration with fellow knowledge workers at the office. As organizations transition towards a more structured system of hybrid work arrangements, there is a concern about workers' performance when they are not visible in the office. On the one hand, working from home can help workers solve their work-life conflicts, which leads to higher job satisfaction and, thus, higher performance (Naqshbandi et al., 2023). On the other hand, working from home can cross the line between work and family life and thus lead to lower performance (Wöhrmann & Ebner, 2021) or does not improve performance as the family might disrupt the work or people feel isolated (De Valdenebro Campo et al., 2021).

From a managerial perspective, working from home or anywhere has consistently raised concerns surrounding the potential loss of managerial control (Eurofound, 2020). Implementing worker monitoring practices seems like a cost-effective solution to address these concerns (Ball, 2021). Monitoring is observing and tracking employees' activities, primarily during remote work (Ball, 2010). Such monitoring technologies encompass a wide range of tools and methodologies, including but not limited to keystroke logging, tracking online search histories, and the use of digital surveillance systems (Eurofound, 2020). In 2020, the global demand for employee monitoring software was growing, with a 108% increase in April and a 70% rise in May compared to figures from 2019 (Brown, 2020). Research suggests that a significant proportion of employers have already integrated such monitoring tools into their companies: A US study found that almost 80% of employers reported using employee monitoring software to track performance and online activity among remote employees. Similarly, Gartner research indicates that the global adoption of tracking tools will increase from 60% registered at the beginning of the pandemic to 70% within the next three years (Hickok & Maslej, 2023). This is also confirmed by a Danish survey, which indicates that 63% of employees experience workplace monitoring with data collection (The Danish Society of Engineers, IDA, 2024). The case of Denmark is especially interesting, as the country scores high in trust in society and at the workplace (OECD, 2020), which might also relate to the hybrid work situation. Although Danish managers might be interested in learning more about their workers' performance when working outside the office, monitoring them would raise mistrust. Furthermore, following the European GDPR, options for workplace monitoring are limited and should not break into workers' privacy at home.

Managers seek ways to monitor their workforce effectively, which can lead to tensions between employees and management. Understanding the different attitudes of employees and managers towards workplace monitoring is therefore essential before extensive monitoring is introduced. Based on a survey among knowledge workers and their managers in a Danish Engineering company, this study aims to answer the following two research questions:

1. Do employees and their managers perceive workplace monitoring differently?
2. What data types do remote employees consider acceptable for sharing within the context of monitoring?

2. Literature Background

2.1 Monitoring as Algorithmic Control at the Workplace

Artificial intelligence increasingly influences people's work and thus also influences human resource management by relying on data and algorithms for managerial decisions (Parent-Rocheleau & Parker, 2022). This algorithmic management is the "large-scale collection and use of data to develop and improve learning algorithms that carry out coordination and control functions traditionally performed by managers" (Möhlmann et al., 2021, p. 2005). Algorithmic management, as a part of Artificial Intelligence techniques, has been conceptualized in algorithmic control and algorithmic matching (Möhlmann et al., 2021). Kellog et al. (2020) discuss six different forms of algorithmic control, one of which is algorithmic recording (or monitoring), where any data on employees is collected and analyzed during their work. Algorithmic management is often discussed in a gig work context but also exists in traditional work settings (Lippert et al., 2023).

Worker monitoring in companies is not a new idea, as it can be traced back to U.S. history from the early to mid-19th century. The introduction of structured shifts, production quotas, and strict timekeeping created a more regulated work environment than prior labor practices. This necessitated increased supervision to ensure productivity and efficiency, which prompted the beginning of worker monitoring (Hickok & Maslej, 2023). While tools like time clocks or cameras were historically used for monitoring performance, digitalization of many knowledge workers' tasks, electronic data collection, and analytics allow for measuring performance and the workers' behavior. Through systematic digital behavior analysis, these tools provide insights into individual and collective behaviors, unravel work patterns, and identify key contributors to overall productivity. Several tools are already available on the market, e.g., Prodoscore, which collects metrics about the utilization of tools, internal collaboration, and workload for activity analysis and performance measurement (Prodoscore, n.d.). Another tool is Teramind, which tracks keystrokes, website, and application usage and assesses files to detect threads and monitor productivity and compliance (Teramind, n.d.).

Policies and guidelines governing employee monitoring, when primarily aligned with the interests of the employer rather than the employees, can trigger privacy concerns (Chang et al., 2015). In general, employers do not need employees' consent for various forms of monitoring if it is based on the legitimate legal interest of the employer. Employers must follow GDPR principles when handling personal data during monitoring, ensuring lawful and transparent data processing, accuracy, limited data retention, security, and being accountable for compliance.

Jeske (2022) identified two purposes for monitoring workers: (1) Employees can only be trusted to work in the company's best interest when visible in the office. This can lead to resistance from employees toward monitoring, and thus, poorer performance and conflicts between employers and employees. (2) Monitoring allows employees to get an overview of the current performance and helps them to focus better on core tasks. This higher transparency can lead to trust among employees, especially if they are involved in the design of the monitoring systems.

Vitak and Zimmer (2023) found from a survey among U.S. adults that the acceptability of workplace surveillance practices is context-dependent and that reductions in privacy and autonomy at work could amplify power imbalances, particularly among vulnerable employees. The authors conclude that some forms of workplace monitoring are justified, such as tracking work-related communication and ensuring security. Nevertheless, they express concerns about the extent of data collection and the proliferation of predictive algorithms that claim to predict hiring, firing, and promotions.

2.2 Workplace Monitoring in Denmark

Understanding how individuals react to the implementation of workplace monitoring is crucial for organizations aiming to foster a positive work environment while embracing technological advancements. Denmark is known for fostering a strong sense of trust in workplaces, and this characteristic plays a crucial role in the country's work culture. The Danish work environment traditionally thrives on mutual trust between employers and employees. This trust is deeply embedded in the social fabric. It is reflected in various aspects of the workplace, such as open communication, collaborative decision-making processes, and a generally flat organizational structure.

A Danish representative questionnaire among managers in Danish workplaces found that digital tools for collecting employee data are widespread in the Danish labor market and that most people have experienced them already (Hald et al., 2024). It reveals a divided landscape, with nearly half of the managers expressing support for data collection while a substantial minority remains skeptical. A key finding of the report underscores the significance of communication and guidelines in fostering trust and a healthy working environment in the context of data ethics. The survey found that managers who openly communicate about collecting employee data with their employees are less likely to damage their relationship with their workforce.

3. Methodology

Data was collected through an online survey in a Danish Engineering company in November/December 2023. The company has a general policy allowing people to work 2-3 days from home, but it is up to the manager to decide based on the specific task they need to perform. They keep track of their tasks via MS TEAMS to ensure transparency and project work if a worker needs to take over another colleague's tasks. The company does not use any digital monitoring tools on the individual level. However, the task performance is measured so that it becomes transparent how much time was spent on a task for project management reasons. This can be used to compare task performance, e.g., between departments, which could lead to additional training or providing better tools to solve tasks.

The survey collected demographic information and answers to 12 questions inspired by the Theory of Planned Behavior regarding attitudes toward surveillance, subjective norms, and perceived behavioral control (see Table 2). The questions used a Likert scale ranging from 1 to 7, where 1='Strongly Disagree' and 7='Strongly Agree.' The questions were analyzed with a T-Test to answer our research question 1 about the different perceptions of managers and employees toward monitoring.

Furthermore, a factorial vignette design was used to answer our second research question, inspired by (Vitak & Zimmer, 2023). This experimental and survey design mix helps investigate judgments in a particular context and under certain conditions (Wallander, 2009). Following this approach, the survey participants had to evaluate different vignettes around workplace monitoring, using the question:

Your company will begin collecting and monitoring employee data through a new company software. [Data collected] may be collected to [purpose of data collection].

Table 1 overviews the two factors and items combined to build the vignettes. The items ranged from reasonable regarding work practices to issues that might be considered highly private. Combining the two factors in Table 1, 64 scenarios would be possible. To keep the answering time for the survey low, every participant got only a randomly assigned set of 32 scenarios for evaluation.

To back up our results and get deeper insights into the participants' perceptions toward monitoring, open questions were included at the end of the survey regarding how workplace monitoring would influence the workplace positively and negatively.

Table 1: Factors and Items for the vignettes, inspired by (Vitak & Zimmer, 2023)

Factor	Nr. of levels	Items
Data collected	8	The average length of your work sessions and the length of the breaks you take during the workday
		Internet usage and website history
		The task completion time and amounts
		Communication logs (emails, chats)

Factor	Nr. of levels	Items
		File and document access history
		The record of all keys typed on your computer and your mouse activity
		Webcam and audio recordings
		Work phone activities
Purpose of data collection	8	Evaluate performance and give individual feedback
		Identify individual training and development needs
		Determine eligibility for promotions and higher compensation
		Ensure compliance with company policies
		Enhance team collaboration and communication
		Ensure healthy working environments
		Improve worker productivity
		Monitor the effectiveness of remote work tools

The participants were asked to rate the appropriateness of each vignette on a 7-point Likert scale, with 1 indicating 'Highly Inappropriate' and 7 representing 'Highly Appropriate'. Every survey participant got 32 scenarios to evaluate. The data is hierarchical, as the participants responded individually, and the responses for multiple scenarios by the same individual are not independent. Given this, Linear Mixed Effects Models (LMMs, (Hox et al., 1991)), especially restricted maximum likelihood (REML), are well-suited for analyzing hierarchical data structures, as they allow for the modeling of both fixed effects (population-level effects) and random effects (individual-level effects). This approach accounted for the correlation among responses from the same individual while treating responses from different individuals as independent.

Forty-five complete answers were collected in the company. From them, 82.2% were male and 17.8% female, with an age range between 24 and 69 (average age 42). 98% were full-time workers, and they came from various departments, but most of them worked in the engineering or the sales and marketing departments, which are classic knowledge workers' areas. Most survey participants have worked for several years in the company, with an average of 18 hours per week from home. One-third (N=15) were managers; the other 30 answers came from employees.

4. Findings

4.1 Different Perceptions of Managers and Employees

As can be seen in Table 2, both managers and employees expressed relatively low scores in the "Attitude toward monitoring" questions, indicating a general skepticism or negative outlook towards the benefits of monitoring for productivity, data confidentiality, and communication with managers (all mean values show negative opinions below the neutral point 4). As for the questions within the "Social norms" category, there is a perceptible shift toward a more positive stance, with scores closer to the neutral point 4 on the scale. In the "Perceived behavioral control" questions, managers and employees exhibit balanced scores, reflecting a more confident perception of their ability to adapt to monitoring tools and maintain effective work-life balance. Significant differences between managers and employees can be only seen in two social norm questions, where managers score significantly higher than employees regarding following the higher-level management's monitoring opinions.

4.2 Vignette Analysis

The first model used LMM on all eight values in the collected data attributes (Table 1). The dependent variable was the "perceived appropriateness". Similar to (Vitak & Zimmer, 2023), the item "communication logs (emails, chats)" was used as constant as it was the attribute with the least privacy concerns. According to the results in Table 3, "Work phone activities" and "task completion time and amounts" have the highest Z-Score and are thus perceived as highly appropriate with a significant p-value (see Table 3). This may be attributed to privacy concerns, a desire for autonomy in online activities, perceived intrusiveness, or potential cultural and organizational factors.

Table 2: Results from the T-Test for managers and employees

Category	Item	Manager Mean (SD)	Employee Mean (SD)	T-value	p-value
Attitude toward monitoring	I believe that remote monitoring of my work enhances my productivity.	2.73 (1.870)	2.33 (1.605)	0.708	0.485 n.s.
	I think remote monitoring is beneficial for maintaining data confidentiality and preventing unauthorized access.	3.00 (1.648)	3.00 (1.597)	0.000	1.0 n.s.
	I feel that remote monitoring respects my privacy and is not intrusive	3.20 (2.042)	2.47 (1.795)	1.181	0.249 n.s.
	I believe that remote work monitoring would contribute to a better performance evaluation.	2.93 (1.792)	2.40 (1.499)	0.992	0.331 n.s.
Subjective norms	I think remote monitoring is a necessary tool for improving communication with my manager.	2.60 (1.805)	2.27 (1.760)	0.589	0.561 n.s.
	I think that my friends, family, and colleagues have influence on my opinions	3.27 (1.831)	3.73 (1.999)	-0.781	0.441 n.s.
	I feel like my decision to support remote monitoring aligns with the expectations of my immediate supervisor.	4.07 (1.668)	2.77 (1.612)	2.493	0.019 *
	I perceive strong social pressure to comply with management's decisions in regard to remote monitoring practices.	3.73 (1.580)	2.63 (1.520)	2.230	0.034 *
Perceived behavioral control	I feel confident in my ability to adapt to remote monitoring tools and processes.	3.93 (1.710)	3.80 (1.864)	0.239	0.813 n.s.
	I feel in control over the way remote monitoring is implemented in my workplace.	4.07 (1.792)	3.70 (1.765)	0.650	0.521 n.s.
	I feel capable of managing my work effectively while being monitored remotely	4.00 (1.890)	3.57 (2.046)	0.705	0.486 n.s.
	I feel confident in my ability to maintain a work-life balance while being remotely monitored.	3.80 (2.077)	3.50 (1.978)	0.464	0.646 n.s.

Table 3: Results for LLM – data collected

Item	Coefficient	Mean (SD)	Z-score	p-value
The average length of your work sessions and the length of the breaks you take during the workday	0.281	0.291 (1.283)	1.283	0.200
Internet usage and website history	0.158	0.171 (0.922)	0.922	0.356
The task completion time and amounts	0.607	0.120 (5.049)	5.049	0.000***
File and document access history	0.249	0.199 (1.251)	1.251	0.211
The record of all keys typed on your computer and your mouse activity	0.562	0.210 (2.678)	2.678	0.007***
Webcam and audio recordings	0.213	0.165 (1.290)	1.290	0.197
Work phone activities	0.913	0.034 (26.570)	26.570	0.000***

In the second model (Table 4), regarding the purpose of data collection, "ensuring compliance with company policies" is used as a constant, following (Vitak & Zimmer, 2023). "Determining eligibility for promotions and higher compensation and "improving worker productivity" gained the highest and significant Z-Scores and are thus considered highly appropriate (Table 4). On the other hand, purposes such as "Monitoring the effectiveness of remote work tools" and "Ensuring healthy working environments" showed lower Z-Scores that were not significant.

Table 4: LLM results for data collection

Item	Coefficient	Mean (SD)	Z-score	p-value
Evaluate performance and give individual feedback	0.627	0.314 (1.999)	1.999	0.046**
Identify individual training and development needs	0.507	0.258 (1.969)	1.969	0.049**
Determine eligibility for promotions and higher compensation	0.701	0.091 (8.054)	8.054	0.000***
Enhance team collaboration and communication	0.617	0.269 (2.297)	2.297	0.022**
Ensure healthy working environments	0.479	0.301 (1.592)	1.592	0.111
Improve worker productivity	0.859	0.113 (7.627)	7.627	0.000***
Monitor the effectiveness of remote work tools	0.309	0.278 (1.113)	1.112	0.266

These differences may stem from the nature of the purposes themselves. Objectives directly related to individual growth and career advancement, like promotions and productivity improvement, may be perceived as inherently aligned with personal and organizational success. In contrast, monitoring tools associated with broader organizational effectiveness or health considerations might introduce more complex perceptions, potentially triggering privacy concerns or uncertainties.
Furthermore, we looked at age, gender, and role (manager, employee). Age (coefficient 6.915, p=0.006***) positively affects the perceived appropriateness. Gender is not significant. Role (coefficient 5.927, p=0.000***) also positively affects perceived appropriateness. The interaction terms are not statistically significant.

4.3 Open Questions for Monitoring and Data Collection

Negative to neutral opinions toward monitoring and data collection were also expressed in the answers to the open questions. Managers expressed that monitoring "*is the same as micromanagement*" and "*…a sign of serious mistrust in employees*" – trust and a good relationship with their employees are vital for the surveyed managers. If monitoring was implemented, it would require "*a lot of transparency and agreed start*." One manager expressed that "*…time and time efforts are not a good monitoring tool*", especially when discussing knowledge work.
Also, the employees mentioned trust as very important, e.g., "*it feels that they do not trust that I do my work." Moreover, "it will damage the trust in the company and management."* and "*this is an invasion of privacy*." Several participants would consider working less from home when monitoring would be introduced or even changing the company. Nevertheless, one employee mentioned that he trusts the company *"…will keep my data safe, that is what we do here*." Another issue is the unique nature of work that the employees do, "*so-called brain work – you can't put a timer on this."* The survey participants mentioned that ideas might be developed in front of the coffee machine, during lunch breaks, or on the way home, and not in front of the computer. Hence, monitoring knowledge work is generally different.

5. Discussion and Conclusion

Our results show that monitoring work was considered negative to neutral among the survey participants. For the first research question regarding the different perspectives toward workplace monitoring, we found that managers always scored higher than employees. However, significant differences could only be found in the subjective norms, as managers agree more that they need to be aligned with their supervisors regarding monitoring. The reason might be that managers consider the benefits this implementation could bring the company. Some advantages are optimization in resource allocation, streamlining workflows, and identifying areas for improvement, ultimately leading to cost savings and improved productivity. From the employees' side, monitoring might negatively affect their performance and job satisfaction and lead to enhanced stress, as discussed in (Siegel et al., 2022). In a high-trust country like Denmark, the concerns toward monitoring may also be rooted in the perceived lack of trust (as employees cannot be trusted when not visible in the office) (Chang et al., 2015), concerns related to privacy (The Danish Society of Engineers, IDA, n.d.), and potential negative consequences associated with the implementation of monitoring tools.

The vignette scenarios addressed the second research question, discovering the acceptability of various data types and purposes for monitoring remote employees' work. "Work phone activities" and "task completion time and amounts" were universally perceived as the most appropriate for monitoring. The latter attribute aligns with the research by (Vitak & Zimmer, 2023). Furthermore, monitoring "task completion" is already regularly

done in our case company as it is crucial for project management. Regarding the purposes of data collection, ”Determining eligibility for promotions or higher compensation” and ”improving worker productivity” were seen as the most appropriate data collection purposes for monitoring, aligning with organizational goals related to career advancement and overall efficiency, as also seen in the Danish survey conducted by (Hald et al., 2024).

The biggest issue with introducing workplace monitoring among managers and employees was the concern about the decrease in trust, which is especially an issue in Denmark as a country of high trust (Sønderskov & Dinesen, 2014). If workplace monitoring should be introduced, it is necessary to balance trust and surveillance and thus include all stakeholders from the beginning – employees, managers, HR, and union representatives. The reason for the monitoring needs to be clear to all, and only acceptable data (e.g., task completions) for acceptable purposes (e.g., ensuring compliance or promotion) should be collected so that it becomes clear who is using data for what. Furthermore, feedback sessions should be introduced to discuss the monitoring and its effects and hear about the employees' concerns. However, as the survey participants expressed, a good relationship between managers and employees is very important, and trust is much better than micromanagement. If monitoring is used to support employees instead of suppressing them, it can even help to increase trust (Jeske, 2022).

This pilot study has limitations, as it included only 45 managers and employees in one Danish Engineering company. This introduces the possibility that those who chose not to participate in the survey might hold different perspectives or experiences than those who responded. This potential bias affected the generalizability of our findings. Furthermore, as the company does not use extensive workplace monitoring, this study could only ask for perceptions toward the influence of monitoring at the workplace. Furthermore, we could not investigate the effect of an already-used tool. In the future, data collection needs to be extended to gain deeper insights into workplace monitoring perceptions.

References

Ball, K. (2010). Workplace surveillance: An overview. *Labor History*, *51*(1), 87–106. https://doi.org/10.1080/00236561003654776

Ball, K. (2021). *Electronic Monitoring and Surveillance in the Workplace*. Publications Office of the European Union. https://doi.org/10.2760/5137

Brown, E. (2020). *Employee surveillance software demand increased as workers transitioned to home working*. ZDNET. https://www.zdnet.com/article/employee-surveillance-software-demand-increased-as-workers-transitioned-to-home-working/

Chang, S. E., Liu, A. Y., & Lin, S. (2015). Exploring privacy and trust for employee monitoring. *Industrial Management and Data Systems*, *115*(1), 88–106. Scopus. https://doi.org/10.1108/IMDS-07-2014-0197

De Valdenebro Campo, A.M., Avolio, B., & Idrovo Carlier, S. (2021). The Relationship Between Telework, Job Performance, Work–Life Balance and Family Supportive Supervisor Behaviours in the Context of COVID-19. *Global Business Review*. https://journals.sagepub.com/doi/10.1177/09721509211049918

Eurofound. (2020). *Employee monitoring and surveillance: The challenges of digitalisation.* Publications Office of the European Union. https://data.europa.eu/doi/10.2806/424580

Hald, C.W., Tranholm-Mikkelsen, Julie Karnøe, & Andersen, Katrine Lindtner. (2024). *Digital Dataindsamling på Arbejdspladsen. En undersøgelse af lederes holdninger til og oplevelser med indsamling af digitale medarbejderdata på arbejdspladsen*. Tænketanken Mandag Morgen. https://taenketanken.mm.dk/wp-content/uploads/2023/09/Minirapport_Digital-dataindsamling-Lederanalyse08.pdf

Hickok, M., & Maslej, N. (2023). A policy primer and roadmap on AI worker surveillance and productivity scoring tools. *AI and Ethics*, 1–15. https://doi.org/10.1007/s43681-023-00275-8

Hox, J. J., Kreft, I. G.G., & Hermkens, P. L-J. (1991). The Analysis of Factorial Surveys. *Sociological Methods & Research*, *19*(4), 493–510. https://doi.org/10.1177/00491241910190040

Jeske, D. (2022). Remote workers’ experiences with electronic monitoring during Covid-19: Implications and recommendations. *International Journal of Workplace Health Management*, *15*(3), 393–409. https://doi.org/10.1108/IJWHM-02-2021-0042

Kellogg, K. C., Valentine, M. A., & Christin, A. (2020). Algorithms at Work: The New Contested Terrain of Control. *Academy of Management Annals*, *14*(1), 366–410. https://doi.org/10.5465/annals.2018.0174

Lippert, I., Kirchner, K., & Wiener, M. (2023). Context Matters: The Use of Algorithmic Management Mechanisms in Platform, Hybrid, and Traditional Work Contexts. *Proceedings of the 56th Hawaii International Conference on System Sciences*, 5282–5291.

Möhlmann, M., Zalmanson, L., Henfridsson, O., & Gregory, R. W. (2021). ALGORITHMIC MANAGEMENT OF WORK ON ONLINE LABOR PLATFORMS: WHEN MATCHING MEETS CONTROL1. *MIS Quarterly: Management Information Systems*, *45*(4), 1999–2022. Scopus. https://doi.org/10.25300/MISQ/2021/15333

Naqshbandi, M. M., Kabir, I., Ishak, N. A., & Islam, Md. Z. (2023). The future of work: Work engagement and job performance in the hybrid workplace. *The Learning Organization*, *31*(1), 5–26. https://doi.org/10.1108/TLO-08-2022-0097

OECD. (2020). *How's Life? 2020: Measuring Well-being*. OECD Publishing. https://doi.org/10.1787/9870c393-en

Parent-Rocheleau, X., & Parker, S. K. (2022). Algorithms as work designers: How algorithmic management influences the design of jobs. *Human Resource Management Review*, *32*(3), 100838. https://doi.org/10.1016/j.hrmr.2021.100838

Prodoscore. (n.d.). *Prodoscore. Your Blueprint for Employee Success*. Prodoscore. Retrieved March 27, 2024, from https://www.prodoscore.com/

Siegel, R., König, C. J., & Lazar, V. (2022). The impact of electronic monitoring on employees' job satisfaction, stress, performance, and counterproductive work behavior: A meta-analysis. *Computers in Human Behavior Reports*, *8*, 100227. https://doi.org/10.1016/j.chbr.2022.100227

Sønderskov, K. M., & Dinesen, P. T. (2014). Danish Exceptionalism: Explaining the Unique Increase in Social Trust Over the Past 30 Years. *European Sociological Review*, *30*(6), 782–795.

Teramind. (n.d.). *Insider Threat Detection & Employee Monitoring | Teramind*. Endpoint User Activity Monitoring Software | Teramind. Retrieved March 27, 2024, from https://www.teramind.co

The Danish Society of Engineers, IDA. (n.d.). *Monitoring at work: Here are your rights*. Retrieved March 26, 2024, from https://english.ida.dk/monitoring-at-work-here-are-your-rights

The Danish Society of Engineers, IDA. (2024). *Rules on surveillance at work need to be tightened | IDA English*. https://english.ida.dk/rules-on-surveillance-at-work-need-to-be-tightened

Vitak, J., & Zimmer, M. (2023). Surveillance and the future of work: Exploring employees' attitudes toward monitoring in a post-COVID workplace. *Journal of Computer-Mediated Communication*, *28*(4). Scopus. https://doi.org/10.1093/jcmc/zmad007

Wallander, L. (2009). 25 years of factorial surveys in sociology: A review. *Social Science Research*, *38*(3), 505–520. https://doi.org/10.1016/j.ssresearch.2009.03.004

Wöhrmann, A. M., & Ebner, C. (2021). Understanding the bright side and the dark side of telework: An empirical analysis of working conditions and psychosomatic health complaints. *New Technology, Work and Employment*, *36*(3), 348–370. https://doi.org/10.1111/ntwe.12208

Knowledge Sharing Techniques in Academic Libraries in Africa: A Perspective from the University of Namibia

Andjengo Anna Shiimi and Madeleine C Fombad
University of South of Africa, South Africa

46726160@mylife.unisa.ac.za
fombamc@unisa.ac.za

Abstract: Knowledge sharing practices in academic libraries is increasingly recognised as a tool for competitive advantage and has become a buzz word for enhancing service delivery in academic libraries in Africa. African scholars are increasing conducting research to establish knowledge sharing strategies in libraries. The International Federation of Library Associations and Institutions reiterates the value of knowledge sharing techniques in academic libraries. Notwithstanding, knowledge sharing practices are still ad hoc and informal. and academic librarians are still grappling with integrating the different knowledge sharing techniques. This article investigates the perceptions of knowledge sharing among university of Namibia library staff to establish the techniques of knowledge sharing. The overall findings reveal that library staff are aware of the various knowledge sharing techniques in academic libraries but are yet to adopt and integrate these techniques. The findings further revealed a preference to technological-based knowledge sharing techniques over human-based or interpersonal knowledge sharing techniques. This article resonates with the findings of most academic libraries in Africa and therefore adds to the body of knowledge on knowledge sharing in academic libraries from an African perspective. Unlike most studies on knowledge sharing that seeks to establish strategies, this article focuses on establishing perceptions of librarians and the different ways by which techniques for knowledge sharing may be enhanced.

Keywords: Knowledge Sharing, Academic Libraries, Namibia, Knowledge Perceptions, Knowledge Sharing Techniques, Africa

1. Introduction

Academic libraries, like most organisations are striving to foster knowledge sharing to stimulate productivity, encourage innovation, and remain competitive in the higher education landscape. The organisational growth and the job performance of academic librarians is contingent upon the extent of their knowledge sharing activities (Ajegbomogun and Diyaolu, 2018:6; Olatokun and Njideaka, 2020:297). The International Federation of Library Associations and Institutions (IFLA 2015) reiterates the value of knowledge sharing techniques in academic libraries. Researchers have perceived knowledge sharing as a cornerstone to the success of academic libraries as it enables library staff to exchange knowledge, skills, and experience. The plethora of studies on knowledge sharing practices in academic libraries in Africa reveals that academic libraries are conscious of the value of knowledge sharing in enhancing the services of libraries although knowledge sharing is still practiced at an ad hoc basis (Izu and Fombad 2024; Bumbie-Chi 2020; Muchaonyerwa and Mutula 2017; Tahleho 2016; Lekay2012; Abdur- Rafiu and Opesade 2015:14; Kabiru 2016:31; Antwi, Ankrah and Frimpong 2020:34; Olatokun and Njideaka 2020:306; Bumbie-Chi 2020:316; Iilonga 2019:171; Muchaonyerwa and Mutula, 2017:11). Notwithstanding there remains a dearth of research on integrating tools and techniques for knowledge sharing in academic libraries in Africa. Also, studies have revealed that library staff are fully cognizant of the concept of knowledge sharing and its benefits and its potentials in increasing productivity and service delivery notwithstanding the lack of a holistic approach to organising knowledge within these libraries (Izu and Fombad 2024; Bumbie-Chi 2020; Muchaonyerwa and Mutula 2017).

Academic library staff perceive knowledge sharing as happening in an uncoordinated, and informal manner, primarily through one-to-one conversation among library staff (Bumbie-Chi 2020). Henttonen et al (2016) noted that Individual -level knowledge sharing affects individual work performance. A knowledge-friendly organisational culture will enhance the organisational performance of an organisation (Liu e t al 2021).

Namibia which is the focus of this study is one of the countries in sub-Sharen Africa. The University of Namibia is one of the four universities in the county with twelve campuses. Each of these campuses has its own library that serves a diverse community. The university of Namibia sixth strategic plan seeks at building and exchanging knowledge through collaboration. Studies on knowledge sharing in Namibia have primarily focused on corporate, public, and ministerial libraries and there has been little focus on academic libraries. Knowledge sharing occurs at the University in at an ad hoc manner. Against this backdrop, this article investigates knowledge sharing perceptions among library staff at the University of Namibia, with a view of suggesting techniques enhance knowledge sharing.

2. Literature Review

2.1 Perceptions of Knowledge Sharing In Academic Libraries

Knowledge sharing is the exchange of articulated or consensual facts, opinions, viewpoints, and scientific knowledge among individuals and groups that encourages knowledge flow, which, in the end, enables the dissemination of knowledge, enhance growth, productivity and success of any organisation. Successful knowledge sharing depends on the eagerness of staff members to share their experience with one another, which results in existing knowledge within the individual, division, or team of an organisation made available to others (Ram and Gupta, 2014:780; Ajegbomogun and Diyaolu, 2018:3). Researchers have established a relationship between knowledge management technologies on the culture and organisational performance. (Liu et.al 2023) Perceptions are opinions or points of view that shape how people act or react in specific situations (Bumbi-Chi, 2018:151). There is a general perception that although library staff at certain levels understand the concept of knowledge sharing, academic libraries have yet to implement policies and strategies to harness library staff expertise as well as formalise knowledge sharing in their library operations (Bumbie-Chi 2018:151; Muchaonyerwa and Mutula 2017; Tahleho 2016; Mayekiso 2013; Lekay 2012). There is also a perception that knowledge sharing in academic libraries is uncoordinated, with the main channel of knowledge sharing being informal communication. among co-workers during regular conversations. Also, there is a perception of a general lack of well-defined policies to achieve knowledge sharing activities (Bumbie-Chi 2018; Muchaonyerwa and Mutula 2017; Maponya 2004) Despite their optimism about knowledge sharing, library staff still prefer to share knowledge on a one-on-one approach (Bumbie-Chi 2018:173; Onifade, 2015:91).

2.2 Techniques of Knowledge Sharing in Academic Libraries

The techniques for knowledge sharing may be classified as human and technological centered. Human cantered techniques facilitate the transfer of tacit-to-tacit knowledge. Examples of human centered techniques are meetings face-to-face sharing, mentoring, Community of Practice, storytelling conversations by water coolers and peer assist. Meetings occur when employees who share common ground and experiences gather in a loosely structured setting to discuss ideas and challenges across organizational levels and to present functional actions. Meetings foster collaborative knowledge sharing through informal and formal networks and provide opportunities for staff to validate their practical knowledge and enhance certain skills like verbal communication and logical reasoning (Aljuwaiber, 2019:235; Khoro; 2019:17). Face-to-face knowledge sharing allows for more extensive discussion whereby individuals offer and receive comments until, they arrive at a consensus. Even though there are other platforms that can be used to share knowledge, Face-to-face exchanges is desired because it facilitates knowledge transfer (Kommey and Fombad 2023). Mentorship happens when a skilled and superior employee with extensive knowledge and experience is required to share their knowledge and experience with less skilled co-workers to provide advice and moral support. A mentoring relationship focuses on guidance and learning between two people (Lefika and Mearns 2015:27). Mentors can help their mentees get more job opportunities and reciprocal networks, learn new skills and knowledge, advance in their careers, and do better work (Khoro, 2019:15). Community of Practice are group of individuals who share mutual goals and collaborate on a regular basis to advance their knowledge in a particular subject (Bratianu, 2018). It can also be viewed as a social interaction group formed to promote learning and innovation within an organisation through knowledge sharing.

On the other hand, the technological centered techniques focus on information communication technologies (ICTS), knowledge management systems and data bases to facilitate explicit to explicit and tacit to explicit knowledge sharing. Technologies such as the internet, intranet, electronic mail, social media, Facebook, Twitter, WhatsApp, Flickr, Instant messaging, Blog or Weblog, instant messaging, blogs, video conferencing, knowledge sharing systems, databases, data mining, portals and artificial intelligence technologies are widely acknowledged as a means of sharing or disseminating knowledge within an organsation.The electronic mail may be used to convey knowledge and promote awareness through reference services in academic library (Valumani, 2016). Social media sites such may be used to share knowledge and improve service delivery in libraries (Umaru and Omame, 2020:5-6). For example, blogs may be used to raise awareness about library news, the acquisition of new consignments, solicit user feedback about library services, provide virtual outreach programs through information (Boateng and Liu, 2014:125; Hilsop 2018:217). Instant messaging may also be employed to enhance the delivery of reference services because it allows library staff to respond to user inquiries immediately. Videoconferencing technologies are face-to-face interplay, which allows participants to vividly see and hear each other, and in turn engage in simultaneous discussions where questions and points are clarified using

demonstrations (Alkhaldi, Yusof and Aziz, 2013:410). Amongst the systems and databases that could be used to share knowledge are expert-locater systems, electronic document management systems, incident report databases, data mining, lesson-learned databases, and best practice databases. Expert-locater systems are knowledge repositories that aim to organize knowledge by identifying and finding professionals who are knowledgeable about a particular topic within an organization and makes such information available to other employees (Janus 2016:35). Expertise location activities encompasses mentoring program facilitation, knowledge gap identification, operational support, and continuing professional development designed to disseminate knowledge among library staff (Hameed Basheer). Electronic document management system is robust software that advocates the process of creating, searching, storing, and retrieving documents electronically. Data mining technology is used in academic libraries to obtain statistical evidence pertaining to user circulation, library collection statistics and other search patterns. Lessons-learned systems collect knowledge gleaned from previous experiences, with the goal of capturing and providing lessons that can benefit other employees (Wang and Wang, 2020:8). It also provides others with insights into how they dealt with similar events, as well as advice on how library staff should provide services. According to Taskin and Van Bunnen (2015:164). Best practices databases describe successful efforts, which are usually the outcome of reshaping business operations and may be relevant to organisational processes (Taskin and Van Bunnen, 2015:164). Artificial intelligent technologies such as Optical Character Recognition, Categorization and Discovery: algorithms offer opportunities in enhancing knowledge sharing and fostering collaboration. Challenges and opportunities abound in leveraging personal knowledge managed through Chat GPT (Nazeer et. al 2023)

3. Research Methodology

The study adopted a mixed-methods approach and a case study design. A census of the entire university of Namibia library staff consisting of 104 respondents was utilised to gather data using questionnaire and a total of seven library management were purposefully sampled to gather data through interviews. Seventy five out of 104 target respondents completed the survey. The survey data was analysed using the Statistical Package for Social Sciences (SPSS) software (Version 26) and Microsoft Excel 2019. The interview data was organised thematically in accordance with the set objectives.

4. Social Exchange Theory (SET)

The Social Exchange Theory (SET) of Homans (1958) is a theory that suggests that social relations can be better defined by the exchange of rewards and costs between both partners (Romani-Dias and Carneiro, 2019). Apart from material or content rewards, exchange awards include intangible benefits such as peer group support, trust, confidence, and recognition (Romani-Dias and Carneiro 2019:464). Knowledge sharing is a type of social exchange that allows people to share their knowledge with their co-workers and to expect a reciprocal exchange of knowledge (Wang, Xiang, Yang and Ma 2019:871). Trust is an important basis for measuring the relationship between benefits and costs. (Jinyang 2015:175). When applied to this article the social exchange theory (SET) provides insight into the motivation for sharing knowledge amongst library staff by using the four basic concepts that influence interpersonal exchange processes which are cost-benefit analysis, reciprocity, social penetration, and equity and inequity (Arsawan et al., 2020). This indicates that the cost-benefit analysis of knowledge sharing in university libraries is determined by the level of trustworthiness shared by library staff.

5. Findings

The article seeks to accomplish the following objectives:

To establish library staff perception on knowledge sharing at the university of Namibia library

To establish the knowledge sharing techniques among library staff at the University of Namibia

6. Perceptions of Library Staff on Knowledge Sharing

The findings on table 1 below revealed that respondents fully understood the importance of sharing among co-workers at the university of Namibia library in enhancing library services and in becoming more innovative and creative, and appreciated the need to share knowledge. The findings were further corroborated by the following qualitative responses.

Interviewee 1*: "In my view, knowledge sharing is crucial and should be practiced openly."*

Interviewee 2 *"Sharing knowledge and expertise, in my opinion, would enable staff members to gain skills through participation in knowledge sharing activities, which could contribute to the better provision of innovative and creative library services to improve performance".*

Interviewee 3*: "In my perception, knowledge sharing is the process by which knowledgeable individuals share their expertise with others, thereby bringing innovation and creativity to library operations*".

It is clear from the qualitative and quantitative findings that library staff understood and valued knowledge sharing, whether tacit or explicit knowledge, as part of their dairy library operations in order to provide efficient services. They believe that sharing knowledge among co-workers has a beneficial effect on enhancing library services and making them more innovative and creative. This is consistent with much of the literature by Africa researchers that describes library staff positive perceptions of the value of knowledge sharing in among co-workers for improving knowledge flow and library service delivery (Izu and Fombad 2024; Akporabore, 2015:32; Muchaonyerwa 2015:125, Bumbi-Chi, 2018:151; Chipeta, 2018:119; Onifade, 2015:96).

Table 1: Perceptions of library staff on knowledge sharing

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
I believe knowledge sharing is a process in which knowledgeable individuals share their knowledge with their co-workers.	74 (98.7%)	1(1.3%)	0(0%)	0(0%)	0(0%)
Sharing knowledge can help library services to be more innovative and creative.	51(68%)	20(26.7%)	4(5.3%)	0(0%)	0(0%)
I am cognizant of the benefits derived from sharing knowledge with myco-workers.	65(86.7%)	9(12%)	1(1.3%)	0(0%)	0(0%)
I can use the experience of others to solve a problem at work if I share my knowledge.	60(80%)	10(13.3%)	2(2.7%)	3(4%)	0(0%)
I feel that sharing knowledge will enhance my library skills.	(46.7%)	33(44%)	7(9.3%)	0(0%)	0(0%)
I believe that 'knowledge is power,' I refuse to share it with others.	0(0%)	0(0%)	1(1.3%)	21(28%)	53(70.7%)
I believe it is important for co- workers to share. their knowledge?	58(77.3%)	14(18.7%)	3(4%)	0(0%)	0(0%)

7. Knowledge Sharing Techniques Among Library Staff at the University of Namibia

The second objective examined the various techniques utilized by the university library staff to impart knowledge. The findings in table 2 below reveal meetings and face-to-face techniques as the two human centred techniques of knowledge sharing. It is worth noting that library staff were aware of various knowledge sharing techniques such as discussion forums, monitoring and brainstorming, organisational culture, coaching, and job shadowing, monitoring, brainstorming, organisational culture, and job shadowing. The open-ended question identified "presentations" "Informal discussions amongst colleagues" "Departmental WhatsApp groups" "Emails and Zoom "as techniques.

Table 2: Knowledge sharing techniques

Techniques for knowledge sharing	YES	NO
Meetings	75 (100%)	0(0%)
Face-to-face knowledge sharing	70(93.3%)	5(6.7%)
Job rotation	47(62.7%)	28(37.3%)
Discussion forum	27(36%)	48(64%)
Monitoring	22(29.3%)	53(70.7%)

Techniques for knowledge sharing	YES	NO
Brainstorming	22(29.3%)	53(70.7%)
Organisational culture	19 (25.3)	56(74.7)
Coaching system	16(21.3%)	59(78.7%)
Job shadowing	15(20%)	60(80%)
Community of Practices	7(9.3%)	68(90.7%)
Storytelling	6(8%)	69(92%)

The qualitative findings revealed an inclination towards the use of technology techniques as noted the following responses.

Interviewee 1*: "staff meetings, in-house training this hosting Zoom meetings and having a departmental WhatsApp group.*

Interviewee 2*: "The use of generic email or email list to all staff, meetings, phone communication, and presentations staff. Face-to-face knowledge sharing, departmental WhatsApp groups "*

Interviewee 3*: "Staff training, email lists, mentorship programs, job shadowing programs, ongoing planning, and job rotation programs, seminars, e-mail, library website,"*

Interviewee 4: "discussion over the telephone, giving a presentation after attending a workshop, having informal discussions among colleagues, creating departmental or campus library WhatsApp groups, using an email list, and holding group meetings via Zoom".

Interviewee 1*: "I primarily use knowledge sharing platforms such as computers, electronic email facilities, websites, portals, forum, the internet, and the telephone, as well as departmental WhatsApp group, Twitter, Facebook, and Instagram, and Wiki to communicate with other colleagues and share information and knowledge".*

Interviewee 2*: "Well, I personally use email, Zoom, University of Namibia forum Imo, YouTube, and online newsletter, as well as social media platforms such as Facebook, ResearchGate, Twitter, and WhatsApp."*

Interviewee 3: *"I mostly use computer-based technology such as work electronic mail, Facebook, Twitter, the internet, and WhatsApp for the campus library or department".*

Interviewee 4: "I am personally aware of knowledge sharing technologies such as Facebook, WhatsApp, emails, Twitter, Skype, Instagram, Wiki, internet, blogs, telephones, and LinkedIn. However, I have had exposure to technologies such as the internet, email, WhatsApp, Twitter, and Facebook. Additionally, departmental or campus WhatsApp groups are used to share insights and experiences among co-workers".

The qualitative findings further revealed the awareness of knowledge sharing systems by academic librarians although usage is still at its infancy.

Interviewee 1: "I *am personally conscious of systems such as Google cloud, Moodle content sharing/Learning Management System, expert-locator systems, LibGuide, electronic resource and institutional knowledge repository incident reports, library news portal, electronic document management systems, incident reports, just to mention a few. However, I have only used a few of these technological systems, including the institutional repository, LibGuide, electronic resources, and library news portal".*

Interviewee 2: ". *We are not incredibly good at it, and some management teams have requested, for example, a shared folder to house all library institutional documents such as annual reports and statistical documents so that they can be easily found, but it is still in its infancy*.

Interviewee 3: "*There are numerous knowledge sharing systems available for use in any library or organisation, including expert-locator systems, electronic document management systems, incident reports, data mining, lesson-learned databases, and best practice databases, electronic resources, and the LibGuide system, However, we lack the majority of the ICT systems that we would like to have for the flow of knowledge, but I am aware of the basics for the time being: the institutional repository, the UNAM portal, library news, electronic resources, and the LibGuide system".*

Knowledge sharing systems has been used in academic libraries, to support and facilitate the distribution of both explicit and tacit knowledge. This helps library staff be more effective at their jobs and improves the efficiency of the library operations (Akporabore, 2015:34; Bozzato, Eiter & Serafini, 2018:77). Technologies such as expert-locator systems, incident reports, and instant messaging, expertise locator system provide a platform for accumulating enormous amounts of technical expertise by harnessing existing knowledge, skills, and experience to enhance productivity and service delivery (Wang & Wang, 2020:7). Janus (2016:35) noted that expertise locator system assists in connecting library staff with knowledgeable professionals at the appropriate time. This implies that the library staff has systems in place that identify, locate, and connect library staff with right expertise on a certain subject and make such knowledge available to other co-workers in a reasonable amount of time.

The findings revealed that academic librarians were aware of social media platforms:

Interviewee 1: ". *Twitter, Facebook, Instagram, Wiki, and WhatsApp are some of the social media platforms that I am familiar with. Other platforms, such as LinkedIn and ResearchGate, I specifically use them on a personal level to distribute research knowledge".*

Interviewee 2: "I *am aware of common networking sites and platforms such as Twitter, Facebook, and LinkedIn. From the qualitative and quantitative findings, it is apparent that most of the techniques used but the library staff for sharing knowledge was technology based. Apparently, mobile phones, WhatsApp, email Zoom, Facebook and Twitter Video conferencing meetings, email, and phone conversations online training, presentations, where the most used technologies for knowledges sharing among co-workers*

Social media technologies such as Facebook and Twitter were the most frequently used techniques for reciprocating knowledge among library staff and across campus libraries. The Google cloud, portals, electronic resources, and the LibGuide system were also used Technologies such as IMO, Skype, Instagram, LinkedIn, Snapchat, ResearchGate, YouTube, Imo, Tik-Tok, Wiki, and other interactive digital tools were the least used.

These findings are consistent that of researchers in academic libraries in Africa (Bumbi-Chi, 2020; Izu and Fombad 2024; Chipeta, 2018; Bumbi-Chi, 2018; Tahleho, 2016; and Onifade, 2015). It is apparent from the findings that the internet, Facebook, electronic email, WhatsApp, telephone video conferencing, Twitter, Instagram, Instant Messages, portal, Snapchat, university of Namibia forum, ResearchGate, YouTube, and Imo as methods used to share knowledge among the university of Namibia.

Notwithstanding the inclination towards ICT based techniques, and the importance perception about its usage, the findings revealed an underutilization of these tools for knowledge sharing. The underutilization stems from difficulties encountered when using these systems, poor network, and internet connection, lack of appropriate ICT infrastructures that support knowledge sharing, insufficient funding for university library operations to acquire modern technological systems, thus impeding knowledge sharing and service delivery. These challenges are consistent with studies on knowledge sharing in academic libraries in Africa whereby academic libraries are inundated with poor networks internet connectivity, a lack of modern infrastructure, and the absence of technological systems that support knowledge sharing across campus libraries. making it difficult for library employees to share knowledge and improve performance and service delivery.

8. Conclusion

The article investigated the perceptions on knowledge sharing among University of Namibia library staff and identified the different techniques used for knowledge sharing and suggest ways by which these techniques may be enhanced. Drawing from the findings, the study recommends library management to implement a policy that formalizes knowledge sharing techniques and creates awareness of the importance and value of knowledge sharing. The policy should incorporate the integration of modern technological infrastructure and artificial intelligence technologies that facilitates the flow of knowledge among library staff and across campus libraries. Both technological-based and human-based knowledge sharing techniques should be prioritized in the library operations. Systems, and technologies such as a best practices database, blogs, electronic document management, and lessons learned systems should be explored. The acquisition of artificial intelligence technologies for knowledge sharing is crucial because it has the potential of revolutionizing knowledge sharing in academic libraries. Progressively, library staff should be continuously trained on ICT-related topics to remain current in their field of expertise and to adapt to the changing world of technologies when reshaping and redesigning library operations. The library management should set aside adequate funds for the acquisition of appropriate technological infrastructure, the maintenance of adequate internet connectivity, and the frequent updating of the library website. Consequently, without proper and substantial technological infrastructure and tools, the success of knowledge sharing is bound to be unsuccessful.

Human cantered approaches to knowledge sharing such as Community of Practice, Storytelling, rewards, and incentives, encouraging a leaning organization discussion forums, mentoring, brainstorming, organisational culture, coaching, and job shadowing should be encouraged. To this end, the elements of trust and reward as noted in social exchange theory are crucial in realizing the human centred approach to knowledge sharing. Successful knowledge sharing will not only enhance service delivery and trust among academic librarians but it will enhance quality education thus realizing the sustainable development goal that will actively contribute to inclusive, equitable, and quality education. These findings contribute to the growing body of knowledge sharing tools and techniques implemented in academic libraries in Africa and promotes a positive perception of knowledge sharing in academic libraries.

References

Abdur-Rafiu, M. and Opesade, A. O. (2015) "Knowledge sharing behaviour of academics in the polytechnic Ibadan." *Library Philosophy and Practice,* 0_1,1-16. Retrieved from https://search.proquest.com/scholarly-journals/knowledgesharing-behaviour academics-polytechnic/docview/1744626203/se-2?accountid=45049 (Accessed 18 April 2024)

Ajegbomogun, O.F. and Diyaolu, O.B. (2018) "Availability of Library Facilities, Knowledge Sharing as Determinants of Job Performance of Library Staff in Southwest Nigeria, *Library Philosophy and Practice (e-journal)*, 1784, available at: https://digitalcommons.unl.edu/libphilprac/1784/ (Accessed 18 February 2024).

Alkhaldi, A.N., Yusof, Z.M. and Aziz, M.J.A. (2013) "The Role of High/low Context Style on Video Conferencing for Knowledge Sharing: The Moderating Effect of National Culture." *Middle East Journal of Scientific Research* 13(3):410-419.

Antwi, J.K., Ankrah, E. and Frimpong, D. (2020) "Electronic resources sharing in academic libraries in Ghana: A comparative study of Ghana technology university college and presbyterian university college libraries". *Library Philosophy and Practice,* 1-38. Retrieved from https://search.proquest.com/scholarly-journals/electronic-resources- sharing-academic-libraries/docview/2446728358/se-2?accountid=45049 (Accessed 20 June 2023).

Arsawan, I., Wirga, I.W., Rajiani, I and Suryantini, N.P.S. (2020) "Harnessing knowledge sharing practice to enhance innovative work behavior: the paradox of social exchange theory. *Polish" Journal of Management Studies*, *21*. https://doi.org/10.1108/IJPPM-04-2020-0192 (Accessed 21 May 2023).

Boateng, F. & Liu, Y. (2014) "Web 2.0 applications' usage and trends in top US academic libraries". Library Hi Tech, 32(1), 120-138.

Bratianu, C. (2018) Knowledge Sharing and Communities of Practice. Organizational Knowledge Dynamics: Managing Knowledge Creation, Acquisition, Sharing, and Transformation *IGI Global:* Hershey PA USA

Bumbie-Chi, D.M. (2018) "Knowledge Sharing among Library Staff in a Multi-Campus University. The Case of the University for Development Studies" (UDS), Tamale. Available from: http://ugspace.ug.edu.gh/handle/123456789/26229 (Accessed 8 October 2023).

Bumbie-Chi, D.M. (2020) "Knowledge Sharing and Multi-Campus University Systems: Ghana's University for Development Studies Library in perspective" *UDS International Journal of Development*, 7(1), 315-329.

Henttonen, K., Kianto, A., & Ritala, P. (2016). Knowledge sharing and individual work performance: An empirical study of a public sector organisation. Journal of Knowledge Management, 20(4), 749-768. https://doi.org/10.1108/JKM-10-2015-0414

Hislop, D. (2018). Knowledge management in organisations: a critical introduction. 3rd edition. Oxford: Oxford University Press.

Homans, G.C. (1958). Social behavior as exchange. *American Journal of Sociology*.

IFLA. CPDWL. (2015). Taking charge of your LIS Career: Personal Strategies, Institutional Programs, Strong Libraries. *In Taking charge of your LIS Career: Personal Strategies, Institutional Programs, Strong Libraries.* Milnerton Public Library: IFLA. Retrieved from: http://library.ifla.org/1924/. (Accessed 25 April 2024).

Ilanga, S. (2019) "The role of the public library towards a knowledge economy of Namibia."*International Journal of Innovation Science*, 11 (1), 139-160IOSR *Journal of Humanities and Social Science*

Izu L Osarugue and Fombad M (2024**)** Knowledge *sharing strategies for improved service provision in the academic library at Delta State University Abraka Nigeria* New Review of Academic Librarianship, https://www tandfonline.com/journals/accessed 14 May 2024

Janus, S.S. (2016) Becoming a knowledge sharing organisation: a handbook for scaling up solutions through knowledge capturing and sharing*". Washington, DC: World Bank.* https://openknowledge.worldbank.org/bitstream/handle/10986/25320/97814648094

Jinyang, L. (2015) "Knowledge sharing in virtual communities: A social exchange theory perspective, Journal of Industrial Engineering and Management" (JIEM), 8 (1), (170- 183).

Kabiru, D.A. (2016) "Patterns of scholarly collaboration among academics in Nigerian universities: Knowledge sharing or knowledge hoarding? *Journal of Balkan Libraries Union", 4*(2), 28-34.

Khoro, L. (2019) Knowledge sharing among library staff of special libraries in KwaZulu- Natal with special reference to using Information and Communications Technology enabled platforms (Doctoral dissertation). Submitted in fulfilment of the requirements of the Master of Management Science in Library and Information Science, Durban University of Technology, Durban, South Africa. http://hdl.handle.net/10321/3375 (Accessed 27 March 2021).

Kommey R and Fombad MC (2023) "Strategies for Knowledge Sharing Among Rice Farmers: A Ghanaian Perspective" Electronic Journal of Knowledge Management 21(2):114-129

Lefika, P.T. and Means, M.A. (2015.) "Adding knowledge cafés to the repertoire of knowledge sharing techniques". *International Journal of Information Management*, 35(1): 26-32.

Lekay, L.L. (2012). Exploring knowledge sharing and creation practices among a selected library staff at the University of the Western Cape. (Master's thesis). Western Cape.

Liu, G., Kianto, A., & Tsui, E. (2023). Knowledge management technologies and organizational performance: A meta-analytic study. Industrial Management & Data Systems, 123(2), 386-408. doi:10.1108/IMDS-02-2022-0121

Liu, G., Tsui, E., & Kianto, A. (2021). Knowledge-friendly organisational culture and performance: A meta-analysis. Journal of Business Research, 134, 738-753. doi:10.1016/j.jbusres.2021.05.048

Maponya, P.M (2004) "Knowledge management practices in academic libraries: A Case Study of the University of Natal, Pietermaritzburg Libraries". SCECSAL Proceedings. Available: http://www.ukzn.ac.za/department/data/leap_scecsalpaper.pdf (Accessed 21 March 2021).

Mayekiso, N. (2013) Knowledge sharing practices in academic libraries with special reference to the UNISA Library. *Master's thesis, University of South Africa, Pretoria.* Mazorodze, A.H. 2017. *Knowledge management and its effectiveness for organisation transformation through knowledge sharing and transfer. University of South Africa.*

Muchaonyerwa, N. and Mutula, S. (2017) "Knowledge sharing Strategies among Library Staff at Selected University Libraries". *Mousaion*, *35* (3): 1–24.

Muchaonyerwa, N. (2015) Knowledge Sharing Strategies in University Libraries in KwaZulu-Natal Province of South Africa Unpublished Doctoral Thesis, University of Kwazulu-Natal, South Africa.

Nazeer, S., Sumbal, M. S., Liu, G., Munir, H., & Tsui, E. (2023). The next big thing: role of ChatGPT in personal knowledge management challenges and opportunities for knowledge workers across diverse disciplines. Global Knowledge, Memory and Communication. doi:10.1108/GKMC-07-2023-0246

Olatokun, W. and Njideaka, T.M. (2020). Knowledge sharing practices among cataloguers in Nigeria's academic libraries Library Management, 41 4/5, pp. 295-309

Onifade, F.N. (2015) Knowledge sharing among librarians in federal university libraries in Nigeria". *Information and Knowledge Management* 5(3):91-97. https://iiste.org/Journals/index.php/IKM/article/view/20587/21008 (Accessed2 2 May 2024)

Ram, M.S. and Gupta, M. (2014) "Knowledge management in teams: Empirical integration and development of a scale". *Journal* of Knowledge Management, 18(4), 777-794.Reference Services Review, 45(3):382-397.

Romani-Dias J and Carneiro, M (2020). "Internationalization in higher education: faculty tradeoffs under the social exchange theory" International Journal of Educational Management. (3). 461-476

Tahleho, T.E. (2016). Improving service delivery at the national university of Lesotho library through knowledge sharing. *Master of Information Science, University of South Africa, Pretoria.*

Taskin, L. and Van Bunnen, G. (2015). "Knowledge management through the development of knowledge repositories: towards work degradation". *New Technology, Work and Employment,* 30(2):158-172.

Umaru, I.A. and Omame, I.M. (2020) "Application of social media and video conferencing in smart library services". *Library Philosophy and Practice* (e-journal). 3915. https://digitalcommons.unl.edu/libphilprac/3915 (Accessed 17 April 2023).

Velumani, K.V. (2016) "An investigation into the impact of e-resources in modern library and information centers", *Harvard data verse*, v1. Retrieved from: https://doi.org/10.7910/dvn/avr0t6 (Accessed 07 May 2020).

Wang, Z.J. and Wang, X. (2020) "From information, to data, to knowledge – Digital Scholarship Centers: An emerging transdisciplinary digital knowledge and research methods integrator in academic and research libraries". *IFLA Journal*, 46(1), 5–14.

Research Trends in Knowledge Management and Innovation: a Bibliometric Review

Monika Sipa and Marcin Sitek
Czestochowa University of Technology (CUT), Częstochowa, Poland

monika.sipa@pcz.pl
marcin.sitek@pcz.pl

Abstract: Due to the important role of knowledge and innovation in the development of organisations or economies, these issues continue to receive considerable attention from practitioners and researchers. Knowledge and innovation are closely related concepts. Without proper knowledge management (KM), it is difficult to design and implement changes, while, on the other hand, innovation creates a demand for new areas of knowledge and continuously develops it. The main objective of this paper is to identify the leading challenges in knowledge management and innovation, by exploring the key themes, their connections and the latest research trends in this area. Using the SCOPUS citation database, publications were reviewed to answer the following questions: (RQ1) How has the perspective of academic research addressing both knowledge management and innovation evolved over the last twenty years? and (RQ2) What are the leading research areas and new trends in research simultaneously addressing knowledge management and innovation? The analysis covered the years 2003-2023. The collected data was pre-selected and then, based on the frequency of co-occurrence of key terms, mapping was performed and keywords were extracted using VOSviewer software. In the years under review, there has been an increase in the number of publications dealing with the topic of knowledge management, including those linked to innovation. Publications in this field are mainly concentrated in three research areas: Business, Management and Accounting, Computer Science and Engineering. Most studies come from China. The dominant research unit in this research area, according to the affiliation of the researchers, is LUT University. Issues such as knowledge sharing and transfer of knowledge, learning organisations, competition or information management among others, continue to be of interest to researchers. Among the most recent trends, research is dominated by: green innovations, mediating roles, big data and covid-19. The study helps to understand the challenges that have arisen for research in the analyzed area in the last two decades. It can provide a valuable study and a guide for identifying available and future research directions on knowledge management and innovation.

Keywords: Knowledge Management, Innovation, Vosviewer, Bibliometrics

1. Introduction

Researchers have eagerly explored knowledge management (KM) and innovation for many years. Both concepts are recognised as key determinants of sustainable growth for economies and businesses. The concept of KM has gained importance with the emergence of the knowledge economy and technological advances. Knowledge management is the systematic process or practice of capturing, storing, sharing and productively using knowledge to improve learning and enhance organisational performance.(Mateu, 2014) It is an essential element in the development of tangible and intangible production that determines the effectiveness of an organisation (Tavasieva et al, 2019, Mustafa and Rexhepi, 2024). As noted by Jain (2016), with the increasing importance of knowledge for economic and business development, ethical and legal issues such as privacy, confidentiality and intellectual property are becoming increasingly relevant.

Innovation is the introduction of new or significantly improved products, operational processes, marketing methods and organisational or management methods in business practices (Ayandibu et al., 2020). They allow organisations to progress in terms of turnover and profits, as well as in terms of knowledge, experience, productivity and quality (Baporikar, 2014, Baporikar, 2015, ul Hassan, 2014). They influence productivity, consumer benefits (Young, 2015), global competitiveness (Krishnamoorthy and Damle, 2017) and economic progress in both developed and developing economies (Mehdi, 2022). In times of rapid technological development, shortened product life cycles, globalised markets and increased competitiveness, innovation is indispensable (Godin, 2017).

Due to the complex and multi-faceted relationship between knowledge management and innovation, these issues are often considered together by researchers. Many authors point to the positive relationship between knowledge management and innovation (Guetat and Dakhli, 2013, Ologbo and Nor 2015, Dow et al., 2019), which are connected through continuous and complex interactions (Guetat and Dakhli, 2013). As highlighted by Barbaroux et al (2016), the evolution of knowledge management processes is linked to the implementation of interactive, collaborative and open innovation models. They cover different types of knowledge and processes at various stages of innovation.Effective knowledge and innovation management is crucial for an organisation's competitive advantage and long-term survival (Guetat and Dakhli, 2013, García, 2020). The rapid development

of information and communication technologies (ICT) strongly influences the processes of knowledge creation, dissemination and exploitation (Nurulin et al., 2019, Martins et al., 2022). Achieving organisational success requires attention to people, processes and technology (Omotayo and Akintibubo, 2024). Employees who engage in knowledge management processes enable the company to push the boundaries of its innovation capabilities (Ologbo and Nor, 2015). To increase innovative thinking among employees, it is necessary to regularly implement knowledge management practices (Luturlean et al, 2021) and, in particular, to encourage creativity and openness in information management (Al-Zagheer et al, 2024).The issues of knowledge management and innovation are hardly new, but the dynamically changing environment allows them to be explored on different, and indeed all-new, levels. Therefore, the main objective of this study was to identify the leading challenges in knowledge management and innovation by exploring the key themes, their connections and the latest research trends in this area.Using the SCOPUS database, publications were reviewed to answer the following questions: (RQ1) How has the perspective of academic research addressing both knowledge management and innovation evolved over the last twenty years? (RQ2) What are the leading research areas and new research trends simultaneously addressing knowledge management and innovation? The focus was on articles published between 2003 and 2023. The results are presented in tabular form and as visual representations showing the resulting research clusters, generated by the VOSviewer software.

2. Data and Methodology

This paper used a bibliometric analysis to identify current research trends among leading scientific publications related to knowledge management (KM) and innovation issues, as used by many researchers (e.g. Carlsson and Noyons, 2009, Zhang et al, 2019, Ruas et al, 2017, Gudanowska, 2017; Gorzeń-Mitka,2020, Lobonţ et al, 2021). As emphasised by Klincewicz et al (2012), this method makes it possible, among other things, to determine the current state of knowledge in a given area, indicate knowledge gaps, predict future research developments in a given area and identify areas characterised by a relatively high saturation of conducted research and links between research areas.

The data for the study was obtained from Web of Science (WoS) and SCOPUS databases. Using the search mechanism of these databases, scientific publications containing the terms "knowledge management" and "innovation" in the "Article title, Abstract, Keywords" box were extracted. The analysis covered publications from the last two decades, i.e. from 2003 to 2023. Further analysis focused on the SCOPUS database due to a slightly larger number of publications indexed there. The results obtained were organised and partially aggregated. The study comprised several stages:

1. Extracting the number of publications on the analysed research area in the WoS and SCOPUS databases and assessing changes in their number in the longer term.
2. Identifying the dominant subject areas into which publications were classified based on the SCOPUS database.
3. Identifying countries/regions, scientific centres and universities of key importance for the analysed research area based on the SCOPUS database.
4. Identifying publications of key importance for the analysed research area based on the SCOPUS database citation index.
5. Identifying research sub-areas based on co-occurrence relationships of the keywords "innovation and knowledge management" in the SCOPUS database using the VOSviewer programme.

The analysis used software like Excel and VOSviewer (Visualizing scientific landscapes, version 1.6.18), as well as data analysis tools available in Web of Science and SCOPUS databases. The analysis covered bibliographic data extracted on 5 April 2024.

3. Analysis Results

At the outset of the analysis, the Web of Science and SCOPUS databases were filtered, and a time series analysis was performed, reflecting the number of included publications addressing innovation and knowledge management. Over the years, there has been a dynamic increase in the number of indexed studies dealing with these issues. The first such studies appeared in the SCOPUS database in 1994, and in Web of Science in 1996.

In the case of WoS, this was the publication by D.W. Straub, The effect of culture on IT diffusion: E-mail and FAX in Japan and the U.S., Information Systems Research, 5(1). There were two entries in the SCOPUS database: J.C. Spender, Making knowledge the basis of a dynamic theory of the firm, Strategic Management Journal 17, pp.

45-62; and R. Sanchez and J.T. Mahoney, Modularity, flexibility, and knowledge management in product and organization design, Strategic Management Journal 17.

This paper analyses publications from 2003 to 2023. By 2003, the total number of relevant papers was 7,648 in the WoS database and 8,672 in SCOPUS. (Fig. 1) Further, it should be noted that in 2007 the number of publications indexed in both databases exceeded 200 papers per year, and in the last decade it was at least 300 and 400 papers annually. The figures were slightly higher in the case of the SCOPUS database, with 600 items on the analysed issues indexed in 2003. The dynamically increasing number of publications in both databases indicates a constantly growing interest in knowledge management and innovation.

Figure 1: Publications devoted to knowledge management and innovation in the WoS and SCOPUS databases (1996-2023)

Source: own elaboration based on WoS and SCOPUS data

SCOPUS data was analysed in greater detail due to the slightly higher number of publications. Taking into account data aggregation, the publication output was analysed according to the thematic areas to which the publications were classified; the country of origin of the authors with the most publications (geographical arrangement) and the scientific centres represented by the researchers with the most frequently published and most frequently cited publications.

In the SCOPUS database, publications dealing with knowledge management and innovation are dominated by conference papers (48.65%) and scientific articles (44.55%). Together, they account for 93.20% of all papers. The other types of publications represent a small percentage of the analysed dataset. (Tab. 1)

Table 1: Main publication types

Document Type	Number of publications	Structure	Document Type	Number of publications	Structure
Conference Paper	4,152	48.647%	Editorial	23	0.269%
Article	3,802	44,546%	Note	15	0.176%
Review	256	2.999%	Short Survey	7	0.082%
Book Chapter	196	2.296%	Conference Review	3	0.035%
Retracted	48	0.562%	Data Paper	3	0.035%
Book	28	0.328%	Erratum	2	0.023%

Source: own elaboration based on SCOPUS data

An analysis of the thematic areas into which the SCOPUS publications were classified leads to the conclusion that the identified papers mainly represented two areas: business, management and accounting (22.12% of publications), as well as Computer Science (21.87% of publications). The other areas with more than 1,000 papers published in the last two decades were Engineering, Decision Sciences and Social Sciences. The distribution across all SCOPUS subject areas is shown in Figure 2.

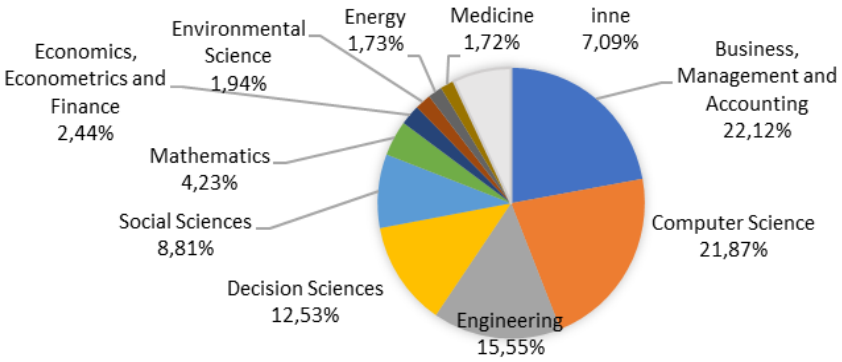


Figure 2: Main subject areas

Source: own elaboration based on SCOPUS data

The authors of publications dealing with knowledge management and innovation were mostly researchers from LUT University in Finland; Zhejiang University and Harbin Institute of Technology from China; Universidade de São Paulo in Brazil and Politecnico di Milano in Italy. (Tab. 2)

Table 2: List of research centres of origin of researchers addressing KM and innovation — Top 5

No	Affiliation	Number
1	LUT University	72
2	Zhejiang University	59
3	Harbin Institute of Technology	54
4	Universidade de São Paulo	46
5	Politecnico di Milano	42
5	Bucharest University of Economic Studies	42

Source: own elaboration based on SCOPUS data

When analysing the country/region of origin of the authors with the highest number of studies on the issue at hand, the dominant position of China is evident. Authors from the United States come second and those from the United Kingdom third. Further countries in the ranking are Germany, Spain and Italy. A list of the top ten countries and research centres of researchers addressing KM and innovation is presented in Table 3.

Table 3: List of countries of origin of researchers addressing KM and innovation — Top 10

No	Country/Territory	Number of Publications	Structure	No	Country/Territory	Number of Publications	Structure
1	China	1,437	13.26%	6	Italy	417	3.85%
2	United States	959	8.85%	7	Australia	324	2.99%
3	United Kingdom	691	6.38%	8	France	296	2.73%
4	Germany	490	4.52%	9	Taiwan	282	2.60%
5	Spain	450	4.15%	10	Brazil	275	2.54%

Source: own elaboration based on SCOPUS data

Considering the source of publications, the leader in the number of publications on knowledge management and innovation is the Journal of Knowledge Management, with 174 such publications. More than 100 research papers in this area were published in "Lecture Notes in Computer Science Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics" (133 items), "ACM International Conference Proceeding Series" (112 items) and "Communications in Computer and Information Science" (111 items). Figure 3 shows the ranking of sources with the largest number of publications dealing with the issue in question.

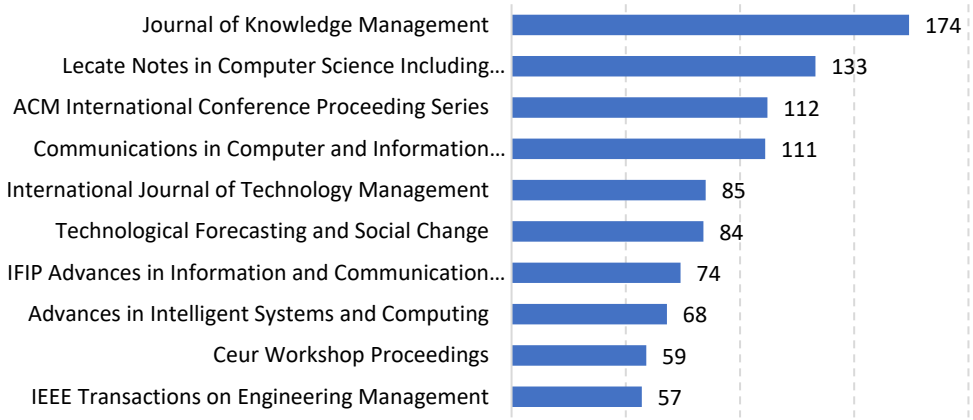


Figure 3: List of sources with the largest number of publications on KM and innovation

Source: own elaboration based on SCOPUS data

According to the SCOPUS database, the most published researchers included Gardoni, M. (20 papers), Kianto, A. and Matos, F. with 19 publications each, and Schmitt U. with 13 papers. (Fig. 4)

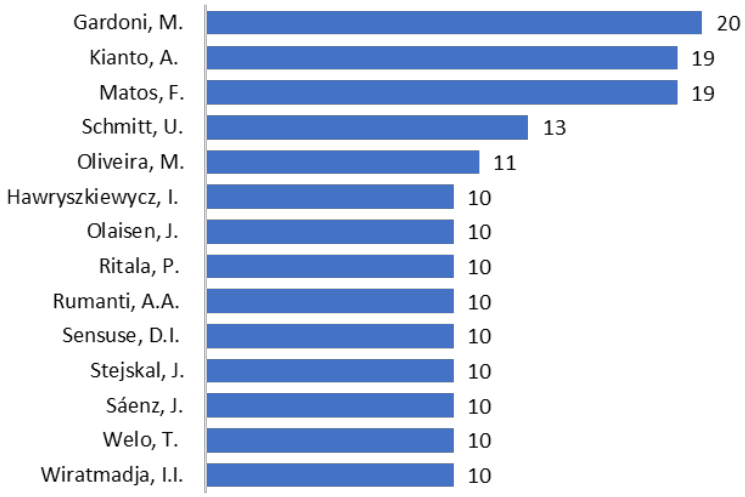


Figure 4: Authors with the highest number of publications on KM and innovation — TOP 5

Source: own elaboration based on SCOPUS data

Notably, the publications of the above researchers are not among the most cited. Of the ten most cited publications addressing both knowledge management and innovation, the article by Argote, L., McEvily, B. and Reagans, R. titled Managing knowledge in organizations: An integrative framework and review of emerging themes, published in 2003 in Management Science, ranked first with 1,494 citations. Table 4 shows a ranking of the ten most cited publications addressing knowledge management and innovation.

The next step in examining bibliometric data was word co-occurrence analysis which, as noted by Liu et al (2015), is used to identify key research topics in a research field or knowledge domain. The analysis involved preparing a map of knowledge and research trends related to knowledge management and innovation in the context of SCOPUS publications indexed between 2003 and 2023. VOSviewer — visualisation software that is particularly helpful when working with large amounts of data — was used for building and visualising bibliometric networks, as well as for scientific mapping. It was used to group and evaluate research sub-areas. The data file generated in the SCOPUS database was further analysed using the VOSviewer visualisation software. Due to the large size of the initial database (8,535 items), only articles published in the years analysed were considered for further analysis. Ultimately, 3,730 items were analysed.

It was decided that "indexed keywords" should be used in the correlation analysis because they reduce duplicate or similar terms (Zhang et al, 2016). To make the visualisation clearer, a term extraction was also performed

with an indication of words with a minimum of 15 repetitions in bibliographic descriptions. In addition, such terms as China, Australia, article, data mining, India and issue were eliminated from the set.

Table 4: Most cited publications on KM and innovation (TOP-5)

Author	Title	Journal	Year	Number of citations
Argote, L., McEvily, B., Reagans, R.	Managing knowledge in organizations: An integrative framework and review of emerging themes	*Management Science*	2003	1,494
Gertler, M.S.	Tacit knowledge and the economic geography of context, or the undefinable tacitness of being (there)	*Journal of Economic Geography*	2003	1,394
Jensen, M.B., Johnson, B., Lorenz, E., Lundvall, B.A.	Forms of knowledge and modes of innovation	*Research Policy*	2007	1,144
Schilling, M.A., Phelps, C.C.	Interfirm collaboration networks: The impact of large-scale network structure on firm innovation	*Management Science*	2007	1,090
Chen, C.-J., Huang, J.-W.	Strategic human resource practices and innovation performance - The mediating role of knowledge management capacity	*Journal of Business Research*	2009	1,011

Source: own elaboration based on SCOPUS data

Based on these assumptions, a database of 184 keywords was obtained and presented in the form of a map. (Fig. 5) The map illustrates current trends in research addressing knowledge management and innovation and shows the links detected over time. The major keywords "knowledge management" and "innovation" were removed because they appeared in all articles (Liao et al, 2023). The terms analysed were grouped by occurrence and strength of interconnection, resulting in seven clusters of terms. Each cluster is marked by a different colour: blue, green, red, purple, blue, yellow and orange.

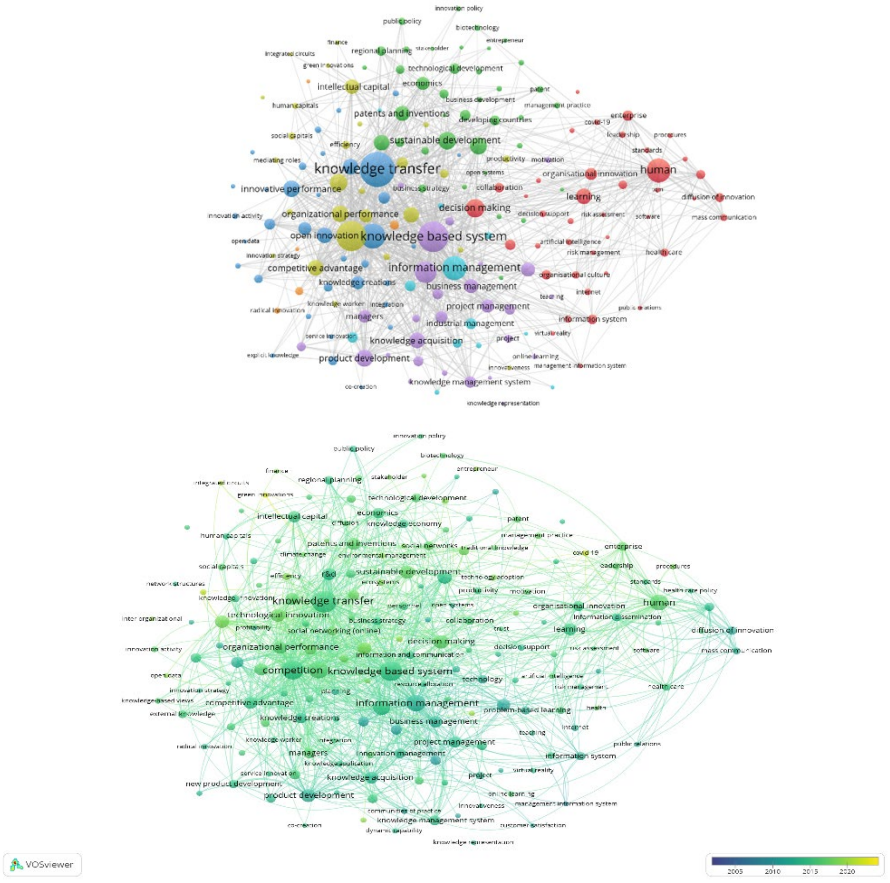


Figure 5: Maps of the intensity of link co-occurrence between keywords and links detected over time

Source: own elaboration using VOSviewer and SCOPUS.

The size of the items (nodes and font) in the maps indicates the frequency of co-occurrence of a given term and the links between network nodes represent their co-occurrence in the analysed group of publications. The larger the item, the greater its importance and popularity relative to others (Perianes-Rodriguez et al., 2016). The distance between the visualisation items roughly indicates their relatedness in the co-occurrence network, so the closer two items are to each other, the stronger their links (van Eck and Waltman, 2019). The stronger the link, the more frequently both terms appear in publications. The map created using VOSviewer features numerous links, making the network quite dense, especially in its central part. It comprises 184 items and 6,836 links, with its central part containing the most frequent keywords. The topics most strongly linked to others within the network were: "human resource management", "employee" and "information management".

The first cluster categorised in VOSviewer is the most numerous, with 40 keywords.(Tab. 6) It is marked in red. The term with the highest link strength (Tls) is "human" (Tls= 655), followed by "decision making" (Tls=512). These terms also have the highest co-occurrence rates (O) in the group, at 182 and 129, respectively.

The red cluster includes publications addressing issues related to artificial intelligence, decision-making, learning, communication and health care. This group also includes terms relating to information, information dissemination and retrieval, the information system and the "management information system". Further, it includes research relating to organisational innovation and the diffusion of innovation, as well as risk management and risk assessment. Publications in this group examine innovation and knowledge management in terms of leadership, organisational culture, trust, creativity and collaboration. There are also references to standards, procedures and TQM. The most frequent and most linked keywords in this cluster are "human" and "diffusion of innovation". Their minimum link strength is 42. References to COVID-19 and "digital storage" are relatively new. For these, the average publication years (AvgPY) are 2021 and 2018, respectively. The average publication year for all issues in the cluster is 2014.79.

The next cluster comprises 38 items and is marked in green. This cluster focuses on issues related to business development, productivity, entrepreneurship, investments, performance assessment, employment and "business strategy". The strongest and most linked relationship in this cluster relates to such keywords as "technology transfer" (Tls =441; O=111) "research and development" (Tls =413; O=101) "sustainable development" (Tls =371; O=118) and "patents and inventions" (Tls =359; O=96).

The dominant term with the highest number of links and the highest link strength (Tls =441; O=111) is "technology transfer". Other related topics are "technological development", "technological forecasting" and "technology adoption". The articles in this cluster focus on issues related to the knowledge economy, knowledge exchange, economic development, economics, research and development, patents and inventions, intellectual property, the innovation system and innovation policy. They also refer to social networks, big data, software design and sustainable development. This cluster includes knowledge management and innovation in the context of economic and enterprise development, i.e. entrepreneurs and other stakeholders. The issues at hand also relate to technological development and forecasting, as well as technology adoption and transfer.

The average year of publication for the entire cluster is 2015.8. Looking at the links detected over time, one can see that the most recent publications in the cluster refer to "big data" and "entrepreneur" (average year of publication: 2019).

The third cluster, marked blue, is related to knowledge, innovation, networks and collaboration. It comprises 35 terms. The highest link strength within the blue cluster occurs in the case of "knowledge transfer" (Tls=954; O=316). This is also the third-highest score for the entire link map. Other blue cluster keywords with high link strength include "knowledge sharing" (Tls=677; O=197) "commerce" (Tls=463; O=97) "innovative performance" (Tls=430; O=108) and "open innovation" (Tls=378; O=98). Notably, much of the research categorised into this cluster relates to networks — innovation, knowledge and social ones, as well as network structure and complexity. A significant number of keywords refer in various ways to innovation and knowledge. In the case of innovation, these include collaborative innovation, innovation activity, innovation process, service innovation and knowledge innovation. In terms of references to knowledge, the blue cluster included research referring to such things as explicit and external knowledge, as well as the creation, application, diffusion, integration and flow of knowledge, and tacit knowledge management. Co-creation, integration, absorptive capacity and crowdsourcing were also among the keywords. Looking at the average time of publication, this group's most recent studies on knowledge management and innovation refer to "open data" (AvgPY=2018.69) and "inter-organisational" (AvgPY=2018.53) issues. The average year of publication for the entire cluster is 2015.32.

The fourth cluster ranked in VOSviewer covers slightly fewer keywords — 27. It is marked in yellow. The most frequent and strongly linked cluster components are "competition" and "competitive advantage" — the strength of the link between them is 95. These terms are the most frequent and linked items not only in the cluster but also in the entire network. The main keywords characterising this cluster are "competition", "competitive advantage", "organisational performance", "technological innovation" and "human resource management". In this cluster, the term "competition" has the highest link and co-occurrence strength (Tls=1073; O=253). This group of publications primarily focuses on issues related to competition, organisational knowledge management, human capital, innovation and environmental management — "climate change" and "green innovation". Analysing the links detected over time, it is noticeable that the yellow cluster is a collection of issues that have begun appearing in publications relatively recently. The average year of publication for the entire cluster is 2016.24, with the lowest AvgPY value being 2013 for "planning" and the highest being 2014.9091 for "competition". New issues covered in innovation and knowledge management publications include green innovation, for which the average publication year is 2021.61, and "mediating roles", with an average publication year of 2020.46.

The fifth cluster ranked in VOSviewer comprises 27 keywords and is marked in purple. This research area concerns knowledge-based systems, learning organisations and product development. The most frequently used keyword in our sample of documents is "knowledge-based system (KBS)". Being the most prominent issue in the group, it is in the central part of the map. The purple cluster covers publications relating to business and project management, knowledge acquisition and information technology. These are the strongest and most linked relationships within this group. Considering the time of publication, the keywords in the purple cluster are not new issues in the context of research considering knowledge management and innovation. The average year of publication for the entire cluster is 2014.06. The keywords in this cluster also include some with an AvgPY of 2010. These are "knowledge engineering", "communities of practice" and "enterprise resource planning".

A further, sixth, cluster comprises 12 keywords. It is marked in light blue. The three main keywords characterising this cluster are "information management", "strategic planning" and "industrial management". "Information management" (Tls=796; O=183) is characterised by the greatest link and co-occurrence strength and is located close to the central part of the map. This cluster also includes publications relating to product innovation, dynamic capability, marketing and customer satisfaction. Looking at the average publication time, one can see that this cluster contains keywords that have not been heavily used in recent years. In this cluster, the most recent studies on knowledge management and innovation are related to "entrepreneurship" (AvgPY=2018.78). The average year of publication for the entire cluster is 2013.75.

The last cluster (orange) includes only 5 keywords. This cluster is the least numerous and the weakest in terms of total link strength and occurrences. The cluster covers the following keywords: "incremental innovation", "innovation capability", "knowledge management strategy", "mergers and acquisitions" and "radical innovation". In this cluster, the term "innovation capability" has the highest link and co-occurrence strength (Tls=168; O=45). The orange cluster contains publications on innovation and knowledge management in the context of innovation capability, including incremental and radical innovation, knowledge management strategy and the changes brought about by mergers and acquisitions. The correlations detected over time show that all the keywords in this cluster, although seemingly familiar, are still readily used in publications addressing innovation and knowledge management. The average year of publication for the entire group is 2015,425, and for individual keywords, it does not extend beyond the last decade. In this case, the lowest AvgPY value is 2013.75.

Looking at the map as a whole, it is also worth highlighting the keywords with the highest link strength regardless of cluster affiliation. The most frequent and most interlinked items among the selected map clusters were "technology transfer" (green cluster) and "knowledge transfer" (blue cluster) — 37 lines. Numerous links also exist between "knowledge transfer" and "competition" (yellow cluster), for which the link strength is 36.

4. Summary

This study presents the evolution of research addressing knowledge management and innovation, which are key factors in developing and building the competitive position of actors and economies. They contribute to solving the challenges of change in organisations and their environment. A co-occurrence network analysis using VOSviewer software was employed to identify new trends in this area. The analysis covered publication data from two decades. The main findings of the study are as follows:

- The number of publications indexed in the analysed databases is systematically increasing, which indicates a growing researcher interest in knowledge management and innovation.
- The issues analysed in this study are typically considered in business, management and accounting, computer science and engineering.
- By forming a keyword co-occurrence network map and simultaneously analysing research activities addressing knowledge management and innovation, it was found that the boundary themes in this research consist of seven representative areas, focused on such main keywords as competition, knowledge-based system, information management, knowledge and technology transfer, innovation capacity and sustainability.
- Recent trends in research addressing innovation and KM refer to green innovation, COVID-19, mediating roles, integrated circuits, big data and entrepreneurship.

This study aimed to identify selected challenges in an exploratory manner and may form the basis for continued work in this area. Nonetheless, it also has certain limitations that open up possibilities for further consideration. The issues of innovation and knowledge management are multidimensional, and this study analysed only the leading trends in these areas. The focus was only on major trends, limiting the analysis to data from the SCOPUS database. Further in-depth research using multiple databases would be advisable. From the point of view of research methodology, a more in-depth analysis of citations, the number of article downloads from the database or the co-existence of author or research centre relationships could be devised. Summarising the trends identified in the study, it can be concluded that knowledge management and innovation continue to pose a challenge for modern actors and economies and are areas of exploration for academic researchers.

References

Al-Zagheer, H., Alda'jah, A.K., Hammouri, Q. and Alshawabkeh, H.A. (2024) “The Role of Internal Knowledge Management Capabilities with the Internet of Things”, 2nd International Conference on Cyber Resilience, ICCR, Dubai, Code 199657.

Ayandibu, A.O., Vezi-Magigaba, M.F. and Kaseeram, I. (2020) “Innovation as an improvement tool for SMMEs”, In: Ayandibu, Ayansola Olatunji (ed) Reshaping Entrepreneurship Education with Strategy and Innovation, pp 78-107, IGI-GLOBAL BOOKS, Hershey, PA, USA.

Baporikar, N. (2014) “Drivers of innovation”, In: Patricia Ordoñez de Pablos, Luis Jovell Turró, Robert D. Tennyson and Jingyuan Zhao (eds) Knowledge Management for Competitive Advantage During Economic Crisis, pp 250-270, IGI-GLOBAL BOOKS, Hershey, PA, USA.

Baporikar, N. (2015) “Innovation knowledge management nexus”, In: Carolina Machado and J. Paulo Davim (eds) Innovation Management: In Research and Industry, pp 85-110, De Gruyter, Berlin, München, Boston.

Barbaroux, P., Attour, A. and Schenk, E. (2016) Knowledge Management and Innovation: Interaction, Collaboration, Openness, Wiley Blackwell.

Carlsson, H. and Noyons, E.C.M. (2009) “Field delineation using medical subject headings (MeSH) – An alternative way to aggregate data in the web of science”, 12th International Conference on Scientometrics and Informetrics. Rio de Janeiro; Brazil; 14-17 July 2009, pp 914-917.

Dow, R.M., Loefdahl, J., Pallaschke, S. and Baldesi, G. (2019) “Role of knowledge management in innovation: The ESA use case”, Proceedings of the International Astronautical Congress, IAC, IAC-19_D5_2_2_x54033.

García, V.H.M., Pachón, J.P.O. and Guzman, K.A.R. (2020) “Integrated Model of Knowledge Management and Innovation”, Advances in Intelligent Systems and Computing, 1159 AISC, pp 114–123.

Godin, B. (2017) “A conceptual history of innovation”, In: Harald Bathelt, Patrick Cohendet, Sebastian Henn and Laurent Simon (eds) The Elgar Companion to Innovation and Knowledge Creation, pp 25-32, Edward Elgar Publishing.

Gorzeń-Mitka, I. (2020) “The Latest Streams Of Research On Communication In Risk Management: A Large-Scale Literature Review Based On Co-Occurrence Data”, *Scientific Papers of Silesian University of Technology – Organization and Management Series*, Vol. 149, pp 219-237.

Gudanowska A.E., (2017) A Map Of Current Research Trends Within Technology Management In The Light Of Selected Literature, Management and Production Engineering Review, Vol. 8 Number , March 2017, pp 78–88.

Guetat, S.B.A. and Dakhli, S.B.D. (2013) “A framework for integration of knowledge and innovation”, World Congress on Computer and Information Technology, WCCIT, Sousse, Tunisia, pp 1-11.

Jain, P. (2016) “Ethical and legal issues in knowledge management life-cycle in business”, In: Priti Jain and Nathan Mnjama (eds) Managing Knowledge Resources and Records in Modern Organizations, pp 82-101, IGI Global.

Klincewicz, K., Żemigała, M., Mijal, M. (2012) *Bibliometria w zarządzaniu technologiami i badaniami naukowymi,* MNiSW, Warszawa.

Krishnamoorthy, B. and Damle, M. (2017) “Models of innovations: An overview of perspectives and expositions”, International Journal of Value Chain Management, Vol. 8, No. 4, pp 342-362.

Liao, H.-T., Lo, T.-M. and Pan, C.-L. (2023) “Knowledge Mapping Analysis of Intelligent Ports: Research Facing Global Value Chain Challenges”, *Systems*, Vol. 3, No. 11, Art No. 88.

Liu, Z., Yin, Y., Liu, W. and Dunford, M. (2015) "Visualizing the intellectual structure and evolution of innovation systems research: a bibliometric analysis", *Scientometrics*, 103(1), 135-158.

Lobonţ O.R., Purcariţa R., Vatavu S. and Costea F. (2021) "A Bibliometric Mapping of the Research Trends of Public Governance and Entrepreneurship Framework", *Postmodern Openings*, Vol. 12(1Sup1), pp 35-53.

Luturlean, B.S., Prasetio, A.P., Saragih, R. and Akbar, M.F. (2021) "The role of knowledge management practices on innovation performance in a public telecommunication company", *International Journal of Learning and Change*, Vol. 13, No. 3, pp 322-334.

Martins, J.M., Haider, S.A., Pereira, J.M. and Abreu, A. (2022) "Innovation Management on Waste Biorefineries", In: Eduardo Jacob-Lopes, Leila Queiroz Zepka, Mariany Costa Deprá (eds) Handbook of Waste Biorefinery. Handbook of Waste Biorefinery: Circular Economy of Renewable Energy, pp 915-932, Springer, Cham.

Mateu, L.L. (2014) "Knowledge management in the pharmaceutical services", Revista Cubana de Farmacia, Vol. 48, No. 4, pp 701-708.

Mehdi, F. (2022) "State Mechanisms for Stimulating Innovative Activities", Review of Economics and Finance, 20 (1), pp 340-352.

Mustafa, N. and Rexhepi, B.R. (2024) "Knowledge Management is the Process of Effectively Managing and Using Knowledge Within an Organization. It Involves the Collection, Organization, And Dissemination of Knowledge to Ensure a Competitive Advantage in The New Economy", International Journal of Religion, vol. 5(5), pp. 855-868.

Nurulin, Y., Skvortsova, I., Tukkel, I. and Torkkeli, M. (2019) "Role of knowledge in management of innovation", Resources, vol. 8(2), 87.

Ologbo, A.C. and Nor, K.M. (2015) "Knowledge management processes and firm innovation capability: A theoretical model", Asian Social Science, Vol. 11 No. 18, pp 10-17.

Omotayo, F.O. and Akintibubo, A.O. (2024) "Knowledge hiding in the academia: Individual and social factors predicting knowledge hiding behaviour of undergraduates of a Nigerian university", Journal of Librarianship and Information Science, Vol. 56 No. 1, pp 145-163.

Perianes-Rodriguez, A., Waltman, L. and van Eck, N.J. (2016) "Constructing bibliometric networks: a comparison between full and fractional counting", *Journal of Informetrics*, Vol. 10 No. 4, pp 1178-1195.

Ruas, T.L., Pereira, L. and Grosky, W.I. (2017) "Science, technology and innovation exploration in biophotonics through a scientometric approach", IEEE International Conference on Smart Technologies and Management for Computing, Communication, Controls, Energy and Materials, Proceedings ICSTM, pp 36-43.

Tavasieva, Z., Pozmogov, A., Kreer, M. , Kallagov, Boris and Tedeyeva, Z. (2019) "Knowledge management as a matter of vital importance for a modern organization", Proceedings of the 33rd International Business Information Management Association Conference, IBIMA 2019: Education Excellence and Innovation Management through Vision 2020, pp 4001-4007.

Than, S.T., Le, P.B., Le, T.P. and Nguyen, D.T.N. (2023) "Stimulating product and process innovation through HRM practices: the mediating effect of knowledge management capability", Evidence-based HRM, Vol. 11, No.1, pp 85-102

ul Hassan, E., Hameed, Z. , Fatima, M. and Shaheen, M. (2014) "Innovation is the key driver for corporate success", Middle – East Journal of Scientific Research, Vol. 19, No. 6, pp 843–847.

van Eck, N.J. and Waltman, L. (2019) *VOSviewer Manual. Manual for VOSviewer version 1.6.11,* software documentation.

Young, R.A. (2015) *Federal influence on innovation: Policy effects and proposals*, Nova Science Publishers, Inc, New York.

Zhang J., Yu Q., Zheng F., Long Ch., Lu Z. and Duan Z. (2016) "Comparing keywords plus of WOS and author keywords: A case study of patient adherence research", *Journal of the Association for Information Science and Technology*, Vol. 67, No. 4, pp 967–972.

Zhang, X., Estoque, R.C., Xie, H., Murayama, Y. and Ranagalage, M. (2019) "Bibliometric analysis of highly cited articles on ecosystem services", *PLoS ONE* , Vol. 14, No. 2, Art. No. e0210707.

Innovation in Development Projects in Poland in the Context of Company

Marcin Sitek and Monika Sipa
Czestochowa University of Technology, Faculty of Management, Department of Economics, Investment and Real Estate, Czestochowa, Poland

marcin.sitek@pcz.pl
monika.sipa@pcz.pl

Abstract: This article aims to identify the introduction of innovations in the activities of residential developers in relation to company size. In order to achieve the objective, the results of a survey conducted in Poland in the form of a questionnaire among developers of the primary residential market, implementing investments in the field of multi-storey multi-family construction, were used. The research conducted allowed the identification of the percentage of residential developers introducing innovations in their real estate projects. Moreover, the structure of the innovations introduced was presented, taking into account the role they play in the market. A correlation of the innovations introduced in their activities with the size of the company and the market range in which the company operates was revealed. The information presented is of key importance today due to the need for innovation in renewable energy sources, which allow for diversification and security of supply in the context of the armed conflict in Ukraine. Introducing innovations in the real estate market is becoming necessary in EU countries due to regulations aimed not only at increasing the competitiveness of EU economies through increased innovation but above all at achieving sustainable development goals — including net-zero carbon emissions. EU regulations introduce strict requirements concerning, among other things, the energy performance of buildings, which will result in the need for innovative projects not only in the primary market but also for projects aimed at modernizing the existing stock (secondary market), which, according to research, is often carried out by smaller companies that have not yet applied innovative solutions in their operations.

Keywords: Innovation, Renewable Energy Sources, Sustainable Construction, Climate Neutrality.

1. Introduction

Socio-economic development is linked to the development of science and technology, where innovation became the catalyst for social and economic change (Fundacja Innowacji i Nowoczesnych Technologii, 2021), thus contributing to the competitive position of regions.

The further dynamic development of the world economies was made possible by the introduction of innovation (Hult et al,2004; Jin et al, 2004). Article 173 (2016) of the Treaty on the Functioning of the European Union (TFEU) within the framework of the Lisbon Strategy (2000), Europe 2020 strategy (European Commission 2010), and now within the framework of Sustainable Europe until 2030 and initiatives such as the “Green Deal” (Green Deal 2022) and Fit for 55 (2023), explicitly emphasis sustainable development, ecological transformation and achieving climate neutrality, which is possible through the implementation of innovation (Innovation Policy, 2023). This implies that green transformation developments will largely affect the real estate sector, as this sector is highly energy-consuming and accounts for a large proportion of greenhouse gas emissions.
The geopolitical situation, namely the armed conflict in Ukraine, is also a driver for innovation in the real estate market. As a direct consequence of Russia’s invasion of Ukraine, the price of raw materials, particularly energy commodities such as oil, natural gas and coal, of which Russia is a strategic exporter, rose dynamically and by leaps and bounds. The situation was all the more serious as Russia was the EU’s main supplier of energy resources, which, combined with successive restrictions, such as the embargo on imports of individual raw materials from Russia, resulted in a cascade increase in their price and also in energy security risks. (Karlinski, 2022; Polish Economic Institute, 2023).

The motivation for addressing the problem was (until the COVID-19 pandemic and the Russian intervention in Ukraine) the highly accelerated economic development associated, among other things, with innovative activities. In Poland, over the last thirty years, the centrally planned state economy was replaced by market economy mechanisms. This creates the necessity to intensify the implementation of innovations to increase the competitiveness of the Polish economy.

Innovation is the basis of knowledge-based leadership, enabling the use of advanced integration methods and practices to achieve organizational goals (Hallinger and Suriyankietkaew, 2018; Faouri 2023, SAhouwen et al. 2022). In light of the above, it can be concluded that green knowledge management is a particularly important concept meaning the management of capabilities and knowledge related to sustainable technologies and

environmental practices. This means that knowledge management is one of the elements of effective implementation of innovations.

Taking into account the current geopolitical risks and the EU regulations being introduced, especially the consequences of real threats resulting from climate change and environmental degradation, an attempt was made to analyze the problem presented above. The paper aims to identify the role of innovation in the activities of residential developers in Poland in the context of changes triggered by the geopolitical crisis and EU legislative initiatives.

The paper reviews the literature on innovation in the real estate market, legislative initiatives undertaken by the EU, particularly in the area of innovation, climate and energy policies, and the consequences in the state's economy and policy caused by the conflict in Ukraine. The author's own survey was used, which was conducted among residential developers in Poland in the second half of 2020 and in the second half of 2022. The results of the study are then presented and discussed in the context of the literature review provided in the preceding section. Synthetic conclusions from the conducted research were used to formulate general recommendations for the development of the Polish housing sector.

2. Literature Review

The dynamic development of world economies is made possible by the introduction of innovation. The most comprehensive market definition is cited by the Oslo Manual (OECD/European Union, 2018):

A new or improved product or process (or a combination thereof) that differs significantly from an entity's previous products or processes and that has been made available to potential users (product) or put into use by the entity (process). However, for the real estate sector, the market definition of innovation was defined according to Bac (2014) and Pryston (2012) as: innovations in the real estate market particularly concern production methods and new goods, i.e. new construction methods and techniques ensuring the creation of a new product (building or structure) meet with energy, ecological and utility standards. They concern production factors (goods, services, production methods, sources of raw materials, or organization of production processes) and new economic activities or new services. Therefore, innovation in the real estate market stimulates pro-ecology, issues of energy efficiency, ergonomics and renewable energy sources. Innovations in the real estate market will stimulate sustainable development.

The development trends of innovation are: (Kamiński 2022):

- the increase in the share of new technologies — web and mobile solutions — is one of the most significant developments in the real estate market,
- the development trend of innovations concerning big data, databases, machine learning, neural networks or artificial intelligence — is widely used in real estate valuation and decision-making support in the investment process,
- the development trend of geolocalization is an extraordinary tool, highly useful, used in marketing, navigation or local services,
- the development trend in construction innovations points to the important influence of electronics and building automation on the functioning of buildings.

As can be seen from the literature analysis (COM 2019; European Climate Law 2021; Green Deal 2022; Fit for 55 2023; Just Transition Fund 2021; Fit for 55, 2023; Fit for 55, 2023; COM 2021). EU countries have committed to achieving climate neutrality by 2050 and thereby fulfilling their obligations under the Paris Agreement (The Paris Agreement, 2015). The EU's green transformation comprises a package of initiaties among which those applicable to the real estate sector should be particularly highlighted:

- Green Deal (2022), (European Climate Law (2021) as the heart of the Green Deal, 2019). The European Green Deal is a package of policy initiatives that aims to put the EU on the path to a green transition and ultimately to achieve climate neutrality by 2050. In this regard, the UN's "Our Common Future" Report (United Nations, 1987, pp.18–19, 119) as well as Vademecum Bezpieczeństwa (2018) emphasise that the importance of energy for the world's developing economies will be increasing.
- the Fit for 55 package (Fit for 55, 2023) as a set of proposals to revise climate, energy and transport legislation and introduce new legislation to bring Union law in line with its climate goals.

- European Climate Pact (2021). - The EU and its Member States have committed to reduce net EU greenhouse gas emissions by at least 55% by 2030, compared to their 1990 levels (European Commission, 2016; COM 2020);
- European industrial strategy, including circular economy. The EU is counting on European industry to steer the transition towards climate neutrality (COM 2020; European Parliament Regulation, 2021);
- In March 2020, the European Commission presented a new roadmap for a circular economy, highlighting the need to ensure green recovery from the Covid-19 pandemic.
- The EU has introduced the Just Transition or Sustainable Finance Mechanism (Parliament Regulation..., 2021; Just Transition Fund JTF, 2021) to financially and technically support regions as a result of the transition to a low-carbon economy. From the perspective of the topic under discussion, the most important consequence of the war in Ukraine seems to have been the increase in the price of energy raw materials, as well as of the supply of such raw materials. This has resulted in an even stronger pressure to develop innovations within the framework of renewable energy sources, driven by the increased importance of energy self-sufficiency (Kolany 2022).

Rapid changes in the perception of technology and knowledge management have led to an increase in interest in ecological knowledge management as a source of competitive advantage (Abbas and Sağsan 2019; Santoro et al., 2019). Managing ecological knowledge is a fundamental factor for a company's survival, leading to great results, such as increasing competitive capabilities in the market (Hottenrott et al., 2016). Optimizing the knowledge process prompts companies to further focus on sharing and organizing green knowledge to replace traditional business perceptions for sustainability (Buter & Van Raan, 2013; Tajpour et al., 2022). The current level of developers' knowledge regarding ecology and green knowledge management requires the development of knowledge, support and transfer of know-how of the innovation project management process. Therefore, the presented EU requirements forcing the implementation of innovations, especially in the field of energy efficiency, should result in the implementation of innovations combined with appropriate knowledge management in this area. To be effective, the process of introducing innovations should be associated with appropriate knowledge management in this area.

Developers, including residential developers, are pursuing a variety of projects - for example lofts. Brown (2018) distinguishes several elements of a successful model for modernization and its management. He points to value as the guiding principle for managing innovation, assuming that value must be based on comfort, well-being, health and aesthetics. He also notes the very topical issue of guaranteeing energy savings and the savings-related integrated supply chains that can provide “a whole-home approach”.

In Poland, price, comfort, well-being, health and aesthetics are also factors driving innovation in the real estate, especially the housing, market. Zhang (2020), on the other hand, shows that risk is one of the driving factors for implementing innovation by investors in the Chinese real estate market. He demonstrates that risk has a positive impact on firms’ innovation performance, including R&D investment, innovation level and other innovation outcomes.

This should be understood in the context of risk appetite, as the taking of risks allows for above-average returns. Therefore, taking into account the risk of non-innovation, one can conclude that it is a driver for increased innovation in business, also for developers.

Killip and Owen (2020) argue that in order to study the real estate investment process, usually in the secondary market, two markets need to be analyzed: the first is the market of repair, maintenance and improvement (RMI) of houses, where energy efficiency, and thus the implementation of innovations, is not the most important; and the second is the market of deep modernization, where the main goal is energy efficiency and thus precisely the implementation of innovations such as energy efficiency. The first market — the RMI market — is dominated by small and medium-sized enterprises, especially micro-enterprises, operating in local markets. Those companies do not maximize profits or focus on the energy efficiency of buildings. In the second market, companies are focused on energy efficiency and are usually large companies working together in regional and national markets. The same situation exists in the primary residential market.

Taking this into account, it is important to emphasize that EU regulations (especially energy regulations) and the need to innovate within the framework of energy decarbonization have also introduced smaller companies to the real estate market (European Court of Auditors, 2017). They presuppose the necessity to reduce the energy consumption of buildings, of the entire stock not only newly built but also the already existing one, in order to meet the standards of having appropriate energy certificates for buildings. If these conditions are not met by

2050, it will not be possible to rent or sell a flat without meeting these conditions. (Central Office for Construction Supervision, 2024).

The introduction of innovations in the housing market refers not only to the use of housing but also, importantly, to resource efficiency in the housing production industry and operational energy efficiency. Industrialized Housing Construction (IHC) is a strategy for implementing emerging innovations in resource-efficient housing (Rohn et al. 2014). Under this strategy, innovations, including RES, are important drivers of value creation in the housing Modular technologies can compete with traditional technologies in the context of sustainability and, at the same time, serve as a cost-optimal solution in the decarbonization of building resources (Kaczorek et al., 2023).

The analysis of the literature has made it possible to identify a research gap in the implementation of innovations by residential developers in the real estate market, which is most relevant to real estate development activities in Poland. To answer the research questions presented below, a survey was conducted and the results analyzed. The research questions were set as follows:

1. What is the percentage of residential developers implementing innovations in Poland?
2. Does the market range of operations of a development company and its size influence decisions to implement innovations in residential projects?
3. What type of innovation is most frequently implemented by residential developers in Poland?

3. Material and Methods

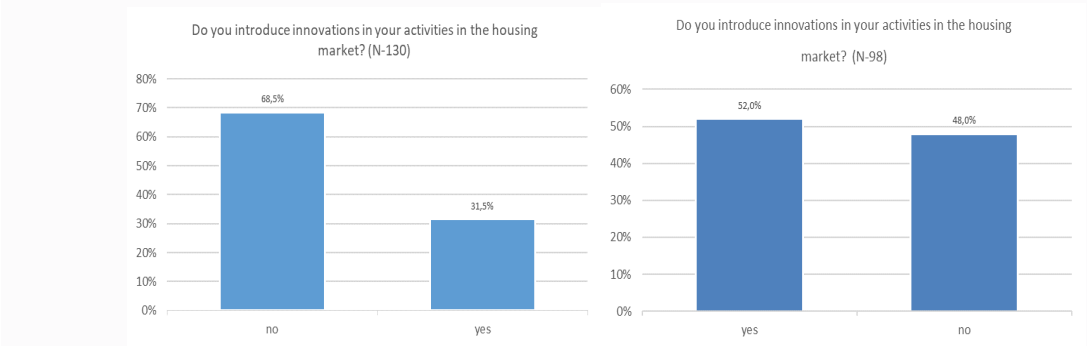
The survey of innovations among primary market residential developers in Poland in the context of company size and market range of the company's operations, motives for their implementation and changes that have taken place in this field in recent years was carried out based on surveys conducted using the CATI (computer-assisted telephone interviewing) method. The survey was not narrowed down to one group of developers, e.g. medium-sized companies, but small, medium-sized and large companies were surveyed, as the selection criterion was the capital strength of the companies, i.e. the implementation of large residential projects. It was decided to carry out such a survey because even developers classified as small enterprises carry out investment large projects in Poland, involving subcontractors in their projects. The survey was conducted twice at a 2-year interval.

Innovation surveys among residential construction companies in the primary market were conducted in August 2020 and in November 2022. The study was conducted on a nationwide sample. The first survey was conducted in August 2020 on a sample of 130 respondents with a then-identified total population of (±5%) 324 entities. This was followed by a further survey in October/November 2022 carried out using the same method on a sample of 98 respondents selected from a total population of (±5%) 230 entities. The research conducted allowed for the identification and analysis of developers' perceptions of innovation in the period before and after the outbreak of the war in Ukraine.

4. Results and Discussion

Preliminary analysis of survey data in the period 2020–2022 (Sitek 2020-2022; Sitek 2023a; Sitek 2023b) clearly indicated the influence of developers' market range on decisions to innovate.

This paper, based on the analysis of the 2020 and 2022 surveys, compared the actual readiness of developers to innovate in the residential property sector in Poland (figure 1)



a) survey 2020 b) survey 2022

Figure 1: Do you introduce innovations in your activities in the housing market?

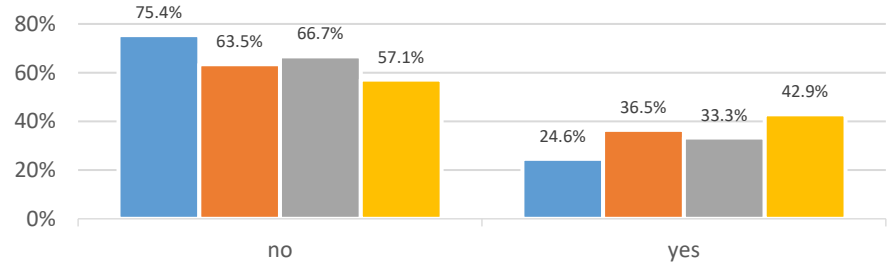
Source: author`s elaboration

The presented surveys showed that the low percentage of companies declaring to introduce innovations in 2020 resulted from three main factors as: the customers choose standard construction, translating into a lack of demand – 23.6%, preference for proven solutions – 22.5% and high costs of innovation – 15.7%.

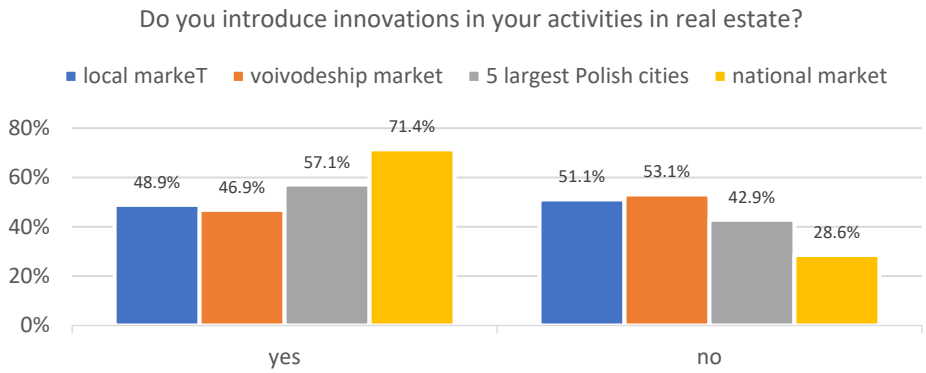
In 2022, on the other hand, developers identified, as the three main determinants of not implementing innovation in their business, the lack of need for it — 23.4%, the difficult market situation — 23.4% and the lack of innovative projects. This shows, first, that the awareness of the need to innovate on the part of residential developers is high, which increases the number of companies declaring innovation . Secondly, that despite the continued importance of the lack of demand/need and the preference for proven solutions in 2022, high investment costs are not shown to be one of the main determinants of the lack of innovation implementation. Whereas the drop in demand was caused by high inflation and consequently high interest rates and limited access to mortgage loans. The increase in costs, on the other hand, was caused by the high price of raw materials, which translated into higher prices for construction materials. On the one hand, there was a major increase in the price of coking coal and, consequently, steel, but also, on the other hand, the price of wood, which in Poland was imported in large quantities from Ukraine, among other countries.

It is impossible not to mention that the most important factor indicated by respondents in both surveys, i.e. the lack of need/demand, changed dramatically in July 2023 in connection with the enactment of the Energy Efficiency Directive. This directive imposes such a need, i.e. it determines the demand for sustainable construction, where buildings should be energy self-sufficient and even generate a surplus of energy obtained, obviously, from renewable sources.

When considering the introduction of innovations from the point of view of the range of activities of the analyzed entities, one can see a clear relationship presented in figure 2.



a) 2020 r.



b) 2022 r.

Figure 2: Do you introduce innovations in your activities in the housing market?

Source: author`s elaboration

It can be observed that both enterprises operating in a wide (nationwide) range and those operating in the five largest Polish cities are much more likely to introduce innovations than enterprises with a small (local) market range of activity. This confirms the general trend also presented in studies by Kilip and Owen (2020) who emphasize that companies operating locally usually do not use innovation, unlike companies with a larger market range. Moreover, firms with a local market range tend to be small companies operating more often in the market for retrofitting and refurbishment of existing space, while firms with a larger market range are larger and more often involved in projects in the primary market (COM 2019; European Climate Law 2021). In addition, the smallest companies, employing a few people, clearly indicate that they do not innovate in their activities, while those with larger employment are more likely to declare the implementation of innovations in their projects (figure 3).

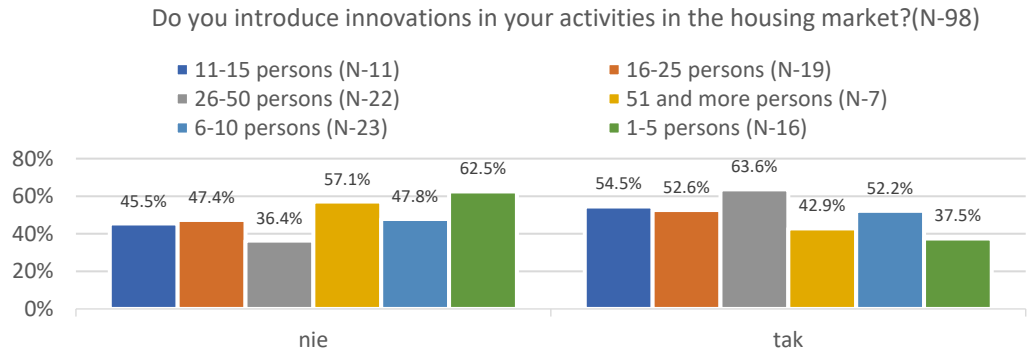


Figure 3: Do you introduce innovations in your activities in the housing market?

Source: author`s elaboration

They unanimously stated that the most frequently introduced innovations belonged to the category of technical and technological (product) innovations (36.52%), marketing innovations (32.17%), financial innovations (20%) and process and organizational innovations (11.3%). In 2020, the types of innovations used were as follows: technical and technological — 39%, marketing — 25%, and financial — 9%, with a surprising percentage of answers indicating process and organizational innovations — 27%. Invariably, the most important and also the most frequently applied innovations are those from the technical and technological category. This seems understandable given the fact that this group includes renewable energy sources or specific materials. It is this category of innovations that allows a real reduction in subsequent operating costs of the property, which is why customers pay attention to it. It can be concluded that in the situation of the implementation of EU regulations related to “Fit for 55”, the role of innovations from the technical and technological category will increase even further. Comparing the results received from respondents in the two surveys, it can still be seen that invariably the marketing innovation category is fairly often chosen by developers, which may be related to advances in showing the offered product using drones or virtual presentations to better showcase their property. The implementation of marketing innovations is relatively low-cost and produces tangible results. A clear difference can be seen in the implementation of financial innovations and process and organizational innovations presented in both surveys. In 2020, process and organizational innovations accounted for a large group with 27% of responses, while financial innovations accounted for 9%, which may have resulted from the fact that interest rates on loans were low at the time and thus access to conventional financing was good. In 2022, as already mentioned, respondents highlighted the difficult market situation, attributable to, among other things, weak demand associated with expensive loans. This situation could have been a reason to look for alternative ways of financing real estate, starting with offering long-term rentals and ultimately offering the option to buy the flat later.

In reference to the above, the importance of knowledge management in the process of implementing innovations should be emphasized. According to respondents' indications, technical and technological (product) innovations are the most frequently chosen and important innovations. However, introducing this type of innovation is a complex process that requires unique knowledge not only related to the innovation itself but also to its appropriate placement in the entire project. Errors in this area result in high costs. Therefore, developers need support not only in the process of acquiring and developing innovations but also in their proper management as part of green knowledge management.

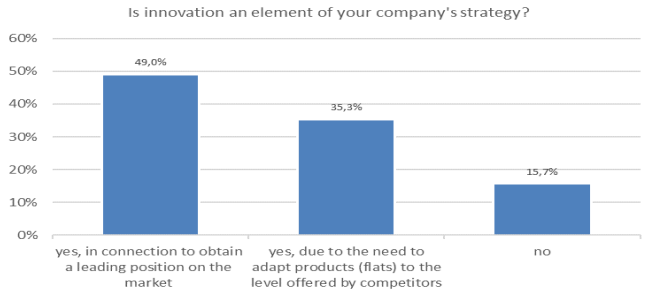


Figure 4: Is innovation an element of your company's strategy?

Source: author`s elaboration

The largest proportion of respondents (49%) stated that they incorporate innovation into their strategy in order to achieve market leadership, followed by (35.3%) indicating that they incorporate innovation in order to catch up with their competitors, while the smallest group (15.7%) does not incorporate any innovation into their strategies (figure 4).

Residential developers in Poland see the advantages of implementing innovations, and they see the risks of not implementing them, especially in the long term, and this is reflected in their strategies. Why, therefore, about half admitted that they do not implement innovations? It seems likely that the wider market has not exerted sufficient pressure on developers to use innovation to gain a more competitive advantage. Despite the rapid development of the real estate market, there is still a shortage of flats in Poland, which may be the reason for this situation. In addition, the process of implementing innovations is not easy and often unfamiliar to developers, which is why they do not reach for new solutions. This clearly indicates the need of knowledge transfer of appropriate innovation management and thus knowledge management. It can be concluded that developers want to introduce innovations, therefore obtaining appropriate competences in the field of knowledge management can facilitate and accelerate this process. In both surveys, the respondents clearly confirmed that the implementation of innovations causes difficulties in managing such projects (Figure 5).

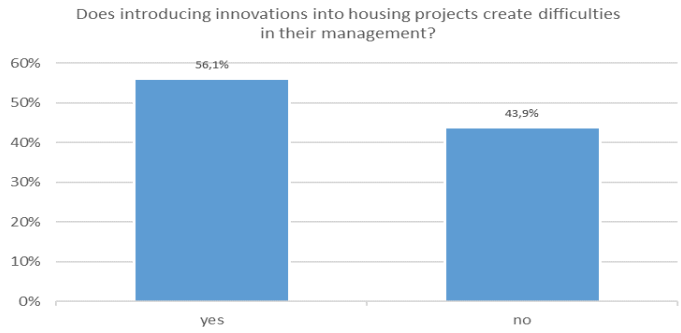


Figure 5: Does introducing innovations into housing projects create difficulties in their management?

Source: author`s elaboration

In conclusion, developers in Poland point to clear problems in managing innovative projects. Over the two years separating the two surveys, this state of affairs hardly changed. On the other hand, the EU-initiated legal changes described in the literature review will confront developers with the requirement of implementing innovation in their projects. This will not happen immediately, but over the next few years, which is not a long period in the real estate market. Therefore, developers should adapt as quickly as possible to future changes, not only in the area of innovation project management, but also in the area of innovation creation, knowledge and implementation. Here, a significant role can be played by support from the state and the EU, which is developing tools, for example, to finance such activities. Developers themselves have indicated that in order to develop innovative activities on the market in Poland, they need help from other external entities, especially public ones.

This leads to the conclusion that assistance, especially in the creation and development of innovations, should be directed to research centers and universities, which in cooperation with companies would create innovations addressed to business.

5. Conclusion

The conducted survey showed that:

- Findings about the number of residential developers with the appropriate capital strength to carry out projects for the construction of multifamily multi-storey residential properties in Poland have shown that there were fewer such enterprises in 2022 than in 2020 (by 44 entities), which may have been caused by difficult market conditions following the outbreak of war in Ukraine.
- Despite a decrease in the number of selected entities, in the general population an increase was observed in the number of developers declaring that they were introducing innovations. This shows the positive direction of the Polish residential market and the awareness of the importance of innovation among developers.
- A higher number of developers introducing innovation was observed in the group of companies operating in a broad market in geographical terms than those operating locally. This may reflect the greater importance of innovation in a situation where there is a need to compete on a broad market, or the market of the largest Polish cities.
- The persistently high percentage of developers not innovating in their business is primarily determined by a lack of demand/need for innovation. In 2022, respondents also pointed to difficult market conditions as a reason for not innovating. In the context of the described changes related to the "Fit for 55" package and the directives being enacted, it can be concluded that the primary determinant, i.e. the lack of need to innovate, has changed by 180 degrees.
- Invariably, the most important and also the most frequently applied innovations are those from the technical and technological category. This is understandable given that this group includes renewable energy sources, specific materials or construction techniques.
- Respondents indicate that a lack of innovation increases the risk of bankruptcy, which is why they include elements of innovation in their strategies. Gaining a competitive advantage and thus a leading position in the market was identified as the main factor for including innovation in strategies.
- Respondents declare that innovation creates problems in the management of development projects. Therefore, the development of knowledge and support, and the transfer of know-how of the management process in innovative projects seems to be important. In this case, the development of knowledge about green knowledge management seems crucial.
- Respondents clearly indicate the need for adequate support in the process of innovation implementation, from external, and especially public, entities. Although the EU is trying to create tools to support innovativeness, it is evident that a systemic change is needed at the level of the state, i.e. Poland.
- It should be emphasized that the most important action to be taken in this situation is identifying the needs of developers in the innovation implementation process in the context of providing them with adequate support and preparing them for the implementation of innovative projects that can meet current and future requirements of sustainable development.

In conclusion, it should be stated that the introduction of innovation into the real estate market is becoming a necessity in European Union countries due to regulations aimed not only at increasing the competitiveness of EU economies through increased innovation but, above all, at achieving sustainable development goals — including net-zero carbon emissions — introduced under the Green Deal, and "Fit for 55". These regulations introduce strict requirements concerning, among other things, the energy performance of buildings, which will result in the need for innovative projects not only in the primary market but also for projects aimed at modernizing the existing stock (secondary market), which, according to research, is often carried out by smaller companies that have not yet applied innovative solutions in their operations. In this context, it can be concluded that it is important to investigate the needs of the smallest enterprises in introducing innovations, and the role of green knowledge management in this process which sets the direction for future research.

References

Abbas, J., & Sağsan, M. (2019). Impact of knowledge management practices on green innovation and corporate sustainable development: A structural analysis. *Journal of Cleaner Production*, 229, 611–620. https://doi.org/10.1016/j.jclepro.2019.05.024

Faouri, Al. (2023) Green knowledge management and technology for organizational sustainability: The mediating role of knowledge-based leadership, *Cogent Business & Management,* T.10, 3rd edition, https://doi.org/10.1080/23311975.2023.2262694

Art. 173 (2016) "Functioning of the EU - Treaty on the Functioning of the European Union", [online], LexLege, lexlege.pl>traktat-o-funkcjonowaniu-unii-europejskiej>art-173,

Bac,M. (2014). W poszukiwaniu innowacji na rynku nieruchomości, Zeszyty Naukowe Małopolskiej Wtższej Szkoły Ekonomicznej w Tarnowie, t. 24, nr 1, s.13

Brown, D. (2018) "Business models for residential retrofit in the UK: a critical assessment of five key archetypes" *Energy Efficiency,* No 11, 1497-1517

Business Insider (2023) "AI wkracza do branży nieruchomości. Morizon i Gratka jako pierwsi w Polsce stawiają na sztuczną inteligencję", [online], businessinsider.com.pl/nieruchomosci/ai-wkracza-do-branzy-nieruchomosci-morizon-i-gratka-jako-pierwsi-w-polsce-stawiaja-na/8nkvrjk

Buter, R. K., & Van Raan, A. F. J. (2013). Identification and analysis of the highly cited knowledge base of sustainability science. *Sustainability Science*, 8, 253–267. https://doi.org/10.1007/s11625-012-0185-1

COM (2019). Komunikat Komisji do Parlamentu Europejskiego, Rady Europejskiej Rady, Komitetu Ekonomiczno-Społecznego i Komitetu Regionów, Europejski Zielony Ład, COM (2019) 640 final, Bruksela, dnia 11.12.2019 r.

COM (2020). Wniosek dotyczący Rozporządzenia Parlamentu Europejskiego I Rady ustanawiającego Fundusz na rzecz Sprawiedliwej Transformacji COM(2020) 22 finał, Bruksela, dnia 14.04.2020 r.

COM (2021), Komunikat Komisji do Parlamentu Europejskiego, Rady, Europejskiego Komitetu Ekonomiczno-Społecznego i Komitetu Regionów *„Gotowi na 55":Osiągnięcie unijnego celu klimatycznego na 2030 r. w drodze do neutralności klimatycznej,* 550 final, Bruksela, dnia 14.7.2021 r.

European Climate Pact (2021),. [online], europa.eu/climate-pact/index.pl.

European Commission (2016). *Clean Energy for all Europeans*, i.e., Unleashing Europe's Growth Potential, Press Release, 30 November 2016 Brussels, [online], ec.europa.eu/commission/presscorner/detail/pl/IP_16_4009

Europejskie Prawo Klimatyczne (2021*) jako „serce Zielonego Ładu*", Dz.Urz.UE L 243/1 z 9.07.2019r.

Europejski Trybunał Obrachunkowy, (2017). *Działania UE w dziedzinie energii i zmiany klimatu*, s. 1-311, [online], op.europe.eu/webpub/eca/Ir-energy-and-climate/pl

Fit for 55 (2023), *The UE plan for a green transition*, [online], whw.consilium.europa.eu/pl/policies/green-deal/fit-for-55-the-eu-plan-for-a-green-transition 02.08.2023

Fit for 55 (2023 a) *Council agrees on stricter rules*. [online], .consilium.europa.eu/pl/press/press-releases/2022/10/25/fit-for-55-council-agrees-on-stricter-rules-for-energy-performance-of-buildings/)

Fundacja Innowacji i Nowoczesnych Technologii (2021), *MIK-21, Międzynarodowa Innowacyjność i Konkurencyjność w XXI w*. Aspekty innowacyjne, (red Łukasz Wójtowicz), Wydawnictwo. Instytut Naukowo-Wydawniczy „Spatium", Lublin, Radom

Gołąbeska. E, (2023),. Wpływ pandemii COVID-19 oraz wojny w Ukrainie na polski rynek nieruchomości mieszkaniowych. *Nieruchomości*, Nr 5.

Gospodarka, (2023). AI w nieruchomościach? Rosną oczekiwania wobec tej technologii Bankier.pl, *Rynki, Gospodarka.*

Green Deal, (2022), [online], .consilium.europa.eu/pl/policies/green-deal/

GUNB, (2024), *Jest już nowy system Centralnej Ewidencji Emisyjnosci Budynków (CEEB).* [online], gunb.gov pl /aktualność/już-jest-nowy-system

Hallinger, P., & Suriyankietkaew, S. (2018). Science mapping of the knowledge base on sustainable leadership, 1990–2018. *Sustainability*, 10(12), 4846. https://doi.org/10.3390/su10124846

Hottenrott, H., Rexhäuser, S., & Veugelers, R. (2016). Organisational change and the productivity effects of green technology adoption. *Resource and Energy Economics*, 43, 172–194. https://doi.org/10.1016/j.reseneeco.2016.01.004

Hult, G.T. M., Hurley R.F., Knight G.A. (2004): Innovativeness: Its antecedents and impact on business performance, *Industrial Marketing Management*, vol. 33, no. 5

Innovation Policy (2023) (Polityka innowacyjności), [online],. Europarl.europa.eu/factsheet/pl/sheet/67/polityka-innowacyjnoscu/

Inteligentne technologie w budynkach (2023). „Jak nowoczesne rozwiązania zrewolucjonizują rynek nieruchomości". [online], nycompanypolska.pl/artykul/inteligentne-technologie-w-budynkach-jak-nowoczesne-rozwiazania-rewolucjonizują-rynek-nieruchomosci/13721

Jin, Z., Hewitt-Dundas, N, Thompson, N.J. (2004*).:* Innovativeness and performance: evidence from manufacturing sectors, *Journal of Strategic Marketing,* No. 12

Just Transition Fund JTF, (2021).. European Commission. [online], ec.europa.eu/rwgionl_policyfunding/just-transition-fund-en?etrans=pl

Kaczorek, D, Piasecki, M, (2023), Ocena jakości środowiska wewnętrznego oraz komfortu użytkowania w modułowym budynku przedszkola wybudowanego w standardzie pasywnym, *Przegląd Budowlany*, 11–12/2023

Kamiński, M. (2022) Usługi innowacyjne na rynku nieruchomości, *Administrator i Menedżer Nieruchomości* 2022, nr 10.

Karliński, K. (2022). *Wpływ wojny w Ukrainie na rynek nieruchomości w Polsce,* [online], kubakarlinski.pl/wpływ-wojny-w-ukrainie-na-r…

Killip, G., Owen, A.,(2020).The construction industry as agents of energy demand configuration in the existing housing stock, *Energy Policy*, No *47*, 111816.

Kolany,K (2022). *You will also pay for Putin`s wars. Consequences of the Russian invasion for the Polish economy.* [online],:.bankier.pl/wiadomości/Konsekwencje-wojny-w-ukrainie-dla-polskiej-gospodarki-8295182.html 02.03.2023

Komisja Europejska (2010), *Europa 2020. Strategia na rzecz inteligentnego i zrównoważonego rozwoju sprzyjającego włączeniu społecznemu.* Bruksela 03.03.2010. COM (2010) 2020 wersja ostateczna,, [online], eurlex.europalex.europa.eu/lexuriserv/lexuriserv.do?uri=com:2010:2020:fin:pl:pdfHTTP://eur-lex-europa europa.eu/lEXuRIsERV/lEXuRIsERV.DO?URI=com:2010:2020:FIN,PL

Lisbon Strategy, (2000). [online], ślaskie.pl>STRATEGIA>strat-L

OECD/Unia Europejska, (2018), Podręcznik Oslo, Wydanie 4, Główny Urząd Statystyczny, Polska, s. 22-23

Polski Instytut Ekonomiczny, (2023).. *Wpływ wojny w Ukrainie na działalność polskich firm*, Wydawnictwo PIE, luty 2023

Pryston, J.(2012) *Innowacje w procesie rozwoju gospodarczego. Istota i uwarunkowania. Podrecznik akademicki, Warszawa, Difin,2012, s. 46*

Przewodnik Wynalazcy, (2017), (red. A.Pyrza), Wyd. Urząd Patentowy Rzeczpospolitej Polskiej, Warszawa, s.239.

Rohn, H. et al, (2014). *Resource efficiency potential of selected technologies, products and strategies, Science of The Total Environment, 473-474*, 32-35, [online], doi.org/10.1016/j.scitotenv.2013.11.024, 05.03.2015

Rozporządzenie Parlamentu Europejskiego (2021) i Rady (UE) 2021/1056 z dnia 24 czerwca 2022 r. ustanawiające *Fundusz na rzecz Sprawiedliwej Transformacji*. Dz.Urz. UE L 231/1 z 30.06.2021 r.

Rynek wewnętrzny: zasady ogólne (2023) *(The internal market: general principles*). [online], europarl.europa. /factsheets/pl/sheet/33/rynek-wewnetrzny-zasady-ogolne

Santoro, G., Thrassou, A., Bresciani, S., & Del Giudice, M. (2019). Do knowledge management and dynamic capabilities affect ambidextrous entrepreneurial intensity and firms' performance? *IEEE Transactions on Engineering Management*, 68(2), 378–386.

Wang, S., Abbas, J., Safdar Sial, M., Alvares-Otero, S., Cioca (2022) Achieving green innovation and sustainable development goals through green knowledge management: Moderating role of organizational green culture, *Journal of Innovation & Knowledge, Vol.7, Num.4,*

Sitek M . (2022) Zarządzanie innowacjami na rynku nieruchomości mieszkalnych, *Polish Journal of Management Studies 2022/26/1* and *International Business Information Management Association (IBIMA)* 2020; 10835-10845 eu

Sitek M., (2023a) Działalność innowacyjna deweloperów mieszkaniowych w Polsce Iw kontekście barier i stymulantów ich implementacji, *Zeszyty Naukowe Wyższej Szkoły Humanitas,* Zarządzanie, t.24, nr 4, 175-191

Sitek M., (2023b). Rola innowacji w strategii deweloperów mieszkaniowych w Polsce ,*Zeszyty Naukowe Politechniki Śląskiej, Seria Organizacja i Zarządzanie*, nr 185, 433-453

Tajpour, M., Hosseini, E., Mohammadi, M., & Bahman-Zangi, B. (2022). The effect of knowledge management on the sustainability of technology-driven businesses in emerging markets: The mediating role of social media. *Sustainability*, 14(14), 8602. https://doi.org/10.3390/su14148602

The Paris Agreement, (2015). [online], .consilium.europa.eu/pl/policies/climate-change/paris-agreement/

United Nations, (1987), *Report of the World Commission on Environment and Development WCEG), Our Common Future;* [online] ,un-documents.net/wced-ocf.htm (26.01.2013)

Vademecum Bezpieczeństwa (2018), (red. O. Wasiuta, R. Klepka, R. Kopeć) Wydawnictwo LIBRON, Kraków, s.757-758

Zhang, D.,(2020*)*.. Innovation dynamics -what are the housing market uncertainty's impacts, *International Review of Economics and Finance,* No 70, 413–422

Variation in Strategies for Deleting Unusable Content Across the Major Wikimedia Projects

Sebastian Skolik[1] and Piotr Konieczny[2]
[1]Management Faculty, Czestochowa University of Technology, Częstochowa, Poland
[2]Department of New Media and Social Informatics, Hanyang University, Seoul, South Korea

sebastian.skolik@wz.pcz.pl
piotr@hanyang.ac.kr

Abstract: One of the negative effects of the rapid development of the information society is the problem of the reliability of content created by millions of users on the Internet. Socially created Wikimedia projects, the largest of which is Wikipedia, quickly developed procedures for identifying and eliminating problematic content. The article presents an analysis of the procedures for removing articles and the discourse on deleting content conducted among active users of the ten largest language versions of Wikipedia. Previous research focused primarily on the lack of neutrality in making decisions about content to be deleted and the resulting social inequalities, and was usually limited to the English-language Wikipedia. Based on previous participant observation, we noticed that individual language versions have different solutions in the context of ensuring project quality, which results in the emergence of different types of problems. We therefore looked into how much the approaches to deleting articles differ in different language versions. At the same time, we attempt to identify the common characteristics of the users who most often initiate discussions about deleting articles. To do this, we analyzed Wikipedia pages used to debate articles submitted for deletion (AfD) in 10 of the largest language versions of this project. The guidelines for submitting articles, the content of automatically generated messages helpful in conducting discussions, and the specific design of the websites where the debates took place were taken into account. Moreover, for three language versions (French, Swedish, and Polish), a statistical analysis of the activity of users of these websites was performed. It was noticed that the procedures for running AfD websites were similar in the analyzed language versions, but they differed significantly in terms of design and automatically generated messages addressed to debate participants.

Keywords: Quality of the Content, Wikimedia Projects, Online Communities, Socially Constructed Strategies, Knowledge Selection

1. Introduction

The emergence of technologies facilitating knowledge sharing among internet users has contributed to the rise of egalitarianism. At the same time, this has led to increased uncertainty regarding the quality of information found in cyberspace. Consequently, various methods have been developed to cope with acquiring useful knowledge. It can be observed that a significant portion of publications regarding behavioral strategies in the virtual space focused on information search strategies (West & Leskovec, 2012; Rodi, Loreto, & Tria, 2017). In the case of Wikimedia, the largest online community of volunteers dedicated to knowledge sharing, research on behavioral patterns often focused on technical and substantive issues related to editing Wikipedia articles (Iba et al., 2010; Hachey et al., 2013). Some studies examined differences in Wikipedia co-authors' approaches to the quality of content created within this service. Among them were cross-sectional papers that addressed the quality of Wikipedia and related projects, to a lesser extent touching upon the complex individual behaviors of users (Mayfield & Black, 2019; Lewoniewski, Węcel, & Abramowicz, 2023), as well as addressing the issues of egalitarianism and the difficulties novices face in mastering the intricate rules of the project (McDowell & Vetter, 2022, pp. 55–65).

In these studies, the focus was primarily on ways of reacting to information being continuously added to the project. Hence, there was a strong emphasis on the difficulties faced by new users. As the project develops, both standards and requirements are becoming increasingly higher. This means that new content posted on Wikipedia is generally much better than what was created in the early stages of the service. Although the rules in all language versions are similar, individual solutions and interpretations of rules for specific cases may vary. Previous studies have also pointed to certain relationships between patterns of behavior and membership in different national cultures (see: Konieczny 2020, 2023).

However, the issue of the community's evolving efforts to remove knowledge resources that were becoming increasingly unacceptable has not been subject to significant scholarly attention until now. Due to this fact, we have set ourselves the exploratory goal of researching and determining this variability. Following the principles of grounded theory (Konecki, 2018), we do not initially assume hypotheses that could be statistically tested. Instead, we pose research questions regarding the diversity of approaches to dealing with the removal of content that does not meet the standards set by Wikipedia communities.

In the next chapter, we review subject-related literature, primarily in the areas of behavioral strategies in virtual environments and concerning practices of detecting and removing articles on Wikipedia. In the methodological section, we present our approach to qualitative research and the method of collecting empirical material.

2. Literature Review

In the theory of mind and the evolution of language developed by Robin Dunbar, it is assumed that the primary function of language was to strengthen group bonds rather than to transmit precise information. Furthermore, the development of human cognitive abilities was not so much related to solving problems associated with functioning in the natural world, but rather to resolving dilemmas in the social environment. This concept is known as the social brain hypothesis and is also referred to as the Machiavellian intelligence hypothesis (Gamble, Gowlett, & Dunbar, 2014). Building social relationships thus involved employing various strategies that led to the formation of specific cultural patterns. These established patterns can be described as evolutionarily stable strategies in evolutionary theory (Dawkins, 2016). Since this is an ancient evolutionary mechanism, it is visible in various cultural environments, including cyberspace, where individuals and communities make decisions about building shared knowledge resources.

Strategies of action adopted by Wikipedians have been described in relation to both conscious choices and unconscious patterns. Wikipedia is often depicted as a place where strategic decision-making processes are co-created by a global community. It is emphasized, however, that certain factors may limit engagement in creating open strategies and thus may lead to frustration among some users (Dobusch & Mueller-Seitz, 2012; Nketia, 2016).

In large social projects, including the volunteer-created Wikipedia, there is considerable diversity among actors, including collective actors. Collective actors can include groups involved in thematic WikiProjects, welcoming committees, administrator groups or arbitration committees. Additionally, some actors do not contribute to shaping shared knowledge resources. As the Wikimedia projects have many language versions, users' actions in each of them may differ due to cultural differences. This diversity has been observed in previous studies (Konieczny 2020, 2023). In cultures with high power distance, a hierarchical structure grows, leading to a longer path to "promotion" from a novice to a user with, for example, administrator privileges (Skolik & Karczewska, 2021). Conversely, cultures with stronger individualism tend to have a smaller number of rules relative to the number of users and a higher number of edits per article (Kukowska & Skolik, 2021). It can be assumed that in "shame cultures," which have a lower Individualism Index, Wikipedians may be less inclined to make corrections to others' articles or may try to create their own articles in a way that avoids the need for corrections.

Individual behaviors may stem from the cultural background of the individuals, but this diversity is mitigated by the strong organizational culture of Wikipedia. For Wikipedians' actions to be acceptable, they must not violate a set of norms — rules, guidelines, and procedures — the number of which rapidly increased in the early years of Wikipedia's development (Kittur et al., 2007; Butler, Joyce, & Pike, 2008). Some users (often called vandals or trolls) intentionally break the established rules, attempt to destroy content, or incite "edit wars." This, in turn, leads to an ongoing "arms race." Special filters are created to quickly detect destructive behaviors, leading to modifications in behaviors among such disruptive users. The greater the awareness of such threats, the more the community may mobilize to cooperate in eliminating them. Although vandalism-detecting scripts are constantly modified, continuous human monitoring is needed to interpret unique behaviors (see: Jankowski-Lorek et al., 2016). This, in turn, requires a stronger internalization of rules. Over time, the number of rules becomes so large that newcomers have significant difficulties in mastering them, even if they are academics (Konieczny, 2021). Standardization also leads to greater technical complexity. Therefore, initiatives aimed at facilitating entry for new users periodically emerge.

An important modifier of behaviors can be the attitude of Wikipedians towards the content contained in the encyclopedia they co-create. In this context, two opposing attitudes are described: inclusionism and deletionism. The supporters of inclusionism lean towards including articles on niche topics, and even all content for which the appropriate sources of information can be found. On the other hand, the proponents of deletionism argue that the priority should be maintaining and raising high standards and removing content that, due to its insignificance, should not be included in Wikipedia (Mayfield & Black, 2019; Worku, Bipat, McDonald, & Zachry, 2020).

The main arena where the supporters of inclusionism and deletionism compete is the discussion pages for articles up for deletion (referred to by the acronym AfD). Administrators, users with privileges allowing, among other things, the deletion of a page, consider the opinions of those in favor of keeping the entry and those in

favor of its deletion. It is worth noting that only 20% of article authors participate in such discussions (Mayfield & Black, 2019). AfD pages contain both nominations for articles identified for deletion shortly after their creation and those whose flaws were not previously noticed. This also contributes to less involvement from their authors, who may have stopped contributing to Wikipedia earlier (sometimes, years earlier).

The decision-making process by administrators in AfD discussions may depend on the number of participants in the debate. In the English-language version, it has been observed that administrators' decisions are influenced by the number of votes for deletion or retention of the entry, despite nominally considering only the quality of arguments (Taraborelli & Ciampaglia, 2010). In the Polish-language version, however, a very large number of participants in the discussion may result in closing the debate as not leading to a consensus. In such a situation, the entry under discussion is not deleted (Skolik, 2013). The participants in the discussion may vary in their flexibility towards the arguments put forward, and their goals for participating in the discussion may differ. Some may strive, regardless of the arguments, for the deletion of the entry, while others may aim to retain it, and some may change their decisions depending on subsequent arguments or improvements made to the articles. Viewing AfD as a playing field involving many players, the stakes in the game could include, for example, the general aim to improve quality (by either deleting or improving the entry) or mobilizing a greater number of Wikipedians to address the problem on a broader scale (articles in a specific field where quality has not been previously addressed).

So far, the focus has been on narrow aspects of such discussions, primarily considering the effectiveness of actions or the inequality of opportunities in arguing between new and experienced Wikipedians. However, there has been a lack of research that would capture the diversity of behaviors leading to the complexity of decision-making processes on pages where deletion discussions take place.

3. Materials and Methods

To classify strategies related to making decisions about article deletion, we conducted qualitative research using a netnographic approach (Kozinets, 2015). Content analysis was employed, with a focus on pages outlining deletion rules as well as randomly selected discussions about article deletion. We did not formulate statistical hypotheses but instead formulated two research questions as follows:

1. What strategies do users adopt in the process of deleting articles that are identified as unacceptable?
2. What strategies do communities of individual language versions develop for articles targeted for deletion?

For the research, 10 of the largest language versions of Wikipedia were selected (the largest as in weighting both the number of created articles and the size of active user communities). These versions included English, Swedish, German, French, Dutch, Russian, Spanish, Italian, Polish, and Japanese. It was assumed that large communities have greater capabilities to identify low-quality content and can create their own tools and decision-making standards for its elimination. The research was conducted from January to April 2024. During this time, a comparison of deletion and archiving systems was conducted, enabling decisions on content selection for analysis. The analyzed AfD pages were created between 2005 and 2013.

The content analysis consisted of several stages (Fig 1.). Initially, attempts were made to identify the differences between language versions, which could result from the development of different action strategies by communities. To achieve this, we compared how different Wikipedias differ with regard to the following:

- Discussion flows in individual AfDs.
- Procedures for submitting articles for deletion (starting an AfD).
- Tools aiding in creating AfDs, such as template messages manually or automatically added by users.
- Methods of archiving submissions.

In the second stage, user comments posted in individual AfDs were analyzed. Twenty such discussions were randomly selected from each language version. If individual pages were archived and categorized, the PetScan tool was used to select these pages. In some language versions, individual AfDs were not categorized, but sets of discussions were archived with daily dates provided. In such cases, two discussions from each year in the last decade were randomly selected. This approach allowed for the selection of discussions where AfD procedures had already been institutionalized, and users might be more engaged in interpreting the rules. For translating comments (the authors only use Polish, English, and Russian), Google Translator was used for this purpose. In doubtful cases (users often make linguistic errors), consultation with individuals proficient in the respective

language proved most often necessary with regards to Japanese as the quality of machine translation between European and Asian languages lags behind that of European to European, which approaches near-perfect quality - at least for tasks such as understanding AfDs.

The coding of comments was conducted in several steps. Firstly, unique comments that did not repeat verbatim were selected in each language version. Subsequently, they were coded as follows: the type of comment was determined, and each comment was assigned categories - detailed and more general. This approach allowed for obtaining a general overview of users' action strategies in the studied language versions. Coding was done by one author and spot-checked by another to improve reliability.

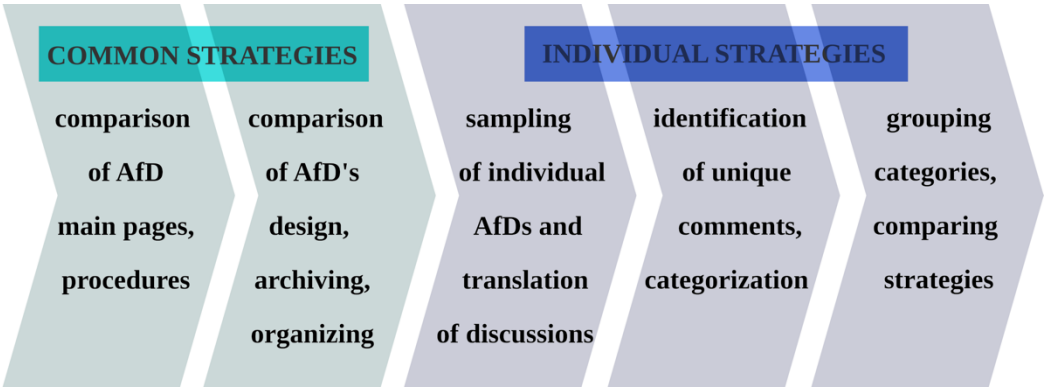


Figure 1: Stages of the analysis of common and individual strategies related to making decisions about article deletion in Wikipedia

4. Results

Among the wide variety of strategies implemented in AfD, we distinguished two primary types: strategies undertaken by individual users and strategies adopted by the language community of Wikipedia versions.

4.1 Common Strategies

The frameworks for the handling of AfDs are established by community procedures. They primarily include the timeframe for action, the manner of conducting the debate, and how it is concluded. In this regard, the studied language versions did not differ significantly. In each of them, emphasis was placed on participants presenting their arguments rather than just expressing support or opposition to the deletion of the entry. Some AfD regulations explicitly state that the deletion procedure is not a vote. In the English version, such non-substantive comments are often ignored or criticized, while in the Polish version, they are struck out. The timeframe for reaching a consensus on the deletion of an article is almost universally set at seven days. Shortening or lengthening was applied if situationally permissible. In the Russian and Japanese versions, some nominations are not closed even for many months.

Certain differences in procedures are visible regarding the opening and closing of AfDs. In the English, Spanish, and French versions, special help pages with tips on how to nominate articles for deletion have been created. In some versions, actions to be taken before nomination are required (e.g. searching for sources in English Wikipedia), while in others, recommended (e.g. in Polish, to inform the author and relevant WikiProjects). On the other hand, when closing the discussion, besides the duration of the discussion, required actions are common. Closers are generally asked to summarize the discussion and based on that, decide the fate of the nominated article.

The greatest differences among the examined language versions were observed in the design of AfDs and related user interfaces and tools. Specific solutions were found in each of the studied language versions in this regard. In the Italian version, the "temperature of discussion" is measured by placing a message about the length of the discussion next to the links to individual AfD discussions. The longer the discussion, the warmer the color of the indicator. In the Polish version, a tool aimed at "cooling down" the discussion is a message encouraging users to express their opinions in a civilized manner, which appears above the AfD page when it is being edited. The Spanish version of the AfD category page contains tables with information about ongoing discussions: the number of users, the number of days since the last edit, and the number of days until the discussion is closed. Additionally, it includes a dictionary of acronyms most commonly used within AfD. A similar glossary is present

in the Dutch version, but it distinguishes itself by explicitly recommending the use of acronyms when submitting articles for deletion.

In some language versions, special subpages are created for submissions of pages that are not articles, and in some cases, subpages are created for individual thematic areas. The greatest diversity in this regard is visible in the English version, where discussions are separately held on topics such as Media, Organizations, Biography, Society, Web, Games, Science, Arts, and Places. These topics are further divided into subtopics, totaling several dozen (e.g. for individual countries, or branches of science). In these discussions, templates with icons are sometimes used, which immediately indicate the commenter's position. The Japanese version has as many as 20 icons for preferred AfDs outcomes. In the Russian version, templates (messages) with declarations of improving the article are used, specifying the time needed for improvement.

Significant differences were also observed in the structure of pages. The German version contains separate sections for submitting articles, lists, categories, user pages, meta pages, and templates. The division of the subpage into sections is also visible in the Swedish version, but in this case, separate positions on what to do with the article are presented in different parts of the page: delete, keep, neutral, merge, redirect. In the French version, each AfD page discussion is preceded by several elaborate messages about the AfD procedure and the possibility of participating in it. In other versions, such messages are either not used or placed so as not to overshadow the main part of the discussion.

The diversity of solutions in the design of AfD pages reflects different approaches to addressing issues related to understanding messages, persuading appropriate actions, or organizing arguments. Each of these aspects pertains to controlling the process of article removal. Some of the solutions developed are not compatible with other language versions. For example, synthesizing solutions from the French, Swedish, and German versions would lead to excessive expansion of AfD pages and could consequently result in cognitive overload.

4.2 Individual Strategies

Analyzing 200 AfD discussions from 10 language versions, some consisting of a few sentences and others spanning several pages, 767 unique comments were identified. Uniqueness meant that comments repeated within the same language version (comments copied by subsequent participants in discussions) were not considered. This allowed for determining the scale of qualitative diversity. Out of all the identified comments, 760 were categorized, and the categories were divided into three types: comments relating to Wikipedia's core principles, comments concerning the quality of the discussed articles, and comments related to the course of discussions at AfDs.

The most frequently posted comments (399 cases) fell into the first category (Table 1). These included comments where those advocating for deletion cited specific provisions in established policies, comments expressing doubts about the application of these provisions in individual cases, and opinions questioning specific principles of the policies themselves. Discussions at AfDs can thus be seen as an arena through which interpretations of Wikipedia's core principles are created and modified. Some rules have been developed after recurring discussions in AfDs within a particular thematic scope (this is particularly common with regards to clarifications of notability criteria; notability means importance and is an important consideration in deletion, i.e. it concerns the question of whether a topic is important enough to merit a Wikipedia article). These discussions often revolve around establishing entry thresholds for articles in a specific area of knowledge, as evidenced by the results of this study. A total of 240 comments (over 30%) were related to the recognition or non-recognition of notability. On the other hand, the submission of multiple articles within a certain scope is a strategy employed by individual users to initiate debate among the community and establish specific notability criteria. A significant part of comments also addressed reliability and verifiability issues, most commonly the lack of sources or the presence of low-quality sources.

Table 1: Comments relating to Wikipedia's main principles

General categories	Specific categories
Notability / What Wikipedia is not (240)	lack of demonstrated notability: topic is local, niche, unknown, the entry is too detailed, or a directory/catalog entry arguments for notability: popularity, media coverage, reach, influence, uniqueness, award-winning; arguments about the lack of references to the article (also in other language versions); and failure to meet specific notability criteria.
Verifiability / No original research (93)	Issues related to lack of citations (sources of information), including the problem of no sourcing for an extended period; searching for and obtaining sources of information; verifying content in sources; determining the credibility of sources, including rejecting and accepting primary sources. Criticism of speculation or original research (forbidden on Wikipedia).
Neutral point of view (36)	Issues related to self-promotion, censorship, advertising, subjective views
Copyrights (18)	Detecting and removing copyright violations
”Ignore all rules” (12)	Arguments about the usefulness or harmlessness of weak articles; denial of specific rules; the need to describe all topics within a certain scope regardless of their individual significance.

It was somewhat surprising to see AfDs being used for discussions on the removal of copyright-infringing content. Out of 18 such comments, 15 originated from the Japanese version, which, incidentally, less frequently employs AfDs for other purposes. In other language versions, procedures related to the removal of copyright-infringing content are usually conducted on separate pages. Transferring discussions on this matter to AfDs may be a good strategy if other pages are not as popular among Wikipedia users in a given project.

Among the comments of the second type, there were more opinions from inclusionists, pointing out the possibilities of improving the content or arguing about the existence of similar articles that have been accepted. Deletionists, on the other hand, pointed out issues such as articles not being improved for a long time, the inappropriate form and style, including faulty translations from other language versions, the presence of false information, and the problem of posting many low-quality articles. Conciliatory-minded Wikipedians, in turn, suggested taking actions that facilitated preserving someone's work, including improvement, integration with other articles, or temporarily moving content to the authors' drafts (Table 2). Understanding the arguments of the participating sides in the debate often led to finding solutions that could be acceptable to adversaries.

Comments of the third type most commonly focused on the behaviors of other users. This included both detecting inappropriate behaviors and expressing positive emotions towards the actions of others. Their appearance in the discussion often led to the development of side threads about the AfD procedure itself and contributed to involving a greater number of users in the discussion. Emotionality can therefore promote greater engagement and the development of more favorable decisions; however, it often leads to a situation where consensus is not reached due to the length of the discussion (see: Skolik, 2013). This type also included ethical evaluations of actions related to the subject of the article, such as writing biographies for payment and assessing the protagonists of the biographies (Table 3).

Table 2: Comments relating to the quality of existing articles

General categories	Specific categories
Comparisons (53)	Pointing out analogies to other articles or other language versions, mainly in the context of the need for the existence or removal of an article.
Correcting or not correcting articles (47)	Pointing out the lack of necessary changes in content for a long time and suggesting the need for more time for improvement; Declaring improvement, making corrections during AfD, and creating articles from scratch; Indicating one's own involvement in improvement; Suggestions for improving the article, including suggestions to move them to user sandboxes.
The form of the article (42)	Pointing out inappropriate form, style, failure to meet standards for old articles, insufficient length of articles; issues arising from incorrect translation of articles and discrepancies between titles and content.
Integration/redirection (33)	Pointing out the need to include the issue in a more general article; integrating content; converting articles into redirects to other articles; moving content to another wiki; and changing articles into disambiguation pages.
Currentness (23)	The problem of lack of updates; pointing out that Wikipedia is not intended for describing current and future (uncertain) events.
Detecting of false content (16)	Describing content as nonsense, garbage, hoaxes, pseudoscience; Detecting falsification of information.

General categories	Specific categories
Series of problematic articles (10)	Detecting authors of many weak articles; arguments about the need for mass deletion of articles within a certain scope.

Table 3: Comments relating to the course of the AfD

General categories	Specific categories
Etiquette/expressing emotions (56)	Assessing the behavior and competence of commentators, including accusations of vandalism and trolling; critically evaluating the course of AfD; expressing thanks (including for content improvement), apologies; joking; expressing discouragement from further action.
AfD internal issues (28)	Canceling AfD; duration of AfD; meta evaluation of AfD; monitoring changes in AfD; opting out of AfD; closing AfD; the issue of "clogging AfD" by too frequent submissions.
Decision making (27)	Questioning and circumventing AfD decisions; reminding that AfD is not a vote; informing about previous discussions on the same topic; suggesting discussions outside of AfD; the issue of repeated deletion and speedy deletion.
Approval/disapproval (11)	Expressing approval of actions, including integration, deletion, or retention of the article; discrediting other participants.
Conflict of interest (8)	Pointing out the independence of the content of the article from the subject it covers; the issue of paid editing; recognizing the primacy of principles over personal judgments.
Subject of the article (7)	Assessing the subject of the article; the issue of posting private data about the subject.

5. Discussion and Conclusions

The research revealed a significant diversity in the behaviors of participants in article deletion discussions. It captured the specificity of technical and organizational solutions, which would not have been possible by analyzing only predefined cultural dimensions (Konieczny 2020, 2023). At the same time, the similarity of procedures in the analyzed versions of Wikipedia may indicate a strong organizational culture. Individual users' comments mostly referred to Wikipedia's main principles. Additionally, arguments, argumentative styles, and counterarguments were similar in each language version, with notable differences observed in the Japanese version, where users more often focused on removing copyright-violating content.

As noted in previous studies referring to behavioral strategy arguments, individuals with broad activity profiles tend to pay less attention to conflict situations. Stronger reactions are observed in individuals who have invested more in developing specific projects (Ocasio, 1997; Klapper & Reitzig, 2018). Similarly, individuals more involved in AfDs or the development of articles submitted to AfD for not meeting standards exhibit stronger reactions. However, comments tend to prioritize rules over personal attachment to the article's subject, which suggests that attachment to jointly developed rules is high.

Future research could delve into the stages of differentiation between language versions more closely. Survey research would help determine the intentions of the most engaged users in AfD from other major language versions.

Although a more precise comparison of individual strategies would require describing the actions' history of the most active users engaging in AfD, based on years of participatory observation, we conclude it is likely that individual actions become routinized over time. We also conclude that AfDs contribute to the development of institutionalized policies and guidelines (in particular, ones related to notability).

Most rules and procedures were copied from the English version, but the pace of their implementation varied. Language versions also differ in enforcing rules developed locally. While it is technically possible to identify when a rule was written, it is harder to determine when it began to be treated as a standard. Recognizing strategies and the complexity of actions on AfD could lead to better handling of conflict situations and optimization of actions by Wikipedia editors, who, as a community, spontaneously manage processes related to removing low-quality content from the encyclopedia.

At the individual level, a variety of behavioral strategies can be observed on AfD (Articles for Deletion) pages. However, at the community level, specific rules and norms tend to crystallize. In the initial years, these rules are frequently modified, but over time, due to organizational inertia, they become increasingly institutionalized, making any changes more challenging to implement. One could argue that certain strategies, once they gain popularity, become stable and are difficult to displace with new patterns, even when solutions from more developed language versions are proposed.

According to Dunbar's social brain hypothesis, the dialectalization and emergence of new languages were linked to the need to distinguish between "us" and "them" in growing human communities (Dunbar, 2011). In the context of Wikipedia, communities that initially create rules collectively (globally) tend to separate over time, thereby strengthening their own identities. This phenomenon leads to a resistance to innovation, a trend observed in many organizations. Consequently, Wikipedia, which began as a grassroots alternative to traditional encyclopedias, is becoming increasingly similar to traditional organizational models.

References

Butler, B., Joyce, E., and Pike, J. (2008) *Don't look now, but we've created a bureaucracy: The nature and roles of policies and rules in Wikipedia*, In: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, pp. 1101–1110.

Dawkins, R. (2016) *The Extended Phenotype: The Long Reach of the Gene*, OUP Oxford, Oxford.

Dobusch, L., and Mueller-Seitz, G. (2012) "Strategy as a Practice of Thousands: The Case of Wikimedia", *Academy of Management Proceedings*, Vol. 2012, No.1, doi: 10.5465/AMBPP.2012.43

Dunbar, R.I.M. (2011), *Grooming, gossip and the evolution of language*, Faber & Faber, London.

Gamble, C., Gowlett, J., Dunbar, R.I.M. (2014), *Thinking big : how the evolution of social life shaped the human mind*, Thames & Hudson, London.

Hachey, B., Radford, W., Nothman, J., Honnibal, M., and Curran, J. R. (2013) "Evaluating Entity Linking with Wikipedia", *Artificial Intelligence*, Vol. 194, pp. 130–150.

Iba, T., Nemoto, K., Peters, B., and Gloor, P. A. (2010) "Analyzing the Creative Editing Behavior of Wikipedia Editors: Through Dynamic Social Network Analysis", *Procedia - Social and Behavioral Sciences*, Vol. 2, No. 4, pp. 6441–6456.

Jankowski-Lorek, M., Jaroszewicz, S., Ostrowski, Ł., & Wierzbicki, A. (2016) "Verifying social network models of Wikipedia knowledge community", *Information Sciences*, Vol. 339, pp. 158–174.

Kittur, A., Suh, B., Pendleton, B. A., and Chi, E. H. (2007) *He says, she says: Conflict and coordination in Wikipedia*, In: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, pp. 453–462.

Klapper, H., and Reitzig, M. (2018) "On the effects of authority on peer motivation: Learning from Wikipedia", *Strategic Management Journal*, Vol. 39, No. 8, pp. 2178–2203.

Konecki, K. T. (2018) Classic Grounded Theory—The Latest Version: Interpretation of Classic Grounded Theory as a Meta-Theory for Research. *Symbolic Interaction*, Vol. 41, No. 4, 547–564.

Konieczny, P. (2020) "Macro-level differences in participation in sharing economy: factors affecting contributions to the collective intelligence Wikipedia platform across different Asian Countries." *Asian Journal of Social Science*, Vol. 48, No. 1-2, pp. 115-149.

Konieczny, P. (2021) From Adversaries to Allies? The Uneasy Relationship between Experts and the Wikipedia Community. She Ji: *The Journal of Design, Economics, and Innovation*, Vol. 7, No. 2, pp. 151–170.

Konieczny, P. (2023) "European Wikipedia platforms, sharing economy and national differences in participation: a case study", Innovation: *The European Journal of Social Science Research*, pp. 1-30, doi: 10.1080/13511610.2023.2195584

Kozinets, R. V. (2015) *Netnography: Redefined*, SAGE Publications Ltd., London.

Kukowska, K., and Skolik, S. (2021) *Wikipedia as a Space for Collective and Individualistic Knowledge Sharing*. In: Proceedings of the 22nd European Conference on Knowledge Management ECKM 2022, Academic Conferences International Limited, Reading, pp. 459–466.

Lewoniewski, W., Węcel, K., & Abramowicz, W. (2023) "Understanding the Use of Scientific References in Multilingual Wikipedia across Various Topics", *Procedia Computer Science*, Vol. 225, pp. 3977–3986.

Mayfield, E., and Black, A. W. (2019). *Analyzing Wikipedia Deletion Debates with a Group Decision-Making Forecast Model*, In: Proceedings of the ACM on Human-Computer Interaction, 3(CSCW), Association for Computing Machinery, New York, pp. 1-26.

McDowell, Z. J., & Vetter, M. A. (2022) *Wikipedia and the Representation of Reality*. Taylor & Francis, New York.

Nketia, B. A. (2016) "The Influence of Open Strategizing on Organizational Members' Commitment to Strategy", *Procedia - Social and Behavioral Sciences*, Vol. 235, pp. 473–483.

Ocasio, W. (1997) "Towards an Attention-Based View of the Firm", *Strategic Management Journal*, Vol. 18, pp. 187–206.

Rodi, G. C., Loreto, V., and Tria, F. (2017) "Search strategies of Wikipedia readers", *PLOS ONE*, Vol. 12, No. 2, e0170746. doi: 10.1371/journal.pone.0170746

Skolik, S. (2013) Informacja i spam. *Ustanawianie progów encyklopedyczności dla podmiotów opisywanych w polskojęzycznej Wikipedii*. In: Nowe media i wyzwania współczesności. Adam Marszałek, Toruń, pp. 134–148.

Skolik, S., and Karczewska, A. (2021) *Power Distance and Hierarchization in Organizing Virtual Knowledge Sharing in Wikipedia*. In: Proceedings of the 22nd European Conference on Knowledge Management ECKM 2022, Academic Conferences International Limited, Reading, pp. 705–715.

Straffin, P. D. (2010) *Game theory and strategy*, The Mathematical Association of America, Washington.

Taraborelli, D., and Ciampaglia, G. L. (2010) *Beyond Notability. Collective Deliberation on Content Inclusion in Wikipedia*, In: 2010 Fourth IEEE International Conference on Self-Adaptive and Self-Organizing Systems Workshop, pp. 122–125.

West, R., and Leskovec, J. (2012) *Human wayfinding in information networks*, In: Proceedings of the 21st International Conference on World Wide Web, Association for Computing Machinery, New York, pp. 619–628.

Worku, Z., Bipat, T., McDonald, D. W., & Zachry, M. (2020) *Exploring Systematic Bias through Article Deletions on Wikipedia from a Behavioral Perspective*, In: Proceedings of the 16th International Symposium on Open Collaboration, Association for Computing Machinery, New York, pp. 1–22.

Intellectual Capital of Natural Sciences and the Efficiency of its Formation at Scientific Institutions

Inese Spica, Rozite Katrina Ponne, Ernests Spics, Peteris Ponnis and Baiba Berzina
Scientific Institution Business Competence Centre, Riga, Latvia

inese.spica@gmail.com
rozite.spica@gmail.com
ernests.spics@gmail.com
peteris.ponnis@gmail.com
baiba.berzina@tvnet.lv

Abstract: The formation of intellectual capital (IC) of natural sciences at scientific institutions (SIs) in Latvia is highly topical. The object of the research is the formation of IC of natural sciences at SIs while the subject of the research is the comparative analysis of the efficiency of the involvement of academic staff and PhD students in the formation of IC of natural sciences at SIs of Latvia. The objective of the research is to study the involvement of academic staff and PhD students in the formation of IC of natural sciences at SIs in Latvia in the period from 2013 to 2018. The following tasks were determined to reach the objective: to study the formation of IC of natural sciences at SIs; to identify the concept of the efficiency of the involvement of academic staff and PhD students in the formation of IC of natural sciences; to calculate main indicators thereof, and, to carry out the comparative analysis of indicators characterising the efficiency of the involvement of academic staff and PhD students in the formation of IC of natural sciences at SIs in Latvia. Research methods used in the paper are content analysis, economic analysis, and economic experiment.

Keywords: Intellectual Capital Indicators, Natural Sciences, Scientific Institutions, Efficiency, Academic Staff

1. Introduction

The aim of the research is to study IC of natural science and the efficiency of its formation at SIs in Latvia. Every six years, the Ministry of Education and Science of the Republic of Latvia (MoES) organises an international evaluation of SIs registered in Latvia. The last International Evaluation of Scientific Institutions' Activity (IESIA) refers to the period from 2013 to 2018. In order to establish the dynamics of efficiency indicators of academic staff involved in the formation of IC in natural science at SIs of Latvia (MoES, 2021), the authors used the output secondary data of findings across the set of evaluation of SIs of natural sciences per period from 2013 to 2018 offered by "Technopolis-group" (TG). Consequently, it provides an opportunity for the authors to calculate the efficiency indicators of IC in na-tural sciences at SIs of Latvia and to compare their results.

Data of the comparative analysis will help to develop support programs to increase the efficiency of involvement of the academic staff in the IC formation. In addition, the comparative analysis will reveal whether the score of natural

sciences at SIs of Latvia in the IESIA of TG coincides with the place of SIs of Latvia in the ratings of IC indicators, and whether the overall score of SIs of Latvia also reflects the efficiency of the involvement of the academic staff of SIs of Latvia in the IC formation.

Hypothesis: The overall score of SIs shows the efficiency of the IC formation at SIs of Latvia.

2. Theoretical Background

The Research of the role of human capital in educational-training process at the university (Contu, 2017) presented different aspects of IC. Spica et al (2017a) state that IC is an economic category, the spiritual value created by the human potential, and it can be accumulated and converted into the value of other capitals. By investigating certain information about the management of education and science, we can increase the capacity and significance of the country's total economic capital movement. Rondeau et al (2022) remind that peer reviewed publications remain a traditional form of academic productivity. Spica et al (2017a; 2017b) have worked out four indicators of the efficiency of the formation of IC in the higher education establishment (HEE): (1)The efficiency of the involvement of academic staff in the formation of IC per year in percentages (AIK); (2)The efficiency of the involvement of academic staff with a Doctorate degree in the formation of IC per year in percentages (DIK); (3)The efficiency of the involvement of students in the formation of IC per year in percentages (SIK); (4)Mutual efficiency of the involvement members of the academic staff with Doctorate degrees and the academic staff without Doctorate degrees in the formation of IC per year in times, (DE).

3. Research Methodology

In order to calculate the AIK, DIK, SIK, and DE of the HEE Spica et al (2017a; 2017b) have worked out four formulas: (1) AIK = (ZPS : AS) x 100; (2) DIK = (ZPS : DS) x 100; (3) SIK = (ZPS : SS) x 100; (4) DE = DIK : AIK. Where: ZPS represents the number of scientific publications of the HEE per year; AS represents the number of academic staff in full-time jobs per year; DS represents the number of academic staff with Doctorate degrees holding in full-time jobs per year; SS represents the number of students per year.

The authors modified the above mentioned formulas for the purposes of the study. Namely, they calculate IC efficiency indicators for total numbers of full time equivalent (FTE) academic and research personnel (KIK), for FTE academic personnel (AIK), for FTE academic and research personnel (PIK) and for PhDs completed at SIs (SIK). In addition, all the said IC efficiency indicators were calculated for different forms of IC such as total number of self-reported outputs of IC (KS), articles in peer reviewed scientific edited journals and conference proceedings included in WoS or SCOPUS (WS), articles in peer reviewed edited journals, and conference proceedings not included in WoS or SCOPUS (RS), monographs (MS), and Latvian patent (LPS), and European patent and International patents (EPS). The authors calculated mutual efficiency indicators (PE) regarding involvement of the FTE academic and research personnel (PS) and the FTE academic personnel (AS) in the formation of IC in times.

In the present research, the authors used the following data from the IESIA: output data on the number of FTE academic personnel (AS), the number of FTE academic and research personnel (PS), the total number of FTE academic and research personel (KS), the number of PhDs completed (SS), the number of articles in peer reviewed scientific edited journals and conference proceedings included in WoS or SCOPUS (WS), the number of articles in peer reviewed scientific edited journals and conference proceedings not included in WoS or SCOPUS (RS), the number of monographs (MS), the number of Latvian patents (LPS), and the number of European and International patents (EPS), and total number of self-reported outputs (KS) in period from 2013 to 2018 per SI of natural science in Latvia. Authors revised the above WS, RS, MS, LPS, EPS and KS for the year.

To calculate the efficiency of the involvement of academic staff in the WS formation used formulas:

AIK = (WS : AS) x 100 (1)

PIK = (WS : PS) x 100 (2)

KIK = (WS : KS) x 100 (3)

SIK = (WS : SS) x 100 (4)

PE = PIK : AIK (5)

In order to calculate the efficiency of the involvement of academic staff in the RS formation used formulas:

AIK = (RS : AS) x 100 (6)

PIK = (RS : PS) x 100 (7)

KIK = (RS : KS) x 100 (8)

SIK = (RS : SS) x 100 (9)

PE = PIK : AIK (10)

The efficiency of the involvement of academic staff in the formation of MS calculated according to formulas:

AIK = (MS : AS) x 100 (11)

PIK = (MS : PS) x 100 (12)

KIK = (MS : KS) x 100 (13)

SIK = (MS : SS) x 100 (14)

PE = PIK : AIK (15)

To calculate the efficiency of the involvement of academic staff in the formation of LPS used formulas:

AIK = (LPS : AS) x 100 (16)

PIK = (LPS : PS) x 100 (17)

KIK = (LPS : KS) x 100 (18)

SIK = (LPS : SS) x 100 (19)

PE = PIK : AIK (20)

Besides, to calculate the efficiency of the involvement of academic staff in the formation of EPS used formulas:

AIK = (EPS : AS) x 100 (21)

PIK = (EPS : PS) x 100 (22)

KIK = (EPS : KS) x 100 (23)

SIK = (EPS : SS) x 100 (24)

PE = PIK : AIK (25)

In this study, one scientific publication or one patent are accepted as one unit of IC. Further, using the modified formulas 1 to 25, were calculated: KIK, AIK, PIK, SIK, PE. Then, according to the results obtained through the author's calculations, a corresponding rating place was assigned to each SI of Latvia per year and each of the above indicators KIK, AIK, PIK and SIK.

Each place in the rating was then assessed with an appropriate score, where the lowest score is 1 point, while the highest score is 5 points. Thus, the SI, which took first place in - KIK, AIK, PIK and SIK received 5 points in the ranking, took second place - received 4 points, took third place - received 3 points, took fourth place - received 2 points, and took fifth to seventh place - received 1 point.

The above mentioned assessment system allows to compare the quantitative efficiency indicators of SIs of natural science in Latvia calculated by the authors to IESIA overall assessment criterion - quality of the SI research performance. The relevant TG Panel was the score of research performance of each SI using a scale where score 5 means an outstanding level of research, score 4 means a very good level of research, score 3 means a good level of research, score 2 means an adequate level of research, and score 1 means a poor level of research (MoES, 2021).

The score assigned to the overall assessment by the relevant TG Panel was based on the assessment of five sub elements A to E, where element A characterises the quality of the research, element B - the impact on the development of the specific field of science, element C - the economic and social impact of the research, element D - the research environment and infrastructure of the institution, element E - the institution development potential. The Panel was provided with scores against each sub-element and the overall score and was also provided with narrative descriptions of their scores, the overall score and the sub-elements (MoES, 2021).

The follow-up authors compared the results of their own estimates of SIs quantitative scores to the qualitative scores of the relevant TG Panel, and calculated the differences between the scores. For this purpose, the authors calculated the average score for each SI recording the efficiency indicators of the involvement of academic staff in IC formation and compared these scores to scores of the research quality of each SI and overall score developed by the TG Panel.

4. Results and Discussion

The number of scientific publications and patents are the main results of the IC formation at SIs of natural sciences. TG analysed 7 SIs of natural sciences of Latvia. In the IESIA there were collected output data on 7 public SIs of Latvia including 6 Latvian university, and one Latvian State Institute were collected.

During the period analysed in the IESIA, there were only 7 such SIs in Latvia: Latvian Institute of Aquatic Ecology, Daugavpils University (DU/LIAE); Institute of Solid State Physics, University of Latvia (ISSP); Latvian State Institute of Wood Chemistry (LSIWC); Research programme “Biology”, Daugavpils University (DU/Bi); Cluster of Natural Sciences, University of Latvia (UL/N), Ventspils University of Applied Sciences Natural Sciences Research Platform (VeU/N), Research programme “Mathematics, Physics, Chemistry”, Daugavpils University (DU/MPC).

It follows from the IESIA that in Latvia, 4 SIs of natural sciences have corresponding fields of science in earth and rela-ted environmental sciences, 4 SIs corresponding fields of science in physical sciences, 3 SIs corresponding fields of science in biological science, 3 SIs corresponding fields of science in chemical sciences, 2 SIs corresponding fields of science in materials engineering, 2 SIs corresponding fields of science in mathematics, and, 2 SIs corresponding fields of science in computer and information sciences. In turn, such corresponding fields of sciences as nanotechnology; che-mical engineering are operated by 1 SI in each field of science.

According to the authors' estimates, from the IESIA data show that the total number of self-reported outputs of SIs of natural science in Latvia is taken in the largest proportion by the WS - 80,72%, which is followed by the RS - 15,97%, the MS - 0,88%, the LPS - 1,70%, the EPS - 0,73%.

4.1 The Efficiency of the Involvement of Academic Staff in the WS Formation at SIs of Natural Sciences

These indicators of SIs and their place in the rating of SIs of natural sciences in Latvia as well as its scores are summarized in Table 1. The table of the SIs indicators, ratings, and score was drawn up by authors. The summarized indicators show that in general, in Table 1, the figure rests in the range from 26% to 659% in respect of the SIs in Latvia. The highest indicator is SIK in the VeU/N, while the lowest indicators is PIK in the DU/LIAE. Comparing the figures collected in Table 1, the authors conclude that the AIK indicator rests in the range from 389% to 550%. The lowest KIK indicators of 27% is for theDU/LIAE, the highest KIK indicator of 128% are for the ISSP, and for the DU/Bi; the highest SIK indicator of 659% is owned by the VeU/N while the lowest SIK indicator of 179% is held by the UL/N. The PS of the SIs of natural sciences are only 0,2 times to 0,4 times efficient in the WS formation.

In Table 1, the authors created the rating and score of the SIs of natural sciences in Latvia based on the AIK, PIK, KIK, SIK indicators of the efficiency of the academic staff and PhDs involvement in the WS formation. According to the AIK indicator, the first place, and highest score is taken by the UL/N; according to the PIK indicator, the first place, and highest score is taken by the DU/Bi; according to the KIK indicators, the first place and highest score is taken also by the DU/Bi; and according to the SIK indicator the first place and highest score is taken by theVeU/N.

On the other hand, when comparing the average score of KIK without SIK, the highest score is obtained by the DU/Bi and the comparison of the average score of KIK with the SIK shows that the highest score goes also to the DU/Bi.

The authors compared the SIK indicators of all students of HEE in Latvia to SIK indicators of PhDs students of SIs of natural sciences in Latvia, and found that SIK indicators of the PhDs students were considerably higher. It follows from the study by Spica et all (2018) that the highest SIK indicators were held by Daugavpils University (1,45% in 2013) and the University of Latvia (1,82% in 2014). Meanwhile, between 2013 and 2018, the highest annual SIK indicator for PhDs students of SIs of natural sciences in Latvia was held by the VeU/N and represented 659%.

Table 1: The efficiency of the involvement of academic and research staff in the WS formation at SIs of natural sciences in Latvia per year in period from 2013 to 2018

SI	AIK (%)	AIK rating	AIK score	PIK (%)	PIK rating	PIK score	KIK (%)	KIK rating	KIK score	Average of AIK & PIK score	PE in times	SIK (%)	SIK rating	SIK score	Average of AIK & PIK & SIK score
DU/LIAE	0	0	0	26	7	1	27	7	1	0,5	0	239	6	1	0,7
ISSP	0	0	0	128	3	3	128	2	4	1,5	0	625	2	4	2,3
LSIWC	0	0	0	66	6	1	66	5	1	0,5	0	255	5	1	0,7

SI	AIK (%)	AIK rating	AIK score	PIK (%)	PIK rating	PIK score	KIK (%)	KIK rating	KIK score	Average of AIK & PIK score	PE in times	SIK (%)	SIK rating	SIK score	Average of AIK & PIK & SIK score
DU/Bi	494	2	4	173	1	5	128	1	5	4,5	0,4	578	4	2	3,7
UL/N	550	1	5	113	4	2	94	4	2	3,5	0,2	179	7	1	2,7
VeU/N	415	3	3	74	5	1	63	6	1	2,0	0,2	659	1	5	3,0
DU/MPC	389	4	2	159	2	4	113	3	3	3,0	0,4	606	3	3	3,0
Average	733			109			95				0,2	241			

When analying the results obtained by SIs in the IC formation in the field of natural sciences, the same methodology was used as in the fields of social sciences, and, humanities and art sciences. Thus, the quantitative results of SIs in these fields can be compared. One of the main criteria for the quantitative evaluation of SIs is the efficiency of the involvement of the SIs academic staff in the formation of WoS and SCOPUS publications.

The comparison of the results of the three fields of science leads to conclusion that the highest score of the KIK indicator in the field of social sciences is 278% (Spica et al, 2022) while the highest score of the KIK indicator in field of natura science is 128%, and, the highest score of the KIK indicator in field of humanities and art sciences is 53% (Spica et al, 2023). In addition, it should be noted that the highest score of the KIK indicator in the field of humanities and art sciences is two times higher than 27% received by the DU/LIAE, which is the lowest score in the field of natural science.

A similar trend is observed when comparing the efficiency of the involvement PhD degree holders in the formation of WoS and SCOPUS publications in the three above-referred fields of science. Here, the highest rate of the SIK indicator in social sciences is 667% (Spica et al, 2022) while in natural sciences the highest rate is 659%, and, the highest rate of the SIK indicator in humanities and art science is 450% (Spica et al, 2023). In turn, the lowest rate of the SIK indicator in the field of natural sciences is 179%; the lowest rate of the SIK indicator in the field of social sciences is 58% (Spica et al, 2022); the lowest rate of the SIK indicator in the field of humanities and art science is 13% (Spica et al, 2023). This means that the lowest rate in the field of natural sciences, however, is almost 14 times higher than the lowest rate in the field of humanities and art science, and, almost 3 times higher than the lowest rate in the field of social sciences.

4.2 The Efficiency of the Involvement of Academic Staff in the RS, MS, LPS, EPS Formation at SIs of Natural Sciences

In Table 2, in respect of SIs of natural science in Latvia, the figure rests in the range from 1% to 165%. The highest indicator is the SIK in the LSIWC, but the lowest indicators are the PIK and the KIK in the DU/LIAE.

Table 2: The efficiency of the involvement of academic and research staff in the RS formation at SIs of natural sciences in Latvia per year in period from 2013 to 2018

SI	AIK (%)	AIK rating	AIK score	PIK (%)	PIK rating	PIK score	KIK (%)	KIK rating	KIK score	Average of AIK & PIK score	PE in times	SIK (%)	SIK rating	SIK score	Average of AIK & PIK & SIK score
DU/LIAE	0	0	0	1	7	1	1	7	1	0,5	0	11	7	1	0,7
ISSP	0	0	0	12	6	1	12	5	1	0,5	0	57	5	1	0,7

SI	AIK (%)	AIK rating	AIK score	PIK (%)	PIK rating	PIK score	KIK (%)	KIK rating	KIK score	Average of AIK & PIK score	PE in times	SIK (%)	SIK rating	SIK score	Average of AIK & PIK & SIK score
LSIWC	0	0	0	43	1	5	43	1	5	2,5	0	165	1	5	3,3
DU/Bi	116	1	5	41	2	4	30	2	4	2,0	0,4	135	2	4	2,7
UL/N	97	2	4	20	4	2	17	4	2	1,0	0,2	32	6	1	1,0
VeU/N	68	4	2	12	5	1	10	6	1	1,5	0,2	109	4	2	1,7
DU/MPC	82	3	3	34	3	3	24	3	3	3,0	0,4	128	3	3	3,0
Average	145			21			19				0,2	48			

The AIK indicators were collected only for the 4 SIs of natural sciences, and the authors conclude that the highest AIK indicator of 116% is held by the DU/Bi, while the lowest AIK indicator of 68% belongs to the VeU/N; the highest PIK indicator and KIK indicator of 43% is held by the LSIWC, while the lowest PIK indicator and KIK indicator of 1% belongs to the DU/LIAE; the highest SIK indicator of 165% is held by the LSIWC, while the lowest SIK indicator of 11% belongs to DU/LIAE.

In Table 3 the figure rests in the range from 1% to 17% in respect of the SIs in Latvia. The highest indicator is SIK in the DU/Bi and the VeU/N, but the lowest indicators are PIK and KIK in the UL/N and the DU/MPC.

Of the 7 Latvian SIs in the field of natural sciences, the 4 SIs have the MS, the 5 SIs have the LPS, and, only the 3 SIs have the EPS.

Table 3: The efficiency of the involvement of academic and research staff in the MS formation at SIs of natural sciences in Latvia per year in period from 2013 to 2018

SI	AIK (%)	AIK rating	AIK score	PIK (%)	PIK rating	PIK score	KIK (%)	KIK rating	KIK score	Average of AIK & PIK score	PE in times	SIK (%)	SIK rating	SIK score	Average of AIK & PIK & SIK score
DU/Bi	14	1	5	5	1	5	4	1	5	5,0	0,4	17	1	5	5,0
UL/N	7	3	3	1	4	2	1	3	3	2,5	0,2	2	4	2	2,3
VeU/N	10	2	4	2	2	4	2	2	4	4,0	0,2	17	2	4	4,0
DU/MPC	4	4	2	1	3	3	1	4	2	2,5	0,4	6	3	3	2,7
Average	8			1			1				0,2	3			

Table 4: The efficiency of the involvement of academic and research staff in the LPS formation at SIs of natural sciences in Latvia per year in period from 2013 to 2018

SI	AIK (%)	AIK rating	AIK score	PIK (%)	PIK rating	PIK score	KIK (%)	KIK rating	KIK score	Average of AIK & PIK score	PE in times	SIK (%)	SIK rating	SIK score	Average of AIK & PIK & SIK score
ISSP	0	0	0	1	4	2	1	4	2	1,0	0	5	3	3	1,7
LSIWC	0	0	0	6	2	4	6	2	4	2,0	0	23	2	4	2,7
DU/Bi	2	3	3	1	5	1	0	5	1	2,0	0,4	2	5	1	1,7
UL/N	9	2	4	2	3	3	2	3	3	3,5	0,2	3	4	2	3,0
DU/MPC	39	1	5	16	1	5	11	1	5	5,0	0,4	61	1	5	5,0
Average	15			2			2				0,2	5			

In Table 4 the figure rests in the range from 1% to 61% in respect of the SIs in Latvia. Comparing the figures collected in Table 4, the authors conclude that the highest AIK, PIK, KIK and SIK score is held by the DU/MPC, while the lowest AIK, PIK, KIK and SIK score belongs to the DU/Bi.

In Table 5 the figure rests in the range from 1% to 11% in respect of the SIs in Latvia; the highest PIK, KIK and SIK score is held by the LSIWC, while the lowest PIK, KIK and SIK score belongs to the UL/N.

Table 5: The efficiency of the involvement of academic and research staff in the EPS formation at SIs of natural sciences in Latvia per year in period from 2013 to 2018

SI	AIK (%)	AIK rating	AIK score	PIK (%)	PIK rating	PIK score	KIK (%)	KIK rating	KIK score	Average of AIK & PIK score	PE in times	SIK (%)	SIK rating	SIK score	Average of AIK & PIK & SIK score
ISSP	0	0	0	1	2	4	1	2	4	2,0	0	7	2	4	2,7
LSIWC	0	0	0	3	1	5	3	1	5	2,5	0	11	1	5	3,3
UL/N	4	1	5	1	3	3	1	3	3	4,0	0,2	1	3	3	3,7
Average	7			1			1				0,2	2			

In the tables from 1 to 5, the awerage indicators PE are the same, and the average SIK indicators are the highest, while the average KIK indicators; the average AIK indicators are the highest, while the average PIK indicators.

The comparison of the results of the three fields of science leads to conclusion that the highest average rate of the PE indicators is 1,8 (Spica et al, 2022) in social sciences, the second highest average rate of the PE indicators is 1,7 (Spica et al, 2023) in humanities and art sciences, and, the lowest average rate of the PE indicators is 0,2 in natural sciences. In addition, it should be noted that the highest average rate of the PE in the field of social sciences is nine times higher than the lowest average rate in the field of natural sciences.

4.3 The Comparison of the Results of Qualitative and Quanatitative Evaluation of SIs of Natural Sciences

Table 6: The Comparison of the results of qualitative and quantitative evaluation of Latvian SIs in the field of natural sciences using the IC form for period from 2013 to 2018

SI	Quality score by TG (QTG)	Overall score by TG (OTG)	Total average score of AIK & PIK using IC form (TAAP)	Difference of score (QTG-TAAP)	Difference of score (OTG-TAAP)	Total average score of AIK & PIK & SIK using IC form (TAAPS)	Diference of score (QTG-TAAPS)	Difference of score (OTG-TAAPS)
DU/LIAE	3	3	0,5	2,5	2,5	0,7	2,3	2,3
ISSP	4	4	1,5	2,5	2,5	1,7	2,3	2,3
LSIWC	4	4	0,5	3,5	3,5	0,7	3,3	3,3
DU/Bi	3	3	4,5	-1,5	-1,5	4,0	-1,0	-1,0
UL/N	4	3	3,5	0,5	-0,5	2,7	1,3	0,3
VeU/N	3	3	1,5	1,5	1,5	2,3	0,7	0,7
DU/MPC	2	1	3,5	-1,5	-2,5	4,0	-2,0	-3,0

Table 7: The Comparison of the results of qualitative and quantitative evaluation of Latvian SIs in the field of natural sciences using the overall IC for period from 2013 to 2018

SI	Quality score by TG (QTG)	Overall score by TG (OTG)	Total average score of KIK using IC overall (TAKO)	Difference of score (QTG-TAKO)	Difference of score (OTG-TAKO)	Total average score of KIK & SIK using IC overall (TAKOS)	Difference of score (QTG-TAKOS)	Difference of score (OTG-TAKOS)
DU/LIAE	3	3	0,4	2,6	2,6	0,4	2,6	2,6
ISSP	4	4	2,2	1,8	1,8	2,3	1,7	1,7
LSIWC	4	4	3,0	1,0	1,0	3,0	1,0	1,0
DU/Bi	3	3	3,0	0,0	0,0	2,7	0,3	0,3
UL/N	4	3	2,6	1,4	0,4	2,2	1,8	0,8
VeU/N	3	3	1,2	1,8	1,8	1,7	1,3	1,3
DU/MPC	2	1	2,6	-0,6	-1,6	2,7	-0,7	-1,7

When comparing the qualitative ratings of TG group to the quantitative assessments perfomed by the authors, it can be concluded that they differ from minus 3,0 points to plus 3,5 points in total.

The study shows that the KIK, AIK, PIK, and SIK of SIs of natural sciences in Latvia were lower than the results compiled by the relevant TG Panel except for one to two SIs of natural sciences, and, except for the DU/Bi, where QTG, OTG, TAKO scores coincided.

5. Conclusions

The study did not result in confirmation of their hypothesis. The hypothesis is accepted *pro tem* for other branches of SIs of Latvia.

The present research includes further development of study on the contents of IC of natural sciences and the efficiency of its formation at the SIs in Latvia, performed comparative analysis characterising the Latvian SIs of natural sciences as awhole, specified the system of IC efficiency indicators and presented its quantitative interpretation.

In order to improve the quality of the IESIA of SIs of natural sciences is encouraged to supplement its methodology with quantitative analysis of IC efficiency indicators.

References

Contu, E.G. (2017) “The Role of Intellectual Capital in Higher Education”, Proceedings of the 9th European Conference on Intellectual Capital, Lisbon, Portugal, 6-7 April, pp. 66 -70.

Latvijas Republikas Izglītības un zinātnes ministrija (2021) “International Evaluation of Scientific Institution Activity, Latvia”, Report by the Technopolis group per period 2013.-2018 , Riga, 5th March

Rondeau, K., Dillon, J., Mansour, N. and Daniels, J. (2022) “Managing Knowledge and Identity across the Boundary of Academic and Commercial Science”, Proceedings of the 17th European Conference on Innovation and Entrepreneurship, Pafos, Cyprus, 15-16 September, pp. 432-440.

Spica, I., Berzina, B., Spics, E., Spica, R.K. and Ponnis, P. (2023) “Intellectual Capital of Humanities and Art Sciences and the Efficiency of its Formation at Scientific Institutions”, Proceedings of the 24th European Conference on Knowledge Management, Lisbon, Portugal, 7-8 September, pp. 1246 -1254.

Spica, I., Berzina, B., Spics, E. and Spica, R.K. (2022) “Intellectual Capital of Social Sciences and the Efficiency of its Formation at Scientific Institutions”, Proceedings of the 17th European Conference on Innovation and Entrepreneurship, Pafos, Cyprus, 15-16 September, pp. 512 - 520.

Spica, I., Garleja, R., Berzina, B. and Spics, E. (2018) “The Involvement of Students in the Formation of Intellectual Capital in Latvia”, Proceedings of the 19th European Conference on Knowledge Management, Padua, Italy, 6-7 September, pp. 811 -820.

Spica, I., Garleja, R. and Berzina, B. (2017a) “Intellectual Capital as the Performance Indicator of the University Studies”, Proceedings of the 9th European Conference on Intellectual Capital, Lisbon, Portugal, 6-7 April, pp. 312 -320.

Spica, I., Garleja, R. and Berzina, B. (2017b) “The Efficiency of the Involvement of Academic Staff in the Formation of Intellectual Capital in Latvia”, Poster of the 9th European Conference on Intellectual Capital, Lisbon, Portugal, 6-7 April.

Multimodal Traffic Management (MTM): Future Training emphasizing Collaboration and Coordination

Trine Marie Stene[1] and Elisabeth Skuggevik[2]
[1]SINTEF Digital, SINTEF, Trondheim, Norway
[2]ITS Technology, Transport and Society, Norwegian Public Road Administration, Norway

Trine.M.Stene@sintef.no
Elisabeth.skuggevik@vegvesen.no

Abstract: This paper is a part of the ORCHESTRA project (Horizon Europe 2021-2024), where the vision is a future where it is easy to coordinate, negotiate and synchronize traffic across all modes (road, rail, sea, and air). Multimodal Traffic Management (MTM) orchestrates traffic across modalities, and with that optimizing capacity in the total transport network. Thus, we may reduce negative impacts of traffic, such as emissions and delays, and still get people and goods to their destination on time. This paper aims to present piloted traffic manager training and reflect upon traffic manager's future competence and training needs, labelled Traffic Orchestrators (TO). The paper presents critical traffic orchestration concepts, measures, and recommendations regarding future TO education. In addition, to learn how to use management tools specific related to their own governance area (GA), TOs also need knowledge on coordination and negotiation with other TOs managing traffic in affected surrounding areas. The pilot form TO training modules for (I) Basic and fundamental competencies, (II) Future scenario handling (normal operation, foreseen events, unforeseen events), and (III) Follow-up modules, refresh studies and specification.

Keywords: Knowledge Creation, Polycentric Multimodal Traffic Management, Education, Inter-Organizational Coordination, Resilience

1. Introduction

This paper is a part of the EU project ORCHESTRA, 2021-2024, addressing the problem that traffic caused by transport has many harmful effects, such as congestions and emissions. These challenges are hard to handle due to a lack of coordination both within and across different transport modes (road, rail, sea, and air). The paper addresses the gap of knowledge and competencies that traffic managers possess today and future requirements for inter-organizational coordination and pro-active traffic orchestration.

The long-term vision of ORCHESTRA is future *Multimodal Traffic Management* (MTM) through *traffic orchestration*, i.e. by coordination and synchronizing traffic management across all modes to cope with diverse demands and situations and to increase optimization and resilience. The general objective is to provide European policymakers, public authorities, transport providers and citizens with new knowledge and technical and organizational solutions to enhance traffic orchestration. The definition of *traffic* is the accumulated vehicles that use infrastructure as a means of travelling from place to place, while *transport* is the movement of people and goods from one place to another using vehicles in all modes (road, air, rail and sea). This paper aims to present a framework for future education, and to reflect upon competence and training needs of future traffic managers, labelled *Traffic Orchestrators* (TO). TOs are key stakeholders in the coordination and cooperation of traffic across governance areas (GA) and network modes. The paper addresses the key questions: (1) What knowledge and competencies do future traffic managers need, and how does it differ from today? (2) How should knowledge creation processes be? (3) How should a future training program look?

1.1 The System of Interest and Key Concepts

ORCHESTRA describes an MTM ecosystem (MTME) and a future polycentric management architecture (PMA). Based on existing structures, policies, regulations, GAs and actors – *polycentric management* aims to bridge communication, coordination and collaboration between several centres through data sharing, described by a PMA and an MTME. Multimodal transport of people and goods may facilitate traffic capacity across networks for optimal transport, avoiding sub-optimization within one modality. MTM includes managing and synchronizing traffic across all transport modes optimizing resources and minimizing negative impacts.

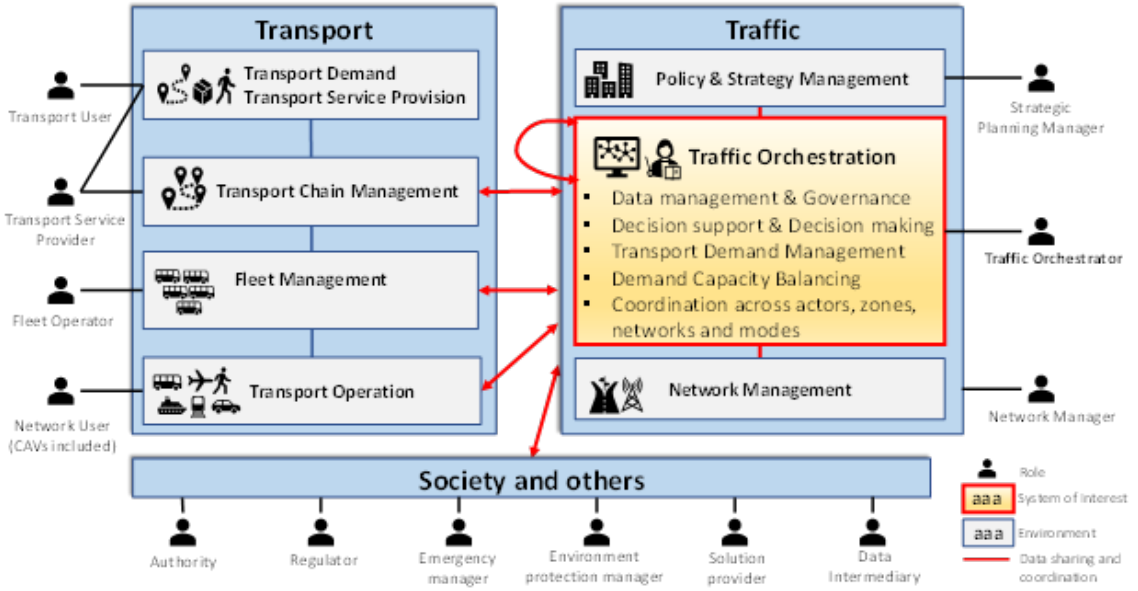


Figure 1: Multimodal Traffic Management Ecosystem (MTME) with System of Interest in its environment).

Figure 1 illustrates the ecosystem constituting Transport, Traffic, and Society and others (Natvig et al, 2024). Stakeholder archetypes represent generic roles with defined responsibilities. Real actors may play one or more roles. A *Traffic Orchestrator* is the executive stakeholder using new measures for:

- *Coordination, cooperation and negotiation across actors, zones, networks, and modes* aiming to arrange for optimization and resiliency using the total transport system.
- *Transport Demand Management* (TDM) aims to arrange everyday traffic flow according to policy and overall strategy of the transport system.
- *Demand Capacity Balancing* (DCB) aiming to cope with current and upcoming situations involving an imbalance between transport demand and capacity in the network.

TOs differ from fleet managers or vehicle operators in the way that they don't manage the fleet or the vehicle but *orchestrate the traffic* generated by fleets and vehicles when transporting people and goods. Traffic orchestration requires knowledge beyond the individual TO's defined governance area (GA), including understanding traffic flows between GAs, co-handling incidents, consequences and ripple effects across networks and GAs. A TO does, therefore, need training in using tools specific to manage traffic within their own GA, and to coordinate and negotiate with other TOs in surrounding GAs.

2. Theoretical Perspectives

One main ORCHESTRA result is to develop enabling toolkit supporting the realisation of MTME, including designing training modules and piloting training adapted to the two Living Labs. The resilience perspective will highlight the following questions: (1) What knowledge and competencies do future traffic managers need, and how does it differ from today? Theories on knowledge creation are presented regarding (2) How should knowledge creation processes be designed? (3) How should a future training program look? In the context of MTM, an educational design model is used.

2.1 Resilience

Resilience is identified as an important aspect for MTM and PMA and is central in the education of future TOs. Numerous definitions of the resilience concept are proposed. The definition used in the ORCHESTRA project is: *"A system is resilient if it can adjust its functioning prior to, during, or following events (changes, disturbances, and opportunities), and thereby sustain required operations under both expected and unexpected conditions"* (Hollnagel, 2019). One main characteristic of a resilient system is *adaptability*, i.e. the adaptive capacity to adjust patterns of activities in the entire ecosystem, for some stakeholders or organisations. Resilient traffic orchestration lies in the PMA, and stakeholder's and organisation's willingness to adapt, negotiate, communicate, and co-manage traffic through harmonising regulations, policies and defined work processes

between organisations and governance areas. Training modules are designed to clarify basic competencies for traffic orchestration of the MTME, and competencies to facilitate resilience in actual traffic orchestration under normal, changed, disrupted and disaster conditions.

Key characteristics of a resilient system are *monitoring* critical issues to know what to do; *anticipating through simulations* potential scenarios to know what to look for; *responding* in actual situations to know what to do; and *learning* of experiences and historical events to know what has happened and to be better prepared in the future. In addition to efficient recovery to a normal stage, to be resilient, a system must develop the ability to adapt both to new conditions and to future changes and surprises. Future work on MTM must build on knowledge about e.g. the safety of CAVs, traffic planning and management, and cyber security.

In MTM, resilience is closely linked to the ability to utilize any available capacity when needed. Today's traffic management is reactive, and done in silos, creating sub-optimization by not being able to efficiently be prepared for events, and utilise spare capacity in neighbouring governance areas or networks. Defined and learned operations for cooperation, proactive measures, coordination and negotiations can enable better utilization of total capacity across networks.

The traffic managers should be trained on how to interpret recommendations of technical tools to avoid disruptions, and on how to take the best decision in case a human intervention is advised (Søråsen, 2024; Grosse et al, 2021). Data sharing and orchestration measures will be significant characteristics to facilitate a pro-active, and more resilient multimodal transport management.

2.2 Knowledge Creation

Future MTM will constitute collaboration and coordination across management levels, organizations, and stakeholders. Learning objectives will transform from current silos focus into polycentric considerations, and from reactive to pro-active orchestration of traffic. *Organizational knowledge-creation* should focus on the active, subjective nature of knowledge (Nonaka & Takeuchi, 1995). Knowledge constitutes "*explicit*" or codified knowledge that is transmittable in formal, systematic language and "*tacit*" knowledge deeply rooted in action, commitment, and involvement in a specific context (Nonaka, 1994). In an organisation explicit knowledge may be seen in newsletters, documents and lectures. Tacit knowledge consists partly of technical skills (*know-how*) and cognitive elements (e.g. mental models and images of reality and the future; *what is* and *what ought to be*), Organisational knowledge creation is often described as a spiral with possible transfer between individuals, to groups, organisation and inter-organisation.

In addition to acquiring knowledge, knowledge creation regarding traffic management involves imagination and understanding future practices for management, including dynamic and continuous adaptation to changing circumstances. *Social construction perspectives* hold that individuals learn and develop when participating in social activities. These are regarded as mutual processes between the individual and society. Later approaches are often cited as e.g. situated learning, socio-cultural theory, cultural-historical activity theory, and distributed cognition (Stene, 2021). All regard the *context* as essential to what humans learn and how they develop. Socially developed *artefacts* are considered mediators between individuals and social contexts. While language is seen as the most significant artefact in learning, thinking, and reflection, dialogue and communication are essential. Artefacts are usually perceived as cultural tools and may also include e.g. serious games, written text, maps, illustrations, and diagrams.

Collaboration may support *scaffolding,* implying what a person can learn by assistance, guidance, or help from others. Reflective practice can be viewed as reflection-in-action and reflection-on-action (Schön, 1998), making a distinction between reflection *during* engagement in an activity and reflection *after* the event.

2.3 Design and Evaluation of Training Programs

This section presents a general theoretical, didactical model used for designing training programs. While pedagogy studies the learning processes at a social level (strategies, methods and techniques), didactics focuses more on the learning processes in a school or organisation.

The didactical model includes six elements for planning and designing training programs (Stene, 2010; Timoshenko et al, 2021). The elements are interrelated, i.e. the specification of one element will influence the other elements. Likewise, when changing or modifying one element we must consider implications for the other elements. (1) *Objectives* may be separated into learning objectives and training objectives/purposes. *Learning objectives* are competencies that the participants should have acquired at the end of the education program (or

specific module). These may be defined knowledge, performance, or attitudes. Requirements to goals are that they should be relevant, realistic, meaningful, and clear (to the participants). This element is associated with "Why" the learning is necessary. *Training purposes* are defined from the perspective of the educator or responsible institution and targets the intended effects on the system. (2) *Learning qualification* means the knowledge, attitudes, and performance the participants face the training with. (3) *Framework conditions* are conditions which make learning possible or place a limitation on learning, for instance teaching aids, time, room facilities and artefacts. (4) *Content* describes the curriculum of the training subject and issues to be covered. The element is related to "What" to learn. (5) *Learning process* concerns "How" to learn. This includes both the teaching and instruction methods used by a facilitator or teacher (e.g. lectures, instructions, demonstrations) and the participants' working methods (individually or in teams). (6) *Evaluation* may involve both the learning process, the goal and the participant's learning.

3. Methodology

3.1 Designing the Training

3.1.1 Design of MTM Training Program

ORCHESTRA includes two work packages that emphasize future MTM training. Kalbere & Stene (2023) present the theoretical approach and suggested program including modules, while Nguyen, Stene and Skuggevik (2024) specify the piloted training trials related to the Living Labs for freight and personnel transport.

3.1.2 Validation of the MTM Program

Validation intended to ensure quality, efficiency and sustainability of the training. To get feedback on the design, strategy and modules, a general program was presented at a Community of Practitioners (CoP) workshop constituting both partners and external stakeholders. Further, partner feedback on drafts of modules and digital training were given in a web-meeting and a plenary face-to-face meeting.

3.1.3 Preparing Training Trials

Prior to the Norwegian training, the authors specified the schedule in the context of the Arendal project (see 3.2) and ORCHESTRA projects, developed a playscript, and specified the six educational elements (see 2.3).

3.2 Training Period and Population

The piloted trials were performed in the January - February 2024 in Norway and Italy. In Norway the training was a two-day physical workshop (face-to-face) that included 10 participants and two facilitators. The participants represented six different organisations involving both external institutions (Agder County, Arendal Harbour, Arendal Municipality) and project partners (ROSAS, HIP, ITS-Norway). The training trials were designed and facilitated by two project partners and the authors of this paper.

In Italy the training was a three-hour digital workshop with six project partner organisations. They included 11 participants (Deep Blue, SEA, TU Delft, Enav, FSTecnology) and two facilitators (ROSAS). The training in Norway served as a blueprint for this shortened, digital version.

4. Piloting Traffic Orchestration Training

This chapter's main part concerns the didactical aspects of the practical and specific training trials. It describes key concepts and measures and the TO training strategy.

4.1 Concepts and Measures

TOs will use *Transport Demand Management* (Figure 2) according to the policy of respective governance areas. The policy will be the condition for measures that are chosen to orchestrate traffic. TOs need to be able to understand the flows and conditions of the information across roles inhabited by actors in the specific MTME and assess the consequences of implementing different measures. Measures used in ordinary situations may include information, traffic calming, access control, priority, and monitoring.

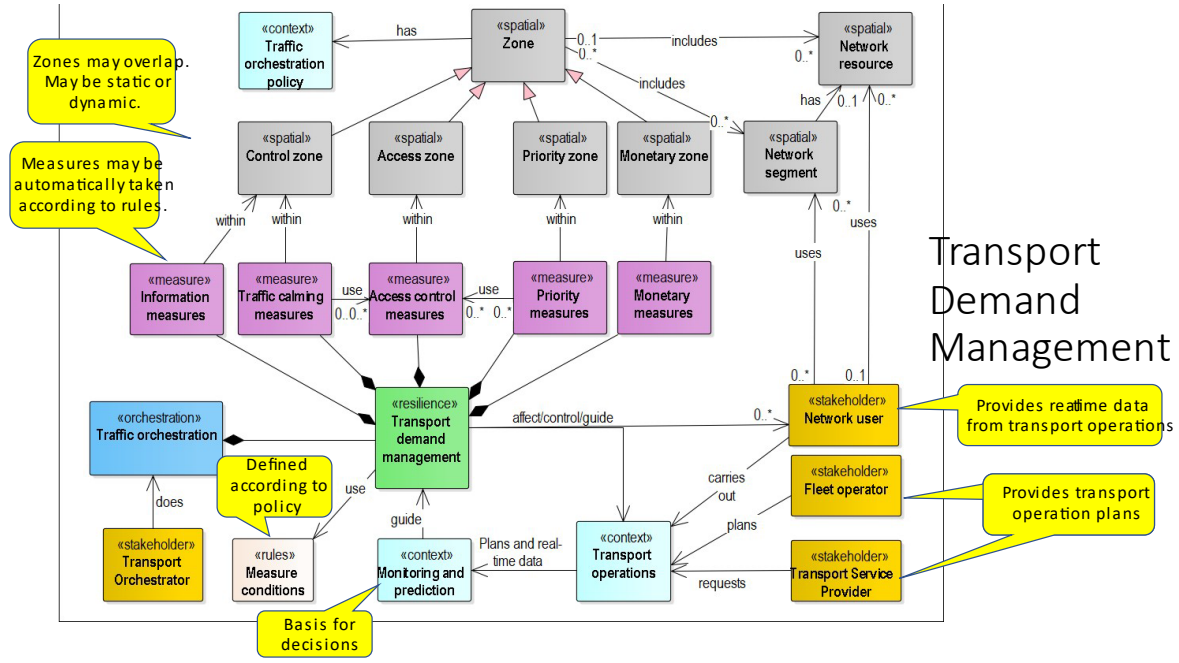


Figure 2: Traffic orchestration using Transport Demand Management (Natvig et al, 2023).

Demand Capacity Balancing may be needed when accidents, increased risks, or events with an unknown cause suddenly strain capacity (Figure 3). In addition to measures used in Transport Demand Management, TOs may need to use more individual measures and measures for capacity adaption. Incidents may also affect neighbouring governance areas, requiring TOs to coordinate and negotiate through coordination measures. To understand the consequences of the implementation of various measures, simulations of "what if" scenarios explore possible plans of operation, giving TOs decision support to effectuate pro-active measures.

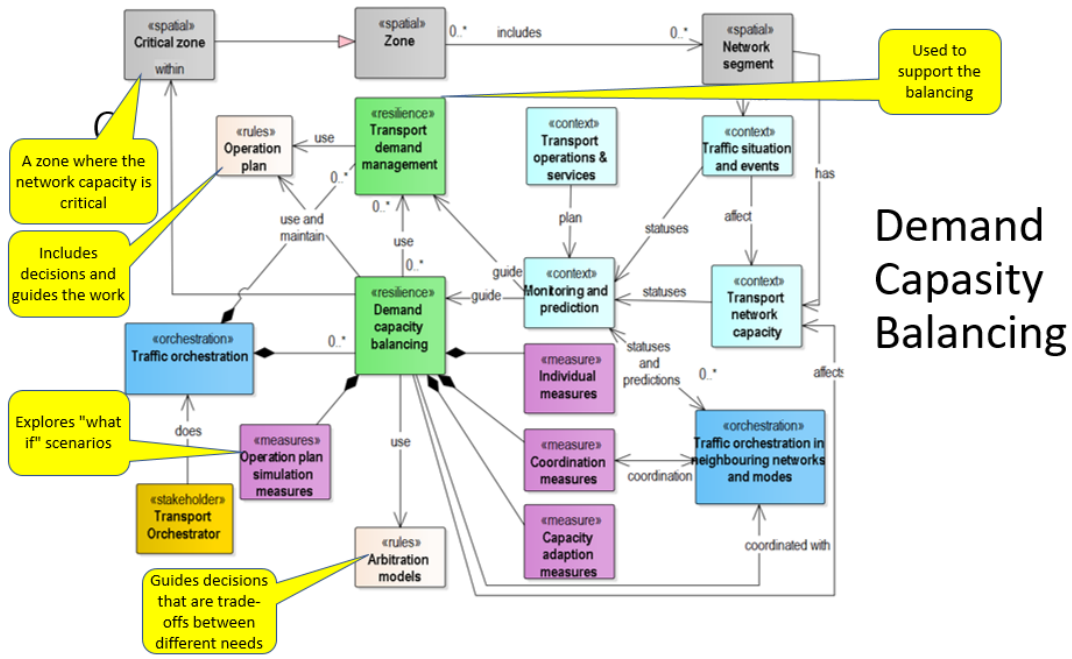


Figure 3: Traffic orchestration using Demand Capacity Balancing (Natvig et al, 2024).

These concepts and measures are the fundamental conditions for the content for the traffic orchestration training and must be understood and continuously rehearsed.

4.2 Training Strategy for Multimodal Traffic Management

The purpose of the TO training program is to educate future TOs on how to manage traffic effectively, i.e. improving resilience of highly automated coordination systems (in normal, disrupted or disaster mode of operation) through better connection and cooperation with the infrastructure and surrounding vehicles. The TO Training Program constitutes three *main parts* (Table 1).

I. *Basic and fundamental competence* includes systems, in addition to practical, operational competencies needed for future traffic orchestration, i.e. performance and skills as a basis for doing traffic orchestration. These may include practical skills, knowledge and/or attitudes.
II. *Resilience competence and traffic orchestration* includes competences to ensure resilience in MTM according to PMA. It is recommended to specify training related to three scenarios: (a) Normal operation, (b) Foreseen events and (c) Unforeseen events.
III. *Specific competencies and refreshment/updating* studies include supplementary competencies, refreshment studies, and specific studies (e.g. specific to contexts and/or local geography).

Table 1: Traffic Orchestrator Training Program.

III. Specific Competencies - Refreshment and updating studies		
I. Resilience Competence - Traffic orchestration Scenarios		
Normal operation	Foreseen events	Unforeseen events
I. Basic and fundamental competencies • Rules, standards, and regulations • Multimodal Traffic Management • Technical tools and equipment (For operation and decision support) • Technology – Traffic flow and data exchange		

The main *participant* to be trained is the TO, who aims to arrange for the most optimal flow of traffic in accordance with policy and in compliance with regulations.

The program includes potential measures, tools, and simulations for traffic orchestration within and between GA. *Resilience* is a significant aspect, and the modules are designed to give necessary competencies about traffic orchestration management principles and measures, in addition to support competencies regarding management in actual (future) scenarios under normal, changed, and disaster conditions.

4.3 TO Training Trials

This section first describes the intended training purposes and learning outcomes of the TO Program, and then the didactical elements in the training trial modules. The section mainly describes the Norwegian training trials because the digital Italian version is mainly a shortened blueprint of this.

The *training purpose* is to prepare, teach and enable future traffic managers (TOs) in an MTME. TO training should enable traffic managers to understand how to orchestrate traffic in their own governance area (GA), using different measures, and cooperate and negotiate with surrounding GAs. In Norway, the purpose was to access the training in the local context, get insights from participants in the actual on-site environment, provide targeted feedback and identify areas for improvement. The intended *learning outcomes* (for the participants) are: (a) *Effects* of completing the program; To increase traffic orchestration performance and skills in future traffic management, handle measures and tools in a resilient manner, and (b) understand *Impacts* of these changes; To improve the resilience.

Framework elements: Three basic training modules were selected, in addition to two resilience modules. Table 2 presents the module names and the duration in the two countries. Most didactical elements (see 2.3) are specified for each module. However, *learning qualifications* are the same for all modules; all participants should have experience with traffic management. Regarding *evaluation*, the participants gave a general evaluation at the end of the last module, in addition to pre- and post-evaluation of each module.

Table 2: Training trials – Modules in Norway and Italy

Time	Modules in Norway	Time	Modules in Italy
Day 1 (8 hours)	A: Introduction B: Traffic orchestration across governance areas C: Simulations, measures and examples of tools	Day 1 (3 hours)	A: General MTM Concept and Traffic Orchestration B: How to effectively use the ORCHESTRA tools and simulations C: Practical use case for tools and simulations for MTM
Day 2 (6 hours)	D: Traffic orchestration according to plan E: Traffic orchestration when incidents occur		

4.3.1 Module A

Learning objectives: After the module participants should have (a) An overview of all training modules and (b) An insight into the ecosystem (MTME), MTM (Multimodal Traffic Management), Roles and responsibilities of MTM, and Possible future scenarios. *Content* and *Learning process:* (a) Introduction to the TO Training Program – Participants presented themselves; TO program and learning objectives for Module A; Pre-evaluation by the participants. (b) MTM Model and concepts (See Natvig et al, 2024) – The facilitators presented the ORCHESTRA project vision, objectives, MTME, and future multimodal traffic scenarios (See Vaillant et al, 2022). The participants commented and asked questions. (c) Future scenarios and the need for MTM – Dialogue and reflections based on illustrations and figures from Vaillant et al, (2023), video of the exploitation project in Arendal (https://www.linkedin.com/company/orchestra2020/), followed by reflections on challenges related to building new industry areas in Arendal illustrated by maps of future transport chains and stakeholders, (d) Reflections and dialogue regarding main topics in Module A, (e) Closing (summing up and post-evaluation).

While facilitators were most active in the beginning by presenting and asking questions, (c) – (e) emphasized involvement, reflection and dialogue.

4.3.2 Module B

Learning objectives: (a) Understand TO methods: TDM (Transport Demand Management, Figure 2), DCB (Demand Capacity Balancing, Figure 3), (b) Understand MTME and PMA: TO (key functions) between GAs, How traffic orchestration can be conducted with the use of local/relevant examples, Key stakeholders and roles, (c) Introduction to traffic orchestration measures and examples of tools. *Content* and *Learning process:* (a) Opening session with a recap of Module A and objectives of Module B, (b) Board Game - Basic traffic orchestration concepts and measures (https://orchestra2020.eu/the-orchestra-board-game/). Two situations were played (Normal traffic; Dry port transport), followed by a post-lecture on main orchestrator concepts and principles. (c) Traffic orchestration – Examples from the Living Labs and exploitation project. Maps were used to reflect on the Living Lab at Herøya (stakeholders, GAs), in addition to how the project is applied in a local context in Arendal. (d) Reflections and dialogue regarding main topics in Module A, (e) Closing.

4.3.3 Module C

Learning objectives: Insight into (a) Potential tools for traffic orchestration and (b) Benefits of simulations (of traffic flow and changes): Decision support, Understanding multiple measures for handling complex situations, Simulation of historical situations and incidents, "What Ifs", and documentation for historical events and potential causes, (c) Connectivity and automation (digital and manual operations of CAV, coordination and data sharing between GA). *Content* and *Learning process*: (a) Opening session, (b) Simulations and tools (See Søråsen, 2024), (c) Simulations and tools in HIP Living Lab, (d) Connectivity and automation in the future, (e) Closing.

4.3.4 Module D

Learning objectives: (a) In-depth understanding of usual cases and everyday operations within MTM using TDM (future normal variations in traffic flow and changes with increased automation, coordination across modalities etc.), (b) In-depth understanding of different TO measures, tools and simulations supporting decisions and actions, (c) Understanding of roles and responsibilities of TOs in GAs – and to be able to translate general roles to actual actors and places. *Content and Learning Process:* In this module, most of the time was used for

discussions and reflections. (a) Opening, (b) Repetition of examples from Module B, (c) Future scenarios for the Herøya and Arendal cases (d) Closing.

4.3.5 Module E

Learning objectives: (a) In-depth understanding of operations within MTM using DCB when incidents occur, (b) In-depth understanding of different TO measures, tools and simulations supporting decisions and actions, (c) Understanding of roles and responsibilities of TOs and GA – and to be able to translate general roles to actual actors and places (d) Insight in how to handle the foreseen incidents (possible incidents that have been thought of). *Content and Learning process:* Discussion of tools and orchestration measures when incidents occur, and how to re-plan and return to operation. (a) Opening, (b) Repetition of examples from Module D, (c) Future scenarios when incidents occur, (d) Closing.

5. Discussion

5.1 What Knowledge and Competencies do Future Traffic Managers Need?

The TO training needs are based on ORCHESTRA's anticipated future traffic scenarios. In addition to understanding general *future* trends, knowledge of *past* and *current* challenges is critical for specifying, updating and determining significant competencies.

5.1.1 Traffic Orchestration – Collaboration and Synchronisation of Plural Managers

Multimodal management will be needed, enabling negotiation for optimal use of capacity across networks during planned operations and when incidents occur to foresee and prepare for capacity problems. TO's role and responsibility is to orchestrate according to policy. That will imply a responsibility to orchestrate the traffic within a GA in a way that will prevent negative consequences in surrounding GAs and across networks. When incidents occur that will affect neighboring GAs, traffic orchestrators must be trained in regulated procedures for cooperation and collaboration, being able to evaluate automated decision support and understand the consequences measures will create for themself and other TOs. This will be practiced best when TOs from neighboring GAs train together. Using coordination measures will enable simulations to indicate the effect of traffic flows, emissions, and other important effects on policy goals.

5.1.2 Simulations of Scenarios – Practicing of Explicit and Tacit Knowledge

Resilience depends on the ability of pro-active measures, and the flexibility in the use of different measures, combinations of measures and an understanding of the immediate effects and chain effects in own, and neighboring GAs.

Training using simulations may facilitate both explicit and tacit knowledge creation. Simulations will be crucial to manage challenges and surprises in actual traffic orchestration. Probable everyday operations and events in local contexts provide the opportunity for discussions and simulations of previously used measures and potential new measures that can be taken to manage incidents and get back to planned operation with minimal negative impact. This gives the traffic orchestrator practice in recognizing the best probable measures and likely consequences. Training and results of simulation may in return give input to automated decision support.

5.2 How Should Knowledge Creation Processes be?

5.2.1 Learning Process

Learning is embedded in practice. The training emphasizes active participants using dialogue and discussions. Learning and development take place when participating in social and culturally shaped contexts. Reflection is regarded as significant in learning and knowledge creation. Experience from practice is significant in both reflection-on-action (past experiences or future intended/unintended acts) and reflection-in-action (experiences when engaged in an activity).

Since context is considered significant for learning, is it central to create good arenas for learning and experience transfer. The training in Norway was physical and in Italy digital. Dialogue face-to-face makes it easier to collaborate and make common reflections by making it possible to notice non-verbal communication and to

make use of tactile collaboration e.g. by using games and the scenarios cases from Herøya and Arendal to create and move signs and symbols on physical maps.

5.3 What Knowledge Strategies may Facilitate MTM?

Knowledge strategies are often linked to organizational outcomes and implemented in one organization. In addition, MTM should include strategies for inter-organisational outcomes of synchronizing management systems, including regulations and plans, stakeholder responsibilities and operations.

5.3.1 How to Cope with a Continuously Changing World?

Digitalization and increased data sharing between vessels, sensors and infrastructure will change the interaction between human and automatic management, requiring dynamic updates of an educational program. Further, knowledge management updates will require rehearsal and repetition of new modules.

Determination of what competencies TOs will need in the future will require continuous updates of documents about e.g. past and current incidents and risks, new digital management tools and measures, and changes of regulations and standards. In addition, foresight science and future trend-analysis may be used to determine resilience competences to handle future normal traffic variations (known-known), and foreseen (known-unknown) and unforeseen events (unknown-unknown).

5.3.2 Knowledge Strategies

Bratianu (2022) presents several organisational strategies, and some perspectives are in accordance with a resilience perspective and may be applicable to create inter-organisational strategies, e.g. integrated knowledge strategies of reactive and proactive components including known and unknown. Resilience should be an important aspect in future TO education, constituting a *reactive* (learning from experiences and historical events) and a *proactive* approach (anticipating potential scenarios to know what to look for). The scenarios and examples used in the training pilots are based on concrete, local cases. Design and updates of scenarios are essential and should aspire to reflect relevant and recognizable cases.

6. Conclusions

The *main conclusion* is that future traffic management requires new knowledge creation due to the shift from reactive traffic management to proactive traffic orchestration (preparation and handling before an incident occurs).

6.1 Piloted TO Training

- The training trials have provided insights into the effectiveness of the modules and their practical application in real-world scenarios.
- The aim of competent traffic orchestration is to find optimal MTM solutions in highly complex situations, foresee most events, execute dynamic measures when needed and thus to ensure the resilience of transport systems.
- Scenarios and exemplification of measures make it possible to discuss and make decisions for various outcomes of historic and foreseen events.
- Artefacts like boardgames, maps, and illustrations are well suited to learning principles and concepts on a general level.
- Contexts may facilitate learning and insight through using scenarios and storytelling related to personal experiences and local context.
- The participants should have traffic management experience.
- The training period for program should be extended, including time between each module, e.g. making room for reflections, exercises or the context related lessons.

6.2 Recommendations for Future TO Training

- Clarify new sets of knowledge, skills, and performance necessary for proactive traffic orchestration.
- A program should clarify both general competence needs, and design context-specific modules related to local challenges.

- It is essential to emphasize cooperation between TOs in neighboring GAs, e.g. roles and responsibilities.
- Develop and use simulations as an active artefact, making TOs able to test measures for optimal management of capacity and handling incidents. Scenarios should include ordinary operations and crisis to prepare TOs for unforeseen situations.

Acknowledgements

This conference paper is part of the project ORCHESTRA (Coordinating and synchronizing multimodal transport improving road, rail, water and air transport through increased automation and user involvement) funded by the European Union's Horizon 2020 research and innovation programme under grant agreement No 953618.

References

Bratianu, C. (2022). *Knowledge strategies*. Cambridge University Press, Cambridge.

Grosse, B. et al (2021). Pre-studies on environment analysis and drivers. *ORCHESTRA Deliverable 2.2.* https://orchestra2020.eu/document/reports/

Hollnagel, E. (2019). *What is Resilience Engineering?* https://www.resilience-engineering-association.org/blog/2019/11/09/what-is-resilience-engineering/

Kalbere, Y. & Stene, T.M. (2024). Training Modules. *ORCHESTRA Deliverable 4.5.* Will be available at: https://orchestra2020.eu/document/reports/

Natvig et al (2024). Final PMA for multimodal traffic management. *ORCHESTRA Deliverable 3.3*. Will be available at: https://orchestra2020.eu/document/reports/

Nguyen, D., Stene, T.M. and Skuggevik, E. (2024). Training trials for multimodal traffic management. *ORCHESTRA Deliverable D5.5.* Will be available at: https://orchestra2020.eu/document/reports/

Nonaka, I. & Takeuchi, H. (1995). *The knowledge-creating company – How Japanese companies create the dynamics of innovation*. Oxford University Press, Inc.

Nonaka, I. (1994). A dynamic theory of organizational knowledge creation. *Organization Science*, 5 (1): 14-37.

Schön, D. (1998). *The Reflective Practitioner. How Professionals Think in Action.* Ashgate.

Schaudel, L.-M. et al (2024). *White paper to policy makers for a European multimodal traffic management ecosystem.* ORCHESTRA Deliverable 2.5. Will be available at: https://orchestra2020.eu/document/reports/

Spender, J. C. (2008). Organizational learning and knowledge manage. *Management Learning*, 39 (2).

Stene, T.M. (2021). How to mobilize knowledge-based innovations in Service industries? A tourism example. *Proceedings from ECKM 2021*.

Stene, T.M. (2010). Educational aspects of systematic occupational training. *Proceedings from ESREL 2010*, Rhodes Greece. London: Taylor & Francis.

Søråsen, R. (2024). Project Management Plan & Handbook. *ORCHESTRA Deliverable 1.1.* Will be available at: https://orchestra2020.eu/document/reports/

Timoshenko K, Hansen OB, Madsen DØ, and Stenheim T. (2021) Designing an Accounting Course Module on Cost Allocation: Pedagogical and Didactical Considerations from a Norwegian Perspective. *Education Sciences. 2021; 11*(5):232. https://doi.org/10.3390/educsci11050232

Vaillant, L. et al (2022). Initial scenarios for multimodal traffic management. *ORCHESTRA Deliverable 2.3.* https://orchestra2020.eu/document/reports/

Vaillant, L. et al (2023). Final scenarios for multimodal traffic management. *ORCHESTRA Deliverable 2.4.* Will be available at: https://orchestra2020.eu/document/reports/

Creating Expert Knowledge on Aligning Tax Systems With Corporate Business Strategies

Marcin Stępień
University of Technology Faculty of Management, Czestochowa, Poland

marcin.stepien@pcz.pl

Abstract: The article presents the possibilities of creating expert knowledge on aligning tax systems with corporate business strategies which can help identify new perspectives for the management of companies in the changing legal environment in which they operate. The lack of comprehensive theoretical research on creating expert knowledge regarding the alignment of tax systems with business strategies has led to an attempt at theoretical analysis and empirical research to fill an identified gap on this matter by deepening the understanding of the knowledge creation processes in this area. The considerations made are based on empirical research conducted in 250 companies that use tax systems in their business strategy. The research procedure involved conducting a survey among randomly selected large and medium-sized Polish enterprises, using the CATI Support method, taking into account the Mann-Whitney U test. This article supports the current view that a higher level of alignment between tax systems and business strategy is more likely to affect large companies than medium-sized ones. What is more, the issue of creating expert knowledge on aligning tax systems with corporate business strategies is important and topical, as there are differences in the perception of the alignment between tax systems and corporate business strategy between corporate executives and tax professionals.

Keywords: Enterprise Business Strategy, Company Tax Policy

1. Introduction

The high dynamics of changes in the area of tax regulations in Poland have resulted in companies being forced to take steps to align their business strategies with existing tax systems. The combination of the two key areas, tax and strategic, requires knowledge to recognize the functioning mechanisms of the strategic areas of business management in the context of possible tax solutions. This means that maintaining the advantageous stability of the company in relation to the legal environment requires the creation of expert knowledge on aligning tax systems with corporate business strategies. Building a company's tax policy on the potential of expert knowledge on aligning tax systems with corporate business strategies can be a source of competitive advantage for the company. Therefore, the study attempts a theoretical analysis and empirical research to investigate whether tax policy is part of a company's business strategy, and whether the companies adjust tax policy with business strategy, by increasing the understanding of the processes of creating expertise in this area. On the other hand, the study draws attention to the perceptions of the alignment of tax systems with corporate business strategy by both managers and tax professionals. The empirical research was conducted on a sample of 250 companies, large and medium-sized, which use tax policy during implementation of their business strategy. The research procedure was carried out on the basis of a survey questionnaire using the CATI Support method. Mann-Whitney U was used to check that the study groups were drawn from the same population. This study assumes that a higher level of alignment between tax policy and business strategy is more common for large companies than for medium-sized ones. It was also assumed that the problem of creating expert knowledge on aligning tax systems with corporate business strategies would be characterized by a dichotomy, consisting of differences in the perception of this alignment by corporate management and by tax professionals.

2. The Role of Taxation Knowledge in the Implementation of Corporate Business Strategy

It is assumed in the literature that the tax system is constituted by legal norms on taxes in a broad sense (Saskia, Pierk, 2020, Slemrod, Gillitzer, 2014). In this context, the tax system is defined as all taxes in force together in a country, linked by a main idea in such a way that they form an organizational whole, both legally and economically (Harpaz, 2021). This means that a tax system is an ordered set of taxes applicable to taxpayers at a given time and in a given country (Bierbrauer, et al, 2021).

Knowledge of the applicable tax system is becoming a significant determinant in running a business. Moreover, effective business management should be based on analysis of potential tax solutions (Shao, Xiao, 2019, Shevlin, et al, 2019, Wang, Zhu, 2023, Lawle, Worley, 2006) as they affect the accuracy of financial and operational decisions taken within the company. The choice of tax options, i.e. the development of a tax policy, requires adequate expertise, which is essential to assess the relationship between the potential of the company and the potential of the tax system. Therefore, an important element of a company's tax policy is to analyze the impact

of changes in tax laws, their interpretation, the ways in which tax authorities apply legal norms, as well as announcements concerning the expected shape of the tax system (Heimberger, 2021). A detailed analysis of the tax environment allows for the implementation of a tax policy designed to support the company's general operating strategy, while minimizing tax risks and charges and ensuring the company's security.

The company has a choice of two options when it comes to building a tax policy and responding to existing tax legislation (Kerzner, 2021). It can take a more conservative or aggressive approach. Conservative tax policy is the fulfilment by the taxpayer of all tax obligations arising from the scope of taxation in order to avoid disputes with the tax authorities (Zwick, 2021). It is about ensuring the greatest possible tax security by correctly identifying tax obligations and determining tax liability (Khmyz, et al, 2023). The company itself does not look for ways to help minimize the tax liabilities, it does not try to take actions to anticipate the possible tax consequences of its decisions. A more aggressive approach is also to comply with all the taxpayer's obligations, using at the same time all possible ways that can help to minimize the tax burden on the way to achieving the company's goal (Baudot, et al, 2020). Prior analysis of the tax legislation, as well as specific tax liabilities, identification of tax risks and threats, helps to achieve this purpose.

Summarizing the theoretical considerations, it is worth indicating that a properly designed tax policy should encourage, on the one hand, the processes of expertise creation and, on the other hand, the implementation of the adopted strategy by companies. Therefore, focusing attention on the objective of creating a competitive advantage in the market, it should be noted that it should be considered through the prism of tax policy, seen as the activities of a company, covering all its spheres of functioning together with the entire value chain.

3. Research Procedure, Research Methodology and Characteristics of the Study Population

The research procedure involved conducting a survey among randomly selected large and medium-sized Polish enterprises. The sampling frame was the databases of medium and large companies, taking into account the records contained in the Bisnode commercial database. Companies were randomly selected from a database of around 1 million records. The CATI Support computer system then drew consecutive telephone numbers for the companies from the operator. The sampling scheme was probabilistic - simple random selection. The study was performed through the following steps:

- Design of survey questionnaires.
- Preparation of a database of companies from which companies will be drawn for the survey. From each company drawn, one manager and one specialist from the accounting and tax department will be surveyed.
- Conducting 250 interviews with management, proportionally distributed among medium and large enterprises.
- Conducting 250 interviews with specialists from accounting and tax departments in the same companies.
- Preparation of a consolidated database of respondents' answers to survey questionnaires. Conducting quantitative analyses of the data obtained using the PS IMAGO package and Excel spreadsheet.

Respondents were asked to rate each statement relating to a particular problem in the surveyed company on a 5-point Likert scale: from 1 - „ I completely disagree" to 5 - „I completely agree". The entire population consists of corporate executives and tax professionals. One managerial representative and one tax professional were surveyed from each company. Some of the analyses were carried out for the entire research sample and some separately for subgroups of managers and accounting and tax professionals. The sample includes 250 questionnaires written by managers and 250 questionnaires written by tax experts. The surveys come from 250 companies (no questionnaire was rejected – due to technically correct answers in all questionnaires). A total of 500 complete surveys were received).

Table 1: Structure of the sample by size of enterprises and type of respondent

Employee Groups			Frequency	Percentage	Percentage of valid
Management	Valid	medium-sized enterprise	242	96.8	96.8
		large enterprise	8	3.2	3.2
		Total	250	100.0	100.0
Tax professional	Valid	medium-sized enterprise	244	97.6	97.6
		large enterprise	6	2.4	2.4
		Total	250	100.0	100.0

Source: own elaboration

Based on the data summarized in Table 1, it can be concluded that the majority of respondents, both managers and tax experts, represent a group of medium-sized companies. Table 2 presents the structure of the research sample, taking into account the organizational and legal form of the companies surveyed.

Table 2: Structure of the sample by legal form of enterprises

		Frequency	Percentage	Percentage of valid	Cumulative percentage
Valid	State-owned enterprise	41	8.2	8.2	8.2
	Cooperative (production, trade, services)	15	3.0	3.0	11.2
	Public limited company	15	3.0	3.0	14.2
	Limited liability company	302	60.4	60.4	74.6
	Civil partnership	30	6.0	6.0	80.6
	General Partnership	32	6.4	6.4	87.0
	Limited partnership	20	4.0	4.0	91.0
	Other legal form	45	9.0	9.0	100.0
	Total	500	100.0	100.0	

Source: own elaboration

Based on the results of the research presented in Table 2, it can be concluded that the survey primarily found that the legal form of the surveyed enterprises was limited liability companies (60.4% of the entities surveyed). Partnerships under Polish tax law (civil, general, limited partnerships) were a total of 16.4% of the surveyed companies.

4. Analysis and Evaluation of the Alignment of Tax Policy with the Business Strategy of the Companies Surveyed

Based on the data presented in Table 3, it can be concluded that an analysis of the significance of differences using the Mann-Whitney U test indicates that large companies are characterized by a higher level of alignment between company tax systems and business strategy than in medium-sized companies. This may be due to the fact that large companies have a greater ability to generate expert knowledge about the alignment between tax systems and the company's business strategy. Moreover, large companies have the capacity, firstly to finance expertise, which is expensive, and secondly, they have the capacity to acquire this expertise in the required time, which is an important variable in the decision-making process. The research shows that, in the large companies, managers continuously monitor whether the implemented tax policy is adjusted to the established objectives of the company's business strategy. It is worth noting that the obtained survey results suggest that the majority of managers of large companies (>80%) have knowledge of what tools can be used in building and implementing a company's tax policy. In addition, it should be noted that, according to respondents, the majority of managers of large companies (>80%) are aware of how tax policy affects the work of subordinate organizational units.

Table 3: Level of adjustment of tax policy to the business strategy of medium-sized and large enterprises

Company size		At all levels of management, there is an open and comprehensible dialogue with employees about the tax policies being implemented.	The tax policy is adjusted to the needs and expectations of the management.	The tax policy is adjusted to the needs and expectations of the tax authorities.	Management checks if the objectives of the company's business strategy are coordinated with the objectives of the company's tax policy.	All planned implementations of tax policy objectives are included in the operational plans of employees responsible for tax policy implementation.	The company has identified factors influencing its tax policy.	The majority of managers (>80%) are aware of how tax policy affects the work of subordinate organizational units.	The majority of executives (>80%) are aware of the tools that can be used in building and implementing the company's tax policy.	Management continually checks that the tax policy is adjusted to meet the priority objectives of the company's business strategy.
medium-sized enterprise	U Manna-Whitneya	13000,000	14161,000	18838,500	14354,000	14077,000	12558,000	11938,500	13007,000	13014,000
	Z	-11,480	-10,853	-8,130	-10,741	-10,879	-11,776	-12,410	-11,631	-11,600
	Asymptotic significance (two-sided)	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000
large enterprise	U Manna-Whitneya	17,000	24,000	14,000	22,500	20,000	12,000	13,000	19,500	14,000
	Z	-0,934	0,000	-1,502	-0,207	-0,562	-1,654	-1,494	-0,600	-1,352
	Asymptotic significance (two-sided)	0,350	1,000	0,133	0,836	0,574	0,098	0,135	0,548	0,176
	Exact significance [2*(one-sided)]	.414[b]	1.000[b]	.228[b]	.852[b]	.662[b]	.142[b]	.181[b]	.573[b]	.228[b]

Source: own elaboration

In order to clarify the process of creating expert knowledge on aligning tax systems with corporate business strategies, respondents were asked whether the coordination of business strategy objectives with tax policy objectives affects the implementation of the company's business strategy. Additionally, respondents were asked whether tax policy objectives were taken into account in business plans, which have an impact on the understanding of the nature of the implementation of the company's business strategy. In the counterpoint, respondents were asked whether identifying the factors influencing the implemented tax policy helps to understand the essence of the implementation of the company's business strategy. The results from the understanding of the essence of the implementation of the company's business strategy are presented in Table 4.

Table 4: Understanding of the importance of implementing the company's business strategy in %

Understanding of the importance of implementing the company's business strategy			
Evaluation	coordination of the company's business strategy objectives with tax policy objectives	taking account of tax policy objectives in operational plans	identification of factors influencing the implementation of tax policy
I completely disagree	3,0	2,4	3,0
I disagree	2,4	2,4	3,8
I have no opinion	12,8	14,0	15,0
I agree	30,4	31,2	32,4
I completely agree	51,4	50,0	45,8

Source: own elaboration

Considering the survey results presented in Table 4, it is noted that the coordination of corporate business strategy objectives with tax policy objectives is an important element in the implementation of corporate

business strategy according to 81.8% of respondents. Only 5.4% of respondents disagree that coordinating business strategy objectives with tax policy objectives is an important element of implementing a company's business strategy, while 12.8% do not see a correlation. In the opinion of 81.2% of respondents, the inclusion of tax policy objectives in business plans occurs in a high degree, 14.0% of surveys and only 4.8% of respondents do not include tax policy objectives in their business plans. According to 78.2% of respondents, understanding the essence of the implementation of a company's business strategy requires the identification of the factors influencing the tax policy implemented. 15% of respondents have no specific opinion on this matter. In contrast, 6.8% of respondents stated that there are no identified factors in their company that influence the implemented tax policy.

In order to investigate whether the managers of the surveyed companies and the tax professionals working or cooperating with the surveyed enterprises have the same understanding of the essence of the implementation of the company's business strategy, both communities were asked about the coordination, consideration and identification of the factors influencing the implemented tax strategy (Table 5 and 6).

Table 5: Understanding of the importance of implementing the company's business strategy according to managers in %

Understanding of the importance of implementing the company's business strategy			
Evaluation	coordination of the company's business strategy objectives with tax policy objectives	taking account of tax policy objectives in operational plans	identification of factors influencing the implementation of tax policy
I completely disagree	0,8	1,6	1,2
I disagree	0,8	0,0	0,8
I have no opinion	6,8	7,6	8,8
I agree	15,6	15,2	14,8
I completely agree	76,0	75,6	74,4

Source: own elaboration

Analyzing the responses of the managers of the surveyed companies (Table 5) in terms of their understanding of the importance of the implementation of the company's business strategy, it is noted that for 91.6% of the respondents the coordination of the company's business strategy objectives with tax policy objectives is important or very important. Only 6.8% of respondents do not perceive an impact. Notably, only 1.6% of respondents disagree or completely disagree that it is important or very important to coordinate the company's business strategy objectives with tax policy objectives. When considering the company's tax policy objectives in the business plans, 90.8% of respondents stated that the impact was significant. 7.6% of respondents do not perceive such an impact and 1.6% of respondents disagree with the above statement. According to 89.2% of the surveyed executives, understanding the essence of the implementation of the company's business strategy requires the identification of factors influencing the implemented tax policy According to 8.8% of managerial respondents, there is no definite opinion and 2% of respondents stated that their company has no identified factors influencing the implemented tax policy. Table 6 shows the responses from the understanding of the essence of the implementation of the company's business strategy given by the tax professionals.

Table 6: Understanding of the importance of implementing the company's business strategy according to the tax professionals in %

Understanding of the importance of implementing the company's business strategy			
Evaluation	coordination of the company's business strategy objectives with tax policy objectives	taking account of tax policy objectives in operational plans	identification of factors influencing the implementation of tax policy
I completely disagree	5,2	3,2	4,8
I disagree	4,0	4,8	6,8
I have no opinion	18,8	20,4	21,2
I agree	45,2	47,2	50,0
I completely agree	26,8	24,4	17,2

Source: own elaboration

Based on the research carried out on a group of tax experts, it can be noted that only 45.2% of the respondents in this group believe that the coordination of the company's business strategy objectives with tax policy objectives is important, and only 26.8% believe that it is very important. At this point, it is worth noting that tax professionals do not fully agree with managers on the ability to coordinate business strategy objectives with

corporate tax policy objectives. The opinion of 18.8% shows that they do not recognize such an impact. Furthermore, according to 9.2% of respondents, the coordination of the company's business strategy objectives with tax policy objectives is weak or very weak.

When considering the results of the survey regarding the reflection of the company's tax policy objectives in the business plans, it should be noted that for 47.2% of the respondents in the group of tax experts, the impact is important and for 24.4% very important, which is also different from the opinion presented by the managers. Surprisingly, as many as 20.4% of respondents in the tax expert group do not perceive an impact and, according to 8% of respondents, there is little consideration of corporate tax policy objectives in business plans.

The survey found that 17.2% of respondents in the group of tax professionals completely agree that understanding the essence of the implementation of a company's business strategy requires the identification of factors influencing the implemented tax policy. Half of the respondents agree with of the above statement and 21.2% of the respondents have no specific opinion. Only 11.6% of respondents in the tax expert group said they disagreed that identifying the factors influencing the implementation of tax policy helps them to understand the essence of the implementation of the company's business strategy.

As the variables studied were mainly qualitative variables (measured on nominal and ordinal scales) a chi-square test of independence was used to examine the strength and possibly the direction of associations between variables, as presented in Table 7. The contingency coefficient, used for variables measured on a nominal scale, was used to assess the strength of the relationship between variables. If the value of this coefficient is 0, it means that there is no relationship between the variables (the variables are unrelated). If the value is close to 1 it means that there is a very strong relationship between the variables.

Table 7: Tests of significance of the dependence in the area of understanding the essence of business strategy implementation between the tax professionals and managers

Employee groups and:	Chi-square statistics	df	Asymptotic significance (two-sided)	Contingency coefficient
coordination of the company's business strategy objectives with tax policy objectives	122,357[a]	4	0,000	0,443
taking account of tax policy objectives in operational plans	134,524[a]	4	0,000	0,460
identification of factors influencing the implementation of tax policy	167,155[b]	4	0,000	0,501

a) 0% of cells (0) have an expected count less than 5. The minimum expected count is 6.00.

b) 0% of cells (0) have an expected count less than 5. The minimum expected count is 7,50.

Source: own elaboration

Table 7 presents the results of testing the relationship between the group of tax professionals and the group of managers in the area of understanding the essence of the implementation of the company's business strategy from the following perspective: coordination of the company's business strategy objectives with tax policy objectives, taking into account tax policy objectives in operational plans and identification of factors influencing the implementation of tax policy. Based on the results obtained, it can be concluded that there is a statistically significant relationship between employee group membership and views on the understanding of the essence of the implementation of the company's business strategy from the discussed perspectives in both groups.

5. Discussion

Attempting to create expert knowledge on aligning tax systems with corporate business strategies firstly requires the development of a tax policy that is in line with the current tax system in the relevant legislation. A company's tax policy should be adjusted to its business strategy.

On the basis of the empirical research carried out, it is noticeable that there are significant differences between the assessments made by the group of managers and the group of tax professionals. Based on the survey, it can be concluded that 68.8% of the tax expert respondents are of the opinion that tax policy is part of the company's business strategy. Among managers, the above view is shared by more than 92%. This may suggest that respondents from the tax expert group, are aware that the tax system is directed to optimize the tax liability to the state budget, and not to minimize the tax burden on companies. It can also be inferred that among the

management representatives, there is a high level of trust in the knowledge of tax professionals, or their knowledge of taxation is characterized by a high level of optimism. This indicates the existence of a dichotomy in the perception of the alignment between corporate tax policy and business strategy in the group of managers and the group of tax experts.

Addressing the noted research gap, it is important to highlight that the differences in perceptions of the alignment of corporate tax systems with business strategy between business executives and tax experts, results from their different perspectives, goals and scopes of knowledge of the two groups. From a management process perspective, it should be noted that the company's managers focus their activities on implementing the overall strategy, achieving business goals and realizing long-term vision. This group views the tax system as a tool to support business objectives, such as increasing revenue, entering new markets, or enhancing profitability. In contrast, tax experts perceive the tax system as a legal solution that applies to a business entity. Therefore, the primary goal of tax experts is to ensure compliance with tax regulations while minimizing tax risks.

Considering the range of knowledge and specialization between business managers and tax experts, it is worth emphasizing that the first group is characterized by general knowledge of tax systems but may not necessarily be familiar with the substantive details of this field. Therefore, managers may underestimate the importance of certain tax aspects that can affect the compliance and efficiency of tax systems. The range of knowledge and specialization for tax experts is characterized by detailed subject matter expertise. They are aware of subtle differences in the interpretation and application of tax laws, which affects their assessment of how the tax system fits into their business strategy.

The company's goals and adopted priorities are also viewed differently by managers and tax experts. The priority of managers is to execute business strategy, while tax issues are often seen as secondary by this group. This makes executives more likely to take tax risks if it helps achieve business goals. Moreover, managers' assessment of tax risks is often treated as one of many business risks, so this group is more willing to accept them in exchange for potential benefits. For tax experts, the goal and priority is to minimize tax risks and comply with regulations. Therefore, tax experts are characterized by greater conservatism and a desire to avoid risk, even at the expense of reduced business flexibility. In addition, tax experts tend to view tax risk as a significant threat that can affect a company's reputation and financial stability.

Differences in perceptions of the alignment of corporate tax systems with business strategy affect the communication processes between the various functional units of the company. This may be because managers do not always understand the importance of substantive issues arising from tax systems that are relevant to tax experts, and experts may not know the full strategic context for their business. It should be emphasized that managers have the final say in shaping business strategy and may be less concerned with tax issues as they focus on value-added. However, the task of tax experts is to focus on compliance and risk, not necessarily on the potential strategic benefits that the tax system might bring to the business strategy.

It should be added that the assumption made that a higher level of adjustment between tax policy and business strategy is more often the case for large companies than for medium-sized ones has been confirmed. This is due to the interpretation of the results obtained, which allow us to notice a slightly higher awareness of the implemented tax policy as part of the company's business strategy, in the group of large companies. This may indicate that, in large companies, the creation of tax expertise is part of the company's business strategy.

6. Summary

Research on the creation of expert knowledge on aligning tax systems with corporate business strategies was made on the basis of the literature on the subject, taking into account the current state of the law in Poland and empirical research. The considerations highlighted in this study enabled the achievement of the research goal, which was to investigate whether tax policy is embedded in a company's business strategy, and whether the companies studied adapt tax policy to business strategy, by deepening the understanding of the processes of creating expertise in this area.

The research carried out led to the following conclusions:

- an examination of the level of alignment between tax systems and the business strategies of medium-sized and large enterprises suggests that a higher level of adjustment between tax policies and business strategies is more common for large enterprises than for medium-sized enterprises, as large enterprises have a greater capacity to generate expertise on the adjustment between tax policies and the enterprise's business strategy,

- coordination of business strategy objectives with tax policy objectives is an important element in the implementation of corporate business strategy,
- the existence of a dichotomy between a group of tax experts and a group of management representatives in coordinating the company's business strategy objectives with tax policy objectives was identified.

Creating expertise on matching tax regimes with a company's business strategy can contribute to new perspectives on the management of companies operating in a changing legal environment. The legal environment, including tax laws, is dynamic and changes with economic and political developments. Therefore, expert knowledge enables managers to understand current changes in tax law, anticipate future changes and adjust their business strategies. Expert tax knowledge allows managers to identify tax optimization opportunities. This enables managers, together with tax experts, to strive to minimize the tax burden in a legal and efficient manner, resulting in a more competitive and profitable business. Aligning tax systems with business strategy allows them to be fully integrated. Executives can develop strategies that achieve business goals on the one hand and take into account tax benefits and risks on the other. This integrated approach can increase management efficiency and contribute to better use of available resources. What's more, the volatility of tax laws creates risks for businesses. Therefore, the knowledge of tax experts helps identify potential tax risks and develop strategies to minimize their impact on business, which translates into financial stability and security. Expert tax knowledge can help identify tax credits, subsidies and other incentives to support innovation. Executives can then integrate these incentives into their business strategy, allowing them to increase investment in research and development, creating new products and services and improving their competitive position. In the era of globalization, many companies operate in international markets. In this context, expert knowledge enables managers to understand different tax regimes and their impact on international operations, allowing for better management of corporate structure, finances and capital flows.

In conclusion, it is important to state that the creation of expert knowledge on aligning tax systems with corporate business strategies can contribute to the creation of new perspectives on the management of companies in the changing legal conditions of their operation. However, the processes of creating expert knowledge about the adjustment of tax policies with companies' business strategies are perceived differently by tax professionals and managers. Furthermore, differences also exist when the issue of creating expert knowledge on aligning tax systems with corporate business strategies is considered through the perspective of company size, leading to further research and exploration in this area.

References

Baudot, L., Johnson, J. A., Roberts, A., & Roberts, R. W. (2020). “Is corporate tax aggressiveness a reputation threat? Corporate accountability, corporate social responsibility, and corporate tax behavior”. Journal of Business Ethics, 163, 197-215.

Bierbrauer, F. J., Boyer, P. C., & Peichl, A. (2021). “Politically feasible reforms of nonlinear tax systems”. American Economic Review, 111(1), 153-191.

Chyz, J. A., Gaertner, F. B., Kausar, A., & Watson, L. (2019). “Overconfidence and corporate tax policy”. Review of Accounting Studies, 24, 1114-1145.

Harpaz, A. (2021). “Taxation of the digital economy: Adapting a twentieth-century tax system to a twenty-first-century economy”. Yale J. Int'l L., 46, 57.

Heimberger, P. (2021). “Corporate tax competition: A meta-analysis”. European Journal of Political Economy, 69, 102002.

Kerzner, H. (2021). “Project Management case studies”. John Wiley & Sons, Inc., Hoboken, New Jersey.

Khmyz, M., Petkov, S., Mylyanyk, Z., Mazur, Y., Koziar, R., Hudyma, V., & Prots, I. (2023). “Digitalisation of the Tax System and Tax Regulation as a Tool to Combat the Shadow Economy”. Path of Science, 9(9), 1008-1014.

Kohlhase, Saskia, and Jochen Pierk. "The effect of a worldwide tax system on tax management of foreign subsidiaries”. Journal of International Business Studies 51 (2020), 1312-1330.

Lawle, E.E., Worley, C.G. (2006). “Built to Change: How to Achieve Sustained Organizational Effectiveness”. Jossey-Bass, San Francisco.

Meyer, C.B., Stensaker, I.G. (2006). “Developing Capacity for Change”. Journal of Change Management. Vol. 6.

Shao, Y., & Xiao, C. (2019). “Corporate tax policy and heterogeneous firm innovation: Evidence from a developing country”. Journal of Comparative Economics, 47(2), 470-486.

Shevlin, T., Shivakumar, L., & Urcan, O. (2019). “Macroeconomic effects of corporate tax policy”. Journal of Accounting and Economics, 68(1), 101233.

Slemrod, J., & Gillitzer, C. (2014). “Tax systems”. Cambridge, MA: MIT Press.

Wang, X., & Zhu, L. (2023). “How does export VAT rebates policy affect corporate investment efficiency? Evidence from corporate tax stickiness”. Pacific-Basin Finance Journal, 82, 102130.

Zwick, E. (2021). “The costs of corporate tax complexity”. American Economic Journal: Economic Policy, 13(2), 467-500.

Relevance of Higher Education for Adults in a Work-Life: A Case Study From Norway

Trygve Stølan, Hanne Haave, Linda Kiønig and Tone Vold
Inland Norway University of Applied Sciences, Norway

Trygve.stolan@inn.no
Hanne.haave@inn.no
Linda.kionig@inn.no
tone.vold@inn.no

Abstract: This case study is conducted in the spring semester of the first year, testing out organizing the mandatory assignments allowing to coordinate the two courses offered: "Project Management" and "Digital work forms in organizations", and facilitate for the students to utilize their own organization as a basis for the case in the assignment. The study programme of Bachelor in Organization and Management consists of a total of eight courses, each semester offering two courses parallel to each other. The students are adult employees and attend two-day seminars five times per semester. The research for this paper will be qualitative in conducting semi-structured interviews. The aim of the research will be to unveil if this has had an impact on the perception of relevance, and their learning outcome. The results will show how successful this "merger" regarding the assignment between the two different courses, based on how the students perceive the outcome to support the relevance regarding their job situation. Moreover, how they perceive the learning outcome from looking at the same case from the perspective of two different curricula will be interesting and may influence the way one organizes future training in higher education institutions.

Keywords: Relevance, Learning, Facilitation, Assignment From one's own Organization

1. Introduction

At the Inland Norway University of Applied Sciences, Rena, the adaption of study programmes has been an ongoing process. The adaption is mainly about meeting the needs of adult students, of whom many are in a worklife. This lifelong learning perspective, combined with providing the students with up-to-date course content, and contributing to the students' perception of relevance of the courses, has been the primary focus from the lecturers' point of view.

Both lifelong learning and the worklife relevance of education are promoted as guidelines for higher education by the Norwegian Government in the white papers (White Paper 16 (2019-2020), White Paper 14 (2019-2020)). To help facilitate this, a high degree of student involvement and engagement is suggested.

At the Inland Norway University of Applied Sciences, Rena, the concepts of a "flipped classroom" and "student involvement" have been developed over several years (Vold, 2014, Nematollahi et al., 2015, Bishop and Verleger, 2013). Hence, there are already opportunities for the students to utilize their own workplaces in their mandatory assignments, which have been tested out and implemented as a standardized work form in the course delineation.

In this study, the student involvement was taken to another level, as some of the students preferred the approach to utilizing their own organization as a case to a degree, in which they suggested integrating and combining the mandatory assignments in two different courses. Even if the courses in the bachelor's degree are designed to complement and build on each other, a joint mandatory assignment has never been tested out. They are to write a thesis at the end of their BA, in which they are encouraged to utilize the courses they have been exposed to, although the courses leading up to this have never been a subject of being combined.

In the following, we will present the two different courses in which a joint mandatory assignment has been tested out, how this pilot was planned and the theoretical foundation that we build for our understanding of the reasoning behind this undertaking. We then present the methodological approach to our data collection, before we present and discuss our data. We conclude on the result of our pilot project, point towards improvement points and present our suggestions for other scholars who would like to test this at their own university.

1.1 The Case Study

The two courses ("Project management" and "Digital work forms in organizations") are taught as seminar-based in the spring semester, with each seminar lasting two days with one course per day. Both courses have

mandatory assignments. In the course "Project management", the assignment has been based on up-to-date cases from the news. In the course "Digital work forms in organizations", the mandatory assignment has for several years offered a choice of either working on a case developed by the teacher – or utilizing their own organization as a basis for the case development.

Both lecturers are generally open to- and encourage student involvement and input. During this semester, the student representatives suggested merging the two assignments, and utilizing the learning from both courses into one assignment. The argument they presented was that they would profit from using one case to discuss the two different perspectives that the two courses offer.

Perceiving this as a novel idea and a possibility to develop the courses, the two mandatory assignments were merged, keeping the opportunity for students who wanted to write two assignments, or who only attended one of the courses, to write separate assignments. It was decided to form an assignment that would have the students tying the curriculum in both courses to one of the group members of their own organization.

The students were encouraged to work in groups of 3-5 students. The feedback would be given to the groups from the different lectures, which meant we had to make them hand in the assignments in both courses in the LMS system (Canvas).

Forty-three students chose to use this opportunity. Some students misunderstood, and chose a case developed by one of the teachers (hence, not writing about their own organization), and still write one assignment with the two perspectives.

2. Theoretical Foundations

The relevance of education is often tied to the perceived connection of curriculum to one's own personal background. This was recognized by the American pragmatists Dewey (1938) and James (2020) as they, amongst others, have pointed out the importance of interest of an area and its connection to learning. Hidi and Renninger (Renninger and Hidi, 2011, Hidi and Renninger, 2006) have developed a four-phase model of interest development. For example, the first phase: "triggered situational interest" is about being triggered by- and gaining interest by being exposed to a case or text. This phase may evolve into the phase of "maintained situational interest", which is about being continuously exposed to the area of interest by perceived meaningful tasks, instructional conditions and learning environments. In turn, this may develop into the "individual interest" phase, and then into a "well developed individual interest" phase. The "individual interest" is based on the individual's emerging interest characterized by positive feelings and stored knowledge and is about reengaging and developing their own "curiosity" about a certain topic or content. The process has a resemblance to Bloom's taxonomy (Bloom et al., 1956), which is about developing cognitive skills from merely remembering content to producing new and original work. However, this still requires some external support in the form of encouragement by peers or experts, e.g., teachers. Obtaining this level of individual interest will probably allow one to be able to pursue the work or questions they seek answers for, even if they face difficulties (Hidi and Renninger, 2006). The fourth phase of the model is about a "well-developed individual interest" (Hidi and Renninger, 2006). This enables a student to endeavour on larger tasks, as the individual interest promotes the perseverance of long-term work. However, the student may benefit from external support and a supportive learning environment.

Highly inspired by John Dewey, David A. Kolb (1984) developed the experiential learning cycle which describes how to prepare for, executing and gaining experience, and to reflect on and conceptualize as a preparation for new active experiencing. This is often referred to within the field of Organizational Theory (Filstad, 2022), and combining the theory with the students' assignments, e.g., allowing them to reflect on actions that have taken place to better understand theory, which may also trigger the individual interest of the students, as it provides them with a link to their own experiences. The actions may be tied to the curriculum in the different courses. In Project Management, it may be about how to pinpoint milestones in a project, while in the course of Digital work forms in organizations, it may be about the introduction of a digital tool, and how this has affected the organization.

In many ways, this relates to Bloom's taxonomy (Bloom et al., 1956) by introducing knowledge, supporting comprehension, encouraging application and a following analysis and synthesis, and lastly encouraging the students to evaluate. The knowledge is presented in the courses through lecturing, video recordings, podcasts and other available materials. The comprehension is about relating the curriculum (knowledge) to examples,

and then tying it to their own background by applying the acquired knowledge. Then, through the assignments, they are to analyse and synthesize the outcome, as well as evaluate this outcome.

Reflection is therefore a common theme within both organizational theory and learning theory (Boud et al., 1985). Reflecting in order to learn and understand is also important to help facilitate in a classroom setting. Assignments and groupwork may aid in the facilitation of reflection. Schön (1987) has contributed to understanding reflection, and how it supports in understanding and developing knowledge. His seminal work on developing reflective practitioners includes reflection in different versions. Reflection in an action obviously requires being in a situation or an action. Nevertheless, reflection on action may refer to reflecting on something that has taken place. Also, allowing the space of time between the reflection and the action may influence the outcome of the reflection and support critical thinking (Moon, 2004, Moon, 2008).

Making students work in groups may support theories of social learning (Vygotsky, 1978). Learning with and from others, and their experiences, may also contribute to a sense of connection and the development of friendships. To develop a mandatory assignment together with others may also encourage a sense of respect, a feeling of achievement and confidence (level 4 in Mazlow's hierarchy of needs) (Maslow, 1981). Developing the inner potential (level 5), in addition to the use of "peak experiences" (Feigenbaum, 2024), may also connect to the development of the individual interest (Hidi and Renninger, 2006) of the learners.

Making students work in groups may also resemble the way they have to work within their organizations. In an organization, this may refer to Communities of Practices (CoP) (Lave and Wenger, 1991). CoPs are often created to solve different problems, as the members are "pursuing shared enterprises" over time (Wenger, 1998). The members are engaging in social learning, as they seek meaning and identity within the social practice.

Learning in teams has also been described within the frames of Organizational Theory. Senge (1992) has explained that learning in teams is one of five disciplines that will support developing a learning organization. Team learning is about collaborating in a group to obtain a common goal. This requires interaction and coordination between the group members, something which in turn supports a learning process, both within the group and the individuals in the group.

3. Methodological Approach

Regarding case studies, Yin (2003) suggests to select a topic, identify research questions and clarify the boundaries of the case study. The data in this paper is collected using a qualitative approach (Patton, 2002) as a follow-up of an educational pilot project. We were three researchers conducting a group interview with four students, using a semi-structured interview guide. Our informants were chosen by use of purposeful sampling (Patton, 2002), and were recruited among a group of adult students taking part in the project. The informants were two women and two men, of whom three had a longer work-life experience, with one being relatively newly educated. Of the four interviewees, two are students' representatives, and thus more interested in participation and commitment to their studies.

During the group interview, one of the researchers had the role as a moderator, while all three took notes of the informants' conversation and discussions. Posterior to the meeting, we reflected on what we thought had come out of the discussion. Later, we wrote out and shared our notes, the next step being to analyse the material by themes and categories, and discuss our findings against relevant theories.

4. Results and Discussion

The project is basically about trying out a particular educational scheme by combining the assignment in two courses and allowing cases from students' own worklife practices. The success of the project depends on how the students respond to the assignment. As a follow-up, we wanted to investigate the effects on the students perceived learning outcome, as well as the relevance of the study for their worklife.

4.1 Combined Assignment in two Courses

The students were positive about having the opportunity to choose between different tasks in the work requirement. "*It's nice to be able to choose"* as one of the respondents articulated. When it comes to how the assignments were communicated and presented, the students' opinion was that due to the short time for preparation and design, the assignments were somewhat unclear or imprecise. Nonetheless, this still mostly went well with the students. We found that a prerequisite was a very good dialogue between students'

representatives and the teachers, who take them seriously and meet the students' expectations and questions. The teachers do facilitate the students to obtain the optimum yield from their studies.

4.2 Cases from Students' own Worklife

To work with tasks from their worklife depends on the students having recognition and experience relevant to the knowledge. This in turn can lead to sharing experiences with other students in their group, *"How have you done this in your workplace? Oh, then I can do this in mine"*. Even the student with less work and project experience reports being able to gain insight and learn from other people's experiences – and this shows that even those with little work experience benefit from- and learn from others. They recognize the situation presented by theories in the studies and are able to obtain having their own knowledge confirmed. For example, they mentioned, *"How to structure the knowledge you have?"* and *"How to handle conflict processes?"* This suggests the direct connection to their work and thus background, as per Dewey (1938) and Kolb (1984). These reflections (Boud et al., 1985, Moon, 2004, Moon, 2008, Schön, 1987) show that they are able to turn the learning into knowledge and start analysing, synthesizing, and even evaluating their learning (Bloom, 1956, Anderson and Krathwohl, 2001).

4.3 Work Forms: The Students own Informal Organization of the Learning Process

Another prerequisite we found is that the students are organized as a team and have developed their own informal studies. They meet regularly via Teams, with one meeting before the gathering and one after. They prepare themselves by going through the curriculum. They also work together during the assemblies, right after the lecture. This is about building relationships and has a great educational benefit. This resembles both CoP (Lave and Wenger, 1991), as they are "joining forces" for a common goal, and Team Learning (Senge, 1992) as they collaborate and learn from each other.

4.4 Learning Outcomes

Regarding learning outcomes, we asked the students, *"What is your experience in terms of the learning outcomes, what types of tasks do you learn the most from?"* As the studies are organized as being seminar-based, our informants find that these intensive sessions work better because they provide the opportunity to go from theory to practice. They also find that group work offers significant learning opportunities, as they find it useful to join other fellow students to share experiences and discuss. They claim that groupwork supports an enhanced learning outcome. The applicable part of the study is of course also the individual. One student claimed that they started out as "unskilled" managers who want to bring in theory that can be used – and translated it into their own practice. By going through the learning processes, they develop as managers. This, again, shows a learning outcome of working in groups/teams learning with, and from each other (Vygotsky, 1978, Senge, 1992, Wenger, 1998, Lave and Wenger, 1991).

4.5 Relevance of the Study

In our opinion, our study shows that in the content of the case study (testing out a joint mandatory assignment in two courses and utilizing the same basis of the assignment) that the students use to obtain an enhanced learning outcome. This includes utilizing the students' own backgrounds, and according to our informants learning both from and with each other is a vital contribution to how they can utilize the knowledge, and draw relevance of the study. The students report that they can relate experiences from their own work practice to the theories of the studies and learn from them to become better managers. One of the students has worked with a digitalization development project in his own organization and recognizes the topic in both project management and digital working methods. One comment that confirms this is: *"Heuristically intuitive: I have done this at work, and this is how I can improve myself."* They are generally very positive regarding linking knowledge from the study to their own work. They recognize the situation, they get their knowledge confirmed, and they recognize oneself in the study.

5. Conclusion

The project is basically about seeing the effects of a particular educational scheme, and what the students get in return. Success depends on whether the students respond. The subject teachers organizing is the starting point, as they take up the idea of a joint task/practical case and implement it. The sample of informants is

significant, as these students seem to be more than average interested in participation and commitment to their studies.

The findings from the interviews show us that the students' individual starting points/experiences are of importance. The students own informal organization of the learning process is of great importance for their perceived learning outcome. Working in self-organized students' groups with the assignments enhances the learning outcome, and contributes to the relevance of the education.

References

ANDERSON, L. W. & KRATHWOHL, D. R. 2001. A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives: complete edition, Addison Wesley Longman, Inc.

BISHOP, J. & VERLEGER, M. 2013. The Flipped Classrom: A Survey
of the Research. 120th ASEE Conference & Exposition. Atlanta.

BLOOM, B. S. (ed.) 1956. Taxonomy of Educational Objectives, the classification of educational goals – Handbook I: Cognitive Domain, New York: McKay.

BLOOM, B. S., ENGELHART, M. D., FURST, E. J., HILL, W. H. & KRATHWOHL, D. R. 1956. Taxonomy of educational objectives: The classification of educational goals. Handbook 1: Cognitive domain, Longman New York.

BOUD, D., KEOGH, R. & WALKER, D. (eds.) 1985. Reflection: Turning Experience Into Learning, London: Kogan Page Ltd.

DEWEY, J. 1938. Experience & Education, New York, Touchstone.

FEIGENBAUM, K. D. 2024. A Critique of Abraham Maslow and Carl Rogers as Educators. The Journal of humanistic psychology, 64, 44-63.

FILSTAD, C. 2022. Organisasjonslæring : fra kunnskap til kompetanse, Bergen, Fagbokforlaget.

HIDI, S. & RENNINGER, K. A. 2006. The four-phase model of interest development. Educational psychologist, 41, 111-127.

JAMES, W. 2020. Pragmatism. Pragmatism. Routledge.

KOLB, D. A. 1984. Experiential learning: experience as the source of learning and development, Englewood Cliffs, N.J., Prentice-Hall.

LAVE, J. & WENGER, E. 1991. Situated learning - Legitimate peripheral participation, Cambridge, Cambridge University Press.

MASLOW, A. H. 1981. Motivation And Personality: Motivation And Personality: Unlocking Your Inner Drive and Understanding Human Behavior by AH Maslow, Prabhat Prakashan.

MOON, J. A. 2004. A handbook of reflective and experiental learning: theory and practice, London, RoutledgeFalmer.

MOON, J. A. 2008. Critical thinking: an exploration of theory and practice, London, Routledge.

NEMATOLLAHI, S., ST JOHN, P. A. & ADAMAS-RAPPAPORT, W. J. 2015. Lessons learned with a flipped classroom. Medical Education, 49, 1143-1143.

PATTON, M. Q. 2002. Qualitative research & evaluation methods.

RENNINGER, K. A. & HIDI, S. 2011. Revisiting the conceptualization, measurement, and generation of interest. Educational psychologist, 46, 168-184.

SCHÖN, D. A. 1987. Educating the reflective practitioner, San Francisco, Calif., Jossey-Bass.

SENGE, P. M. 1992. The fifth discipline : the art and practice of the learning organization, London, Century Business.

VOLD, T. How Can the Concept of "Flipped Classroom" Support the Development of Reflective Practitioners in Higher Education? . ITHET2014, 2014 York, UK. University of York, UK.

VYGOTSKY, L. S. 1978. Mind and society: The development of higher mental processes, Cambridge, MA, Harvard University Press.

WENGER, E. 1998. Communities of practice: learning, meaning, and identity, Cambridge, Cambridge University Press.

WHITE PAPER 14 (2019-2020) The Skills Reform - Lifelong Learning,. In: MINISTRY OF EDUCATION AND RESEARCH (ed.).

WHITE PAPER 16 (2019-2020) Education for change - Enhanced worklife relevance in higher education,. In: MINISTRY OF EDUCATION AND RESEARCH (ed.).

YIN, R. K. 2003. Designing case studies. Qualitative research methods, 5, 359-386.

Managing Knowledge in a Tourism Crisis: A Case Study From Poland

Ewa Stolarek-Muszyńska[1*], Malgorzata Zieba[2], Ettore Bolisani[3] and Enrico Scarso [3]
[1] Doctoral School, Gdansk University of Technology, Poland
[2] Division of Management, Gdansk University of Technology, Poland
[3] Department of Management and Engineering - University of Padua, Vicenza, Italy

ewa.stolarek-muszynska@pg.edu.pl
mz@zie.pg.gda.pl
ettore.bolisani@unipd.it,
enrico.scarso@unipd.it

Abstract: Purpose: This study deals with a tourism organisation from Poland, which experienced not only the COVID-19 pandemic, but also the close war situation in Ukraine which caused a significant decrease in tourist traffic and revenues. Since, based on the literature, knowledge management can be useful for crisis management, this study aims to explore the role and usefulness of KM during crisis situations in tourism. Methodology: Qualitative in-depth analysis was conducted by using data collected via semi-structured interview with the CEO of a local tourism organisation in Poland. The research output is presented in the form of a single case study with that organisation as the unit of analysis. Findings: The case highlighted that: a) a crisis may not be the most appropriate time for the implementation of KM from the scratch in an organisation; b) having some minimal KM experience can be essential for a more structured and complex KM approach; c) organisations may benefit from lessons learned during the crisis to get insights for developing KM. These findings suggest that practitioners and policymakers facilitate KM awareness among tourism organisations to enhance resilience in coping with future crises. Research limitations: This is a single case study and thus it cannot be easily generalised or provide a comprehensive overview of the whole sector. It is also a case study from a single country, affected by two serious crises which limits the applicability of the results to other countries. Practical implications: The study provides useful insights for practitioners in tourism organisations aspiring to improve internal processes of knowledge management and thus mitigating the future tourism crises. Originality/value: This paper contributes to the body of knowledge in terms of the role and relevance of KM during the tourism crisis. It provides food for thought for researchers investigating the knowledge and crisis management processes within the tourism industry.

Keywords: Knowledge Management, Tourism Crisis, Tourism, Case Study

1. Introduction

Knowledge management has proven its applicability and usefulness in many different organisational contexts and areas. According to some studies, knowledge management can support many organisational activities, such as innovation management (Andreeva and Kianto, 2011; Vaccaro et al, 2010), organisational performance (Junges et al, 2015), or sustainability (Martins et al, 2019). Knowledge management has also been useful in many different sectors, for example for the organisations from the KIBS (knowledge-intensive business services) sector (Zieba, 2021), construction industry (Fong and Choi, 2009) or tourism industry (Anand et al, 2023; Martínez-Martínez et al, 2015).

Knowledge management has also been indicated as potentially useful in case of a crisis or disaster situation in tourism (Mistilis and Sheldon, 2006). Defining a crisis in tourism is a challenging task as there is no one single agreed-upon definition in the literature – and the definitions that appear usually are used to describe a particular crisis context (Santana, 2004). Sönmez et al (1994) affirms that a tourism crisis in general is "any occurrence which can threaten the normal operation and conduct of tourism related businesses; damage a tourist destination's overall reputation for safety, attractiveness and comfort by negatively affecting visitors' perceptions of that destination". Examples of crises can be natural disasters, like earthquakes, tsunami or volcano eruptions.

Although there are some studies indicating the usefulness of knowledge management in a crisis situation in the tourism industry (Barišić et al, 2020; Orchiston and Higham, 2016; Racherla and Hu, 2009), it is still unclear how tourism organisations manage their knowledge during a crisis. To fill this knowledge gap, this paper is going to explore the topic in a sample tourism organisation from Poland. The case study presents managing knowledge by this kind of organisation in a crisis situation caused by COVID-19 and the war in a neighbouring country (Ukraine). This research is preliminary and exploratory in nature, as it is based on a single case-study.

This paper develops as follows. First, knowledge management in the crisis in tourism is described. Second, the methodology of the study is presented and third, the findings are described. The paper ends with the discussion section and conclusion and future research avenues.

2. KM in Crisis in Tourism

The relationship between knowledge management (KM) and crisis management has been extensively examined, with numerous studies underscoring the significance of robust KM practices in effectively handling crises (Anand et al., 2023). However, research has been diverse and somewhat scattered across various subjects of analysis, such as: military and war scenarios from the perspectives of states and peacekeeping organisations (Bolisani and Damiani, 2010), natural disasters (Dorasamy et al, 2013), medical emergencies (Wickramasinghe et al, 2006), economic crises (Ponis and Koronis, 2012), and disruptions in logistics and supply chains (Ponis and Ntalia, 2016).

Knowledge in crisis can serve as means of support in mitigating the effects of the crisis events. It may assist organisations in overcoming early challenges arising from a crisis, supporting the development of new knowledge, and facilitating the application of lessons learnt (Ng et al, 2022). Additionally, it can hinder possible damages and reinforce defence mechanisms (Kir Kuščer et al, 2021), as well as contribute to ensuring the safety of workplace and employees (Schiuma et al, 2021). Ongoing knowledge exchange, in the form of systematic updates of the tourism industry, can successfully foster organisations during the crisis response stage (Orchiston and Higham, 2016).

Knowledge management can function as an invaluable instrument, enhancing organisational resilience and fortifying their defensive strategies (Paraskevas et al, 2013), therefore creating a centralised knowledge repository (Racherla & Hu, 2009) becomes vital for tourism companies to deal with the crises effectively. Mistilis and Sheldon (2006) affirm that knowledge is needed at various stages: before, during and after a crisis. Nevertheless, while reviewing the tourism literature, it can be stated that scholars focus on selected KM processes in relation to specific crisis phases and research on KM issues in the context of overall crisis management is limited.

While the existing studies on the relationship between KM and crisis management employ varied methodologies and perspectives, there is broad agreement on two key points. Firstly, KM practices enhance learning abilities, resilience, and preparedness of organisations in managing crises (Raman and Jennex, 2010). Secondly, the success of KM in crisis management often relies on the preemptive implementation of strategic and structured approaches (Ponis and Koronis, 2012; Wang and Belardo, 2005).

This insight presents two significant challenges for tourism organisations, a sector where the link between crisis management and KM has also been investigated to a small extent (Mistilis and Sheldon, 2006; Stolarek-Muszyńska and Zieba, 2022). This sector tends to be less organised and resilient, making it vulnerable to global disruptions, as evidenced by the recent COVID-19 crisis (Kahveci, 2023; Nilsson et al, 2023). The approach to KM in these organisations is often informal, unstructured, not strategically planned, and can be described as "emergent" – typically a response to immediate problems that need solving (Zieba et al, 2016). Unfortunately, this tendency results in inefficient responses in times of crisis due to delayed reactions.

3. Methodology

The purpose of this study is to explore in-depth the role and usefulness of knowledge management during crisis situations in tourism. As this aim is strictly context-related and “the boundaries between phenomenon and context are not clearly evident” (Yin, 2003), this research adopts a case study approach.

The study addresses the following research questions:

> RQ 1: To what extent does a tourism organisation apply KM processes during a crisis and whether this is a conscious and/or planned or unconscious and/or unplanned approach?
>
> RQ 2: How aware is the decision-maker of the tourism organisation of the potential support the KM processes offer during the crisis?
>
> RQ 3: What are the challenges related to knowledge management during the crisis?

With the view of the exploratory focus, this study is based on qualitative in-depth analysis (Creswell, 2014) and research output is presented in the form of a single case study with the organisation as the unit of analysis. Mariotto et al (2014) argues that research may benefit from the single case study approach as it provides a deep understanding of the topic that is being investigated. Primary data for this study was collected via semi-structured interview which took place in November 2023. The full interview was recorded and transcribed *verbatim* (Poland, 1995) in Polish and afterwards translated to English.

The interview was conducted with the CEO from a local tourism organisation in Poland which represents an entity within the structure of a public-private association. The organisation coordinates local marketing activities for the destination and plays a key role in the integration of the local government units and tourism industry companies from i.e., lodging sector, gastronomy, tour operator, transport, etc. As part of the subject research, a representative of the local tourism organisation operating in the metropolitan area has been chosen for in-depth analysis.

4. Findings

This section is aimed at answering the research questions based on what emerged from the analysis of the investigated case. First of all, it has to be recalled that in the last years the examined tourism organisation reported facing three relevant crises related to: the COVID pandemic, the war in Ukraine, and inflation (these are the crises the organisation faced in the opinion of the respondent). Further challenges are due to the changes in the financial structure of the local government which are affecting the amount of the local government's contribution to tourism organisations, which constitutes the majority of the organisation's budget.

According to the opinion of the organisation member, the three crises have had different impacts. In particular:

> "COVID pandemic brought out good qualities in the industry, such as the willingness to cooperate, to join forces - so this was also very beneficial in terms of even local development, gaining partners, association members, and strengthening cooperation with other organisations in the POT-ROT-LOT system".

> "The war in Ukraine. I would say, there was a positive aspect that we were able to test in practice the organisational efficiency of the organisation as such and the team".

> "…this inflation hurts us doubly. … our costs are rising … running the Tourist Information, just compared to last year, they have already risen by 50%".

All summed up, in the organisation's opinion the most prominent crisis was the one caused by the war in Ukraine.

> [The most significant crisis was] "the war in Ukraine because, due to the proximity of the border …. Tourists either postpone their visit to our city or cancel it altogether. …. our tourist influx is reduced".

Therefore, in what follows, the authors will mainly refer to the crisis caused by the war in the neighbouring country.

As concerns RQ1 - To what extent does a tourism organisation apply KM processes during a crisis and whether this is a conscious and/or planned or unconscious and/or unplanned approach – it must be said that the new, and unexpected conditions, forced the examined organisation to collect and process a lot of information concerning the Ukrainians-related touristic demand.

> "…here we can see … the impact of information management - by collaborating with members, such as cultural institutions, museums, hotels, restaurants, etc. Knowing that suddenly we have a lot of users of tourist infrastructure whose first and main language is Ukrainian. We really started to gather this information: how many of these people are there, and on the other hand gather information about adapting the tourist offer in Ukrainian, and also encouraging the creation of such an offer."

This was an unplanned activity, made easy for the organisation's flat structure and its strict relationships with the various stakeholders, which allowed to gather information, rapidly:

> "… directly from the Ukrainian refugees … or … in restaurants, hotels, accommodation places, or public utility buildings that normally operate for tourists and residents, but during the crisis also provided services directly to refugees".

Summing up, the examined organisation applied some KM processes during the crisis, but they did it in a completely unconscious way, which they confirmed by stating that:

> "… [KM] had absolutely no significance".

Coming to RQ 2 - How aware is the decision-maker of the tourism organisation of the potential support the KM processes offer during the crisis? – first it must be underlined that the organisation was completely unprepared to face the crisis, apart from the knowledge of Ukrainian language:

" … we were linguistically ready. We were actually able to provide services in Ukrainian …"

In spite of this, the organisation did not change, or at least they affirm that nothing has changed in their way of doing KM:

> "… it's hard to say that there were any additional actions undertaken … it was business as usual in terms of work … so we just continued with the team's regular schedule".

At the same time, they state that they were:

> "… organizationally agile enough to quickly respond to the emerging needs …"

and that the President of the Board was involved in communicating crucial information to the external partners.

The previous assertions further confirm that managers were involved in KM without having a clear perception of KM itself.

Concluding with RQ 3 - What are the challenges related to knowledge management during the crisis? – it was considered crucial to have all the needed information concerning the emerging new situations as soon as possible.

As concerns the activities performed by the organisation to assist refugees, and particularly the creation and managing of a helpline, they affirmed that a challenge was faced:

> "… how to collaborate with NGO. If we had [such knowledge], we would have approached cooperation in a way that better protected our organisation's interests".

Effective and rapid knowledge sharing was a particularly crucial element in acting in a crisis.

> "… I would say knowledge sharing [is an important KM element in crisis management]. Because in this particular crisis, our organisation had no knowledge about the reception of refugees. But possibly... more about knowledge sharing by other organisations with us, like [organisation name], [organisation name], which quickly helped us to make up for the shortcomings and effectively carry out the activities we started".

It must be underlined that cooperation was considered an effective way to face the KM related challenges raised by the crisis, and this was one of the most important lessons learnt by the organisation.

> "Oh, I was saying that it gave us experience in cooperating with organisations outside the tourism industry."

Cooperation also enabled the organisation to collect and process the information needed to face the crisis. This concerned also the pandemic related crisis.

> "… in the pandemic crisis, the important role of how we collected information from the industry locally was really visible. We exchanged this local-level knowledge with other organisations, and using the knowledge of these other organisations, we were able to adapt our local actions. That was very evident and very important at the time."

5. Discussion

As it can be seen on the basis of the results from the case study, some elements of knowledge management were visible in the crisis situation, although these elements were implemented rather unconsciously, meaning that the organisation did not have the awareness of the knowledge management concept itself, its elements and the usefulness of its implementation. The examined organisation has implemented elements of KM rather intuitively, responding to the needs from the environment, without planning - this kind of approach can be called "emergent approach to KM", as defined by Zieba et al (2016). It can be expected that the introduction of some basic elements of KM might constitute a base for further development - on that basis an organisation can make a reflection and draw some conclusions which can support the company in the next crisis.

It is also possible that a crisis situation is not a perfect moment for KM implementation due to various turbulences and the resources the organisation needs to appoint to deal with this crisis. It would be more advisable to implement KM earlier and adjust it to the present needs in a crisis situation (e.g., knowledge sharing with external partners indicated by the examined organisation that was implemented during the crisis). Organisations may implement some KM activities as an effect of the crisis, but during it, under the pressure, they may just implement some ad hoc activities, responding directly to the current needs.

What could be recommended for organisations dealing with crises is a self-reflection activity done after the crisis itself. Organisations could examine then what worked and what did not, as well as focus on the type of knowledge that is crucial from their perspective for crisis management. As a crisis situation is a difficult one and probably implementing changes is quite challenging then, organisations could learn afterwards and implement new solutions on the basis of lessons learnt during the crisis.

6. Conclusion and Future Research Avenues

This study endeavoured to investigate in-depth the role and usefulness of knowledge management in a tourism crisis. Two large crises, namely COVID-19 and Russian invasion on Ukraine, have proved the vulnerability of the tourism industry in Poland and clearly demonstrated that tourism organisations need to be prepared and equipped with tools and crisis knowledge in order to mitigate the impact of hazardous events, both short and long-term.

The findings from the case study point out that KM is somehow present during managing crises by tourism organisations. Even though the organisation is not aware about the knowledge management concept and the theory behind it, it can still benefit from the KM elements. Managing knowledge can be useful in the crisis (Mistilis and Sheldon, 2006), but it is vital to prepare before such hazardous events and implement KM processes earlier, as the crisis moment itself is not the best one for KM introduction due to urgent diverse organisational challenges.

This paper contributes to the body of knowledge in terms of the role and relevance of KM during the tourism crisis. It offers food for thought for researchers investigating knowledge and crisis management processes within the tourism industry. The study provides also useful insights for the practitioners from the tourism organisations sector aspiring to improve internal processes of knowledge management and thus, mitigating the future tourism crises better and easier.

As this study adopts a case study approach, it is subject to the methodology-related limitations. Research output is limited to the analysis of a single organisation and thus it does not give a comprehensive overview of the whole sector. It is also a case study from a single country, affected by two serious crises and it also limits the applicability of the results to tourism organisations from other countries.

Future research avenues may focus on expanding the initial findings from a single case-study to multiple cases in order to explore similarities or differences within the tourism industry. The subsequent research studies could entail validating the qualitative results with the use of quantitative approach. Additionally, tourism organisations from other countries could be examined, especially the ones facing similar crises (COVID-19 or other pandemic and wars in neighbouring countries). By examining tourism organisations from other countries and comparing the results, the cultural aspects of dealing with the crisis with KM support could be detected.

Acknowledgements

The authors greatly acknowledge the financial support from the National Science Centre, Poland, within the grant no. UMO-2022/45/B/HS4/02631, entitled “Knowledge management in tourism organisations in crisis.”.

References

Anand, A., Buhagiar, K., Kozachenko, E., & Parameswar, N. (2023) “Exploring the role of knowledge management in contexts of crisis: a synthesis and way forward”, *International Journal of Organizational Analysis*, 31(7), 2953-2978.

Anand, A., Shantakumar, V. P., Muskat, B., Singh, S. K., Dumazert, J. P., & Riahi, Y. (2023) “The role of knowledge management in the tourism sector: a synthesis and way forward”,. *Journal of Knowledge Management*, *27*(5), 1319–1342. https://doi.org/10.1108/JKM-02-2022-0083

Andreeva, T., & Kianto, A. (2011) “Knowledge processes, knowledge-intensity and innovation: a moderated mediation analysis”, *Journal of Knowledge Management,* 15(6), 1016–1034. https://doi.org/10.1108/13673271111179343

Barišić, Anton Florijan; Rybacka Barisic, Joanna; Miloloža, Ivan (2020) "Knowledge Management Perspective in the Tourism and Hospitality Industry", In: Proceedings of the ENTRENOVA - ENTerprise REsearch InNOVAtion Conference, Virtual Conference, 10-12 September 2020, IRENET - Society for Advancing Innovation and Research in Economy, Zagreb, pp. 114-123,

Bolisani, E., & Damiani, F. (2010) *Knowledge management in complex environments: the UN peacekeeping. Measuring Business Excellence*, 14(4), 76-84.

Creswell J. W. (2014) *Research design: Qualitative, quantitative, and mixed method approaches* (4th ed.), SAGE Publications.

Dorasamy, M., Raman, M., & Kaliannan, M. (2013) "Knowledge management systems in support of disasters management: A two decade review", *Technological Forecasting and Social Change*, 80(9), 1834-1853.

Fong, P. S. W., & Choi, S. K. Y. (2009) "The processes of knowledge management in professional services firms in the construction industry: a critical assessment of both theory and practice", *Journal of Knowledge Management*, 13(2), 110–126. https://doi.org/10.1108/13673270910942736

Junges, F. M., Gonçalo, C. R., Garrido, I. L., & Fiates, G. G. S. (2015) "Knowledge management, innovation competency and organisational performance: A study of knowledge-intensive organisations in the IT industry", *International Journal of Innovation and Learning*, 18(2), 198–221. https://doi.org/10.1504/IJIL.2015.070867

Kahveci, E. (2023) "Business strategies for small-and medium-sized tourism enterprises during COVID-19: a developing country case", *Journal of Hospitality and Tourism Insights*, 6(4), 1569-1593.

Kir Kuščer, S. E. M. P. (2021) "Tourism organizations' responses to the COVID-19 pandemic: an investigation of the lockdown period", *Current Issues in Tourism*, *25*(2), 247–260.

Mariotto, F. L., Zanni, P. P., & Moraes, G. H. S. M. D. (2014) "What is the use of a single-case study in management research?", *Revista de Administração de Empresas*, 54(4), 358–369.

Martins, V. W. B., Rampasso, I. S., Anholon, R., Quelhas, O. L. G., & Filho, W. L. (2019) "Knowledge management in the context of sustainability: literature review and opportunities for future research", *Journal of Cleaner Production*, *229*, 489–500. https://doi.org/10.1016/j.jclepro.2019.04.354

Mistilis, N., & Sheldon, P. (2006) "Knowledge management for tourism crises and disasters", *Tourism Review International*, 10(1-2), 39-46.

Nilsson, M., Ljunggren, G., & Stein, T. (2023) *Small and Medium-Sized Tourism Enterprises' Response to COVID-19: An Outlook of Business Resilience in Bali, Indonesia. Research Report,* Linnaeus University, Sweden

Ng, D. W. L., Duarte Alonso, A., Bressan, A., and Vu, O. T. K. (2022) "Impacts, lessons learnt and envisioning the future of firms under COVID-19 – implications for knowledge management", *Journal of Knowledge Management*.

Orchiston, C., & Higham, J. E. S. (2016) "Knowledge management and tourism recovery (de)marketing: the Christchurch earthquakes 2010–2011", *Current Issues in Tourism*, *19*(1).

Paraskevas, A., Altinay, L., McLean, J., & Cooper, C. (2013). Crisis knowledge in tourism: Types, flows and governance, *Annals of Tourism Research*, 41, 130–152.

Poland, B. D. (1995) "Transcription Quality as an Aspect of Rigor in Qualitative Research", *Qualitative Inquiry*, 1(3), 290-310.

Ponis, S. T., & Koronis, E. (2012) "A knowledge management process-based approach to support corporate crisis management", *Knowledge and Process Management*, 19(3), 148-159.

Ponis, S. T., & Ntalla, A. (2016) "Crisis management practices and approaches: Insights from major supply chain crises", *Procedia Economics and Finance*, 39, 668-673.

Racherla, P., & Hu, C. (2009) "A framework for knowledge-based crisis management in the hospitality and tourism industry", *Cornell Hospitality Quarterly,* 50(4), 561–577.

Raman, M., & Jennex, M. (2010) "Knowledge management systems for emergency preparedness: The way forward", *Journal of Information Technology Case and Application Research*, 12(3), 1-11.

Schiuma, G., Jackson, T., and Lönnqvist, A. (2021) "Managing knowledge to navigate the coronavirus crisis", *Knowledge Management Research & Practice*, *19*(4), 409–414.

Santana, G. (2004) "Crisis management and tourism: Beyond the rhetoric", *Journal of Travel and Tourism Marketing*, 15(4), 299–321. https://doi.org/10.1300/J073v15n04_05.

Sönmez, S. F., Backman, S. J., and Allen, L. (1994) *Managing tourism crises: A guidebook*, Department of Parks, Recreation and Tourism Management, Clemson University.

Stolarek-Muszyńska, E., & Zieba, M. (2022) "Knowledge Management for Managing Crisis in Tourism: Theoretical insights", In: European Conference on Knowledge Management (Vol. 23, No. 2, pp. 119-1157).

Vaccaro, A., Parente, R., & Veloso, F. M. (2010) "Knowledge Management Tools, Inter-Organizational Relationships, Innovation and Firm Performance", *Technological Forecasting and Social Change*, 77(7), 1076–1089. https://doi.org/10.1016/j.techfore.2010.02.006

Wang W-T and Belardo S. (2005) "Strategic Integration: A Knowledge Management Approach to Crisis Management," Proceedings of the 38th Annual Hawaii International Conference on System Sciences, Big Island, HI, USA, pp. 252a-252a, doi: 10.1109/HICSS.2005.559.

Wickramasinghe N., Bali R.K. and Naguib R.N.G. (2006) "Application of Knowledge Management and the Intelligence Continuum for Medical Emergencies and Disaster Scenarios," International Conference of the IEEE Engineering in Medicine and Biology Society, New York, pp. 5149-5152, doi: 10.1109/IEMBS.2006.260825.

Yin, R. K. (2003) *Case Study Research: Design and Methods*, SAGE Publications.

Zieba, M. (2021). *Understanding Knowledge-Intensive Business Services*, Springer International Publishing.

Zieba, M., Bolisani, E., & Scarso, E. (2016) “Emergent approach to knowledge management by small companies: multiple case-study research”, *Journal of Knowledge Management*, 20(2), 292-307.

The Integration of ChatGPT in Higher Education: A Study of Future Prospects

André Sucena[1], Sladjana Cabrilo[2] (Corresponding author) and Susanne Durst[3]
[1]NECE- Research Center for Business Sciences, Department of Management and Economics, University of Beira Interior (UBI), Covilhã, Portugal
[2]I-Shou University, Department of International Business Administration, Kaohsiung, Taiwan
[3]Reykjavik University, Department of Business and Economics, 102 Reykjavík, Iceland

andre.sucena@ubi.pt
sladjana@isu.edu.tw
susanned@ru.is

Abstract: In recent years, the integration of artificial intelligence (AI) technologies has gained widespread attention in the education sector. This study explores the impact of ChatGPT, a deep learning-based natural language model, on teaching and learning processes in Higher Education Institutions (HEIs). In the education sector, the use of ChatGPT can be a double-edged sword, on the one hand, it can lead to innovation in the sector, on the other hand, there are also risks associated with it. By reviewing scientific papers published since the launch of ChatGPT in November 2022, this study identifies and discusses the main research themes investigated as well as opportunities and risks of integrating ChatGPT in HEIs. On this basis, it provides a more comprehensive understanding of the potential role of ChatGPT and similar solutions in shaping the future of higher education. The findings inform educators, education policy makers and researchers about the ongoing discourse on the integration of AI technologies in higher education and offer practical recommendations for optimizing the benefits of ChatGPT while considering potential risk factors to optimize student learning and the learning experience in HEIs.

Keywords: ChatGPT, Artificial Intelligence, Higher Education, Higher Education Institutions, Systematic Review, Future Prospects

1. Introduction

Technological advancements, especially the new generation of artificial intelligence (AI), have emerged as pivotal change agents of work, life, and communication modes (Hill-Yardin et al., 2023). AI technologies, characterized by their capacity to process big data and simulate human-like intelligence and actions fundamentally reshape all industries and the whole society (Strzelecki, 2023; Yu, 2023; Montenegro-Rueda et al., 2023).

Generative AI differs from traditional AI models, as instead of making predictions based on identified patterns, these advanced AI models produce novel outputs and can support self-learning, meaning that they can continuously enhance people's knowledge base and improve their decision-making processes through iterative interactions with data (Yu, 2023). Furthermore, as they are powered by transformer designs, Large Language Models (LLMs) like ChatGPT (Generative Pre-trained Transformer) skillfully navigate the complexities of natural language processing and generate contextually relevant responses to prompts and inquiries. ChatGPT is a conversational AI chatbot proficient in mimicking human-like communication with the end user (Dempere et al., 2023). With around 100 million users only a few months after its release, ChatGPT has become the fastest-growing app in history (Strzelecki, 2023).

In the context of education, ChatGPT can revolutionize teaching and learning processes (Lim et al., 2023). Trained on extensive data, it can comprehend linguistic nuances and generate human-like coherent text autonomously. In HEIs, Chat GPT can positively affect various academic activities, for example, create interactive learning experiences, assist students in comprehending teaching materials (Wang et al., 2017), and facilitate personalized learning (Fuchs, 2023; Dempere et al., 2023.). ChatGPT's intuitive conversational interface facilitates real-time interaction, empowering students to seek academic assistance and clarify their doubts in real-time. Moreover, its adaptive algorithms serve individual learning styles and preferences, fostering a tailored learning experience. Personalized learning has proven to improve student's learning engagement and academic achievements (Wu, 2017). ChatGPT can also assist teachers in HEIs in creating customized learning plans tailored to the individual student's needs and enable data-driven insights into student performance and adaptive assessment (Fuchs, 2023). In general, a tailored approach to individual student needs could improve student services, student life, and student overall experience and in that way help HEIs to increase student retention (Dempere et al., 2023).

However, the integration of ChatGPT in post-secondary education is not without challenges. Although ChatGPT has the potential to improve the quality of academic writing and make research more accessible to non-experts, it also brings challenges regarding the authenticity and reliability of generated solutions and authorship issues

(Dwivedi et al., 2023). The major concerns related to using ChatGPT in HEIs are unethical data gathering, privacy issues, unlawful use of data (Dampere et al., 2023), academic dishonesty, plagiarism, and cheating (Yu, 2023; Gill et al., 2024), decreasing human interaction in the learning process (Fryer et al., 2017), over-reliance on AI and ChatGPT that can negatively impact students' cognitive abilities (Shiri, 2023; Dwivedi et al., 2023), augmenting preexisting prejudices through data training (Fuchs, 2023), AI-generated hallucination errors, that are AI-generated responses not explained by training data (Strzelecki, 2023) and finally the absence of regulation surrounding ChatGPT (Strzelecki and ElArabawy, 2024).

With potential innovations but also great challenges brought by ChatGPT into education, we have witnessed tremendous speculation among stakeholders in academia (Fuchs, 2023). Therefore, this paper positions itself within a rich debate about the possibilities and challenges of using ChatGPT in HEIs to contribute to the understanding of the positive and negative aspects of using ChatGPT in HEIs and anticipate future integration of ChatGPT and AI tools in the education sector.

2. Method

A literature review was conducted to develop a better understanding of the topic, identify gaps in knowledge, suggest promising avenues for future investigation, and locate contributions to the field of research (Donthu et al., 2021). The Web of Science database was used to identify relevant articles due to its high quality and scientific rigor, which is widely recognized in academic circles. The terms 'Chat GPT' and 'education' were used to search for relevant articles. This search resulted in 34 documents. These articles were analyzed using the VOSviewer software tool. The application of the tool led to the automatic removal of 13 articles because they were not relevant to the topic under study. A cluster analysis was performed on the remaining 21 articles.

3. Results

In this section the results of the cluster analysis are presented. To determine the most important research themes that were pursued in the reviewed articles,, bibliographic coupling was used. A minimum of five articles per cluster was required, resulting in three clusters. The analysis produced the cluster network depicted in Figure 1, which includes cluster (1) Transformation in Digital Communication, cluster (2) Chat GPT in Academia, and cluster (3) ChatGPT in the Study of Medicine.

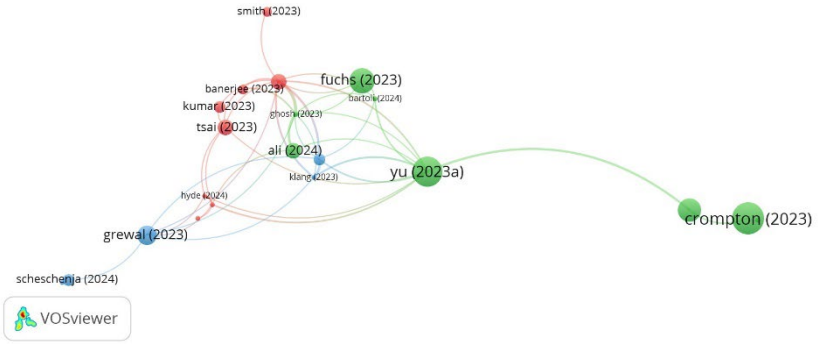


Figure 1: Bibliometric Network

3.1 Cluster 1 – Transformation in Digital Communication N = (8)

In the current digital landscape, language models like ChatGPT, which are based on advanced architectures such as GPT, play a central role in redefining the interaction between humans and machines (Chen et. al, 2024). These models not only understand linguistic contexts in an enhanced way but can generate contextualized texts, ranging from virtual assistants to autonomous content creation as well (Tsai et. al, 2023).

Despite the advances in technology, ethical considerations play a significant role in their development. It is crucial to address challenges such as bias in training data to ensure equitable application (Preiksaitis and Rose, 2023).

These technologies have vast applicability, transforming not only everyday interactions with virtual assistants but also the dynamics of digital content generation (Kumar et. al, 2023). However, ethical challenges highlight the need for constant improvement, especially regarding fairness in the use of these tools (Hyde et. al, 2024).

Current research aims to enhance the contextual comprehension of these models and effectively address the ethical challenges they pose. In the future, there is an anticipated shift towards even more natural human-machine communication, with research focusing on interpreting multimodal inputs and processing complex linguistic contexts (Smith et. al, 2023).

3.2 Cluster 2 – Chat GPT in Academia N = (8)

The use of artificial intelligence has brought about significant changes in academia, and ChatGPT, as a powerful language model, has played a crucial role in this context (Bartoli et. al, 2024). Its ability to understand and generate text contextually and coherently makes it a valuable tool for students and researchers.

However, the implementation of ChatGPT in academia poses certain challenges. Ethical issues surrounding the responsible use of technology, transparency in relation to algorithms, and concerns about possible biases built into the model are currently areas of debate (Borger et. al, 2023). Additionally, the effective integration of ChatGPT into educational processes requires careful consideration of how to balance aiding human creativity with preserving academic integrity.

However, ChatGPT presents exciting opportunities for learning and collaboration. ChatGPT can be used as a brainstorming tool to generate ideas and explore concepts (Yu and Guo, 2023). Additionally, its ability to understand specific contexts can facilitate interaction with students by offering clear explanations of complex topics and providing personalized support.

As Fuchs (2023) reiterates AI continues to evolve, so it is crucial to embrace a balanced approach to incorporating ChatGPT into academia. Exploring the capabilities of ChatGPT to enhance creativity, support teaching, and boost research can result in significant advances. However, it is imperative to address ethical concerns and ensure that ChatGPT is a tool that augments, rather than replaces, the human experience in academia (Yu, 2023).

3.3 Cluster 3 – ChatGPT in the Study of Medicine N = (5)

The integration of ChatGPT into the field of medicine marks a significant shift in the way students and healthcare professionals access information and collaborate on research. This advanced language model presents ample opportunities to improve medical learning and practice (Lower et. al, 2023).

Its capacity to handle large amounts of data and retrieve contextual information enables swift access to current medical knowledge. Students can explore a variety of topics, including diagnoses and innovative treatments, to improve their understanding and make informed decisions (Grewal et. al, 2023).

In the clinical field, ChatGPT serves as a valuable support tool. It can assist in formulating diagnoses by reviewing clinical data and suggesting evidence-based treatment options. Additionally, it facilitates clinical discussions among healthcare professionals, promoting the exchange of knowledge and perspectives (Lockie and Choi, 2023).

However, implementing ChatGPT in medicine presents challenges. Ethical issues, such as patient privacy and the reliability of the generated information, require careful attention (Lower et. al, 2023). It is also important to recognize the limitations of the model and understand that it does not replace clinical experience and human judgment (Lockie and Choi, 2023).

As ChatGPT becomes more integrated into the field of medicine, it is crucial to maintain a balance between the advantages of this technology and an ethical approach that acknowledges its limitations (Lockie and Choi, 2023; Lower et. al, 2023).

4. Opportunities for Integration of ChatGPT in Higher Education

In this section, the potential opportunities of integrating ChatGPT in higher education are presented.

4.1 Personalized Learning for Students

ChatGPT comes closer to the idea of personalized learning as it can accommodate the needs, interests and abilities of individual students and in turn could lead to higher engagement and better learning outcomes (Fuchs, 2023). Personalized learning is facilitated by incorporating students' language patterns and feedback (Dampere, 2023). The students could have access to personalized learning plans adjusted to their needs (Fusch, 2023).

4.2 Boosting Learning Efficiency and Supporting Cognitive Initiative

ChatGPT has significant advantages in improving learning efficiency (Yu, 2023) and supporting the cognitive preparing students for work in AI era (Yu, 2023). Responding immediately to students' inquiries, ChatGPT provides personalized tutoring and speeds up students' learning (Hwang and Chen, 2023). It may be like a 'study buddy' to help students reflect on learning materials (Strzelecki and ElArabawy, 2024). This technology is not only a tool that assists in crafting emails and writing essays (Dampere, 2023), but it can also unleash students' creativity and critical thinking (Yu, 2023; Tan, 2023). ChatGPT may inspire students to generate alternative ways of thinking and expressing ideas (Strzelecki and ElArabawy, 2024). The application of ChatGPT may enhance students' cognitive learning, as it prompts students to articulate their thoughts, analyze information, evaluate arguments, and formulate logical responses, thus fostering their critical thinking.

4.3 An Important Resource for Educators

The results indicate that ChatGPT supports the learning process, i.e. represents a new and interesting resource for educators. ChatGPT provides them with a versatile teaching tool that can be used not only to design and deliver more innovative teaching, but also to increase students' motivation to learn and engagement in class (Yu, 2023). This technology can also help educators to design personalized learning materials, improve the quality of teaching and support students' learning experiences (Yu, 2023; Strzelecki and ElArabawy, 2024). ChatGPT can support the instructors in creating personalized learning plans that include content, activities, and assessments adjusted to the individual student's needs (Fusch, 2023).

5. Risks of Integration of ChatGPT in Higher Education

This section presents the risks identified in the reviewed papers regarding the integration of ChatGPT in higher education.

5.1 Potential Escalation of Plagiarism and Cheating Among Students

ChatGPT brings a great academic integrity risk in the education sector (Yu, 2023; Strzelecki and ElArabawy, 2024). Students may use ChatGPT-generated content and present it as their work without proper acknowledgment (Mhlanga, 2023). In that way, students misrepresent their knowledge, skills, abilities, and academic achievements violating academic integrity. Using ChatGPT to complete assignments may lead to academic dishonesty and cheating behaviors (Strzelecki, 2023; Yu, 2023). Based on identified academic dishonesty risks, many schools and HEIs have been alarmed by the launch of ChatGPT and even banned the usage of ChatGPT and AI tools considering it academic fraud and cheating (Yu, 2023; Dempere et al., 2023). While some from academia suggest that students write by hand during class sessions to ensure full control over students' performance and achievements, others emphasize the relevance of teaching digital literacy (Dempere et al., 2023). It becomes obvious that HEIs have to adjust teaching and examination standards to ensure that students adhere to academic integrity when using new AI technologies (Mhlanga, 2023).

5.2 Over-reliance on ChatGPT

Scholars have also pointed out the challenges of over-reliance on ChatGPT and AI tools. Excessive dependence on ChatGPT and AI may hinder the development of essential cognitive abilities, such as understanding ability (Yu, 2023), analytical and critical thinking skills (Dwivedi et al., 2023; Fuchs, 2023), problem-solving skills (Tan, 2023), and research abilities (Shiri, 2023). Students, who do not do their assignments until the last minute, may create their work entirely based on ChatGPT and without their independent thinking and problem-solving skills. In this case, students are just passive learners who accept the responses generated by ChatGPT, without critical thinking and questioning the relevance and accuracy of the information provided (Fuchs, 2023). Recent surveys revealed that most American college students use Chat GPT to complete homework tasks and to write papers and essays (Dampere, 2023; Yu, 2023; McGee, 2023). This trend of over-reliance on AI technology in learning may significantly limit students' learning outcomes and development (Yu, 2023) and their ethical awareness (Tan, 2023).

5.3 Reducing Human Interaction

The integration of ChatGPT in HEIs also poses a risk of reducing human interaction in learning (Dampere, 2023). As ChatGPT provides immediate responses to students' queries, there is a risk that students rely solely on the

ChatGPT information and guidance, bypassing interactions with their teachers (Yu, 2023). Replacing human interaction in the learning process may impede students' ability to develop strong and trustful relationships with their instructors and lower their engagement and learning outcomes (Fryer et al., 2017).

5.4 Misinformation and Stereotyping

This risk includes the inaccurate transmission of information and unverified content (Tan, 2023), spreading misinformation and unpredictable outputs referred to as hallucinations (Dampere, 2023). Hallucinations have been caused by data beyond its training set. If the training data is not adequate, i.e. it is of low quality, the AI-based tool might learn incorrect or incomplete patterns, which further leads to inaccurate responses (Strzelecki and ElArabawy, 2024). Misinformation may negatively affect learning outcomes if learners do not scrutinize the information generated by ChatGPT (Tan, 2023). Moreover, if the AI system is trained on biased data, it might reinforce existing biases and inequalities in higher education (Fuchs, 2023). Therefore, it reinforces existing biases and perpetuates inequalities in education. For example, if the system is trained on biased or incomplete data, it might generate responses reflecting these biases, thereby leading to a reinforcement of existing inequalities and a failure to challenge and disrupt discriminatory practices in higher education.

5.5 Lack of Regulations

Although many risks have been related to over-reliance on ChatGPT and similar AI tools, many scholars agree that banning these tools is not an adequate solution (e.g. Dwivedi et al., 2023, Yu, 2023). However, it is critical to develop digital literacy in the education sector and ensure that teachers and students use ChatGPT correctly and responsibly facilitating their independent thinking and creativity (Yu, 2023; Fuchs, 2023).

6. Conclusion

Based on a literature review this paper explored the impact of the ChatGPT on teaching and learning processes in Higher Education Institutions. The articles included in the study were subjected to a cluster analysis, which resulted in three different clusters, namely: (1) Transformation in digital communication, (2) ChatGPT in science and (3) ChatGPT in medical studies. The review also allowed the identification of opportunities and risks associated with the integration of ChatGPT in the teaching and learning processes. Concerning the opportunities, the current body of learning suggests that it facilitates personalized learning, boosts learning efficiency, and supports cognitive initiatives. Moreover, both educators and students appear to benefit from its use as it complements or supports teaching or learning-related activities. In terms of potential risks, the results suggest that the use of ChatGPT can reinforce or trigger plagiarism and cheating. Over-reliance on ChatGPT also harbors the risk that students, instead of trying to solve a task themselves, "outsource" it to ChatGPT and thus reduce or forget their ability to approach a problem. This over-reliance could also lead to less interactions with other students or teachers. The findings also addressed the issue of content quality/accuracy and possible consequences. The lack of regulations in this regard was listed as a further risk.

In summary, it can be concluded that while the integration of ChatGPT and similar tools can improve the teaching and learning processes of HEIs, there is a concurrent need to navigate ethical considerations and strive for continual improvement in their development and application. The results emphasize the importance of permanent communication and education measures aimed at both groups, i.e. students and teachers. Both groups need the necessary tools to be able to use ChatGPT in a targeted manner for learning and teaching. The focus should be less on bans and more on the development and empowerment of capable and informed individuals. However, this work cannot be undertaken by universities alone, but requires close cooperation with upstream learning institutions, starting with kindergartens. This means that there is a need for ChatGPT usage regulations that cover the entire development/learning process of a person from kindergarten, through school, training, university, and beyond. The study provides the basis for further studies on the topic. For example, it would be interesting to use an experimental design to find out whether and to what extent the learning success of students differs between those who study scientific skills ChatGPT supported and those who study ChatGPT without support. A similar design could also be set up with university lecturers to find out whether the learning objectives are achieved similarly, better or worse by using ChatGPT.

References

Bartoli, A., May, A.T., Al-Awadhi, A. and Schaller, K. (2024), "Probing artificial intelligence in neurosurgical training: ChatGPT takes a neurosurgical residents written exam", *Brain and Spine*, Vol. 4, p. 102715.

Borger, J.G., Ng, A.P., Anderton, H., Ashdown, G.W., Auld, M., Blewitt, M.E., Brown, D.V., et al. (2023), "Artificial intelligence takes center stage: exploring the capabilities and implications of ChatGPT and other AI-assisted technologies in scientific research and education", *Immunol Cell Biol*, Vol. 101 No. 10, pp. 923–935.

Chen, K., Shao, A., Burapacheep, J. and Li, Y. (2024), "Conversational AI and equity through assessing GPT-3's communication with diverse social groups on contentious topics", *Sci Rep*, Vol. 14 No. 1, available at:https://doi.org/10.1038/s41598-024-51969-w.

Dempere, J., Modugu, K., Hesham, A. and Ramasamy, L.K. (2023), "The impact of ChatGPT on higher education", *Front. Educ.*, Vol. 8, available at:https://doi.org/10.3389/feduc.2023.1206936.

Donthu, N., Kumar, S., Mukherjee, D., Pandey, N. and Lim, W.M. (2021), "How to conduct a bibliometric analysis: An overview and guidelines", *Journal of Business Research*, Vol. 133, pp. 285–296.

Dwivedi, Y.K., Kshetri, N., Hughes, L., Slade, E.L., Jeyaraj, A., Kar, A.K., Baabdullah, A.M., et al. (2023), "'So what if ChatGPT wrote it?' Multidisciplinary perspectives on opportunities, challenges and implications of generative conversational AI for research, practice and policy", *International Journal of Information Management* , Vol. 71, p. 102642.

Fuchs, K. (2023), "Exploring the opportunities and challenges of NLP models in higher education: is Chat GPT a blessing or a curse?", *Front. Educ.*, Vol. 8, available at:https://doi.org/10.3389/feduc.2023.1166682.

Gill, S.S., Xu, M., Patros, P., Wu, H., Kaur, R., Kaur, K., Fuller, S., et al. (2024), "Transformative effects of ChatGPT on modern education: Emerging Era of AI Chatbots", *Internet of Things and Cyber-Physical Systems*, Vol. 4, pp. 19–23.

Grewal, H., Dhillon, G., Monga, V., Sharma, P., Buddhavarapu, V.S., Sidhu, G. and Kashyap, R. (2023), "Radiology Gets Chatty: The ChatGPT Saga Unfolds", available at:https://doi.org/10.7759/cureus.40135.

Hill-Yardin, E.L., Hutchinson, M.R., Laycock, R. and Spencer, S.J. (2023), "A Chat(GPT) about the future of scientific publishing", *Brain, Behavior, and Immunity*, Vol. 110, pp. 152–154.

Hyde, S.J., Busby, A. and Bonner, R.L. (2024), "Tools or Fools: Are We Educating Managers or Creating Tool-Dependent Robots?", *Journal of Management Education*, available at:https://doi.org/10.1177/10525629241230357.

Kumar, M., Mani, U.A., Tripathi, P., Saalim, M. and Roy, S. (2023), "Artificial Hallucinations by Google Bard: Think Before You Leap", available at:https://doi.org/10.7759/cureus.43313.

Lim, W.M., Gunasekara, A., Pallant, J.L., Pallant, J.I. and Pechenkina, E. (2023), "Generative AI and the future of education: Ragnarök or reformation? A paradoxical perspective from management educators", *The International Journal of Management Education*, Vol. 21 No. 2, p. 100790.

Lockie, E. and Choi, J. (2024), "Evaluation of a chat GPT generated patient information leaflet about laparoscopic cholecystectomy", *ANZ Journal of Surgery*, Vol. 94 No. 3, pp. 353–355.

Lower, K., Seth, I., Lim, B. and Seth, N. (2023), "ChatGPT-4: Transforming Medical Education and Addressing Clinical Exposure Challenges in the Post-pandemic Era", *JOIO*, Vol. 57 No. 9, pp. 1527–1544.

McGee, R.W. (2023), "Is Chat Gpt Biased Against Conservatives? An Empirical Study", *SSRN Journal*, available at:https://doi.org/10.2139/ssrn.4359405.

Mhlanga, D. (2023), "Open AI in Education, the Responsible and Ethical Use of ChatGPT Towards Lifelong Learning", *SSRN Journal*, available at:https://doi.org/10.2139/ssrn.4354422.

Montenegro-Rueda, M., Fernández-Cerero, J., Fernández-Batanero, J.M. and López-Meneses, E. (2023a), "Impact of the Implementation of ChatGPT in Education: A Systematic Review", *Computers*, Vol. 12 No. 8, p. 153.

Montenegro-Rueda, M., Fernández-Cerero, J., Fernández-Batanero, J.M. and López-Meneses, E. (2023b), "Impact of the Implementation of ChatGPT in Education: A Systematic Review", *Computers*, Vol. 12 No. 8, p. 153.

Preiksaitis, C. and Rose, C. (2023), "Opportunities, Challenges, and Future Directions of Generative Artificial Intelligence in Medical Education: Scoping Review", *JMIR Med Educ*, Vol. 9, p. e48785.

Shiri, A. (2023), "ChatGPT and Academic Integrity", *Information Matters*, Vol. 3 No. 2, pp. 1–5.

Shrivastava, R. (2022), "Teachers fear ChatGPT will make cheating easier than ever", *Forbes* , available at: https://www.forbes.com/sites/rashishrivastava/2022/12/12/teachers-fear-chatgptwill-make-cheating-easier-than-ever/?sh=5b0ab2ac1eef (accessed 3 February 2023).

Smith, J., Choi, P.M. and Buntine, P. (2023), "Will code one day run a code? Performance of language models on ACEM primary examinations and implications", *Emerg Medicine Australasia*, Vol. 35 No. 5, pp. 876–878.

Strzelecki, A. (2023), "Students' Acceptance of ChatGPT in Higher Education: An Extended Unified Theory of Acceptance and Use of Technology", *Innov High Educ*, available at:https://doi.org/10.1007/s10755-023-09686-1.

Strzelecki, A. and ElArabawy, S. (2024), "Investigation of the moderation effect of gender and study level on the acceptance and use of generative AI by higher education students: Comparative evidence from Poland and Egypt", *Brit J Educational Tech*, available at:https://doi.org/10.1111/bjet.13425.

Tan, X. (2023), "The Impact of ChatGPT on Education and Future Prospects", *HSET*, Vol. 61, pp. 138–143.

Tsai, M.-L., Ong, C.W. and Chen, C.-L. (2023), "Exploring the use of large language models (LLMs) in chemical engineering education: Building core course problem models with Chat-GPT", *Education for Chemical Engineers*, Vol. 44, pp. 71–95.

Wang, Y.F., Petrina, S. and Feng, F. (2017), "VILLAGE—Virtual Immersive Language Learning and Gaming Environment: Immersion and presence", *Brit J Educational Tech*, Vol. 48 No. 2, pp. 431–450.

Wu, J.-Y. (2017), "The indirect relationship of media multitasking self-efficacy on learning performance within the personal learning environment: Implications from the mechanism of perceived attention problems and self-regulation strategies", *Computers & Education*, Vol. 106, pp. 56–72.

Yu, H. (2023), "Reflection on whether Chat GPT should be banned by academia from the perspective of education and teaching", *Front. Psychol.*, Vol. 14, available at:https://doi.org/10.3389/fpsyg.2023.1181712.

Yu, H. and Guo, Y. (2023), "Generative artificial intelligence empowers educational reform: current status, issues, and prospects", *Front. Educ.*, Vol. 8, available at:https://doi.org/10.3389/feduc.2023.1183162.

Measuring The Process of Knowledge Transmission and Absorption in The Organization

Katarzyna Szymczyk
Czestochowa University of Technology, Czestochowa, Poland

katarzyna.szymczyk@pcz.pl

Abstract: The aim of the paper is to identify the degree of knowledge sharing and measure the scale of behavior related to giving and receiving knowledge in the organization. The author of this study focuses on presenting and analyzing the results of a quantitative survey conducted among 131 academy employees. Academic teachers and non-academic staff participated in the study conducted in March-April 2024 based on a questionnaire developed by R.E. De Vries, B. Van den Hoff, and J.A. De Ridder in 2006. A five-point Likert scale was used to measure the knowledge transfer and absorption scale. The study results showed that the transmission of knowledge and its absorption generally occur evenly. This means that employees, on the one hand, share knowledge, but on the other hand, they are also willing to use and acquire knowledge from others. This may result from a specific behavioral model created because of the conditions imposed in the organization, or it was created due to the need for cooperation and co-help in sharing knowledge to facilitate and improve work. The presented study is preliminary and requires further development to enrich the actual knowledge-sharing subjects' theory and practice. Yet, the presented data can be useful in comparative analyses and other deepening studies on similar matters.

Keywords: Knowledge Management, Knowledge Transmission, Knowledge Absorption, Organization

1. Introduction

The concept of knowledge management in an organization, according to the universal definition in a narrow sense, is a set of activities aimed at identifying, preserving, disseminating, and using the explicit and implicit knowledge of the company's personnel to increase the efficiency and effectiveness of employees' activities. In a broader sense, this concept also considers employee motivation, sociological and social aspects, intelligence, and communication skills. Therefore, knowledge should be treated as the vital intangible resource of a given organization. Based on the acquired knowledge, an organization can learn and improve. It must not only gain knowledge, e.g., from the business environment but can also transfer it both within and outside the organization (Demarest, 1997; Kowalczyk & Nogalski, 2007; Yi, 2009; Karaś & Piasecka-Głuszak, 2013; Witherspoon et al., 2013; Kokot-Stępień & Krawczyk, 2023). Sharing knowledge is integral to the organization's performance (Yeboah, 2023; Asrar-ul-Hag et al., 2016; Yi, 2009). It occurs in two aspects: transferring and acquiring knowledge. Sharing knowledge in an organization potentially takes place differently in large, hierarchical, and complex organizations than in smaller organizations with less formalized structures and fewer employees. Sharing knowledge will be different in small and medium-sized enterprises than in large enterprises, which are strictly hierarchical corporations, and will be different in state institutions, associations, cooperatives, groups of mutual interest, etc. Any organization's flow of information and knowledge is crucial to its proper functioning (Asrar-ul-Hag et al., 2016; Witherspoon et al., 2013; Ipe, 2003). However, knowledge management and sharing may be more complicated and sometimes even more difficult in an organization with a complex structure. This is mainly due to the hierarchical levels that prevail. The knowledge exchange between company managers, starting from owners, managers, directors, and lower-level employees, may be slower, limited, or incomplete. In organizations with a simple structure in which owners or managers have closer contact with employees, the exchange of information usually runs more efficiently and faster. In the workplace, where access to knowledge and information often depends on management decisions, the company may contribute to a situation where employees do not have the necessary knowledge or do not know where to obtain it and might be less willing to share their knowledge. This happens, especially when there is high competition between employees in the workplace or when a given organization has not introduced an appropriate organizational culture based on building mutual trust, cooperation, and a sense of belonging to the organization. It is worth mentioning, however, that despite the limitations in acquiring and sharing knowledge among employees, they may still want to acquire and share knowledge with others to improve their work and develop the skills and competencies needed for their development. It is essential for company owners and managers that all employees have access to knowledge and can share it, and for this purpose, it is worth using tools to measure the scale of knowledge sharing. Measuring the scale of knowledge transfer and acquisition may help modify the strategy of managing personnel and information flow in the organization, which should ultimately bring tangible benefits for the organization's functioning from the inside to the outside.

2. Knowledge Sharing Measuring

In knowledge management, the issue of sharing knowledge between superiors and employees, between employees, and between employees and their superiors deserves particular attention. This issue can be considered in two ways: the process of transmission and absorption of knowledge. Recognizing and understanding the process of knowledge sharing and its measurement may help identify the degree of effectiveness of the organization's operation from the inside, understanding interpersonal relations, the level of trust between employees, and the intensity of cooperation as the potential causes of its lack in favor of unhealthy competition. The extent to which an organization functions as a team, a well-coordinated group, or even an organism of interconnected vessels may be intensely dependent on the skills, needs, and willingness to share knowledge, exchange information, and learn from each other. Sharing knowledge can benefit the organization by improving its functioning and strengthening it from the inside, ultimately translating into its functioning externally and allowing it to maintain or gain a competitive advantage. Therefore, every organization should learn to identify and measure the knowledge transmission and absorption process and take action to improve this process. The knowledge-sharing literature contains many studies worth mentioning. Much research concerns enterprises and industry, but many studies have also been conducted in public institutions like universities. It is worth noting the works of Cheng et al. (2009), Alhammad et al. (2009), Sadiq Sohail & Daud (2009), Zawawi et al. (2011), Fullwood et al. (2013), Chmielecki (2013), Wei Chong et al. (2014), Ramayah et al. (2014), Yasir et al. (2017), ÅšwigoÅ (2017), Akosile & Olatokun (2020), Javaid et al. (2020), Al-husseini & Abdel Baqi, 2023. In this study, the author discusses issues related to knowledge sharing, mainly its transmission and absorption. The author presents the analysis of quantitative research results based on a survey questionnaire conducted in 2024 on a group of high-, middle- and low-level employees of a state organizational unit - a university. Knowledge Sharing (KS) behavior scale developed by R.E. De Vries, B. Van den Hoff, and J.A. De Ridder in 2006 was used to prepare the survey questionnaire. Knowledge sharing considers knowledge transfer (donating) and accumulation (collecting) (De Vries et al., 2006). Donating and collecting knowledge are crucial in building organizational culture and job satisfaction. De Vries et al.'s knowledge-sharing model measures the level of transfer and accumulation of knowledge and allows for analysis of what knowledge-sharing practices look like in each organization, whether they are appropriately implemented, and whether a given organization adequately manages the knowledge-sharing processes. De Vries et al.'s model also allows for determining the extent to which the organization members are eager to give/donate and absorb/collect knowledge from other members. Considering the advantages of the above-mentioned authors' model, this study used it to measure the organization's transfer and absorption of knowledge.

3. Study

Quantitative research based on a survey questionnaire conducted in March-April 2024. The research sample included university employees, both academic teachers and non-academic employees. Knowledge Sharing (KS) behavior scale developed by R.E. De Vries, B. Van den Hoff, and J.A. De Ridder in 2006 was used to prepare the survey questionnaire. Knowledge transmission and absorption were measured using a five-point Likert scale. The questionnaire was emailed to the offices of the Deans of selected universities with a request to send it to employees. Ultimately, 131 people participated in the study. The return of surveys could potentially be higher, which is a reason to repeat the study, and the collected results should be treated as a preliminary study. The relatively small number of employees who participated in the survey may be due to the time the survey was conducted, namely the pre-Easter period. The other reason may be reluctance or lack of time to complete the survey. Considering this analysis is a preliminary study, the collected results may be helpful for comparative analyses in similar studies. The study included 57% women, 42% men, and 1% non-binary persons. Most respondents are employees who are academic teachers - 80% of the respondents, and the remaining 20% are employees who are not academic teachers. Not academic teachers are generally employed in administering a given faculty. The detailed distribution of respondents by job position is presented in Figure 1.

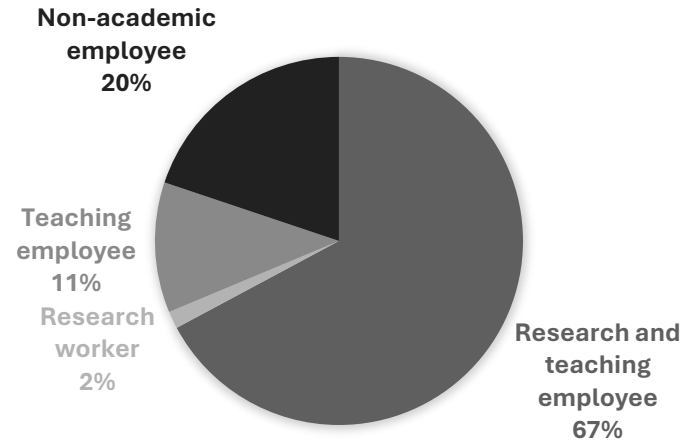


Figure 1: Division of respondents by form of employment

Most respondents in the research sample have been working for at least 16 years or longer. There were relatively few people working for six to 15 years—20%. Less recorded are people who have been working at the university for a short time and no longer than five years. Figure 2 presents a detailed breakdown of the collected results.

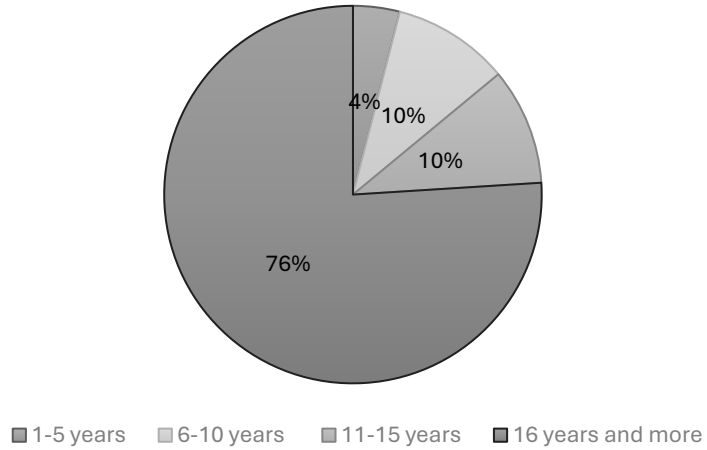


Figure 2: Percentage of survey respondents by length of employment

58% of respondents hold functional positions, and the remaining 42% do not have such. Teaching is a functional position, including heads of institutes, departments, laboratories, etc., deputies of these heads, deans, vice-deans, rectors, vice-rectors, chancellors and deputies, heads or directors of administrative units, etc.

4. Results

As mentioned, the survey questionnaire was prepared using the Knowledge Sharing (KS) behavior scale developed by R.E. De Vries, B. Van den Hoff, and J.A. De Ridder in 2006. The study aimed to determine to what extent employees of a given organization, in this case, a university, are willing to share their knowledge with their coworkers/collaborators and to what extent they can acquire knowledge from their coworkers. The survey contained a total of eight questions. It was divided into two parts. The first part concerned transferring knowledge to colleagues, while the second concerned acquiring knowledge from colleagues:

1. The Knowledge Transmission

When I learn something new, I share it with my coworkers.

I share all the information I have with my coworkers.

I think it's important that my coworkers know what I do.

I regularly tell my co-workers what I do.

2. The Knowledge Absorption

When I need some knowledge, I ask my co-workers about it.

I like to be informed about what my co-workers know.

When I need to learn something, I ask my co-workers about their skills.

When a coworker is good at something, I ask him/her to teach me how to do it.

The study was conducted in Polish. Knowledge transmission and absorption were measured using a five-point Likert scale:

1 - I strongly disagree

2 - I rather disagree

3 - I have no opinion/it's hard to say

4 - I rather agree

5 - I strongly agree

The questions included the concept of a collaborator, as in an organization such as a university, employees have contact with other employees, but not all of them remain in close contact; they cooperate, they take part in the same tasks, they stay in the same rooms and carry out the same or similar tasks. projects. Therefore, the study emphasized that the respondents expressed their opinion on sharing knowledge with people with whom they cooperate daily, are in the workplace, or are in relatively close contact with them rather than with other employees working in the same building.

4.1 The Knowledge Transmission

Almost 70% of the respondents admitted that when they learn something new, they share it with their colleagues. 21% had no opinion on this matter. 10% of respondents indicated that they do not share their acquired knowledge with their colleagues in such situations. The detailed distribution of respondents' answers is presented in Figure 3.

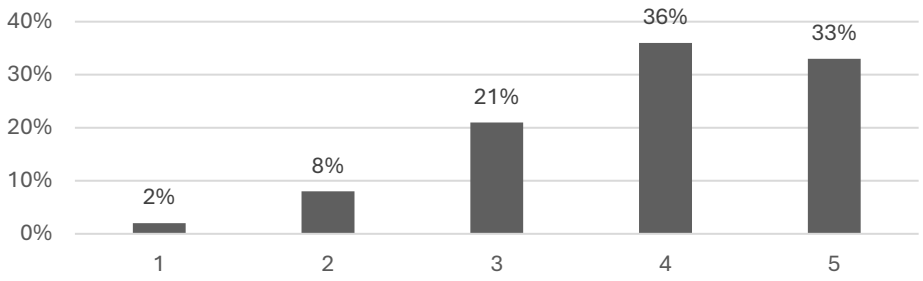


Figure 3: When I learn something new, I share it with my coworkers. N=131

57% of respondents said they share all their information with their coworkers. In this case, 20% had no opinion, while 23% admitted they were unwilling to share all their information with their coworkers. The detailed distribution of responses obtained from respondents participating in the study is presented in Figure 4.

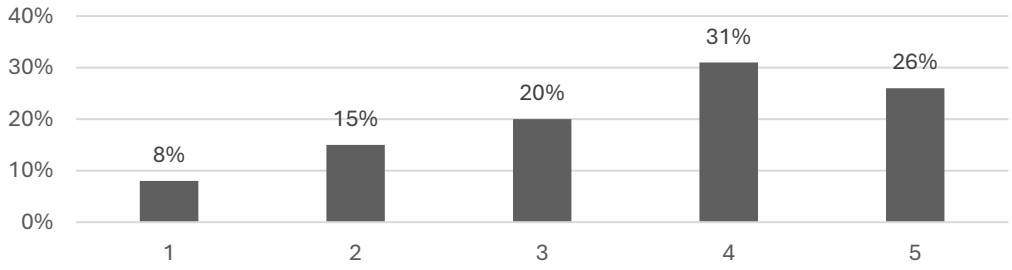


Figure 4: I share all the information I have with my coworkers. N=131

67% of respondents strongly agree or agree with the statement that it is important for co-workers to know what a given employee does. Figure 5 presents the detailed distribution of respondents' answers.

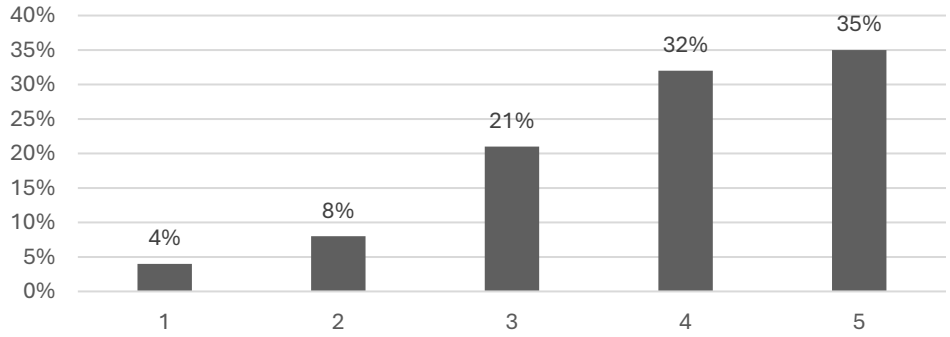


Figure 5: I think it's important that my coworkers know what I do. N=131

Regarding whether an employee regularly informs coworkers about what he or she does, 54% definitely or rather agreed, 24% have no opinion on this matter, 13% said rather not, and 9% said they do not regularly inform coworkers about what they do. deals with. The detailed distribution of responses obtained from respondents participating in the study is presented in Figure 6.

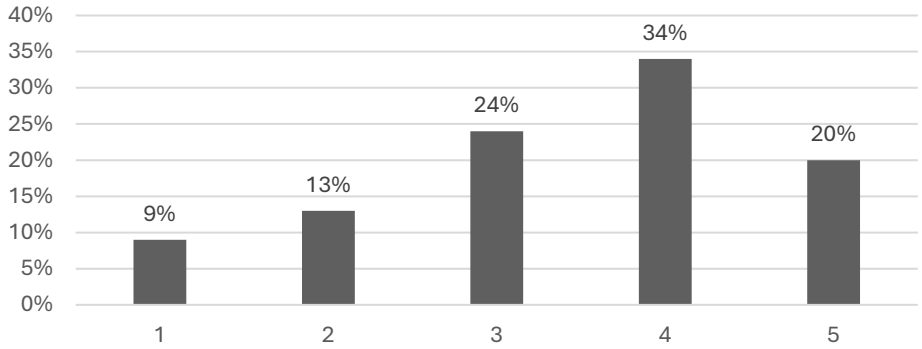


Figure 6: I regularly tell my co-workers what I do. N=131

4.2 The Knowledge Absorption

Most respondents admitted that they ask their co-workers if they need any knowledge. 31% of respondents strongly agree, and 44% agree that they turn to their coworkers for knowledge when they need to learn something. 6% of respondents said that when they need to acquire knowledge, they do not ask their coworkers about it, and only 2% admitted that they do not do it. 17% have no opinion on this matter. The answers obtained from respondents are presented in Figure 7.

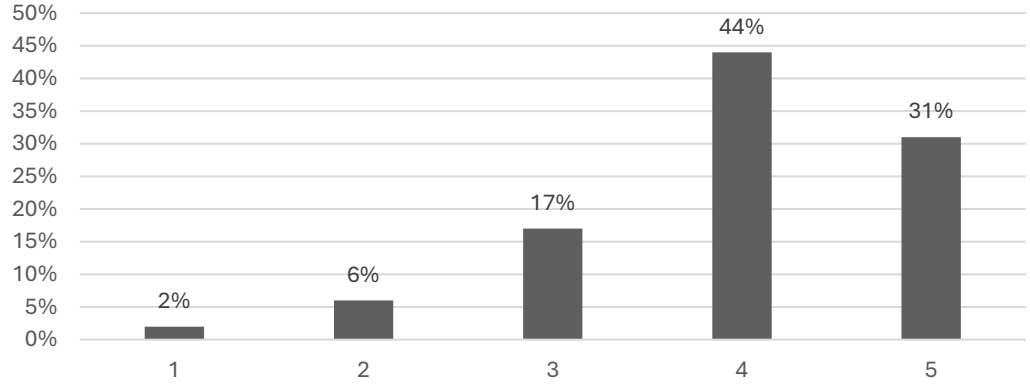


Figure 7: When I need some knowledge, I ask my coworkers about it. N=131

41% definitely, and 29% would rather be informed about what their coworkers know. 13% probably do not want such information, and only 2% do not want to be informed about what their coworkers know. 15% of respondents indicated that they had no opinion on this issue. The collected responses are presented in Figure 8.

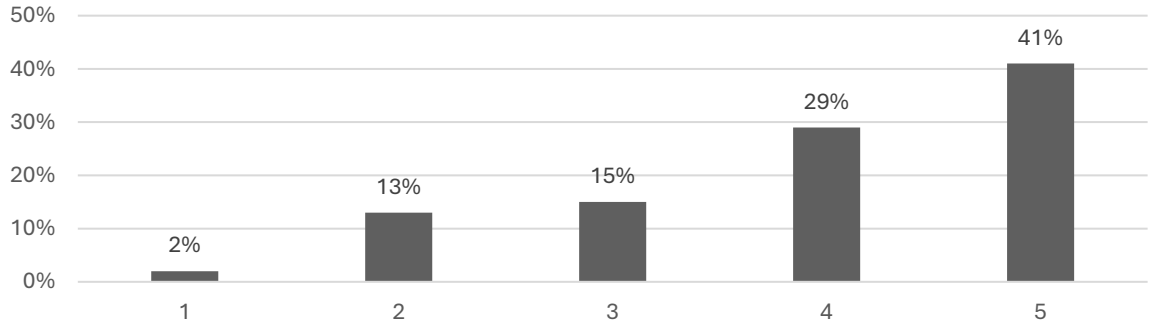


Figure 8: I like to be informed about what my coworkers know. N=131

60% of survey respondents admitted that if they need to gain knowledge and learn something new, they turn to their coworkers to learn about their skills. 20% of respondents had no opinion on this matter, 15% admitted that they disagreed, and 5% strongly disagreed with the statement that if they need to learn something new, they turn to their coworkers and ask about their skills. The collected responses are presented in Figure 9.

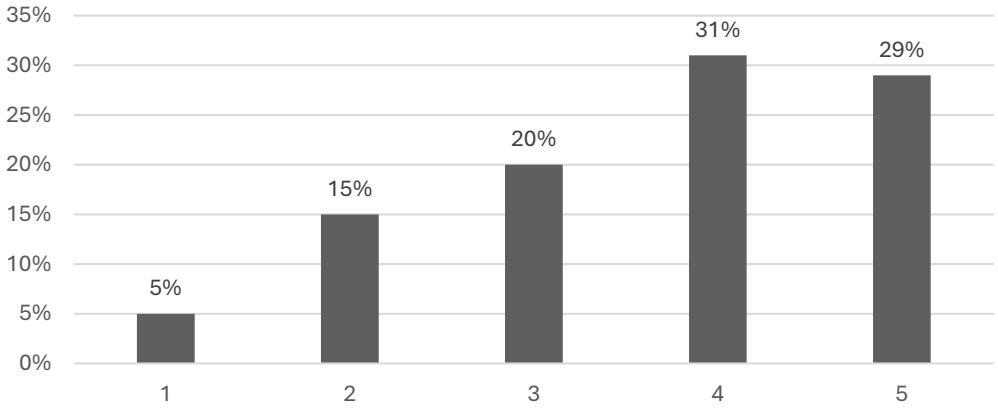


Figure 9: When I need to learn something, I ask my coworkers about their skills. N=131

54% of respondents admitted that they strongly agree, and 21% rather agree that if a coworker is good at something, they ask him or her to teach them what they know. 75% of study participants expressed positive opinions on this issue. 15% had no opinion on this matter. A total of 10% expressed reluctance to learn from others. Figure 10 presents the collected answers.

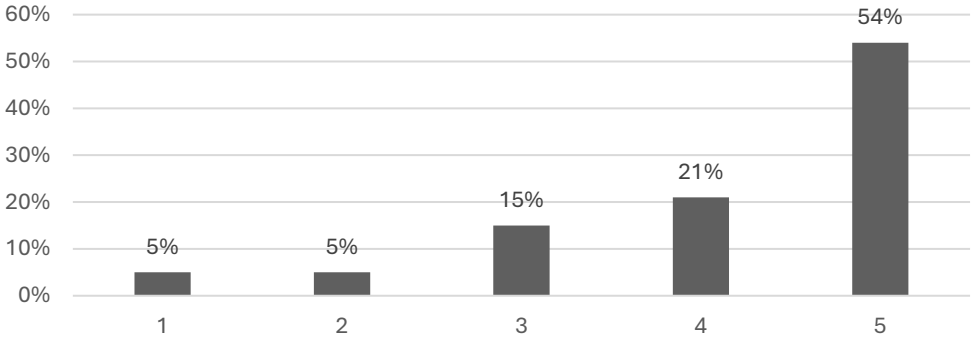


Figure 10: When a coworker is good at something, I ask him/her to teach me how to do it. N=131

The next part of the study summarizes the collected results and discusses the conclusions drawn from the research.

5. Discussion

The collected research results were sorted into knowledge transmission and knowledge absorption. Positive and negative behaviour in both groups were listed. The answers of respondents participating in the study who did not express opinions were not considered. A summary of the collected responses in percentage terms is presented in Table 1.

Table 1: Summary of survey results, including positive and negative behaviour

	The Knowledge Transmission		The Knowledge Absorption		
	Positive behaviour	Negative behaviour		Positive behaviour	Negative behaviour
When I learn something new, I share it with my coworkers	70%	10%	When I need some knowledge, I ask my co-workers about it	75%	8%
I share all the information I have with my coworkers	57%	23%	I like to be informed about what my co-workers know	70%	15%
I think it's important that my coworkers know what I do	67%	12%	When I need to learn something, I ask my co-workers about their skills	60%	20%
I regularly tell my co-workers what I do	78%	22%	When a coworker is good at something, I ask him/her to teach me how to do it	75%	10%

By analyzing selected research results, some conclusions can be drawn. First, it is worth noting that the study indicated the respondents are relatively willing to share their information and knowledge with their coworkers (70%). When they need this knowledge, they are eager to ask their collaborators about it (75%). However, when it comes to sharing all information with coworkers, the percentage of respondents willing to do so is somewhat lower (57%) than that of respondents who want to be informed about what they know and what their collaborators know (70%). Interestingly, most respondents indicated that they regularly notify their co-workers about what they do (78%), and 67% said that it is important for co-workers to know what a given employee does. Most respondents (75%) also admitted that if a co-worker is good at something, they ask him for help and to teach them how to do something. Slightly less, but more than half, 60% of respondents admitted that if they need to learn something, they ask their co-workers about it to learn about their skills. Respondents who expressed rather negative opinions on the above-mentioned issues are a minority. The most negative responses, 23%, were indicated about sharing all information with coworkers. There was also some controversy about regularly informing coworkers about what a given person is doing - 22% of people participating in the study had a negative attitude toward this issue. Similarly, when one needs to learn something and asks coworkers about their skills, 20% of respondents reacted negatively to such action. Respondents replied most positively to the issues of learning something and sharing this knowledge with coworkers, regularly informing them about what they are doing, acquiring knowledge from their coworkers, and learning something new from them. The study also shows that employees are relatively willing to be informed about what their coworkers know.

The respondents' positive behavior regarding knowledge sharing was also considered regarding gender. In this case, only respondents' responses were considered in which they strongly agreed or agreed with the presented statements. Women are more eager to be informed about what their colleagues are doing. The willingness to ask co-workers about their knowledge and skills to learn something is also greater among women than men. As employees, they seem to be much more communicative and open, and they are more willing to inform their co-workers about what they are doing than men. The issue of providing all information to co-workers and transferring what a given employee has learned occurs similarly for both women and men. The detailed responses are presented in Figure 11.

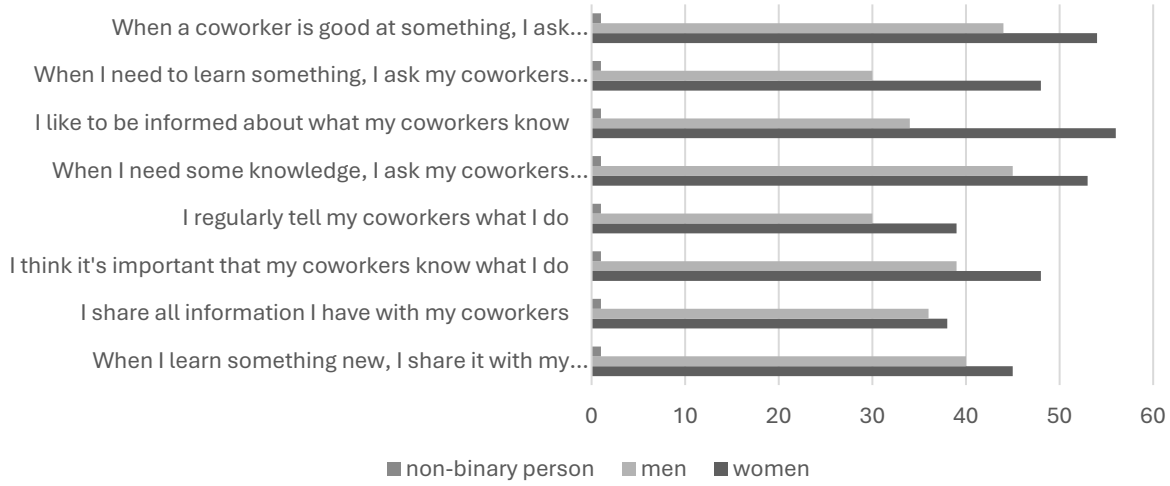


Figure 11: Positive behavior regarding knowledge sharing by gender

Considering the functional position the respondents hold or not, the research noticed that people who hold a functional position, compared to people who do not have such positions, are less willing to share and acquire knowledge from coworkers. People who do not perform any function are more willing to learn from others, ask about their skills and expertise, and provide them with the knowledge and information they have. The detailed share of responses is shown in Figure 12.

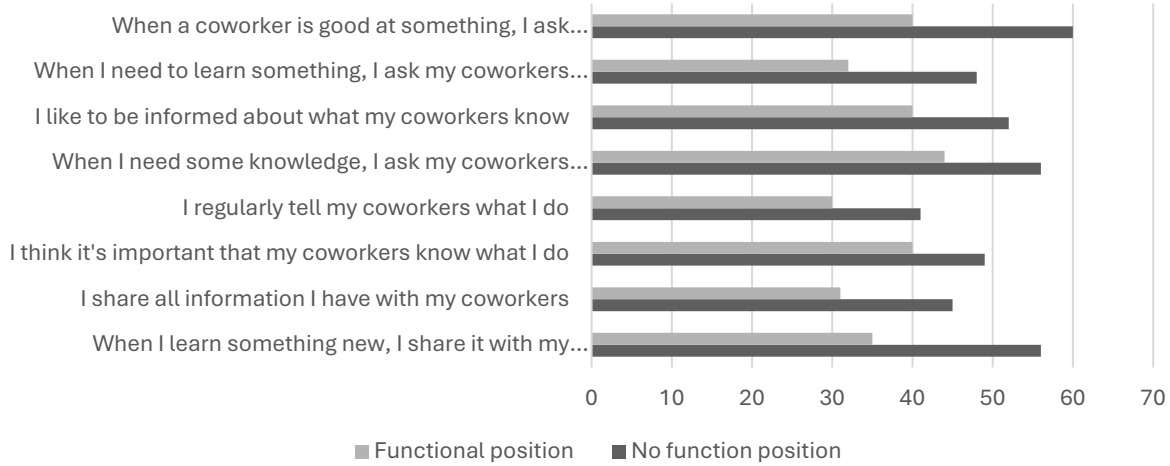


Figure 12: Positive behavior due to functional position.

Based on the collected research results, it can be generally stated that the transmission of knowledge and its absorption in the group of university employees occurs similarly. There were no vast differences between knowledge transmission and absorption. Respondents in the study indicated that they are willing to share knowledge and simultaneously seek knowledge from their coworkers and are eager to acquire it. However, female workers are keener to share and absorb knowledge from their coworkers than male workers. Workers who do not hold functional positions at work are more willing to gain knowledge from coworkers, learn from them, and are more eager to give their knowledge or share the information they learned than workers who hold functional positions. Of course, it should be emphasized here that the research is preliminary, and it is difficult to draw general conclusions for the entire university population. Nevertheless, this is already an overview of knowledge sharing in an organization with a hierarchical and complex structure.

6. Conclusions

The article analyzes the results of research on knowledge sharing in organizations. The study focused on the issue of knowledge transmission and absorption. A survey questionnaire was prepared using de Vries et al.'s

model to conduct the study. The research sample included employees of selected faculties of universities in Poland. Both non-teaching staff and academic teachers took part in the study. The survey questionnaire was made available via e-mail, and the number of respondents ultimately amounted to 131. The study was conducted in March and April 2024. The study aimed to determine to what extent employees of organizations with a complex structure are willing and able to transfer their knowledge to co-workers and acquire and collect knowledge from them. Therefore, the above-mentioned model was used to measure the behavior of organization members in terms of knowledge transmission and absorption. Based on the collected research results, it was found that there are no fundamental differences between transmission and knowledge absorption. The survey shows that employees are relatively willing to share knowledge with coworkers and are also willing to acquire knowledge from coworkers. The research results may indicate that the university, as an organization with a specific organizational structure, imposes behavioral models in which knowledge transfers to coworkers and the collection of knowledge from coworkers occurs evenly. This may indicate that the key to efficient operation in this type of organization is cooperation, and there is a relatively strong need to share knowledge, both in giving and receiving terms. However, the presented study is preliminary and requires extension and comparative analyses to draw more precise conclusions. Therefore, the presented research results can be used for research of a similar nature for comparative purposes or internal analyses of knowledge management issues in the organization.

References

Akosile, A. and Olatokun, W. (2020) "Factors influencing knowledge sharing among academics in Bowen University, Nigeria." *Journal of Librarianship and Information Science*, Vol 52, No. 2, pp 410-427. https://doi.org/10.1177/0961000618820926

Alhammad, F., Al Faori, S. and Abu Husan, L. S. (2009) "Knowledge sharing in the Jordanian universities." *Journal of Knowledge Management Practice*, Vol 10, No. 3, pp 1-9.

Al-husseini, S. and Abdel Baqi, R.D. (2023) "Knowledge Sharing for Contextual Performance: An Empirical Study in the Ministry of Culture, Tourism and Antiquities in Iraq." *Proceedings of the 24th European Conference on Knowledge Management*, Vol. 24, No. 1, pp. 50-57. https://doi.org/10.34190/eckm.24.1.1152

Asrar-ul-Haq, M., Anwar, S. and Nisar, T. (2016) "A systematic review of knowledge management and knowledge sharing: Trends, issues, and challenges." *Cogent Business & Management*, 3(1). doi: 10.1080/23311975.2015.1127744.

ÅšwigoÅ, M. (2017) "Knowledge sharing practices in informal scholarly communication amongst academics in Poland." *Malaysian Journal of Library and Information Science*, Vol 22, No. 2, pp 101-115.

Cheng, M.Y, Ho, J. S. Y. and Lau, P. M. (2009) "Knowledge Sharing in Academic Institutions: a Study of Multimedia University Malaysia." *Electronic Journal of Knowledge Management* Vol 7 No. 3, pp 313-324. https://academic-publishing.org/index.php/ejkm/article/view/853

Chmielecki, M. (2013) "Knowledge sharing among faculty–Qualitative research findings from Polish universities." *International Journal of Contemporary Management*, Vol 12, No. 3, pp 93-102.

de Vries, R.E., van den Hooff, B. and de Ridder, J.A. (2006) "Explaining Knowledge Sharing." *Communication Research*, Vol 33, No. 2, pp 115–135. doi:https://doi.org/10.1177/0093650205285366.

Demarest, M. (1997) "Understanding knowledge management." *Long Range Planning*, Vol 30, No. 3, pp 374-384. doi:https://doi.org/10.1016/s0024-6301(97)90250-8.

Fullwood, R., Rowley, J. and Delbridge, R. (2013) "Knowledge sharing amongst academics in UK universities." *Journal of knowledge management*, Vol. 17, No. 1, pp 123-136.

Ipe, M. (2003) "Knowledge Sharing in Organizations: A Conceptual Framework." *Human Resource Development Review*, Vol 2, No. 4, pp 337-359. https://doi.org/10.1177/1534484303257985

Javaid, J., Soroya, S. and Mahmood, K. (2020) "Impact of personal and organizational factors on knowledge sharing attitude of university teachers in Pakistan." *The Electronic Library*, Vol 38 No. 2, pp 317-336. https://doi.org/10.1108/EL-05-2019-0121

Karaś, E. and Piasecka-Głuszak, A. (2013) "Zarządzanie wiedzą – dlaczego tak ważne?" *Management Sciences*, Vol 4, No. 17, pp 45-60. doi:https://doi.org/10.15611/noz.2013.4.04.

Kokot-Stępień, P. and Krawczyk, P. (2023) "Business Environment Institutions as a Catalyst for Knowledge and Technology Transfer." *Proceedings of the 24th European Conference on Knowledge Management*, Vol. 24, No. 1, pp. 692-699. https://doi.org/10.34190/eckm.24.1.1555

Kowalczyk, A. and Nogalski, B. (2007) *Zarządzanie wiedzą, koncepcje i narzędzia*, Difin, Warszawa.

Ramayah, T., Yeap, J. A. L. and Ignatius, J. (2014) "Assessing Knowledge Sharing Among Academics: A Validation of the Knowledge Sharing Behavior Scale (KSBS)." *Evaluation Review*, Vol 38, No. 2, pp 160-187. https://doi.org/10.1177/0193841X14539685

Sadiq Sohail, M. and Daud, S. (2009) "Knowledge sharing in higher education institutions: Perspectives from Malaysia." *VINE*, Vol 39 No. 2, pp 125-142. https://doi.org/10.1108/03055720910988841

Wei Chong, C., Yen Yuen, Y. and Chew Gan, G. (2014) "Knowledge sharing of academic staff: A comparison between private and public universities in Malaysia." *Library Review*, Vol 63 No. 3, pp 203-223. https://doi.org/10.1108/LR-08-2013-0109

Witherspoon, C.L., Bergner, J., Cockrell, C. and Stone, D.N. (2013) "Antecedents of organizational knowledge sharing: a meta-analysis and critique." *Journal of Knowledge Management*, Vol 17 No. 2, pp. 250-277. https://doi.org/10.1108/13673271311315204

Yasir, M., Majid, A., and Yasir, M. (2017) "Nexus of knowledge-management enablers, trust and knowledge-sharing in research universities." *Journal of Applied Research in Higher Education*, Vol 9, No. 3, pp 424-438.

Yeboah, A. (2023) 'Knowledge sharing in organization: A systematic review', *Cogent Business & Management*, 10(1). doi: 10.1080/23311975.2023.2195027.

Yi, J. (2009) "A measure of knowledge sharing behavior: scale development and validation." *Knowledge Management Research & Practice*, Vol 7, No. 1, pp 65-81. doi:https://doi.org/10.1057/kmrp.2008.36.

Zawawi, A. A., Zakaria, Z., Kamarunzaman, N. Z., Noordin, N., Sawal, M. Z. H. M., Junos, N. M. and Najid, N. S. A. (2011) "The study of barrier factors in knowledge sharing: A case study in public university." *Management Science and Engineering*, Vol 5, No. 1, pp 59-70.

Stewardship for Managing Societal Challenges

Emőke Takács and Toon Abcouwer
ERI Hungary - European Research Institute Hungary, Budapest, Hungary

t.emoke@eri.net.in
toon@abcouwer.nl

Abstract: Technological developments have made us live in a complex and constantly changing world. The focus was mainly on a more accessible and better life for individuals, leaving nature and surroundings out of consideration. However, the impact on nature and the environment makes it clear that striving for environmental sustainability is starting to be a bare minimum. Also, the disproportionate impact on marginalised communities is an unintended side-effect. There is increasing emphasis on sustainable practices, conservation of resources, mitigating the effects of climate change, and addressing environmental injustices. Aside from that, mitigating the growing divides in the world requires a different view of our contemporary world. Some of us face increasing anxiety, and others are enthusiastic about the future. It is this future that makes knowledge management play a crucial role in adapting to these new circumstances. Using the existing knowledge based on being proud of the past and, at the same time, being curious and innovative to develop new knowledge to manage unpredictable future events are equally relevant. We recognise that the different settings of change require different types of management styles. Most scientific literature assumes that management is skilled enough to operate well in certainty, while leadership is needed when risk arises. We propagate to integrate the concept of stewardship as a required means in a setting of uncertainty. So far, this concept has gained little attention in knowledge management. Our paper deals with developing skills and competencies for stewardship, managing knowledge to prepare for the unforeseeable futures. In current dynamics, enriched with complexity, it is inevitable to manage knowledge, develop resilience and new skills, respect one another, and build sustainability. Also, new competencies are recognised to manage in current times of change.We combine the paradigms of understanding the different phases of change with the specific types of knowledge management and the competencies required to address the challenges and divides of today. It involves collaboration and shared values among 'We': governments, organisations, communities, and 'Me', individuals to enact meaningful change for 'All', now and in the future.

Keywords: Change, Knowledge Management, Stewardship, Resilience, Sustainability, Competencies

1. Introduction

The never-ending human developments throughout history, have created a complex and constantly changing world, which we all keep adapting to (Beck, 2006; Folke et al., 2002). People react differently to changes. Some of us face growing anxiety, and others are enthusiastic about the future, depending on how confident we are in managing it. Our confidence depends much on how certain we are in the results of change: if we find it a threatening risk for our lives, or if we are completely uncertain about the effects of the changing circumstances, which we are also unsure about (Abcouwer et al., 2022). We face uncertainty independent of how much we try to be prepared for the unknown future and do our best to be knowledgeable (for a description of certain, risk and uncertain see Gigerenzer, 2015). To sustain our equilibrium and present successes, we need several types of skills, knowledge and knowledge management (E. Takács & A. W. Abcouwer, 2020).

In a well-functioning organisation, management is skilled at operating in certainty, where the situation is known, just as the effects of the daily interventions. Leadership is necessary when the equilibrium is disturbed by risks. Stewardship seems to be efficient in uncertain circumstances (Takács et al., 2019). Science studies management and leadership thoroughly, but what is 'stewardship' Can we develop stewardship? What knowledge, skills and competencies does it require to manage unforeseen events? Managing knowledge, developing resilience and new skills are inevitable in our dynamically changing complex world (E. Takács et al., 2022).

Based on our research activities, we first explain why stewardship is necessary today by analysing the aspects of continuous change, identifying the roles for managing different challenges and the skills to sustain in the future. The diverse theoretical insights with practical recommendations of the European Commission highlight the urgent need to change our attitudes, knowledge management practices, leading to the acknowledgment of the importance of Stewardship for managing societal challenges.

2. Complexity of Challenges and Adapting to Change

Human nature insists on solving the arising problems, but it is becoming clear that the causes we presume for the dynamic societal changes are not manageable on their own. Dealing with challenges one by one only makes us realise the interplay of many underlying issues and cannot reach solutions. As the concept of

intersectionality[1] highlights, no singular problems exist, but they interrelate (Runyan, 2018). The unique dynamics and effects of the intersecting issues create complexity that cannot be solved separately or in a unified way. Understanding complexity by intersectionality helps us to use a broader perspective on knowledge management, while understanding the change process helps managing the challenges more successfully.

The Adaptive Cycle of Resilience (ACoR) model (E. Takács & A. W. Abcouwer, 2020) is based on the dilemma of what we want, must and can do in the given situation (Heene, 2002). The sign of eternity illustrates the ongoing change process starting with an equilibrium, disturbed by challenges, which we need to find new combinations to operationalise so we can reach a new equilibrium. We recognise that in certainty, managers can optimise operations, but when uncertainty arises, creative leaders can support the adaptation to the new circumstances by coming up with new ideas to put in operation and reach certainty again (Takács et al., 2021). These new ideas should be based on new insight and new knowledge that has to be managed carefully.

Figure 1: Developments and the Adaptive Cycle of Resilience (Takács & Abcouwer, 2011)

Change does not stop but evolves. Adaptability and sustainability are crucial challenges for all of us in such a rapidly changing world. We need to deal with the ever-changing societal challenges, and besides adaptivity, different skills, knowledge and attitudes are necessary in the four mentioned stages of change. We identified management, leadership and stewardship as the ones that can handle the challenges successfully.

3. Dealing with Change: Management, Leadership, Stewardship

In the constantly changing environment, different skills, knowledge and attitudes are needed.

In equilibrium (or certainty), managers work well. They know what they want, must and can do to keep the operations balanced. When challenges arise, and we leave our certainty in our abilities (can), we need strengths and faith that we can handle the problem. It certainly requires leadership, just as when we need to find the solution to handle the change. To operationalise and conserve the new ways of working, going concerned is again efficiently manageable with the knowledge and skills of the managers (E. Takács & A W Abcouwer, 2020). But what is Stewardship? When does it play a role in change management and what new requirements for knowledge arise?

Stewardship goes beyond business activities. It also regards organisations' effects on the world around them, looking at values, ethics, and morals. Stewardship guards all resources (time, money, goods and services) with the human responsibility to care for and manage the natural world. Ownership, responsibility, accountability, and reward describe managers and leaders with stewardship (Contrafatto, 2014). They search for solutions to transform ownership, governance, and finance by reconsidering the so-called "truths" accepted by society and redesigning the organisations' operations. They work on adapting to change and sustain while considering all stakeholders: 'Me', the individuals; 'We', the organisations and the groups of individuals; and 'All', the world (Abcouwer & Takács, 2022; Abcouwer et al., 2022). Stewardship changes the focus from 'solving one thing here

[1] According to the concept of intersectionality, different systems, like inequality, are based on multiple forms of discrimination that "intersect" and create unique dynamics and effects.

and now' to a broader and longer perspective thinking, which results in a sustainable present and future for the people (Me), the organisations (We), and our environment (All).

Figure 2: Management-Leadership-Stewardship (Takács et al., 2021)

Managers' concerns work with knowledge transfer because in certainty, it is easy today to find and manage the proper knowledge to handle the problem at stake. In risk and uncertainty, we need the leadership's innovative thinking and courage to solve the arising challenges. Being adaptive requires stewardship to keep answering unknown questions. Shifting to stewardship requires good knowledge management and sensitivity, to be able to get a better understanding of the unknown futures ahead.

A leader who is consciously involved in life-long learning and knowledge management should easily reach stewardship. Those who care for their organisations also pay attention to their people. Knowledge is power, and more and more the value and the primary source for individual and organisational development. We highlighted the importance of knowledge exchange, which is necessary for successful learning and management. The use of information and knowledge is becoming more relevant than its ownership (Brouwers et al., 2022). Experiences built under changing circumstances should focus more on knowledge exchange, although disputes around ownership have increased. Recognising and valuing human capital and building trust and security in the organisation can be a gain for both the individuals and the organisation - and once we recognise the importance of stewardship, - also for the world. Leaving ownership of information and focusing on building new knowledge and practices together leads to questioning and revising accepted (scientific/"true") knowledge sources, which is also characteristic of innovative leaders. To set a favourable environment in the organisation, hierarchy must be changed to trust, cooperation, learning, security, inclusion, equality, flexibility, inspiration, and renewal. Moving the focus to using and interpreting knowledge is a differentiating factor that forms the basis for creating value. Stewardship, backed by wisdom, is conducive to a service mindset. Leadership alone is less likely to invoke cooperation and collaboration. (Dell'Era et al., 2020) In a cooperation, where decision makers share ownership and communicate their interpretations, we explore a new role for the "we" (the organisational value), compared to the traditional orientation where organisations are for fulfilling the shareholders' value or interest.

Stewardship is the careful and responsible management of the things entrusted to our care (Chapin III et al., 2009) a collective work to advance healthy, equitable, sustainable communities describes leaders—both people and organizations—who take responsibility for forming working relationships to drive transformative change in regions and communities (Institute for People Place and Possibility (IP3), n.d.). Importantly, stewards must have a vested interest in promoting an equity orientation regarding purpose, power, and wealth.

Table 1: Differences between Management-Leadership-Stewardship (own source, adaptation of (Lunenburg, 2013))

Category	Management	Leadership	Stewardship
Thinking process	focus on issues looking inward	focus on people looking outward	focus on all the creatures (ecojustice) looking in- and outward

Category	Management	Leadership	Stewardship
Goal setting	executing plans improving the present seeing the trees	articulating a vision creating the future seeing the forest	understanding complexity live in the present with ownership, responsibility and accountability for the future
Employee Relations	controlling subordinates directing and coordinating	empowering colleagues trust and developing	encouraging equality accept, respect and reward
Operations	doing the things right managing change serving super-ordinates	doing the right things creating change serving subordinates	doing as best as can understanding and adapting to change serving the world with all included
Governance	uses authority avoids conflicts acts responsibly	influence uses conflict acts decisively	motivates, encourages respects and accepts responsible and decisive

Can we learn to be a steward? What skills and competencies are needed?

Individuals can serve as stewards to advance community well-being, and stewardship is best accomplished when people work together across differences and sectors to expand the vital conditions that all people and places need to thrive. Stewardship has the most significant impact as a mechanism for shared responsibility and collective action when the work has expanded, aligned with breadth and depth, and, in turn, expanded reach and impact.

4. Skills and Competencies

4.1 EC (2022) European Sustainability Competence Framework

GreenComp (Bianchi et al., 2022) is a reference framework for sustainability competencies. It provides a common ground to learners and guidance to educators, advancing a consensual definition of sustainability as a competence.

It responds to the growing need for people to improve and develop the knowledge, skills and attitudes to live, work and act sustainably. It is designed to support education and training programmes for lifelong learning. It is written for all learners, irrespective of age and education level and in any learning setting – formal, non-formal and informal.

The competencies are grouped around four areas. The competences to

- embody sustainability values
- embrace complexity in sustainability
- envision sustainable futures
- act for sustainability.

These four areas require different kinds of knowledge that must be carefully managed. In the following figure, we describe the areas in more detail to give an indication of what kind of knowledge must be available to embrace the sustainability competencies.

Figure 3: Sustainability competencies (own source, adaptation of the European Sustainability Competence Framework)

Embodying sustainability values require the competences of valuing sustainability, supporting fairness and promoting nature, as humans are part of nature, so should respect the needs and rights of other species and the nature itself to restore and regenerate healthy and resilient ecosystems.

Embracing complexity in sustainability can be achieved by developing the competences of systems thinking, critical thinking with thorough analyses, and framing the current or potential challenges as a sustainability problem in terms of difficulty, involved people, time and geographical scope to identify suitable approaches to anticipating and preventing problems and mitigating and adapting to already existing problems.

Envisioning sustainable futures are very important for youths with their future ahead. Competences as futures literacy for developing alternative scenarios and identifying the steps needed to achieve them, adaptability and creativity, and exploratory thinking can support decision making in complexity and result in novel ideas and methods.

Acting for sustainability with political agencies, collective actions and individual initiatives and potentials for sustainability to actively contribute to improving prospects for the community and the planet.

Sustainability competencies show the individuals' responsibilities ('Me') for their communities ('We') and the environment ('All'). They can help people become systemic and critical thinkers, as well as develop agencies and form a knowledge basis for everyone who cares about our planet's present and future state.

5. The 'Me-We-All' Approach

We recognise that single challenges do not exist, so solving problems one by one will not lead to sustainable solutions. ACoR shows the ever-changing circumstances phase by phase, with skills, competencies, learning and management styles to handle them appropriately. We see how complex it is to live with and manage changes and how vital information management and education are. Like intersectionality, we must consider different aspects and look at problems with a broader view to identify equal opportunities for everyone. When decisions consider all stakeholders, 'Me-We-All', - *"Me": the People, "We": the organisations and "All": the society or our environment* - they can intersect to reach resilience and sustainability in dynamics. For such abilities besides education, we also need supporting values at these three levels (Schwartz, 2012). Organisational values cannot be the guiding principles, purposes and directions anymore, they are something the members create and shape with the consideration of 'Me-We-All' (Abcouwer & Takács, 2022; Abcouwer et al., 2022).

Figure 4: Changing values (Abcouwer et al., 2022)

When leaders change their values towards ethical and sustainable measures, they find stewardship to deal with the changing circumstances.

- Managers who regard intersectionality will understand differences, and with tolerance, acceptance, and focused education they can decrease any divides, strengthen cooperation of diverse teams, and opt for more creative ways to deal with challenges.
- Appropriate competencies and new methods in education can improve awareness and build trust and engagement in the organisations, leading to better performance at all levels for 'Me-We-All'.
- Sharing and caring can reach economic empowerment to steward the organisation's future.
- Equity, creativity, technology and digital inclusion can contribute to an equitable and more sustainable future.
- Considering Environmental Sustainability is an absolute must. Neither 'Me' nor 'We' or 'All' can survive without it.

Stewardship plays an essential role in this process. For a sustainable present and future, managers and leaders must acquire the ethical values that form the basis for responsible planning and management of resources. Careful and responsible management considers not only the businesses but also the environment and nature, their human capital, their knowledge and information, their culture and diversity. Stewarding the future is motivated beyond economic values. They build the organisation's capacity via education and cooperation to act for 'Me-We-All'. By understanding and making available sources, stewardship helps to create individual (Me) and organisational (We) wealth and contributes to the well-being of the people (Me and We) and the society (All).

Intersectionality (Runyan, 2018) also teaches that differences need to be accepted and included. Offering equal prospects and ways to all is not a solution either. Standard paths served mass production during industrialisation and mechanisation, to provide solutions for living, working, teaching and access to products and services. The answer in stewardship is something completely different. It "re-norms" and changes standards. It is to offer equal outcomes and other paths that can be unique to many people. Caring for individual cases is much more complex, but letting stewardship enter our views gives power, determination and fair opportunities for equal

prospects and outcomes. According to Thomas Sowell (Sowell & Friedman, 1981; Sowell & Weiner, 2010), Diversity, Equity, and Inclusion in practice support discriminatory trends because the practical ramifications of the ideology was not thought through, turning the results the other way around. "Undeserved inequalities call for redress", he says, where the chances for opportunities and success are equal, regardless of educational level, gender or cultural background. Believing that with stewardship, the abilities of individuals can be useful, they can contribute in their own unique way to work out solutions in a diverse problem space. Stewardship facilitates changing Equality to Equity offering everyone choices on accommodating individual differences for equal outcomes. So, not the same shoes for everyone, but shoes that fit the person. Management can ensure equity once they understand the root causes of outcome disparities. Then, they can eliminate barriers to full participation and bring fairness to the procedures and processes. It is also a different approach to striving for diversity. A sustainable society for everyone requires acceptance, trust and a broader view of reality than only for the privileged ones.

Equity (Minow, 2021; Sowell, 2001), referring to the common stock of the organisations, brings ownership and intellectual property in sight. For sustainability, as the world's ability to host our successors, managers and leaders should not limit themselves to traditional certainties, like intellectual property, value and ownership (Van den Broek et al., 2023). Such open-minded, careful and attentive stewardship will base cooperation in front. Instead of owning solutions, members of diverse teams contribute to results with their abilities, competencies and equal opportunities (Takács & Abcouwer, 2023).

6. Developing Stewardship for Managing Present Societal Challenges for a Liveable Future

Education plays a crucial role in shielding children and youth with sustainability competencies so they can be responsible stewards in organisations, that care for future generations (E. k. Takács et al., 2022).

Changing school cultures and developing school leadership teams is the first action to take (Hahn, 2021). Understanding the nature of change and the need for adaptivity can support the development of management, leadership and stewardship skills, competencies and attitudes (Takács & Abcouwer, 2021).

This understanding is very important not just for schools which develop future leaders, but also for organisations, which are already responsible for managing change in a way that does not harm any individuals, society, or the world. Being aware of the differences between Management, Leadership and Stewardship, understanding the role of motivation can ensure sustainable change management for organisations (Abcouwer et al., 2021).

The European Sustainability Competence Framework (Bianchi et al., 2022) can guide school leaders and organisational managers to embody sustainability values, embrace complexity in sustainability, envision sustainable futures, and act for sustainability. On all these issues, knowledge must be available to be able to support decision-making on these fields (E. Takács & A. W. Abcouwer, 2020). We find that a change must happen both in school cultures and organisational cultures when we want to ensure futures for the people (Me), organisations (We) and the Earth (All). The need for different types of knowledge is apparent for understanding the challenges we will face in future (E. Takács & A W Abcouwer, 2020). Our paper wished to provide a basic understanding of such a change with some helpful insights and instructions.

References

Abcouwer, A. W., & Takács, E. (2022). *The 'Me-We-All'-approach for a more sustainable and responsible world* ECMLG 2022, Lisbon.

Abcouwer, A. W., Takács, E., & Rácz, C. (2021). Innovating Management and Leadership in Contemporary Times: Motivation and Evaluation in Learning. 17th European Conference on Management, Leadership and Governance, Malta.

Abcouwer, A. W., Takács, E., Schilstra, T., & Banga, O. P. (2022). *The Me, We, All Approach - Circular Resilience*. A.A.A.& O.

Beck, U. (2006). Living in the world risk society. *Economy and Society*, *35*(3), 329-345.

Bianchi, G., Pisiotis, U., & Cabrera Giraldez, M. (2022). *GreenComp The European sustainability competence framework*.

Brouwers, K., van Lelyveld, W., Takács, E., & Abcouwer, T. (2022). Lifelong learning through knowledge-sharing & digital collaboration. 23rd European Conference on Knowledge Management Vol 1,

Chapin III, F. S., Kofinas, G. P., Folke, C., & Chapin, M. C. (2009). *Principles of ecosystem stewardship: resilience-based natural resource management in a changing world*. Springer Science & Business Media.

Contrafatto, M. (2014). Stewardship theory: Approaches and perspectives. In *Accountability and social accounting for social and non-profit organizations* (Vol. 17, pp. 177-196). Emerald Group Publishing Limited.

Dell'Era, C., Magistretti, S., Cautela, C., Verganti, R., & Zurlo, F. (2020). Four kinds of design thinking: From ideating to making, engaging, and criticizing. *Creativity and Innovation Management*, *29*(2), 324-344.

Folke, C., Carpenter, S., Elmqvist, T., Gunderson, L., Holling, C. S., & Walker, B. (2002). Resilience and sustainable development: building adaptive capacity in a world of transformations. *Ambio*, *31*(5), 437-440. https://www.ncbi.nlm.nih.gov/pubmed/12374053

Gigerenzer, G. (2015). *Risk savvy: How to make good decisions*. Penguin.

Hahn, E. R. (2021). The developmental roots of environmental stewardship: Childhood and the climate change crisis. *Current opinion in psychology*, *42*, 19-24.

Heene, A. (2002). *Praktijkboek strategie*. Scriptum.

Institute for People Place and Possibility (IP3). (n.d.). *Community Commons*. https://www.communitycommons.org

Lunenburg, F. (2013). Leadership versus management: A key distinction - at least in theory. *Main Issues Of Pedagogy And Psychology*, *3*(3), 15-18.

Minow, M. (2021). Equality vs. equity. *American Journal of Law and Equality*, *1*, 167-193.

Runyan, A. S. (2018). What is intersectionality and why is it important? *Academe*, *104*(6), 10-14.

Schwartz, S. H. (2012). An overview of the Schwartz theory of basic values. *Online readings in Psychology and Culture*, *2*(1), 11.

Sowell, T. (2001). *The quest for cosmic justice*. Simon and Schuster.

Sowell, T., & Friedman, M. (1981). *Markets and minorities*. Basic Books New York.

Sowell, T., & Weiner, T. (2010). *Race and culture*. Blackstone Audio, Incorporated.

Takács, E., & Abcouwer, A. W. (2020). Framework for Adaptive Change: Towards Sustainable Innovation. *International Journal of Innovation in Management*, *8*.

Takács, E., & Abcouwer, A. W. (2020, 26-27 October 2020). *Leadership, management and teams - A way of being successful.* 16th European Conference on Management Leadership and Governance (ECMLG), Oxford.

Takács, E., & Abcouwer, A. W. (2021, December 11 - 12 2021). Resilience, people and Information, a Triangle to build Sustainability. 2021 SIGED International Conference on Information Systems Education and Research, Austin Texas/online.

Takács, E., & Abcouwer, A. W. (2023). Empowering Competence Development In a Dynamic and Networked World. ICISER 2023, Hyderabat.

Takács, E., Abcouwer, A. W., & Banga, O. P. (2019). *Is there a need for a system approach for management, leadership and teams?* EBES, Coventry.

Takács, E., Abcouwer, A. W., & de Boer, R. (2021). Management and Leadership Skills and Attitude in Uncertainty. 17th European Conference on Management, Leadership and Governance, Malta.

Takács, E., Schilstra, T., & Abcouwer, A. W. (2022). *The Me-We-All Approach Applied to Learning* ICISER, Copenhagen.

Takács, E. k., Schilstra, T., & Abcouwer, T. (2022). The Me-We-All Approach Applied to Learning.

Van den Broek, B., Takács, E., & Abcouwer, T. (2023). From Student Education to Societal Impact: Assessing University Value.

Knowledge Transfer Dynamics in Family Businesses Through Digitalisation: A Systematic Literature Review

Alessia Talarico, Antonio Lorena, Ludovica Zoccali and Marzia Ventura
University Magna Græcia of Catanzaro, Catanzaro, Italy

alessia.talarico2@studenti.unicz.it
antonio.lorena87@gmail.com
ludovica.zoccali@studenti.unicz.it
marziaventura@unicz.it

Abstract: In the current unpredictable and constantly evolving scenario, knowledge is a strategic resource for businesses (Argote L., Ingram P., 2000), particularly in the case of family businesses (Zapata – Cantu L. et al., 2023). In this context knowledge transfer is most important and technology and innovation can concretely support the transfer of information, both inside and outside organizations; but family businesses are not very technology-oriented (Bouncken R. & Schmitt F., 2022). So, the aim of this study is to understand how digitalization could impact on knowledge transfer dynamics in family businesses and in particular on codifying explicit knowledge, on transfer of tacit knowledge and on generational succession in family businesses.

Keywords: Knowledge Transfer Dynamics, Family business, Digitalization

1. Introduction

In recent years many authors, such as Drucker, point out that the only significant resource for businesses is knowledge (Nonaka et al., 1996) and how management of this knowledge is essential for organisations and their survival in the existing context (Omotayo, 2015). Furthermore, it is also one of the most important sources for competitors of an organization to gain an advantage. Indeed, the relationship between knowledge and performance can be better comprehended by focusing on the four fundamental components of knowledge management: knowledge creation, knowledge acquisition, knowledge coding and knowledge transfer; the last is the element in which this study focuses on. Specifically, knowledge transfer is an efficient process used to increase the productivity of an organisation (Argote, 2000) and to obtain the best results and achieve an elevated level of innovation (Riege, 2007). According to Argote and Ingram (2000), knowledge transfer affects one unit through the experience of another. In particular, knowledge transfer improves the behaviour and activities of an organisation's members, (Omotayo, 2015) and therefore cannot be considered as simple as the movement of knowledge between people or from one place to another (Riege, 2007). Indeed, although most studies of business organisation address the issue of knowledge transfer dynamics by focusing on the characteristics and attitudes of the parties involved, it has emerged that these dynamics are influenced by the intrinsic nature of knowledge and its complexity (Szulanski, 1996). This complexity depends on the different understandings of knowledge. While the traditional Taylor and Herbert's theory point that is explicit, formal and systematic (Nonaka et al., 1996), others such as Nonaka and Takeuchi, who in agreement with Michael Polanyi, recognize a tacit knowledge that is hard to communicate, to transfer or to share with others.

In this context, digitalization, which can be defined as a socio-technical process of mass adoption of digital technologies (Yonghong et al., 2023), can concretely support the transfer of information, both inside and outside an organization (Bouncken et al, 2022), as it can eradicate the boundaries between an enterprise and external organizations (Yonghong et al., 2023). Indeed, digitalization and technology help organizations to connect, to cooperate, to communicate, to gain knowledge (Yonghong et al., 2023) and to facilitate the relationship with internal and external agents. It also allows for the reduction in information asymmetries (Nieto et al., 2023) rendering the information received more productive, fostering a greater learning from and with a variety of partners (Brynjolfsson et al., 2023). For these reasons digitalization is vitally important to organizations, undeniably becoming a priority for managers and policy-makers (Legner et al., 2017). Not all companies however, are digitally oriented and a clear example of this are family businesses (Nieto et al., 2023). It is in fact family businesses that are the object of this present research. Admittedly, some authors, namely Lubatkin and Schulze, point out that they are less innovative when compared to other types of enterprises (Bouncken et al, 2022). And in order to survive they must constantly learn, create, transfer and apply knowledge in an effort to adapt more easily to changes in the environment in which they operate (Zapata – Cantu L. et al., 2023). They need to manage the diffusion of information inside the organization, allowing the transfer of knowledge to increase the success of the family firm's succession process (Valenza et al., 2021) and beyond the perimeters of

the family business, outside, between organizations into its own external environment. It is necessary to deepen the various types of knowledge which can be transferred (Mustake et al., 2017) and to also understand which forms are most important for the growth of the organization (Valenza et al., 2021). In this regard different studies illustrate how the differences between family and non-family firms depend on their own socio-emotional characteristics (Gómez-Mejía et al., 2007), as it particularly influences the tacitness level of family firm's knowledge and when this is very high, it can be very difficult to digitalize knowledge transfer (Brynjolfsson et al., 2023).

Based on the arguments discussed, the aim of this study is to understand how digitalization can impact on knowledge transfer dynamics in family businesses that are complex and influenced by various factors including the nature of the knowledge, the roles of family members, and the impact of digitalization.

2. Methodology

The methodology adopted in this study consists of a systematic review of the literature (Tranfield et al., 2003). This methodological approach, based on predefined criteria, is the reference standard for synthesizing evidence thanks to their methodological rigor.

2.1 Search Strategy and Selection Criteria

Three major academic databases were selected for the purpose of this study: Scopus, Web of Science and Google Scholar. These databases, having extensive archives of scholarly articles, conference proceedings and critical academic publications in the fields of business management and digital technologies allow for a thorough and robust analysis.

As the objective of this research is to understand the dynamics of knowledge transfer in family businesses through digitisation, three specific initial keywords were chosen to capture the relevant literature and the essentials of the study: "digital*", "knowledge transfer dynamic*" and "family business*". Using these keywords, a comprehensive search strategy was developed, employing the Boolean AND operator to refine the search queries and improve the accuracy of the results

The search focused on peer-reviewed articles published up to July 2024 to ensure the inclusion of contemporary and relevant studies on the interaction between digitalization, knowledge transfer dynamics, and family businesses published in English. Attention was also paid to research that includes empirical data, theoretical frameworks, and case studies relevant to the topic. These criteria were applied to ensure the relevance, quality, and focus of the selected studies, resulting in a refined set of articles for detailed analysis.

The initial search founded no results in all databases used. For this reason, the second step was to modify the string replacing the keyword "family business*", step by step, with "family firm*", "family enterprise*", "family organization*" and "family compan*". Also in this case the search founded no results. Due to this, alternating this different synonyms in the string in all databases selected, the keyword "knowledge transfer dynamics" was replace with "knowledge transfer" to include a major number of articles in which the selection was made in function of the knowledge transfer dynamics concept. The results were then rigorously screened based on titles and abstracts to assess their relevance to the research questions.

2.2 Thematic Analysis and Synthesis

The articles selected after initial screening were subjected to in-depth full-text review through careful reading. The purpose was to check the relevance of the article to the research objectives and to include in the final analysis only those studies consistent with the topic under study.

Each article was read thoroughly to confirm its direct relevance to the research questions concerning the interplay between digitalization, knowledge transfer dynamics and family businesses. Detailed information was extracted from each article using a standardized data extraction form. This form included fields for authors' names and affiliations, year of publication to ensure the timeliness of the data, research methodologies, key findings, theoretical frameworks, and the identification of research gaps.

The data collected were systematically organized into specific thematic categories. This process allowed similar findings and theoretical references to be grouped together to promote a coherent synthesis.

Specifically, the mechanisms through which digitization influences the transfer both tacit (implicit, uncoded) and explicit (codified, easily shared) knowledge dynamics within organizations were attended to. It emerged, in this regard, how digital tools and platforms can support communication, collaboration and knowledge sharing especially in family businesses. With the chosen strings, the process of systematically analysing and organizing the extracted data provided a comprehensive understanding of the current state of research of digitization to support knowledge transfer dynamics within family businesses. This process simplified the detection of key trends and existing gaps in the literature, paving the way for future research directions. To increase the reliability and validity of the results obtained, data from the three databases were compared and cross-referenced for consistency and robustness of the identified themes. The comparison of the results obtained from the different sources was intended to reduce bias and strengthen the credibility of the conclusions.

Finally, a synthesis of the data obtained was made to more easily identify any gaps in the literature from which future theoretical studies could be drawn. The purpose was to contribute to a comprehensive understanding of the current state of research on the topic studied to better clarify the impact of digitization on knowledge transfer dynamics in family businesses.

3. Results

The search strategy yielded varying results across the three academic databases, highlighting the importance of utilizing multiple sources for a comprehensive literature review. The following table shows results obtained.

Table 1:

Keywords	Scholar	Web of Science	Scopus	Total results
Digital*, Knowledge transfer dynamic*, family business*	0	0	0	**0**
Digital*, Knowledge transfer dynamic*, family firm*	0	0	0	**0**
Digital*, Knowledge transfer dynamic*, family enterprise*	0	0	0	**0**
Digital*, Knowledge transfer dynamic*, family organization*	0	0	0	**0**
Digital*, Knowledge transfer dynamic*, family compan*	0	0	0	**0**
Digital*, Knowledge transfer, family business*	314	2	4	**320**
Digital*, Knowledge transfer, family firm*	152	0	2	**154**
Digital*, Knowledge transfer, family enterprise*	37	0	0	**37**
Digital*, Knowledge transfer, family organization*	6	0	0	**6**
Digital*, Knowledge transfer, family compan*	2	0	1	**3**
Total results	**511**	**2**	**7**	**520**

After the initial retrieval of 520 articles, a meticulous screening process was conducted to assess the relevance of each article. This rigorous screening aimed to filter out articles that did not directly address the research questions or did not meet the quality and focus criteria established for this review. After this careful evaluation, 45 articles were identified as highly relevant and suitable for in-depth analysis.

The result produced by Scopus, Web of Science and Google Scholar (restricted to 45 after the screening process) offer a nuanced and complete view of the current state of research in this field on basis of the chosen search string. This summary underscores the necessity of utilizing multiple databases to obtain a holistic understanding of the literature landscape and to ensure that no significant studies are overlooked.

It should be noted that the choice of keywords influence the results obtained. So, making variations in the keywords might produce different results by capturing other relevant studies that were not identified using the strings of the present study. This suggests that a more flexible and iterative approach to keyword selection could enhance the comprehensiveness of the literature review.

4. Finding and Discussion

From the reviewed literature, different common denominators emerged. The results of the analysis will be presented below focusing attention on: knowledge and knowledge transfer dynamics in family business and the impacts of digitalization on knowledge transfer dynamics in family business.

4.1 Knowledge and Knowledge Transfer Dynamics in Family Business

In general, knowledge assets, which are challenging to replicate and transfer, have become the primary source enabling organizations to achieve superior results compared to their competitors. Unlike the assets which traditionally formed the basis for competitive advantage, knowledge assets now play a crucial role in driving organizational success (Zapata-Cantu et al., 2022). For these reasons family businesses must stay open to new ideas and continuously update their knowledge to align with emerging market trends and technologies, preventing stagnation and ensuring profitable use of their knowledge base (Andersén, 2015; Filippini et al., 2012; Wang, 2016, Putz et al, 2023). The presence of dynamic changes means that no single solution or routine can be long-term, as such rigidity can hinder business development (Wang, 2016; Putz et al, 2023). In this context, what is important is knowledge renewal that can be sourced from suppliers, customers, employees, and intermediaries and their networks (Boyd et al, 2012; Klewitz et al., 2012; McAdam et al., 2010, Putz et al, 2023). So, intra and inter-organization relationships became essential to exchange information inside and outside (Zahra et al, 2007; Zapata-Cantu, 2021). However, other authors indicate that family firms are less inclined to share knowledge (Mazzola et al., 2008; Botero et al., 2021; Zapata-Cantu et al, 2021) when there is a lack of trust, commitment, predecessor involvement in the training of a successor and organizational culture (Zapata-Cantu et al, 2021). Also, strong social relationships within firms facilitate the adoption of new technologies and resource sharing, enhancing business performance (Meng et al.). Collaboration among family members promotes the dissemination of technological ideas, strengthening continuous innovation and business resilience (Gamba, 2019; Meng et al.). Engaging with stakeholders allows companies to quickly identify and integrate new market trends, crucial for developing new products and services (Chaudhary et al, 2018; Chen et al., 2009; Fredrich et al., 2019). Effective knowledge transfer within companies requires strong communication, facilitating mutual learning and innovation (Szulanski, 1996; Tsai, 2001) especially for tacit knowledge transfer, which is fundamental in creating a strong competitive advantage, as Letonja and Duh (2016) point out.

In this regard, taking into account the importance of relational social capital, i.e. the positive attitudes existing between the parties involved (Nahapiet and Ghoshal, 1998) and cognitive social capital, i.e. the codes, languages and narratives shared between the parties involved (Lane and Lubatkin, 1998) in knowledge transfer dynamics, the role of family members in the knowledge transfer process is crucial; the older generation, often the repository of tacit knowledge, plays a central role in guiding and mentoring the next generation, Zapata-Cantu et al. (2023) emphasise that these older members must be actively involved in the transfer process to ensure that valuable tacit knowledge is not lost. The successors, typically the next generation, are responsible for integrating and applying this knowledge to move the company forward. Valenza et al. (2021) emphasise the importance of successors being properly prepared and involved in this process to facilitate a smooth transition and continued business success. Valenza et al. (2021) point out that ensuring critical knowledge is preserved and passed on to the next generation is vital for maintaining the longevity and success of the business. Maintaining a repository of both tacit and explicit knowledge helps family businesses stay competitive, as underscored by Zapata-Cantu et al. (2023).

Regular evaluation of the knowledge transfer processes is essential for continuous improvement. Feedback mechanisms allow for the assessment of the effectiveness of these processes, enabling businesses to adapt and refine their methods based on changing needs and feedback from participants. This ongoing adaptation ensures that knowledge transfer remains effective and aligned with the evolving goals and challenges of the family business.

4.2 The Impact of Digitalization on Knowledge Transfer Dynamics in Family Business.

One of the main observations that emerges from the analysis of the selected literature is that knowledge transfer dynamics in family businesses are influenced by digitisation despite the fact that this type of business is less oriented towards this process than other types of organisations (Zapata-Cantu et al.). Digitisation helps, in fact, to break down internal organisational and external boundaries, fostering better collaboration and communication also with one's partners (Bouncken et al. 2022).

The sourcing, sharing, and processing of information through digital technologies improves the connectivity and dissemination of information within and outside the company (Radicic and Petković, 2023). Through digital platforms advanced technology tools can increase a company's efficiency and better support customers by streamlining organizational processes (Ardito et al, 2021).

In particular, family businesses, which generally have a wealth of industry-specific skills and knowledge-spanning generations (Sirmon et al, 2003; Iwu et al., 2024), can demonstrate a remarkable ability to adapt to new technologies, using digital tools to improve decision-making and management processes. Additionally, these factors could improve the competitiveness of the family business (Prasanna e al, 2019) benefiting from both external and internal environmental knowledge (Breivik-Meyer et al, 2020; Iwu et al, 2024). These benefits encourage family businesses to cooperate (Chirico et al, 2020, Iwu et al, 2024). Digital technologies also support the creation of collaborative environments that enhance intergenerational communication and promote the sharing of competencies, essential for succession and the professionalization of successors (Del Rio Castro et al., 2021, Nieto et al, 2023).

The transfer of tacit knowledge in the digital age poses a challenge. According to Brynjolfsson et al. (2023) tacit knowledge is interpersonal in nature and requires direct interaction that may be difficult to pursue by digital means alone. Furthermore, there are many benefits of effective knowledge transfer, for example, as Riege (2007) argues, improved innovation capabilities that lead to better performance and competitive advantages.

The ability to leverage digital technologies to improve knowledge management and support innovation is seen as a key element for the long-term success of family businesses (Zapata-Cantu et al., 2022).

4.3 Implications, Limitations and Future Research Directions

The findings emerging from the present study could influence future research on the impact digitization has on knowledge transfer dynamics in family businesses. Due to the great importance of digital technologies in improving knowledge management processes, there is a need to identify digital tools and platforms specifically for family businesses. For example, possible solutions could be the adoption of artificial intelligence tools, data analytics and collaborative platforms that have a relevant impact on knowledge creation, sharing and utilization processes. In addition, it is necessary to understand how the specific characteristics of family businesses (e.g., their dependence on socio-emotional wealth and intergenerational dynamics) may limit or promote digital transformation in this type of organization.

Future research should also be conducted by seeking to understand how the characteristics of family businesses may influence the impact of digital technologies on knowledge transfer dynamics. Thus, the role of family governance structures, the involvement of multiple generations in decision making the impact of family values and culture on digital orientation should be considered.

What emerges from this study is the importance of external networks and collaborations that enable family organizations to enrich their knowledge base. For this reason, it is very important to focus on the mechanisms that these enterprises adopt to create relationships with external stakeholders, such as suppliers, customers, and industry associations, to enrich their digital skills and knowledge.

Understanding how family businesses can leverage resources from the external environment to enhance innovation and competitive advantage requires an understanding of these relationships.

Knowledge transfer is a complex process, especially that of tacit knowledge, so future research should deepen, emphasizes the need for further research into methods and practices that can facilitate this process in the digital age. It would be interesting to understand how digital technologies can be designed and applied in organizational settings to support the transfer of tacit knowledge, which in family businesses is represented by the experiences and knowledge of family members. This would make it easier to understand the impact of digitization in family businesses.

The present study was conducted comprehensively on the chosen keywords but nevertheless has limitations. The first is that using specific keywords may unintentionally exclude relevant literature studies using different terminologies. More keywords or a different string should be considered in the future to include studies other than those found with the present study.

For the future, it would be advisable to conduct the studies without neglecting the geographical and cultural context in which family businesses operate, as these aspects influence the adoption and orientation toward digitization in knowledge transfer and by identifying digital tools and platforms that can best contribute to this

process. Finally, future research could be conducted taking into account that the effectiveness of digitization affects the characteristics of family businesses that influence the effectiveness of digitization in knowledge transfer, for example, socio-emotional wealth, governance structures, and intergenerational dynamics.

By overcoming these limitations, future research directions could help to better understand the impact of digitization in knowledge transfer in family business.

References

Andersén, J. (2015) "The absorptive capacity of family firms: How familiness affects potential and realized absorptive capacity", Journal of Family Business Management, 5(1), 73-89.

Ardito, L., Raby, S., Albino, V., & Bertoldi, B. (2021) "The duality of digital and environmental orientations in the context of SMEs: Implications for innovation performance" Journal of Business Research, 123, 44-56.

Argote, L., & Ingram, P. (2000) "Knowledge transfer: A basis for competitive advantage in firms" Organizational Behavior and Human Decision Processes, 82(1), 150–169.

Boyd, B., & Hollensen, S. (2012) "Strategic management of a family-owned airline: Analysing the absorptive capacity of Cimber Sterling Group A/S" Journal of Family Business Strategy, 3(2), 70-78.

Botero, I. C., Barroso Martinez, A., Sanguino, G., & Binhote, J. (2022) "The family's effect on knowledge sharing in family firms" Journal of Knowledge Management, 26(2), 459-481.

Bouncken, R., & Schmitt, F. (2022) "SME family firms and strategic digital transformation: inverting dualisms related to overconfidence and centralization" Journal of Small Business Strategy, 32(3), 1-17.

Breivik-Meyer, M., Arntzen-Nordqvist, M., & Alsos, G. A. (2020) "The role of incubator support in new firms accumulation of resources and capabilities" Innovation, 22(3), 228-249.

Brynjolfsson, E., Li, D., & Raymond, L. R. (2023) Generative AI at work (No. w31161). National Bureau of Economic Research.

Castro, G. D. R., Fernandez, M. C. G., & Colsa, A. U. (2021) "Unleashing the convergence amid digitalization and sustainability towards pursuing the Sustainable Development Goals (SDGs): A holistic review" Journal of Cleaner Production, 280, 122204.

Chaudhary, S., & Batra, S. (2018) "Absorptive capacity and small family firm performance: exploring the mediation processes" Journal of knowledge management, 22(6), 1201-1216.

Chen, Y. S., Lin, M. J. J., & Chang, C. H. (2009) "The positive effects of relationship learning and absorptive capacity on innovation performance and competitive advantage in industrial markets" Industrial marketing management, 38(2), 152-158.

Chirico, F., & Nordqvist, M. (2010) "Dynamic capabilities and trans-generational value creation in family firms: The role of organizational culture" International Small Business Journal, 28(5), 487-504.

Filippini, R., Güttel, W. H., Neirotti, P., & Nosella, A. (2012) "The different modes for absorbing knowledge: an analytic lens on absorptive capacity from a process perspective" International Journal of Knowledge Management Studies, 5(1-2), 45-65.

Fredrich, V., Bouncken, R. B., & Kraus, S. (2019) "The race is on: Configurations of absorptive capacity, interdependence and slack resources for interorganizational learning in coopetition alliances" Journal of Business Research, 101, 862-868.

Galeone, G., Campobasso, F., & Dell'Atti, V. (2023) "Innovation and digitalisation: what challenges and opportunities for family business?" International Journal of Digital Culture and Electronic Tourism, 4(2), 155-170.

Gamba, F. J. (2017) "Social capital in selected business associations of food processing SMEs in Tanzania and Rwanda: A synthetic-based approach" International Journal of Asian Social Science, 7(1), 63-84.

Gómez-Mejía, L. R., Haynes, K. T., Núñez-Nickel, M., Jacobson, K. J., & Moyano-Fuentes, J. (2007) "Socioemotional wealth and business risks in family-controlled firms: Evidence from Spanish olive oil mills" Administrative science quarterly, 52(1), 106-137.

Iwu, C. G., Malawu, N., Ndlovu, E. N., Makwara, T., & Sibanda, L. (2024) "Sustaining Family Businesses through Business Incubation: An Africa-Focused Review" Journal of Risk and Financial Management, 17(5), 178.

Klewitz, J., Zeyen, A., & Hansen, E. G. (2012) "Intermediaries driving eco-innovation in SMEs: A qualitative investigation" European Journal of Innovation Management, 15(4), 442-467.

Kraus, S., Kumar, S., Lim, W. M., Kaur, J., Sharma, A., & Schiavone, F. (2023) "From moon landing to metaverse: Tracing the evolution of Technological Forecasting and Social Change" Technological Forecasting and Social Change, 189, 122381.

Kuruppuge, R. H., & Gregar, A. (2017) "Family involvement, employee engagement and employee performance in enterprising family firms" Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis.

Lane PJ, Lubatkin M (1998) "Relative absorptive capacity and interorganizational learning" Strategic Management Journal 19(5): 461–477.

Legner, C., Eymann, T., Hess, T., Matt, C., Böhmann, T., Drews, P., ... & Ahlemann, F. (2017) "Digitalization: opportunity and challenge for the business and information systems engineering community" Business & information systems engineering, 59, 301-308.

Letonja, M., & Duh, M. (2016) "Knowledge transfer in family businesses and its effects on the innovativeness of the next family generation" Knowledge Management Research & Practice, 14(2), 213-224.

Magrelli, V., Rovelli, P., Benedetti, C., Überbacher, R., & De Massis, A. (2022) "Generations in family business: A multifield review and future research agenda" Family Business Review, 35(1), 15-44.
Mazzola, P., Marchisio, G., & Astrachan, J. (2008) "Strategic planning in family business: A powerful developmental tool for the next generation" Family Business Review, 21(3), 239-258.
McAdam, R., Miller, K., McMacken, N., & Davies, J. (2010) "The development of absorptive capacity-based innovation in a construction SME" The International Journal of Entrepreneurship and Innovation, 11(3), 231-244.
Meng, F., Rieckmann, J. M., & Li, C. (2016) "Empirical evidence how social capital effects the internationalisation process of SME in Zhejiang" Transnational Corporations Review, 8(3), 196-206.
Meng, M., Wahat, N. W. A., Abdullah, H. B., & Zairul, M. (2023) "A Thematic Review on Successor Development in Chinese Family Business" International Journal of Academic Research in Business and Social Sciences, 13(12), 4862-4880.
Misangyi, V. F., Greckhamer, T., Furnari, S., Fiss, P. C., Crilly, D., & Aguilera, R. (2017) "Embracing causal complexity: The emergence of a neo-configurational perspective" Journal of management, 43(1), 255-282.
Muskat, B., & Zehrer, A. (2017) "A power perspective on knowledge transfer in internal succession of small family businesses" Journal of Small Business & Entrepreneurship, 29(5), 333-350.
Nahapiet J, Ghoshal S (1998) "Social capital, intellectual capital and the organizational advantage" Academy of Management Review 23(2): 242–266.
Nieto, M. J., Santamaria, L., & Bammens, Y. (2023) "Digitalization as a facilitator of open innovation: Are family firms different?" Technovation, 128, 102854.
Nonaka, L., Takeuchi, H., & Umemoto, K. (1996) "A theory of organizational knowledge creation" International journal of technology Management, 11(7-8), 833-845.
Omotayo, F. O. (2015) "Knowledge Management as an important tool in Organisational Management: A Review of Literature" Library Philosophy and Practice, 1(2015), 1-23.
Pigola, A., & da Costa, P. R. (2023) "Relational Capabilities into Small-and Middle-Sized Firms: a Mind-Blowing Strategic Asset" Journal of the Knowledge Economy, 1-25.
Prasanna, R. P. I. R., Jayasundara, J. M. S. B., Naradda Gamage, S. K., Ekanayake, E. M. S., Rajapakshe, P. S. K., & Abeyrathne, G. A. K. N. J. (2019) "Sustainability of SMEs in the competition: A systemic review on technological challenges and SME performance" Journal of Open Innovation: Technology, Market, and Complexity, 5(4), 100.
Pütz, L., & Werner, A. (2024) "Absorptive capacity in family firms: a systematic literature review" Review of Managerial Science, 18(2), 577-632.
Radicic, D., & Petković, S. (2023) "Impact of digitalization on technological innovations in small and medium-sized enterprises (SMEs)" Technological Forecasting and Social Change, 191, 122474.
Rickne, A. (2006) "Connectivity and performance of science-based firms" Small business economics, 26, 393-407.
Riege, A. (2007) "Actions to overcome knowledge transfer barriers in MNCs" Journal of knowledge management, 11(1), 48-67.
Sirmon, D. G., & Hitt, M. A. (2003) "Managing resources: Linking unique resources, management, and wealth creation in family firms" Entrepreneurship theory and practice, 27(4), 339-358.
Spiezia, V. (2011) "Are ICT users more innovative? an analysis of ICT-enabled innovation in OECD firms" OECD Journal: Economic Studies, 2011(1), 1-21.
Szulanski, G. (1996) "Exploring internal stickiness: Impediments to the transfer of best practice within the firm" Strategic management journal, 17(S2), 27-43.
Tranfield, D., Denyer, D., & Smart, P. (2003) "Towards a methodology for developing evidence-informed management knowledge by means of systematic review" British Journal of Management, 14(3), 207–222.
Tsai, W. (2001) "Knowledge transfer in intraorganizational networks: Effects of network position and absorptive capacity on business unit innovation and performance" Academy of management journal, 44(5), 996-1004.
Valenza, G., Caputo, A., & Calabrò, A. (2023) "Is small and medium-sized beautiful? The structure and evolution of family SMEs research" Journal of Family Business Management, 13(2), 453-485.
Van de Vrande, V., De Jong, J. P., Vanhaverbeke, W., & De Rochemont, M. (2009) "Open innovation in SMEs: Trends, motives and management challenges" Technovation, 29(6-7), 423-437.
Van Veldhoven, Z., & Vanthienen, J. (2022) "Digital transformation as an interaction-driven perspective between business, society, and technology" Electronic markets, 32(2), 629-644.
Yilmaz, Y., Raetze, S., Groote, J. D., & Kammerlander, N. (2024) "Resilience in Family Businesses: A Systematic Literature Review" Family Business Review, 08944865231223372.
Yonghong, L., Jie, S., Ge, Z., & Ru, Z. (2023) "The impact of enterprise digital transformation on financial performance—Evidence from Mainland China manufacturing firms" Managerial and decision economics, 44(4), 2110-2124.
Wang, Y. (2016) "Environmental dynamism, trust and dynamic capabilities of family businesses" International Journal of Entrepreneurial Behavior & Research, 22(5), 643-670.
Zagni, L. U. C. A., & Baima, G. (2023) "Beyond the game: a two-decade systematic literature review of advertising in digital games" In EUROMED ACADEMY OF BUSINESS CONFERENCE BOOK OF PROCEEDINGS (pp. 1184-1188). EuroMed Press.
Zahra, S. A., Neubaum, D. O., & Larrañeta, B. (2007) "Knowledge sharing and technological capabilities: The moderating role of family involvement" Journal of Business research, 60(10), 1070-1079.
Zapata-Cantu, L., Sanguino, R., Barroso, A., & Nicola-Gavrilă, L. (2023) "Family business adapting a new digital-based economy: Opportunities and challenges for future research" Journal of the Knowledge Economy, 14(1), 408-425.

Exploring the Relationship Between Decentralised Organisational Design and Knowledge Acquisition Capacity

Edilene Cavalcanti dos Anjos[1], Alisson Luiz Lessak[1], Guillermo Antonio Dávila[2] and Gregório Varvakis[1]

[1]Department of Knowledge Engineering and Management, Federal University of Santa Catarina, Florianópolis, Brazil

[2]Scientific Research Institute and Faculty of Engineering and Architecture, Universidad de Lima, Lima, Peru

edilene.anjos@posgrad.ufsc.br
alisson.lessak@posgrad.ufsc.br
gdavila@ulima.edu.pe
g.varvakis@ufsc.b

Abstract: Business firms face challenges in maintaining their sustainability in the global market. As a result, it is increasingly necessary for them to focus on ensuring sustainable performance by balancing financial, social and environmental outcomes. One of the efforts companies make to achieve sustainable organisational performance and gain a competitive advantage is by increasing their utilisation of knowledge. According to the knowledge-based view, performance differences among organisations result from their different knowledge stocks and their different capabilities for knowledge use and development. Therefore, the ability to acquire and manage knowledge internally becomes essential. It enhances the organisation's competencies, sustains them, and contributes to achieving a competitive advantage. As a vital resource for organisational success, managing knowledge through practices is necessary. Organisational design refers to how power is distributed in an organisation. Previous research has examined the effects of knowledge management on absorptive capacity and organisational performance. However, few studies have investigated how the relationship between decentralised organisational design and knowledge acquisition capabilities works. To fill this gap, this study aims to investigate the relationship between decentralised organisational design and knowledge acquisition capability in achieving sustainable performance. A sample of 125 responses was collected from companies in the state of Santa Catarina, Brazil, through an online questionnaire. The data were analysed using partial least squares structural equation modelling applied to validate the model and test the hypothesis, through the free and open source SEMinR package of the R language. The results indicate that a decentralised organisational design has a positive and significant impact on a company's knowledge acquisition capability. Therefore, for companies to achieve sustainable organisational performance, they must adopt appropriate organisational design methods that allow for a clear distribution of tasks and responsibilities, as well as promote learning and problem-solving and encourage the creation of a culture of knowledge sharing among employees.

Keywords: Knowledge Management Practices, Organisational Design, Knowledge Acquisition, Sustainable Performance, SEMinR.

1. Introduction

Companies strive to enhance organisational performance through effective knowledge utilisation, a strategic resource as per the knowledge-based view of the firm (Grant, 1996). Knowledge acquisition (KA) capacity, a component of absorptive capacity (ACAP), is vital for enhancing skills and gaining a competitive edge (Zahra and George, 2002).

Given knowledge's critical role in organisational success, effective management through various practices is essential (Andreeva and Kianto, 2012; Inkinen, Kianto and Vanhala, 2015; Qader et al, 2022). Knowledge management (KM) practices facilitate value extraction from knowledge-based assets, supporting efficient and effective knowledge management for organisational benefit (Andreeva and Kianto, 2012; Inkinen, Kianto and Vanhala, 2015). Inkinen, Kianto and Vanhala (2015) categorise KM practices into areas like supervisory work, information technology (IT), and organisational design (OD).

OD significantly impacts KA within companies. It encompasses the arrangement of people and positions to facilitate work processes (Syed-Ikhsan and Rowland, 2004). OD complexity, formalisation, and centralisation are key factors (Lin, 2008). Centralised ODs limit decision-making to a select few, whereas less centralised structures foster dispersed decision-making and individual autonomy (Raziq et al, 2020).

Decentralised OD serves as a crucial KM practice to enhance knowledge utilisation within an organisation. This approach involves delegating authority and decision-making responsibilities to knowledge workers, forming and utilising cross-functional teams, and endorsing diverse communities of practice (Inkinen, Kianto and

Vanhala, 2015). Susanty, Yuningsih and Anggadwita (2019) suggest that while hierarchical structures impede knowledge dissemination, endorsing multiple communities of practice fosters a robust knowledge development environment that can bolster organisational performance.

Previous research has explored the impact of KM practices on ACAP and organisational performance (Inkinen, Kianto and Vanhala, 2015; Qader et al, 2022; Susanty, Yuningsih and Anggadwita, 2019). Additionally, studies have delved into the direct influence of ACAP on innovation and financial performance (Kostopoulos et al, 2011; Liu et al, 2021).

Nevertheless, there remains a scarcity of studies examining the interplay between decentralised OD and KA capacity. Hence, this study endeavours to elucidate the connection between OD and KA capacity and to assess how these practices can foster firms in attaining sustainable performance.

In addition, in the context of emerging countries, such as Brazil, besides global competition, companies face other institutional and regional challenges that are characteristic of these countries (Dávila, Andreeva and Varvakis, 2019). However, the literature lacks studies that investigate KM practices in this context.

This paper is structured into five sections, in addition to this introduction. Section 2 provides a concise definition of each construct and research hypothesis, followed by the methodological approach outlined in section 3. Subsequently, section 4 elaborates on and discusses the results, while section 5 presents the primary conclusions.

2. Literature Review and Research Hypothesis

This section provides a brief review of KM practices and ACAP, with a focus on the constructs of OD and KA capacity. The review is followed by the presentation of the research hypothesis.

2.1 Knowledge Management Practices and Organisational Design

KM practices are not confined to a single approach (Hussinki et al, 2017; Inkinen, Kianto and Vanhala, 2015; Kianto and Andreeva, 2014). They are organisational aspects that can be consciously manipulated by management to efficiently utilise knowledge for organisational benefit (Andreeva and Kianto, 2012).

Targeted at achieving organisational objectives, these practices can confer a competitive advantage (Hussinki et al, 2017). They can be classified into dimensions such as Organisational Development (OD), strategic knowledge management, organisational culture, human resource management practices, and information and communication technology (Kianto and Andreeva, 2014).

OD involves decisions related to work distribution and task coordination to foster learning and problem-solving (Abdelwhab Ali et al, 2019; Inkinen, Kianto and Vanhala, 2015; Kianto and Andreeva, 2014). These decisions can either facilitate or hinder knowledge processes (Abdelwhab Ali et al, 2019; Kianto and Andreeva, 2014).Research indicates that a highly centralised environment can impede knowledge sharing (Raziq et al, 2020). To enhance knowledge sharing, managers should consider a less centralised structure, promoting open workspaces, increased communication, and informal meetings (Abdelwhab Ali et al, 2019).

In the Brazilian context, Dávila, Andreeva and Varvakis (2019) found that OD mechanisms had the most significant positive impact on innovation performance, compared to ICTs, rewards, and organisational culture.

2.2 Absorptive capacity and Knowledge Acquisition

To Cohen and Levinthal (1990), the ACAP refers to a firm's ability to recognise the value of new information, assimilate it, and apply it to commercial ends. They argue that firms that conduct their research and development are better equipped to use externally available information effectively.

Based on these authors, Zahra and George (2002) define ACAP as the dynamic capability related to knowledge creation and utilisation that enhances a firm's ability to gain and sustain a competitive advantage. The ACAP of an organisation depends on the ACAP of its members (Cohen and Levinthal, 1990).

According to Flatten et al (2011), a firm's ACAP is composed of four distinct but complementary capabilities: (i) acquisition, refers to the firm's ability to identify and acquire external knowledge and information from the environment; (ii) assimilation, involves the firm's ability to understand and interpret the new knowledge and information acquired; (iii) transformation, refers to the firm's ability to integrate and recombine the new

knowledge with existing knowledge to create new ideas and products; and (iv) exploitation, involves the firm's ability to use the new knowledge and ideas to improve its products or services and gain a competitive advantage.

Zahra and George (2002) categorise the four dimensions of ACAP into two categories: (i) Potential ACAP, which refers to the ability to recognise and acquire external knowledge that is valuable to the organisation. This includes the KA capacity (gathering new knowledge) and assimilation (integrating new knowledge with existing knowledge); and (ii) Realised ACAP, which refers to the organisation's ability to effectively utilise the knowledge that has been acquired and assimilated. This includes the processes of knowledge transformation (modifying existing knowledge to create new knowledge) and exploitation (using existing knowledge to create value for the organisation).

The greater the organisation's capacity to acquire and assimilate information obtained from external sources, the greater the possibilities to respond to the high competition of the external environment (Flatten et al, 2011). In this article, we focus specifically on KA capacity, which plays a key role in enabling organisations to renew their stock of knowledge and continuously innovate.

According to Zahra and George (2002, p. 189), "acquisition refers to a firm's capability to identify and acquire externally generated knowledge that is critical to its operations". Flatten et al (2011, p. 100) define acquisition as "a firm's ability to identify and obtain knowledge from external sources".

2.3 Knowledge Management Practices and Absorptive Capacity

Studies that address the relationship between KM practices and absorptive capacity are scarce (Dávila and Dos Anjos, 2021). Such studies show that there is a positive relationship between these constructs (Valentim, Lisboa and Franco, 2012).

Valentim, Lisboa and Franco (2012), when investigating 4,534 firms in Portugal, concluded that these firms are committed to the use of KM practices executed through collaboration with business partners, favouring experience-based learning processes, knowledge transfer to staff and/or knowledge absorption by staff.

Dávila (2016) analysed the relationship between KM Practices, ACAP, and organisational performance. The results showed that KM practices related to strategic management of knowledge, organisational culture and organisational design influence potential ACAP; while KM practices about strategic management and information and communication technologies influence realised ACAP.

Considering knowledge as a resource capable of helping companies overcome economic challenges and the importance of acquiring and managing this knowledge through an adequate organisational structure, to achieve sustainable performance, we propose the following hypothesis: The decentralised OD is positively associated with the firm's KA capacity.

3. Method

This article takes a positivist approach and employs a quantitative methodology to explore the relationship between OD and the KA capacity.

3.1 Sample

To answer this research question, we collected research data in the state of Santa Catarina, Brazil, using scales previously validated in an international context. Santa Catarina is located in the southern region of Brazil, which Hofstede et al (2010) describe as more hierarchical, less formal, more individualistic and more achievement-oriented.

The target companies were selected through a database of the Federation of Industries of Santa Catarina. The data were collected with top or middle-level managers of the companies. From this, we obtained 146 responses, representing a response rate of 9.3%. After excluding 21 incomplete or uncodified responses, we had a usable sample of 125 for further analysis.

The most represented industries were food and drink (32.8%), textile and clothing (19.2%), capital equipment (7.2%), metal-mechanical industry and metallurgy (6.4%), and chemical (4.8%). In terms of the number of employees, the largest group (44%) was micro and small businesses with up to 99 employees. Most respondent companies have been in the market for between ten and thirty years (45%) (Table 1).

Table 1: Profile of Firms and Respondents

Respondent characteristics	Frequency	(%)
Sector		
Food and drink	41	32.8
Textile and clothing	24	19.2
Capital equipment	9	7.2
Metal-mechanical industry and metallurgy	8	6.4
Chemical	6	4.8
Others	37	29.6
Number of employees		
20-	6	4.8
20-50	35	28.0
51-99	14	11.2
100-200	17	13.6
201-500	16	12.8
501-1000	9	7.2
1000+	28	22.4
Age		
10-	13	10
10-30	56	45
31-100	49	39
100+	7	6
Respondent's position		
Director	39	31.2
Owner	12	9.6
Manager	33	26.4
Others	41	67.2
Total	125	

3.2 Measures

In this study, the dependent variable was the KA capacity, which was examined through three indicators from Flatten et al (2011). The independent variable was DO, which was investigated using five indicators from Kianto and Andreeva (2014). Both the dependent and independent variables were measured using a five-point Likert scale, with 1 representing "strongly disagree" and 5 representing "strongly agree".

3.3 Analysis

To ensure the accuracy of our results and control for common method bias (CMB), we implemented a series of solutions following the recommendations of Podsakoff, MacKenzie and Podsakoff (2012). Our hypothesis was tested using partial least squares structural equation modelling (PLS-SEM), which was chosen due to its suitability for small sample sizes and lack of distributional assumptions (Hair et al, 2021). To perform the analysis, we used the SEMinR package in the R programming language, which offers user-friendly syntax and intuitive functions (Hair et al, 2021).

As the indicators from both scales are highly correlated, it was necessary to evaluate the reflective measurement model. This evaluation is based on several criteria, including indicator reliability, internal consistency reliability, convergent validity, and discriminant validity (Hair et al, 2021).

Having assessed the reflective measurement model, the structural model was evaluated. It was, therefore,

necessary to analyse the significance and relevance of the relationships in the structural model, as well as the explanatory and predictive power of the model (Hair et al, 2021).

4. Results and Discussion

This section presents the application of CMB remedies, the results of the analysis of the measurement model and the structural model, for testing the hypothesis developed.

4.1 Remedies for Common Method Bias

We utilised some procedural remedies suggested by Podsakoff, MacKenzie and Podsakoff (2012). The online survey was managed and conducted by the Federation of Industries of Santa Catarina. By doing so, we ensured that the respondents were provided with the same data collection standards they were accustomed to (e.g. ethics, privacy, communication style, and channel), thus increasing the likelihood of obtaining honest responses. We selected respondents who possessed knowledge of innovation and business management issues. On the statistical side, we tested a model that included an additional unmeasured latent factor to represent CMB. As recommended by Liang et al (2007), we confirmed that the loadings on the unmeasured latent factor were lower than the loadings on the construct factors. Additionally, we verified that the variance inflation factors (VIF) for each construct factor in each latent variable were lower than 3.3 (Kock, 2015). Taken together, these procedural and statistical procedures reduced the risk of CMB being a significant concern in this research. We also compared the responses from early and late respondents to test for nonresponse bias using discriminant analysis (Armstrong and Overton, 1977), and no significant differences were detected.

4.2 Measurement Model

In reflective measurement models, it is essential to estimate the relationships between the reflexively measured constructs and their indicators, which are known as loadings. Indicator loadings above 0.708 are recommended as they suggest that the construct explains more than 50% of the indicator's variance, indicating acceptable indicator reliability (Hair et al, 2021). Table 2 displays the loadings for each indicator.

Table 2: Loadings for each indicator

Constructs and Indicators	Loadings
OD - Organisational Design (Kianto and Andreeva, 2014)	
OD1 People from different parts of our organisation interact informally with each other in a frequent manner	0.735
OD2 In our organisation, open dialogs are common among/between employees and manager	0.763
OD3 In our projects, our organisation uses teams consisting of people with skills and expertise from diverse fields	0.875
OD4. In our organisation, we frequently use cross-functional teams and projects	0.838
OD5 In our organisation, we have purposeful overlap of functional responsibilities	0.689
KA - Knowledge Acquisition (Flatten et al., 2011)	
KA1 The search for relevant information concerning our industry is every-day business in our company	0.713
KA2 Our management motivates the employees to use information sources within our industry	0.880
KA3 Our management expects that the employees deal with information beyond our industry	0.761

Only the indicator OD5 remained below the recommended value of 0.708, indicating that the variance explained by its construct is 47.5% (0.689^2). However, even though the indicator loading was slightly below the recommended value of 50%, we chose to keep the indicator, considering that its exclusion could affect the content validity of the construct, which refers to how well each indicator represents a facet of the construct (Hair et al, 2021).

Internal consistency reliability is evaluated to determine whether the indicators that form the scales consistently measure their respective constructs. In PLS-SEM, three main measures are used for this purpose: (i) Cronbach's alpha; (ii) composite reliability (rhoC); and (iii) consistent reliability coefficient (rhoA) (Hair et al, 2021). While Cronbach's alpha is considered conservative, rhoC can be considered too liberal, and the true reliability of the construct is usually found between these two extreme values, as assessed by rhoA (Hair et al,

2021). To sum up, the recommended values for these three measures range from 0.7 to 0.9.

The assessment of convergent validity is based on the average variance extracted (AVE) values (Hair et al, 2019). Convergent validity is the extent to which a construct converges to explain the variance of its indicators (Hair et al, 2021). The minimum acceptable AVE is 0.5, which means that the construct explains 50% or more of the variance of the indicators that make up the construct (Hair et al, 2019).

Table 3 displays the three measures of internal consistency reliability and the measure of convergent validity.

Table 3: Measures of internal consistency reliability and convergent validity

Constructs	Cronbach's Alpha	rho_C	rho_A	AVE
Organisational Design	0.842	0.864	0.887	0.613
Knowledge Acquisition	0.700	0.759	0.830	0.621

All measures of internal consistency reliability are observed to be within the recommended values. Moreover, the measure of convergent validity (AVE) was higher than the recommended value.

SEMinR provides two methods to evaluate whether the measurement constructs exhibit discriminant validity: the Fornell-Larcker criterion and the heterotrait-monotrait (HTMT) correlation ratio (Henseler, Ringle and Sarstedt, 2015). However, it has been noted in the literature that the Fornell-Larcker criterion is not a reliable method for detecting discriminant validity issues (Henseler, Ringle and Sarstedt, 2015; Hair et al, 2021).

Thus, in this study, we employed the heterotrait-monotrait ratio (HTMT) of correlations to analyse discriminant validity (Henseler, Ringle and Sarstedt, 2015). As the constructs are substantially different, Henseler, Ringle and Sarstedt (2015) propose that the HTMT should be less than 0.85. The HTMT between the two constructs in our study was 0.524.

The bootstrap analysis utilized 10,000 samples, applying the percentile method to derive confidence intervals at a 5% significance level, with estimated t-values (T Stat.) surpassing 1.96 (Hair et al, 2021). Table 4 displays that the upper bound of the 97.5% confidence interval is below 0.85, as suggested by Hair et al (2021).

Table 4: Bootstrapped HTMT

Constructs	Original Est.	Bootstrap Mean	Bootstrap SD	T Stat.	2,5% CI	97,5% CI
OD -> KA	0.524	0.532	0.106	4.965	0.324	0.732

Therefore, all measurements of the reflexively measured constructs are reliable and exhibit high levels of convergent validity. Once it has been established that the measurement of constructs is reliable and valid, the next step involves evaluating the results of the structural model.

4.3 Structural Model

The procedure for assessing the structural model involves evaluating issues related to collinearity, the significance and relevance of relationships, and explanatory power (Hair et al, 2021). However, in the case of this model, which has only one independent and one dependent variable, evaluating collinearity is unnecessary.

The assessment of significance involves using bootstrapping standard errors to calculate t-values of path coefficients (β) or confidence intervals (Hair et al, 2021). Therefore, Table 5 shows that the relationship between OD and KA is statistically significant at the 5% level based on bootstrapped standard errors, as the t-value (T Stat.) is greater than the critical value of 1.96, and its β is 0.432.

Table 5: Path coefficient estimates, significance, and confidence intervals

Constructs	β	Bootstrap Mean	Bootstrap SD	T Stat.	2,5% CI	97,5% CI
OD -> KA	0.432	0.455	0.076	5.668	0.302	0.598

Given that β is equal to 0.432, it suggests a positive relationship between OD and KA. Specifically, an increase of one standard deviation unit in OD corresponds to a 0.432 standard deviation unit increase in KA.

The coefficient of determination (R2) represents the fraction of variability in the dependent variable (KA) that can be accounted for by the independent variable (OD) in the model. This indicates the extent to which the

independent variable can explain the variation in the dependent variable. R2 ranges from 0 to 1, with higher values indicating a better model fit (Hair et al, 2021). In this case, the R2 value is 0.187 (adjusted R2 = 0.180), which indicates that OD explains approximately 19% of the variance in KA.

Finally, Figure 1 displays the bootstrapped model along with some details explained above, including: (i) the loading and significance of each indicator; (ii) the value (0.432), significance, and confidence intervals of β between OD and KA; and (iii) the R2 value of KA (0.187).

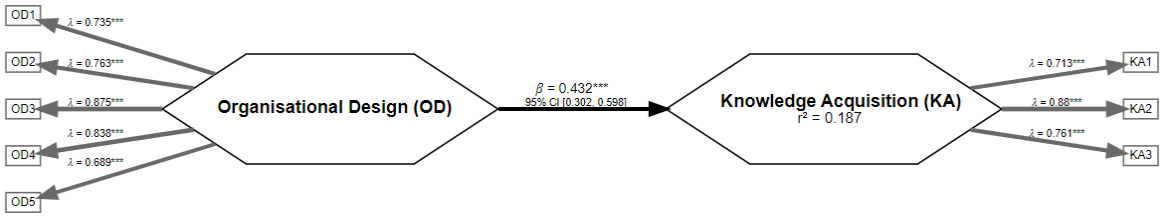


Figure 1: Bootstrapped Model

The findings of this empirical study reveal that OD plays a crucial role in KA capacity. To attain sustainable organisational performance, companies need to adopt appropriate OD strategies that enable the effective distribution of tasks and responsibilities, encourage learning and problem-solving, and promote a culture of knowledge sharing among employees. Furthermore, the implementation of a decentralised OD can lower hierarchical barriers, enhance collaboration and communication among employees, and foster an environment conducive to knowledge creation and transfer. These factors collectively contribute to strengthening companies' ability to acquire and utilise knowledge efficiently, ultimately resulting in improved sustainable organisational performance and increased capacity to adapt to changes in the business environment.

5. Conclusion

In an ever more dynamic and uncertain world, particularly in emerging economies, it is becoming progressively crucial for firms to engage in more effective KM. This empirical study has shown that OD has a positive and significant effect on the KA capacity of companies based in Santa Catarina, Brazil. Consequently, the implementation of OD can enhance KM efficiency within companies, such as by empowering knowledge workers to make decisions, creating cross-functional teams, and recognizing diverse communities of practice, all of which significantly contribute to the KA capacity of companies.

The hierarchical structure can sometimes impede knowledge flows, but a decentralised OD can enable companies to establish a resilient environment for knowledge development that can enhance sustainable organisational performance.

Through investigating the influence of OD on KA capacity, this study highlights the significance of establishing a conducive setting for knowledge workers to excel and enhance their knowledge. Furthermore, by exploring the association between these two constructs and sustainable performance, the study can contribute to the literature on KM and sustainability.

5.1 Theoretical and Practical Contributions

The results of this research have significant theoretical and practical implications. From a theoretical standpoint, investigating the influence of OD on KA capacity contributes to the overall understanding of KM. In practical terms, managers can use the findings to identify KM practices that can be adopted to enhance business capabilities.

From a practical perspective, the relationships between OD and the KA capacity can provide clues to how companies can promote the use of knowledge to leverage their sustainable performance.

This study proposes that managers should prioritise key dimensions of KM. Organisations can tailor their strategies to delegate decision-making responsibilities and encourage horizontal communication. Executives should promote initiatives to enhance OD to improve the KA capacity and, consequently, the company's performance.

5.2 Limitations and Future Research Directions

The results of this research have a limited scope due to the small sample size. Additionally, as an applied research, it is cross-sectional. Future studies could adopt a longitudinal approach to investigate the factors that affect OD and its association with KA capacity.

Our study's research context is based on a specific country. Future research should examine our research hypothesis in a cross-country context to understand how OD and KA capacity operate across different cultural and institutional contexts.

Acknowledgements

We acknowledge the support received from the CAPES UFSC/PRINT 88887.311528/201800; andin part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Brasil (CAPES) – Finance Code 001".

References

Abdelwhab Ali, A., Panneer selvam, D.D.D., Paris, L. and Gunasekaran, A. (2019) "Key factors influencing knowledge sharing practices and its relationship with organizational performance within the oil and gas industry", Journal of Knowledge Management, Vol. 23 No. 9, pp 1806–1837.

Armstrong, J. S. and Overton, T. S. (1977) "Estimating Nonresponse Bias in Mail Surveys", Journal of Marketing Research, Vol. 14 No. 3, pp 396–402.

Andreeva, T. and Kianto, A. (2012) "Does knowledge management really matter? Linking knowledge management practices, competitiveness and economic performance", Journal of Knowledge Management, Vol. 16, No. 4, pp 617–636.

Cohen, W. M., and Levinthal, D. A. (1990) "Absorptive Capacity: A New Perspective on Learning and Innovation", Administrative Science Quarterly, Vol. 35, No. 1, pp 128–152.

Dávila, G.A. (2016). Relações entre práticas de gestão do conhecimento, capacidade absortiva e desempenho: evidências do sul do Brasil. Doctoral Thesis, Federal University of Santa Catarina, Florianópolis.

Dávila, G.A., Andreeva, T. and Varvakis, G. (2019) "Knowledge Management in Brazil: What Governance Mechanisms are Needed to Boost Innovation?", Management and Organization Review, Vol. 15, No. 4, pp 1-30.

Dávila, G.A. and Dos Anjos, E.C. (2021) "Configurations of knowledge management practices, innovation, and performance: exploring firms from Brazil", International Journal of Innovation Management, Vol. 25 No. 06, pp 2150065.

Flatten, T.C., Engelen, A., Zahra, S.A. and Brettel, M. (2011) "A Measure of Absorptive Capacity: Scale Development and Validation", European Management Journal, Vol. 29, No. 2, pp 98–116.

Grant, R.M. (1996) "Toward a Knowledge-Based Theory of the Firm", Strategic Management Journal, Vol. 17, pp 109–122.

Hair, J.F., Hult, G.T.M., Ringle, C.M., Sarstedt, M., Danks, N.P. and Ray, S. (2021). Partial Least Squares Structural Equation Modeling (PLS-SEM) Using R: A Workbook. Springer International Publishing, Cham.

Hair, J.F., Risher, J.J., Sarstedt, M. and Ringle, C.M. (2019) "When to use and how to Report the Results of PLS-SEM", European Business Review, Vol. 31 No. 1, pp 2–24.

Henseler, J., Ringle, C.M. and Sarstedt, M. (2015) "A New Criterion for Assessing Discriminant Validity in Variance-based Structural Equation Modeling", Journal of the Academy of Marketing Science, Vol. 43 No. 1, pp 115–135.

Hofstede, G., Garibaldi De Hilal, A.V., Malvezzi, S., Tanure, B. and Vinken, H. (2010) "Comparing Regional Cultures Within a Country: Lessons From Brazil", Journal of Cross-Cultural Psychology, Vol. 41 No. 3, pp 336–352.

Hussinki, H., Kianto, A., Vanhala, M. and Ritala, P. (2017) "Assessing the Universality of Knowledge Management Practices", Journal of Knowledge Management, Vol. 21, No. 6, pp 1596–1621.

Inkinen, H.T., Kianto, A. and Vanhala, M. (2015) "Knowledge management practices and innovation performance in Finland", Baltic Journal of Management, Vol. 10, No. 4, pp 432–455.

Kianto, A. and Andreeva, T. (2014) "Knowledge Management Practices and Results in Service-Oriented versus Product-Oriented Companies", Knowledge and Process Management, Vol. 21, No. 4, pp 221–230.

Kock, N. (2015) "Common Method Bias in PLS-SEM: A Full Collinearity Assessment Approach", International Journal of e-Collaboration, Vol. 11 No. 4, pp 1–10.

Kostopoulos, K., Papalexandris, A., Papachroni, M. and Ioannou, G. (2011) "Absorptive Capacity, Innovation, and Financial Performance", Journal of Business Research, Vol. 64, No. 12, pp 1335–1343.

Liang, H., Saraf, N., Hu, Q. and Xue, Y. (2007) "Assimilation of Enterprise Systems: The Effect of Institutional Pressures and the Mediating Role of Top Management", MIS Quarterly, Vol. 31 No. 1, pp 59.

Lin, W.-B. (2008) "The Effect of Knowledge Sharing Model", Expert Systems with Applications, Vol. 34, No. 2, pp 1508–1521.

Liu, S.M., Hu, R. and Kang, T.W. (2021) "The Effects of Absorptive Capability and Innovative Culture on Innovation Performance: Evidence From Chinese High-tech Firms", The Journal of Asian Finance, Economics and Business, Vol. 8, No. 3, pp 1153–1162.

Podsakoff, P.M., MacKenzie, S.B. and Podsakoff, N.P. (2012) “Sources of Method Bias in Social Science Research and Recommendations on how to Control it”, Annual Review of Psychology, Vol. 63 No. 1, pp 539–569.

Qader, A.A., Zhang, J., Ashraf, S.F., Syed, N., Omhand, K. and Nazir, M. (2022) “Capabilities and Opportunities: Linking Knowledge Management Practices of Textile-Based SMEs on Sustainable Entrepreneurship and Organizational Performance in China”, Sustainability, Vol. 14, No. 4, pp 2219.

Raziq, M.M., Ahmad, M., Iqbal, M.Z., Ikramullah, M. and David, M. (2020) “Organisational Structure and Project Success: The Mediating Role of Knowledge Sharing”, Journal of Information & Knowledge Management, Vol. 19, No. 2, pp 2050007.

Syed-Ikhsan, O. S. and Rowland, F. (2004) “Knowledge Management in a Public Organization: A Study on the Relationship Between Organizational Elements and the Performance of Knowledge Transfer”, Journal of Knowledge Management, Vol. 8, No. 2, pp 95–111.

Susanty, A.I., Yuningsih, Y. and Anggadwita, G. (2019) "Knowledge Management Practices and Innovation Performance: A Study at Indonesian Government Apparatus Research and Training Center", Journal of Science and Technology Policy Management, Vol. 10 No. 2, pp 301–318.

Valentim, L., Lisboa, J. and Franco, M. (2012) “Knowledge management: An Empirical Study of the Absorptive Capacity of Portuguese SMEs”, in Proceedings of the 13th European Conference on Knowledge Management. Universidad Politécnica de Cartagena, pp 1230–1238.

Zahra, S.A. and George, G. (2002) “Absorptive Capacity: a Review, Reconceptualization, and Extension”, Academy of Management Review, Vol. 27, No. 2, pp 185–203.

Examining Misinformation and Deep Fakes

Namosha Veerasamy, Zubeida Khan and Danielle Badenhorst
CSIR, Pretoria, South Africa

nveerasamy@csir.co.za
zdawood@csir.co.za
dbadenhorst@csir.co.za

Abstract: Misinformation in the form of deep fakes and phishing links can not only spread false information but can only be used a weapon in the hands of cyber criminals. To combat this problem, the authors investigate fake news and misinformation, in a South African context. In the paper, the use of cyber scams that contain misinformation will also be unpacked. This aims to create an awareness and defensive approach to tackling emerging cyber threats that prey on misinformation. This paper tackles a growing concern by examining the pervasiveness of fake news by looking into the extent that fake news infiltrates various media channels and its potential impact on public perception and decision-making. The paper will also explore the anatomy of fake news by dissecting the common tactics and strategies employed by purveyors of fake news and highlight red flags that can help the public identify misinformation. Maintaining academic integrity is pivotal to the research and publication community. This paper will also promote the use of trusted sources and verification of information. The paper aims to promote media literacy by sharing strategies to enhance media literacy and critical thinking skills, empowering individuals to discern credible information from misleading content. This paper proposes a human-centric framework to empower individuals in South Africa to become discerning consumers of information. Recognizing the limitations of Artificial Intelligence (AI)-based detection methods and the unique challenges of the South African context (multilingualism, resource constraints), the framework emphasizes critical thinking and media literacy skills. It outlines a step-by-step process for evaluating information sources, including source credibility analysis, content verification, and cross-referencing. The effectiveness of the framework is demonstrated by a relevant use-case.

Keywords: Misinformation, Deep Fakes, Fake News, Disinformation, Mal-Information, Artificial Intelligence, Cybersecurity, Cybersecurity Learning Factory

1. Introduction

“Fake news is not a new phenomenon. It has been around since news became a concept 500 years ago with the invention of print—a lot longer, in fact, than verified, “objective” news, which emerged in force a little more than a century ago. From the start, fake news has tended to be sensationalist and extreme, designed to inflame passions and prejudices (Soll 2016)”. Fake news can be extremely dangerous, powerful and persistent. Wild fake stories can promote prejudice, distrust and circulate unverified content. Thrilling counts of monsters, politicians and criminals have been provoking and enthralling audiences. Trust in news establishments can be questionable and may continue to decline. Fake news has now become a powerful force as we are bombarded with content without any accuracy and objectivity. As fake news grows, there is also associated terminology like misinformation, disinformation, mal-information. These concepts are examined next.

Misinformation refers to false or inaccurate information, especially that which is deliberately intended to deceive (Oxford, 2024).

Disinformation is a form of propaganda involving the dissemination of false information with the deliberate intent to deceive or mislead (Oxford b 2024).

Mal-information is information that is based on reality but is used to inflict harm on a person, organisation or country such as catphishing or swatting (Mediadefence.org 2024)

Fake news are false stories that appear to be news, spread on the internet or using other media, usually created to influence political views or as a joke (Cambridge 2024)

Fake news is false information that has been purposefully crafted, contains sensationalism, can be emotionally charged, misleads or fabricates information that mimic mainstream news. Fake news can be wholly fabricated or a mix of fact and fiction.

According to Wardle, there are seven types of fake news (Wardle 2017):

- Satire Or Parody ("No Intention To Cause Harm But Has Potential To Fool")
- False Connection ("When Headlines, Visuals Or Captions Don't Support The Content")
- Misleading Content ("Misleading Use Of Information To Frame An Issue Or An Individual")
- False Context ("When Genuine Content Is Shared With False Contextual Information")

- Impostor Content ("When Genuine Sources Are Impersonated" With False, Made-Up Sources)
- Manipulated Content ("When Genuine Information Or Imagery Is Manipulated To Deceive", As With A "Doctored" Photo)
- Fabricated Content ("New Content Is 100% False, Designed To Deceive And Do Harm")

The proliferation of fake news and misinformation can have vast consequences. Some examples include (University of Exeter Library 2024):

- Distrust in the media
- Undermining the democratic process
- Platforms for harmful conspiracy theories and hate speech
- Spread of false or discredited science

Information today has grown in volume, variety, veracity, value and velocity. In today's information landscape, the spread of fake news poses significant threats to individuals, organisations, and society at large. The challenges posed by the proliferation of fake news in the digital age is on the rise. The use of misinformation and fake news can have dire consequences. Harmful misleading intentions, influence, creation of bias, manipulated content and propaganda are some of the negative outcomes. Various collaborative efforts can be applied in order to try and combat the issues of fake news and misinformation. This paper provides valuable insights on how to overcome this issue of fake news and misinformation in the growing digital era.

Fake news raises a serious concern about the continued reliability and truthfulness of information that form the underlying base for knowledge domains. With the rise of additional technologies like Artificial Intelligence, these platforms support the growth and development of deep fakes and other malicious tampering of information.

The remainder of the paper is structured as follows. The next section of the paper looks at existing works, followed by a section on the use of misinformation for the proliferation of cyber scams. Thereafter the paper delves into deep fakes and the use of AI in Section 4. The subsequent section, Section 5, explores the detection and battle against fake news. Finally, the authors conclude and discuss future work.

2. Detection of Misinformation at an Elementary Level

When fake news or misinformation is encountered, users may easily trust that the content is true, even though it may be inaccurate. Readers face an ongoing struggle to determine whether the content they find in digital channels is actually true reporting or a fabrication.

Diverse methodologies and frameworks to detect mis-, disinformation and fake news **can be applied**. This section provides a brief overview of common techniques for detection of misinformation and fake news.

Many frameworks attempt to calculate scores of credibility to distinguish real or fake news. Bhattarai et al. (2021) introduced an interpretable fake news detection framework based on the Tsetlin Machine, using conjunctive clauses to capture lexical and semantic properties of news text. This approach not only classifies news as fake or real, but also calculates a credibility score for fake news (Bhattarai et al., 2021). Zhang et al. (2019) proposed a text analytics-driven approach for fake news detection that transforms news from a document-based corpus into a topic and event-based representation. Fake topics and fake events can be detected with their two-layered approach, with a 92.49% classification accuracy and 94.16% recall (Zhang et al., 2019).

Other approaches consider tools that could be employed by laypeople or focus on cognitive aspects of fake news and its proliferation. Choy & Chong (2018) propose a LeSiE (Lexical Structure, Simplicity, Emotion) framework, with the goal of equipping laypeople with the ability to identify fake news without requiring complex tool. They consider the anomalous lexical structure, over-simplification and increased cognitive simplicity, as well as emotionally arousing material found in fake news artefacts. Batailler et al. (2021) discuss the application of signal detection theory to fake news, separating the ability to accurately distinguish real from fake news from biases in judging news veracity. Their framework considers the influence of partisan bias and cognitive reflection on fake news identification (Batailler et al., 2021).

The frameworks in the literature often rely on machine learning trained on specific datasets that may not reflect the multilingual and multicultural reality of South Africa. South Africa has a history of political and social tensions caused by misinformation. A human-centric approach could be more relevant and reachable for citizens to critically evaluate information.

A further abuse of misinformation is the generation of cyber scams. Trusting users may view adverts, phishing emails and other promotions without any knowledge that the content is fraudulent. The next section looks at the application of misinformation in the creation of cyber scams.

3. Cyber Scams Using Misinformation

Awareness also needs to be created on the use of misinformation and disinformation in the generation and proliferation of cyber scams. This section provides a brief overview of just a few of these scams to shed light on other malicious practices that benefit from misinformation and disinformation.

False information can also be used for false advertising and fraud. False information can be used to trick people into handing over money, credentials or other benefits. Scams make use of fraudulent and illegal means to confuse/deceive people. The next section looks at a few of these schemes that utilise false information and advertising as part of a dishonest scheme (Brooks 2023). Such scams deceptively pose as legitimate business practices.

Various phishing scams may contain misinformation in order to trick users into divulging their personal information. Phishing emails can claim to update user account details or verify certain credentials. Phishing emails may impersonate banks, service providers, online shopping sites and a host of organisations that users traditionally transact with.

Office supply scams occurs when scammers pose as legitimate companies offering office supplies. Fraudsters impersonate legitimate companies offering office supplies. Businesses place orders and pay, but the supplies never arrive.

Fake invoicing occurs when businesses are targeted with seemingly legitimate invoices and payment requests. Due to the high volume of invoices processed, companies can be vulnerable to these scams.

Charitable solicitations occur when charitable requests may stem from scammers that are trying to take advantage to steal money. The fundraising or sponsorship invite may be fake and form part of a fraudulent charity scam; this tends occur following a disaster or high-profile event.

With many of these scams, AI technology is the catalyst to create fake requests and deceive the users into believing that the invitation is legitimate. The next section looks at the use of AI in creating fake content.

4. AI, Deep Fakes and Fake News

AI plays a major role in the dissemination of fake news, mis- and disinformation. Potential offensive uses of AI in fake news includes the creation of deepfakes, and automated content generation (Cybenko & Cybenko, 2018). AI technologies, particularly deep learning algorithms, enable the creation of convincing deepfakes. Deepfakes are algorithmically produced, hyper-realistic fake images, videos or audio recordings. Deepfakes have various applications, ranging from entertainment and education to malicious uses such as spreading misinformation, propaganda, election rigging and more.

Deepfakes have been used to create fake videos of political leaders, potentially influencing voter behaviour and destabilising political environments. For example, fabricated videos of politicians saying or doing things they never did could sway public opinion (Vaccari & Chadwick, 2020). Deepfake technology allows for the creation of content that can be rapidly spread, undermining trust in media institutions, which can be particularly damaging when used to spread propaganda or false narratives to large audiences (Rana et al., 2022). Beyond politics, deepfakes pose threats to individuals' privacy and security, including potential harassment and blackmail (Rana et al., 2022; Pantserev, 2020).

Furthermore, AI can be utilised to aid automated content generation; fake news articles or social media posts mimicking the style or appearance of legitimate news can be automated, making it difficult to individuals to discern between the validity of the content (Cybenko & Cybenko, 2018). Social media bots and amplification can be AI-driven and leveraged to amplify fake news stories, providing undue credibility. These bots can like, share and spread misinformation across platforms at a scale impossible for humans, increasing the reach of fake news using social media engagement algorithms (Meyers et al., 2020). Further, AI algorithms can analyse cast amounts of data to identify biases or preferences of individual users, and then microtargeting these users with fake news stories that the user would be more likely to believe or share, further propagating misinformation (Kumar et al., 2021). Advanced NLP techniques allow AI to write or modify fake news stories, making them more compelling

or tailored to specific audiences. This can include altering headlines or content to make them more clickable or shareable, thereby increasing their spread (Mohseni et al., 2020).

AI tools can also help with the generation of malicious content. Users can phrase the request in an innocent manner but thereafter use the response to create various scams like phishing, fake invoicing, charitable solicitations, or office supply scams. AI tools now provide for a seamless approach to content creation for scams as the outputs are now phrased appropriately and remove the obstacles of poor grammar or other tell-tale signs.

5. Detecting Fake News

Combatting misinformation requires critical thinking skills, fact-checking, and responsible sharing of information. Since AI and deepfakes are used to assist in the generation of fake news, detecting fake news requires a multifaceted approach. While automated software can be helpful in identifying certain red flags, critical thinking remains essential. A skilled person should be able to analyze the source of the information, examining its credibility and potential biases. Ultimately, fostering a questioning mindset is the key solution in detection fake news.

Therefore, the scope of this framework is about detecting fake news as a person, i.e., a human-centric approach, empowering individuals with the critical thinking skills and knowledge to discern credible information from misleading content. Human -centric approach focuses on the needs, preferences and experiences of human beings. When faced with material, content and information, users are engaged in a human-centric experience as they need to intuitively digest and make sense of the subject matter. Automated, programmable analysis is not always ideal as users need to rapidly look through the information and make judgements, decisions and responses.

Other studies use software-based detection approach. There are several unique characteristics about fake news in South Africa that deems a human-centric approach preferred:

- Fast-paced cyberthreat landscape: This shift in focus aims to equip users with the long-term ability to navigate the ever-evolving landscape of online information.
- Lack of resources: In a disadvantaged country such as South Affrica, some individuals do not have access to high-speed internet, or advanced devices needed to run complex AI-based detection software.
- Mult-lingual environment: South Africa has eleven official languages. AI detection tools trained on one language might miss fake news spread in another. A human-centric approach equips South Africans to analyse information regardless of language.
- Local culture: Understanding the cultural nuances of South Africa can help in identifying fake news that might play on specific cultural anxieties or biases. For instance, South African communication styles can sometimes be indirect or use humour. Understanding these nuances can help South Africans avoid misinterpreting online content as fake news simply because it uses sarcasm or satire. A human-centric approach allows for this contextual understanding.
- Digital literacy: While most South Africans have mobile devices and intermittent internet access, they lack the lack the technical skills to navigate complex online platforms or apps. For example, many users make use of online platforms like WhatsApp in South Africa as a means of rapid communication. However, users may still lack knowledge about whether the messages received can be trusted. Human-centric tools can get better outreach for South Africans in order to empower them to become more discretionary and not just simply spread messages without verifying it.

5.1 i-Fakt (Identify fake truth) Human-Centric Framework

The ability to discern fact from fiction has become a critical skill. The proposed human-centric framework I-Fakt empowers individuals to navigate the complexities of the digital age by fostering media literacy and critical thinking. The rationale behind selecting this approach is rooted in the unique socio-cultural and technological landscape of South Africa. This includes 11 official languages, and a digital divide. The factors for this are now provided.

- Socio-Cultural Context: South Africa's diverse linguistic and cultural environment calls for a flexible and adaptable framework that can be applied across different languages and cultural contexts, catering for unique cultural nuances faced by the citizens. AI-based tools, often trained on datasets from specific languages and cultural backgrounds, may not be effective for this.

- Resource and Technological Constraints: Many South Africans lack access to high-speed internet at all times, and advanced technological devices required for sophisticated AI-based tools and technologies. A human-centric approach, which uses readily available resources is more practical and sustainable in this context.
- Digital/ Media Literacy Levels: While mobile device usage is high, digital literacy levels vary significantly, across the country. A framework that prioritizes education by critical thinking and media literacy is better suited to improving the awareness around misinformation and disinformation.

By following the steps of the framework, one can develop the tools needed to become a discerning consumer of information. A high-level overview is provided in Figure 1, and each pillar is unpacked in the following section.

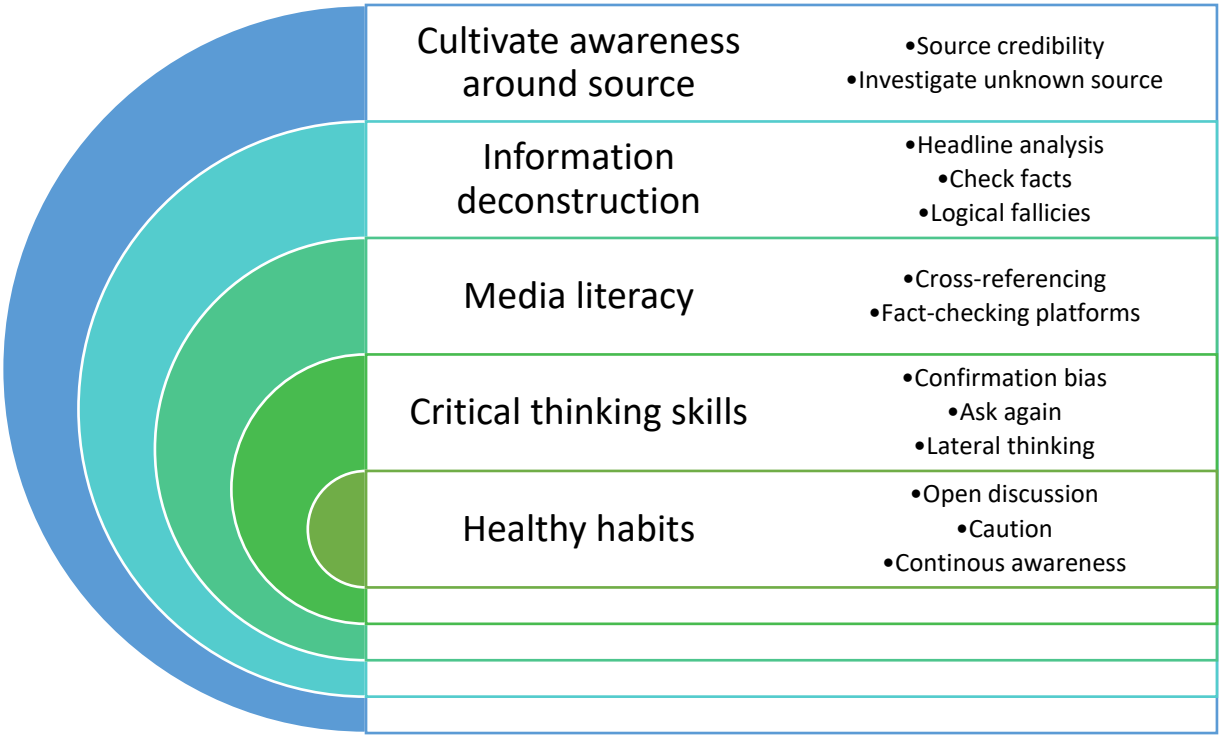


Figure 1: I-Fakt (Identify Fake Truth) Human-centric fake news detector framework

5.1.1 Cultivate Awareness Around Source

The onset of the framework lies in understanding where information and news stems from. The parameters of this pillar are as follows:

- Understanding Source Credibility: Learn to identify reputable news organizations with a history of fact-checking and ethical reporting. Explore resources that evaluate news source credibility. For instance,
- Investigate Unknown Sources: Before engaging with unfamiliar websites or social media pages, research their background and mission statement. Look for red flags like unusual domain extensions, unprofessional design, or lack of "About Us" or further information.

5.1.2 Information Destruction

Once the credibility of the source has been established, it is crucial to inspect the information itself, to understand the intent and veracity of the information.

- Headline analysis: Individuals need to be wary of sensationalized headlines with excessive exclamation points, strange grammar and uppercase letters. One must look for headlines that accurately reflect the content of the article.
- Check facts: Individuals should not solely rely on the information presented in the piece in question but should look for evidence to support claims, such as data from credible sources. For instance, consider a social media post claims that a new government policy will drastically reduce child grant payouts. This

sparks outrage and panic among many South Africans. An individual should check governmental policy websites to confirm this fact.
- Logical fallacies: Fake news commonly presents common logical fallacies such as appeals to emotion. For instance, a headline claiming that consuming South African herbs is a miracle cure for HIV/AIDS! Would appeal to individuals' sense of hope.

5.1.3 Media Literacy

This pillar of the framework empowers one to become a proactive participant in the digital information landscape by delving into techniques for verifying information beyond a single source.

- Cross-referencing: Individuals should not accept information at face value but should verify the information by searching for it from other established news outlets such as News24, The Daily Maverick, etc. If no reputable sources report the story, it could be fake.
- Fact-checking platforms: Utilize fact-checking websites like Snopes, PolitiFact, and Africa Check to verify information and debunk common fake news narratives.

5.1.4 Critical Thinking Skills

This pillar equips and individual to develop a questioning mind and foster intellectual curiosity.

- Confirmation bias: Individuals need to be aware of their own biases and how they might influence the interpretation of information. For instance, an individual, already having a negative perception of a political party, is more likely to accept negative information about the party in question at face value. One should seek out diverse perspectives to avoid falling victim to confirmation bias.
- Ask again: Approach online information sceptically. Individuals should question such as who is presenting such information, and do they have an agenda/ ulterior motive?
- Lateral thinking: Individuals should consider alternative explanations for the information presented. For instance, a certain celebrity did not attend the South African Music Awards. A voice note shared on messaging apps claims that he had been arrested for a serious crime. South Africans can apply lateral thinking by checking reputable news websites and social media accounts of the celebrity for any official statements before spreading fake news.

5.1.5 Healthy Habits

- Open discussion: Discuss this with peers and family members critically to consider whether the news is factual or not.
- Caution: Individuals should not share the piece of news without fact-checking. By sharing unverified information, individuals unwittingly contribute to the spread of fake news. This makes it more difficult for accurate information to reach people who need it.
- Continuous awareness: Regularly reading up and learning about current cybersecurity trends and engaging in discussions about media literacy and information verification reinforces healthy habits and strengthens the collective defence against misinformation. The cybersecurity learning factory [] could be rolled out around South African communities to encourage continuous awareness.

This framework empowers South Africans to become discerning consumers of information in the digital age. It emphasizes critical thinking and media literacy as key tools to assist in detecting fake news.

5.2 Use Case

A South African comes across the following post on X (formerly Twitter): *BREAKING! Disgraced again! [Politician's Name] caught in massive bribery scandal!!! Full story: [http://www.politicianscandal.co.za] #SouthAfrica #Corruption #PoliticalParty.*

As the citizen scrolls through Tiktok, he comes across a video, showing a clip with a voiceover: *"Did you hear about [Politician's Name]? Caught in a bribery scandal. See the full story at the link in my bio. #SouthAfrica #Corruption"*

An individual should consider each pillar of the framework and apply it to the post as follows.

- Cultivate Awareness Around Source: The source, on both X and Tiktok, leads to an unknown website with a sensational headline and lacks context. This raises red flags about credibility.
- Information Deconstruction: The headline is accusatory and uses exclamation points to evoke outrage. No evidence or details about the scandal are provided. The video on uses dramatic music and selective editing to amplify the claim without providing supporting evidence.
- Media Literacy: A search for the story on established news websites (in the South African context- News24, Daily Maverick, SABC News) reveals no mention of the incident. Checking Africa Check also shows no record of the claim in the above example.
- Critical Thinking Skills: Considering the political landscape, this accusation might be aimed at damaging the politician's reputation. Checking the politician's social media might reveal a response. One could also check if the politician has addressed the issue on their official TikTok or other social media accounts.
- Healthy Habits: Based on the analysis, the post and video is likely fake news. An individual should not share it and encourage others to be critical of online information.

The human-centric framework is an adaptable solution for combating misinformation. This use-case validates the framework's applicability across various contexts.

6. Conclusion

Knowledge on the topic is critical to preventing the spread of fake news and misinformation. Many readers may get caught up in the virality of certain feeds, posts and articles without any awareness that the information is sensationalism. The proliferation of fake news and misinformation poses a significant threat to South Africans. This research has examined the pervasiveness of it, its potential consequences, and strategies for detection. The authors found that AI plays a growing role in creating and disseminating fake news through techniques like deepfakes and automated content generation. Effectively detecting fake news as South Africans is challenging due to unique factors such as evolving threat landscape, cultural nuances, etc., and requires a human-centric approach based on critical thinking. This paper presented a human-centric framework empowering individuals to become discerning consumers of information in the digital age, alongside an illustrative use-case. Through this research, it is envisaged that users can be empowered with the techniques to fact check and verify information.

7. Future Work

Future work would involve extending the framework to include psychological factors. Understanding the psychological factors that make people susceptible to believing fake news can assist with improving judgment and reducing susceptibility to fake news and misinformation. Another direction is to consider the cybersecurity learning factory as a vehicle to demonstrate usage of the framework. The cybersecurity learning factory is an innovative educational platform designed to provide engaging and interactive learning experiences in cybersecurity. The aforementioned human-centric framework could be integrated into to the Cybersecurity learning factory to include experiential learning into modules based on the framework. These modules can teach South Africans how to identify fake news sources, analyse information critically, and verify information through credible resources.

References

Batailler, C., Brannon, S., Teas, P., & Gawronski, B., 2021. A Signal Detection Approach to Understanding the Identification of Fake News. *Perspectives on Psychological Science*, 17, pp. 78 - 98. https://doi.org/10.1177/1745691620986135.

Bhattarai, B., Granmo, O., & Jiao, L. (2021). Explainable Tsetlin Machine Framework for Fake News Detection with Credibility Score Assessment. *ArXiv*, abs/2105.09114.

Brooks C, 2023, Business Scams 101: Common Schemes and How to Avoid Them, Available at https://www.business.com/security/business-scam-guide/, Accessed 20240307

Cambridge, 2024, Fake news, Available at https://dictionary.cambridge.org/dictionary/english/fake-news, Accessed 20240307)

Choy, M., & Chong, M., 2018. Seeing Through Misinformation: A Framework for Identifying Fake Online News. *ArXiv*, abs/1804.03508.

Cybenko, A., & Cybenko, G., 2018. AI and Fake News. IEEE Intelligent Systems, 33, pp. 1-5. https://doi.org/10.1109/MIS.2018.2877280.

Gupta, A., Kumar, N., Prabhat, P., Gupta, R., Tanwar, S., Sharma, G., Bokoro, P., & Sharma, R., 2022. Combating Fake News: Stakeholder Interventions and Potential Solutions. IEEE Access, 10, pp. 78268-78289. https://doi.org/10.1109/access.2022.3193670.

Mediadefence.org, 2024, Misinformation, Disinformation and Mal-information, Available at https://www.mediadefence.org/ereader/publications/introductory-modules-on-digital-rights-and-freedom-of-expression-online/module-8-false-news-misinformation-and-propaganda/misinformation-disinformation-and-mal-information/#footnote--7, Accessed 20230307.

Murayama, T., Wakamiya, S., Aramaki, E., & Kobayashi, R., 2021. Modeling the spread of fake news on Twitter. PLoS ONE, 16. https://doi.org/10.1371/journal.pone.0250419.

Oxford, 2024, Misinformation, Available at https://www.google.com/search?client=firefox-b-e&q=definitions+for+misinformation, Accessed 20240307

Oxford b, 2024, Disinformation, Available at https://www.google.com/search?client=firefox-b-e&q=disinformation+meaning, Accessed 20240307

Pantserev, K., 2020. The Malicious Use of AI-Based Deepfake Technology as the New Threat to Psychological Security and Political Stability., pp. 37-55. https://doi.org/10.1007/978-3-030-35746-7_3.

Paschen, J., 2019. Investigating the emotional appeal of fake news using artificial intelligence and human contributions. Journal of Product & Brand Management. https://doi.org/10.1108/JPBM-12-2018-2179.

Rana, M., Nobi, M., Murali, B., & Sung, A., 2022. Deepfake Detection: A Systematic Literature Review. IEEE Access, 10, pp. 25494-25513. https://doi.org/10.1109/access.2022.3154404.

Soll J, 18 December 2016, The Long and Brutual History of Fake News, Politico Magazine, Available at https://www.politico.com/magazine/story/2016/12/fake-news-history-long-violent-214535/, Accessed 20230307

University of Exeter Library, 2024, Fake News, Available at https://libguides.exeter.ac.uk/fakenews/consequences, Accessed 20240307.

Vaccari, C., & Chadwick, A., 2020. Deepfakes and Disinformation: Exploring the Impact of Synthetic Political Video on Deception, Uncertainty, and Trust in News. Social Media + Society, 6. https://doi.org/10.1177/2056305120903408.

Wardle C, 2017, Fake news. It complicated, Available at https://firstdraftnews.org/articles/fake-news-complicated/, Accessed 20230307.

Zhang, C., Gupta, A., Kauten, C., Deokar, A., & Qin, X., 2019. Detecting fake news for reducing misinformation risks using analytics approaches. *Eur. J. Oper. Res.*, 279, pp. 1036-1052. https://doi.org/10.1016/J.EJOR.2019.06.022.

Telling a Story to Share Knowledge: A Case Study of Agrifood Corporate Museum

Walter Vesperi[1], Rocco Reina[2], Marzia Ventura[2], Concetta Lucia Cristofaro[3] and Anna Maria Melina[4]

[1] University of Palermo, Italy
[2] Magna-Graecia University of Catanzaro, Italy
[3] E-Campus University, Italy
[4] University of Messina, Italy

walter.vesperi@unipa.it
rreina@unicz.it
marziaventura@unicz.it
concettalucia.cristofaro@uniecampus.it

Abstract: To respond to changes in the global competitive context, organizations must base their competitive advantage on the enhancement of new knowledge within production and decision-making processes. At the same time, the continuous processes of innovation and technological advancement define a higher rate of knowledge obsolescence. With these premises, organizations find themselves constantly introducing new knowledge into their processes and, at the same time, setting aside knowledge that has now become obsolete. Corporate museums represent organizations that collect organizational artifacts of a parent organization. The main theoretical contributions on the phenomenon of corporate museums have offered a focused contribution on the marketing and corporate communication perspective. In fact, there are few studies on corporate museums in knowledge management studies. From the theoretical perspective of knowledge management, corporate museums represent a place where the knowledge of a parent organization is collected and narrated through its organizational artefacts. This study aims to analyze corporate museums as a place for collecting, exploitation and transferring the organizational memory of a parent organisation. The study is based on the analysis of a case study. A corporate museum connected to the agrifood sector was analysed, through interviews and analysis of company documents. The findings of this study can be traced back to theoretical contributions and practical implications. From the perspective of theoretical contribution, this study analyzes the corporate museum as "ba", or as a place for collecting and sharing knowledge. From the perspective of managerial implications, the results highlight that the corporate museum can take on a strategic role in the valorisation and diffusion of organizational memory. It follows that the museum can be considered as a BA capable of generating new knowledge and innovation to be transferred within the parent organization. The results of this study offer new theoretical and empirical contributions to studies on knowledge management, on the phenomenon of corporate museums linked to the agrifood sector. The agrifood sector has demonstrated a greater need to enhance and implement knowledge in its organizational processes, through mechanisms that take into consideration the peculiarities of the sector.

Keywords: Knowledge Transfer, Corporate Museum, Agrifood Sector, Story Telling, Organizational Memory, *(*max 5 words)

1. Introduction

In recent years, companies have learned that they must base their competitive advantage on the valorization of knowledge. Knowledge, therefore, can be understood as a strategic lever to increase and maintain competitive advantage (Mårtensson, 2000; Vesperi and Gagnidze, 2023). Consolidated literature on knowledge management has highlighted that some sectors have a greater propensity to enhance and implement knowledge in their internal processes. Within KM studies, it is possible to identify empirical observations linked to specific sectors such as automotive (Canonico, et al., 2021) or hospitality (Hallin and Marnburg, 2008; Fauzi, 2020). At the same time, it is possible to distinguish contributions within knowledge management studies on public administrations (Syed-Ikhsan and Rowland, 2004; Massaro, et al., 2015) or small and medium enterprises (Lim and Klobas, 2000; Yew Wong and Aspinwall, 2004; Durst and Runar Edvardsson, 2012; Durst, et al., 2023).

Despite the strategic role that the agrifood sector plays in the global economic system, the attention of KM scholars has been scarce. In fact, knowledge management studies appear scarce on the agri-food sector and agri-food organisations. For this reason, the agri-food sector and agri-food organizations represent a new challenge for KM scholars. It is possible that agri-food organizations are micro and small (Ménard and Klein, 2004) with low propensity for innovation and low investments in research and development and characterized by low-knowledge managerial practices. From the point of view of valorising knowledge, agri-food organizations represent an interesting case study as they simultaneously combine the valorisation of traditional knowledge and the need to innovate. With the aim of valorising traditional knowledge, some agri-food organizations have created corporate museums.

There are still few studies dealing with corporate museums linked to agri-food organisations, making use of theoretical frameworks based on organizational theory, and in particular linking corporate museums to knowledge transfer and organizational memory.

This study aims to offer some initial reflections to fill this gap in the literature. This study - in the context of management and organizational theory studies - analyzes the strategic role of the company museum as a form of organizational memory and heritage capable of transferring knowledge. To achieve this objective, a qualitative descriptive methodology based on the analysis of secondary sources is used. We present the rest of this work as follows: after this (i) introduction, (ii) the main theoretical elements on Corporate Museum, Organizational Memory and agri-food organizations are discussed. Below, (iii) the methodological process is illustrated. Finally, (iv) the main conclusions and suggestions for future research.

2. Theoretical Background

2.1 Corporate Museum

The first corporate museums began to spread in the early 1900s. Corporate museums can be defined as corporate spaces dedicated to conserving, enhancing, and archiving organizational artifacts of the parent company. Analyzing the literature, various purposes and objectives attributed to corporate museums emerge. It is possible to trace the final aim of the first corporate museums to the "collection" of corporate artifacts (Iannone and De Chiara, 2019; Martinez, 2020). From the perspective of knowledge management (KM), corporate museums can share and transmit the knowledge and values created within the parent organization. The corporate museum, therefore, contains and represents the organizational memory of another organization. The representation and narration of organizational memory allow the organization to improve dialogue with its external and internal stakeholders (Sandberg & Tsoukas, 2020).

In the vast and varied landscape of KM studies, only a few studies have investigated the phenomenon of corporate museums using the theoretical frameworks of organizational theory, based on the constructs of organizational memory and knowledge transfer. This article explores corporate museums using the theoretical perspective of knowledge management, as a form of organizational memory, and when they are strategically used as a tool to transfer knowledge from the organization. The concept of organizational memory can be traced back to the concept of depository (Huber, 1991; Grant, 1996; Alavi & Leidner, 2001). Following this approach, memory can be defined as a set of knowledge present within an organization in the form of documents, informational material, or any other form that can facilitate internal activities and be easily accessible. From this perspective, the artifact takes on a particular meaning. The corporate museum becomes a tool for transferring knowledge and daily practices through the narration of the culture and organizational memory of the parent company.

Some elements of organizational culture are codified and shared in the organization's formal documents (such as official company documents, strategic plans, internal communications, disciplinary procedures). These documents become organizational artifacts, often displayed and used in corporate museums. These artifacts make an organization distinguishable from other organizations.

Corporate museums are not just passive archives of objects and documents but play an active role in constructing and communicating corporate identity. They can serve as marketing tools, enhancing the company's image with customers and the public. They can also act as training tools for employees, providing a deeper understanding of the company's history, values, and practices. Through curated exhibits and narratives, corporate museums can emphasize the company's innovations and successes, creating a sense of pride and belonging among employees.

Moreover, corporate museums can serve as platforms for dialogue and collaboration between the company and its various stakeholders. They can host events, conferences, and workshops that facilitate the exchange of ideas and knowledge. These spaces can also be used to promote corporate social responsibility, showcasing the company's efforts in sustainability, ethics, and community involvement.

A crucial aspect of corporate museums is their ability to adapt and evolve over time. With the advent of digitalization, many corporate museums are integrating digital technologies to enhance the accessibility and interactivity of their collections. Through virtual tours, digital archives, and interactive applications, corporate museums can reach a wider and more diverse audience, overcoming the physical limitations of traditional exhibition space.

In conclusion, corporate museums represent a key element in knowledge management and the construction of organizational memory. They not only preserve the company's past but also actively contribute to shaping its

present and future by facilitating knowledge transfer, improving communication, and strengthening corporate identity.

2.2 BA and Knowledge Management

The concept of "Ba" was introduced by Ikujiro Nonaka and Noboru Konno in their 1998 paper, "The Concept of 'Ba': Building a Foundation for Knowledge Creation." This concept is integral to understanding how knowledge is created and shared within organizations. Rooted in Japanese philosophy, "Ba" refers to a shared space for emerging relationships. It is a dynamic context, physical or virtual, that fosters knowledge creation, sharing, and utilization.

“Ba” is a Japanese term that roughly translates to “place” or “space”, but in the context of Nonaka and Konno’s work, it embodies more than just a physical location. It represents a shared context in which knowledge is shared, created, and utilized. According to Nonaka and Konno, “Ba” is a space where individuals come together and interact, and through this interaction, knowledge is created and expanded. “Ba” can be physical (such as meeting rooms), virtual (such as online forums), mental (such as shared experiences), or any combination of these. The key characteristic of “Ba” is its ability to provide a context that encourages participants to share their tacit knowledge, which is personal, context-specific, and hard to formalize, making it difficult to communicate to others. Nonaka and Konno identified four types of “Ba” each corresponding to a stage in the SECI (Socialization, Externalization, Combination, Internalization) model of knowledge creation:

- Originating Ba: This is the space where individuals share experiences, feelings, and mental models. It is primarily associated with the socialization phase, where tacit knowledge is shared through direct interaction and shared experiences. For example, informal meetings or social gatherings within an organization can serve as Originating Ba.
- Interacting Ba: This space supports the externalization phase, where tacit knowledge is articulated into explicit concepts. Interacting Ba facilitates dialogue and collective reflection, enabling individuals to express their tacit knowledge in a form that can be shared with others. Workshops and brainstorming sessions often act as Interacting Ba.
- Cyber Ba: This virtual space supports the combination phase, where explicit knowledge is systematized and combined. Cyber Ba utilizes technology to enable the sharing and combination of explicit knowledge across time and space. Online databases, intranets, and knowledge management systems are examples of Cyber Ba.
- Exercising Ba: This space supports the internalization phase, where explicit knowledge is absorbed and converted into tacit knowledge by individuals. Exercising Ba provides the context for learning by doing, where individuals internalize knowledge through practice and experience. On-the-job training and simulations are examples of Exercising Ba.

“Ba” plays a crucial role in the SECI model of knowledge creation. It provides the necessary context for the conversion of knowledge from tacit to explicit and vice versa. By facilitating the interaction and exchange of knowledge among individuals, “Ba” helps to create a shared understanding and collective knowledge within an organization.

Understanding and leveraging “Ba” can significantly enhance an organization's ability to create and manage knowledge. By intentionally creating and nurturing different types of “Ba” organizations can foster a culture of continuous learning and innovation.

In conclusion, the concept of “Ba” as articulated by Nonaka and Konno is a foundational element in the understanding of knowledge creation within organizations. By recognizing and fostering different types of "Ba," organizations can create an environment that supports continuous knowledge creation, sharing, and utilization, leading to sustained innovation and competitive advantage.

3. Methodology

To analyze the phenomenon of corporate museum enterprises it is necessary to also consider the involvement of the parent organization. In fact, analyzing the corporate museum, without taking into consideration the influence and relationship with the parent organization, could lead to a limited vision and create distorted results. For this reason, the complexity of the analysis phenomenon is amplified. To resolve these critical issues, consistently with studies with similar objectives (Nissley and Casey, 2002; Vacca, 2014; Vesperi, et al., 2022), this study adopted a qualitative methodology with an exploratory approach. The present study is based on a

qualitative methodology, through an exploratory analysis, with semi-structured narrative interviews. The qualitative nature allows us to explore a phenomenon that is not well defined and understand aspects that are still unseen. Therefore, a qualitative approach seems suitable for the analysis of a complex phenomenon, such as that of corporate museums. The qualitative methodology based on a case study, therefore, was considered an appropriate method to obtain an overall view on corporate museums and the relationship with the parent company. This methodology has the main advantage of adopting an exploratory and qualitative research design to investigate the phenomenon in detail (Eisenhardt, 1989; Locke, 2020, Budhwar, et al., 2023), considered complex, recent and poorly defined. A company museum connected to a parent company operating in the agrifood sector has been identified.

The data and information were collected between January 2024 and April 2024, integrating multiple sources. We used internal company documents, such as annual reports, internal company reports and company websites. In agreement with the company and the interviewees, all names have been made anonymous and the documents not directly traceable, to guarantee their confidentiality. The manager of the corporate museum was interviewed. 3 interviews were conducted. The interviews, with the interviewee's consent, were transcribed and shared. This allowed us to eliminate interpretative errors and distortions. Furthermore, this allowed us to increase the quality of the interviews, collect comments on the interviews and their content. The interviews were reanalyzed using a narrative approach (Boje, 2001; Czarniaswka, 2004). We analyzed the interviews as texts, identifying the relational dynamics between the corporate museum and the parent company and practices related to knowledge management.

4. Results and Discussion

Since there is a vast literature on knowledge management (KM), but observations on corporate museums still appear scarce; the main objective of this study was to fill this gap. Especially within knowledge management studies, corporate museums are still little explored. This condition has strongly influenced this study. In fact, it was necessary to carry out an exploratory study.

The focus on corporate museums is justified as they represent containers of organizational artifacts, strongly connected to the parent companies. The analysis of corporate museums is characterized by the sector in which the parent company operates. The results of this study confirmed what has just been highlighted. In fact, the interviews revealed the strong bond and the knowledge transfer relationship between the parent organization and the corporate museum. Knowledge is conveyed to the corporate museum in the form of artifacts.

Analyzing knowledge within the corporate museum represents an indirect way to analyze knowledge within the parent company. Understanding the historical evolutions of the parent organization, therefore, appears necessary to understand the different forms of knowledge that are present within the corporate museum. This is the prerequisite for the analysis of the corporate museum. The observed case study has highlighted that the corporate museum is able to simultaneously collect, archive and valorize different types of knowledge, represented in different forms. The representation of knowledge, in the form of organizational artefacts, represents the evolution of KM practices used within the parent company.

The interviews have highlighted different aspects. In particular, the attention has emerged.

The second aspect is the strategic use that is attributed to the corporate museum. In fact, the interviews have highlighted that the corporate museum must not represent a collection of organizational artefacts, but must valorize the knowledge present within the corporate museum and generate advantages for both the corporate museum and the parent organization. In fact, the main studies on corporate museums have limited themselves to defining corporate museums as marketing tools. Without any advantage for the museum itself. The museum, according to these studies, is a tool that shifts all the benefits of its activity to the parent organization. From the interviews, however, it emerged that the corporate museum must be a stable and autonomous organization. The interviews highlight that the corporate museum must generate a competitive advantage for the museum and at the same time for the parent organization. In fact, through the valorization of knowledge considered obsolete by the parent organization, the corporate museum must generate value (not only economic) for itself and for the parent organization. The interviewees, in fact, highlighted that the corporate museum should return new knowledge to the parent organization. In this context, a BA is generated that allows the reuse of obsolete knowledge to undertake new paths of innovation and knowledge creation. The interviewees stated that the corporate museum must represent a shared space with the employees of the parent organization in order to spread the values of the organizational culture of the parent organization and, above all, encourage the development of new ideas, creativity and innovation that return to the parent company in the form of

innovation. The process of creating new knowledge within the corporate museum still appears not completely clear. The interviewees expressed the intent to achieve this goal. At the same time, no certain element has emerged. Until now, no concrete results have been presented regarding the use of the corporate museum as a BA. Our results highlight that it is therefore not possible to analyze the corporate museum independently, but we must understand the deep relationship between the parent company and the corporate museum. From the interviews it was possible to distinguish the phases of acquisition, archiving and sharing of knowledge within the corporate museum. This study is not without limitations. These limitations, however, can offer KM and corporate museum scholars potential opportunities for future research directions. The main limitation of this study is related to the methodology adopted. The study did not take into account elements such as the economic sector, the geographical area and the economic and socio-cultural conditions. For this reason, future studies could focus their attention by trying to consider discriminating variables such as the economic sector and the relative level of diffusion or rate of obsolescence of the widespread technology, organizational size or organizational knowledge.

References

Alavi, M., & Leidner, D. E. (2001). Knowledge management and knowledge management systems: Conceptual foundations and research issues. *MIS quarterly*, 107-136.

Boje, D. (2001). Narrative methods for organizational & communication research. *Narrative Methods for Organizational & Communication Research*, 1-160.

Budhwar, P., Chowdhury, S., Wood, G., Aguinis, H., Bamber, G. J., Beltran, J. R., ... & Varma, A. (2023). Human resource management in the age of generative artificial intelligence: Perspectives and research directions on ChatGPT. *Human Resource Management Journal*, *33*(3), 606-659.

Canonico, P., De Nito, E., Esposito, V., Fattoruso, G., Iacono, M. P., & Mangia, G. (2021). Visualizing knowledge for decision-making in Lean Production Development settings. Insights from the automotive industry. *Management Decision*.

Czarniawska, B. (2004). *Narratives in Social Science Research*. SAGE.

Durst, S., & Runar Edvardsson, I. (2012). Knowledge management in SMEs: a literature review. *Journal of knowledge management*, *16*(6), 879-903.

Durst, S., Edvardsson, I. R., & Foli, S. (2023). Knowledge management in SMEs: a follow-up literature review. *Journal of Knowledge Management*, *27*(11), 25-58.

Eisenhardt, K. M. (1989). Building theories from case study research. *Academy of management review*, *14*(4), 532-550.

Fauzi, M.A. (2023), "A bibliometric review on knowledge management in tourism and hospitality: past, present and future trends", International Journal of Contemporary Hospitality Management, Vol. 35 No. 6, pp. 2178-2201. https://doi.org/10.1108/IJCHM-03-2022-0381

Grant, R. M. (1996). Toward a knowledge-based theory of the firm. *Strategic management journal*, *17*(S2), 109-122.

Hallin, C. A., & Marnburg, E. (2008). Knowledge management in the hospitality industry: A review of empirical research. *Tourism management*, *29*(2), 366-381.

Huber, G. P. (1991). Organizational learning: The contributing processes and the literatures. *Organization science*, *2*(1), 88-115.

Lim, D., & Klobas, J. (2000). Knowledge management in small enterprises. *The electronic library*, *18*(6), 420-433.

Locke, K. (2000). Grounded theory in management research. *Grounded Theory in Management Research*, 1-160.

Mårtensson, M. (2000). A critical review of knowledge management as a management tool. *Journal of knowledge management*, *4*(3), 204-216.

Martinez, M. (2020). L'amore fra organizzazione e tecnologia" al tempo del digitale". *L'amore fra organizzazione e tecnologia" al tempo del digitale"*, 231-239.

Massaro, M., Dumay, J., & Garlatti, A. (2015). Public sector knowledge management: a structured literature review. *Journal of knowledge management*.

Ménard, C., & Klein, P. G. (2004). Organizational issues in the agrifood sector: toward a comparative approach. *American journal of agricultural economics*, *86*(3), 750-755.

Nissley, N., & Casey, A. (2002). Viewing corporate museums through the paradigmatic lens of organizational memory: the politics of the exhibition. *British Journal of Management*, *13*(1), 35-45.

Sandberg, J., & Tsoukas, H. (2020). Sensemaking reconsidered: Towards a broader understanding through phenomenology. *Organization Theory*, *1*(1), 2631787719879937.

Syed-Ikhsan, S. O. S., & Rowland, F. (2004). Knowledge management in a public organization: a study on the relationship between organizational elements and the performance of knowledge transfer. *Journal of knowledge management*.

Vacca, F. (2014). Knowledge in memory: Corporate and museum archives. *Fashion Practice*, *6*(2), 273-288.

Vesperi, W., & Gagnidze, I. (2023). From the university ecosystem to the entrepreneurial ecosystem–the way for developing the local economy. *International Journal of Economics and Business Research*, *25*(4), 431-455.

Vesperi, W., Coppolino, R., & Ingrassia, R. (2022). ENHANCE KNOWLEDGE MANAGEMENT PRACTICES IN AGRI-FOOD SECTOR: SOME PRELIMINARY CONSIDERATIONS. In *Sustainable Business Concepts and Practices* (pp. 1393-1395). Publisher EuroMed Press.

Vesperi, W., Melina, A. M., Ventura, M., Coppolino, R., & Reina, R. (2021). Organizing knowledge transfer between university and agribusiness firms. *Systems Research and Behavioral Science*, *38*(3), 321-329.

Yew Wong, K., & Aspinwall, E. (2004). Characterizing knowledge management in the small business environment. *Journal of Knowledge management*, *8*(3), 44-61.

Organizing the World's Largest Songwriting Camp: From a KM Perspective

Tone Vold, Trygve Stølan, Hanne Haave, Carl-Henrik Wahl, Ole Jørgen Ranglund and Linda Kiønig
Inland Norway of Applied Sciences, Rena, Norway

Tone.vold@inn.no
Trygve.stolan@inn.no
Hanne.haave@inn.no
Carl-henrik.wahl@inn.no
Ole.ranglund@inn.no
Linda.kionig@inn.no

Abstract: In June 2024 the worlds' largest songwriting camp took place in a small town in Norway. The main organizer is a small music production company called the Woods. Although having organized more than 100 "ordinary" music camps, this was -by far- be the largest one, with approximately 153 participants from approximately 20 countries. The logistics alone is nothing less than challenging. This study will focus on the knowledge management perspective regarding the organizing, and we have through a qualitative study interviewed the main organisers. Our perspective has been to unveil how they plan for, coordinate and organize the participants as well as keeping track of the different groups' progress regarding developing songs.

Keywords: Project Management, Knowledge Sharing, Coordinating Processes

1. Introduction

Sometimes songs take a long time to be finished. Then it needs to be recorded and produced before the marketing and publishing. At The Woods, who is a company specializing in producing and publishing music, they have been organizing "music camps" to effectively develop songs. "Music camps" are camps organized as seminars lasting approximately 2-3 days (often from Friday afternoon to Sunday afternoon). The purpose of the camps is to write songs (lyrics and melody) that can be published. Most times the songs need further work such as a better production, but this varies.

After having organized nearly one hundred music camps, the Woods decided to organize a world record attempt by organizing the worlds largest music camp, Rena Song Festival.

For this they engaged the municipality, the university, hotels and hostels, restaurants and other providers in the municipality of Åmot.

After a year of preparations, the invitations went out and 153 participants showed up, making this the worlds largest music camp.

From an organizational perspective, the knowledge management in such a temporary organization is interesting to unveil. This paper investigates how knowledge is disseminated within this organization and how knowledge has been distributed during the preparations for the record attempt and during the camp. For the person that was the initiator and has been the "driving force" behind the project, it has been important to avoid crisis and to be as prepared as possible in beforehand. He has been agile regarding the fact that crisis might still occur, crisis that is beyond what is possible to plan for. The planning has however been meticulous in order to foresee most of what may go wrong.

Our research question is thus; *Rena Song Fest – how to organize the world's largest songwriting camp?*

Through group interviews and individual interviews, we have sought to identify how the people working in this temporary organization have perceived how their level of knowledge and access to knowledge have facilitated their work execution before and during the camp.

2. Theoretical Foundations

Knowledge Management is about sharing, disseminating and saving knowledge (Hislop, 2009, Davenport and Prusak, 1998). Knowledge sharing and communication have in this project been seen as vital to secure that this music camp runs smoothly. Knowledge can be shared in several ways within the context of organizational theory.

However, it is important to know what type of knowledge this is about. Tacit knowledge requires different approaches to sharing than explicit. Tacit knowledge is implicit and difficult to express as it may be about skills, wisdom or intuition (Polanyi, 1967, Davenport and Prusak, 1998). Explicit knowledge is thus what is possible to articulate, to write down and store.

The knowledge-creation process is about turning tacit knowledge such as ideas, experiences, impressions into externalized knowledge, combined with previous knowledge with the co-workers and then internalized (Castellani et al., 2021, Nonaka and Takeuchi, 1995, Nonaka, 1994). This model is otherwise called the SECI-model. This model is often referred to within theory of "Learning organizations" (Filstad and Blåka, 2007) as learning in organizations often depends on "unlocking" the tacit knowledge and sharing it with others in the organization.

Learning in organizations and organizational learning are terms that has been debated (Örtenblad, 2018). In some definitions it is a focus on the individual as a learner whilst other definitions are focused on the organization (Örtenblad, 2018, Marsick and Watkins, 1999).

Argyris and Schön (1996) proposes another take on organizational learning. Their single and double loop learning has had huge impact on how to view how organizations learn. The single loop is about acting on a result, for example something that has gone wrong, a complaint, etc. The double loop is about searching the reasoning for why the result occurred (for example a faulty product can stem from different types of predating issues, such as using faulty but cheap screws in a product) fixing the reasons for the results rather than just fixing what has been wrong (providing a new product if a product is faulty).

Crisis may still occur, and it may damage the reputation of an organization (Coombs, 2007). A crisis may be defined as a "sudden and unexpected event that threatens to disrupt an organizations and poses both a financial and reputational threat" (Coombs, 2007). As the organizing company (The Woods) is mainly attracting customers due to a good reputation, it was vital that any crisis could be solved so that anything that may damage their reputation is solved as soon as possible.

Situational Crisis Communication Theory (SCCT) provide a framework that allows for understanding how stakeholders may react to a crisis. Stakeholders in this setting, may be the attendances at the music camp. Being on top of information going out to stakeholders are thus important. With the emergence of social media, news travels faster than ever. Stakeholders would also like to know how any crisis is treated to avoid a new happening. Emotions are also an important feature to pay attention to within handling crisis. According to Coombs (2007) *"behavioural responses are positive when a person is judged not to be responsible and sympathy is evoked"* (p. 166). This means that if the stakeholders perceive The Woods representatives to have done what they can to avoid crisis, they are more inclined to be positive and forgiving. Stakeholders with a previous bad relationship may amplify how they feel about the company.

It is also about how a message is framed as it may shape the perception of how a problem is defined, what caused it, who is responsible and how has it been solved (Coombs, 2007). It is also important to understand and assess the incidents recognized as crisis.

The SCCT model shows the different issues regarding a crisis. It shows that the crisis history and prior relationship reputation will affect the organizational reputation. Any crisis response strategies will influence crisis responsibility and organizational reputation as well as any Emotions. Emotions will influence behavioural intentions. If they are negative before entering the camp, they will be even stronger if something negative occur.

As the table 1 in the Appendix shows, there are possibilities of countering bad reputations.

Even if the staff working at Rena Song Fest establish what can be labelled an "ad hoc" organization (Morgan, 1998, Jacobsen and Thorsvik, 2002), it is still important to seek to avoid any crisis and unexpected events. It is about being "better safe than sorry" and thus take all possible precautions. Hence, the easiest way according to Gangdal and Angeltveit (2014) is to develop a culture within the organization based on routines, collaboration, cooperation and a unified understanding of what to be done, how it should be done and why these things should be done. It is about having clear goals, a common understanding of what the challenges may be, and how to arrive at common solutions. It is also about being able to place the responsibilities of the different tasks, work towards a common understanding of solutions, establish routines for detecting and preventing unwanted incidents and also develop a culture in which the participants encourage and dare to correct eachother. This, according to Gangdal and Angeltveit (2014) provides the manager with space and time that can be spent being ahead and prevent unwanted incidents.

3. Method of Inquiry

This paper is one of several reports from a longitudinal research project following the Woods song camps production management. We have used a qualitative approach that has included group interviews and individual interviews (Patton, 2002, Creswell, 2003). The group interviews were with the staff that were to support the people attending the music camp. The individual interviews have been with the representatives from The Woods. The interviews were conducted using a semi-structured interview guide to pursue relevant themes (Denzin and Lincoln, 2005, Jacobsen, 2015). The data material has been analyzed by reading through transcripts from the recorded interviews to identify any interesting issues that throw light on the research themes. Our findings give us insight in project management processes; the planning beforehand and how the Rena Song Fest was carried out. Along the process we have discussed our findings in the research group, and our findings are also presented and discussed with the Woods project team. This check-back validates the understanding of our findings (Guba and Lincoln, 1989).

4. Results and Discussion

4.1 Planning the Rena Song Fest Project – Seeking to be "Better Safe Than Sorry"

The responsible organizers claim that they have planned for a long time, checking and double checking every detail in their plan. For example, all the food and beverage services were checked out, the hotels and hostels were contacted to double and triple check about the accommodation. Lists over who would share room with whom were distributed prior to the camp, and they even booked rooms that were not occupied, just in case something would happen, and they would need an extra room.

This shows that they have sought to be highly detailed in their planning process. This is in line with what Gangdal and Angeltveit (2014) suggest regarding seeking to be ahead of unforeseen happenings.

There were mandatory meetings where the staff was trained in issues that may emerge. Also, they had to attend regular meetings to report on progress and situation both before and during the Rena Song Fest.

This show that within their "ad hoc" organization, they shared knowledge (Nonaka and Takeuchi, 1995) and through their common discussions and seeking to unveil challenges, were prepared to handle situations and solve problems that emerged (Gangdal and Angeltveit, 2014).

Equipment was organized well in advance and 38 studios distributed across the centre of the municipality (at the Inland University of Applied Sciences, Rena, at the County Hall and at The Woods) were set up several days before the start of the camp. All equipment was tested to check that the participants would be able to work as they expected allowing them to focus on the creative part of the song writing.

The preparation that the employees at The Woods have done to avoid crisis we find to be very (Coombs, 2007). They also seem to have sought to eliminate any occurrence of crisis. This may be due to their previous experiences with up to 100 music camps, although they have much less attendance. This record attempt would represent new experiences, but some issues they knew they had to attend to prior to the music camp. This indicate that their *tacit knowledge* allows for substantial preparations, both regarding accommodation, food&beverages, studio facilities and issues that may arise. Hence, the *tacit knowledge* the representatives from The Woods have obtained aid the process of sharing knowledge with what is now a part of the extended ad hoc organization (Nonaka and Takeuchi, 1995, Nonaka, 1994). By giving the staff instructions and explaining what to do, what to avoid, what to report and how to solve (known) possible problems the representatives at The Woods have sought to externalize the tacit knowledge allowing the staff to combine this knowledge with prior experience and by working in the music camp, they have the potential to internalize this knowledge.

These preparations also show that they act according to Argyris and Schön's single and double loop learning model (Argyris and Schön, 1996). In fact, they seem to anticipate and solve any problems before they arise.

4.2 Running the Rena Song Fest – Hands on and Problemsolving

The employees from The Woods experiences from previous camps had also led to dividing the attendants into groups based on self-reported levels of competences regarding the different areas that are required to develop songs (singer, songwriter, producer, musicians, etc.). However, some producers fell ill and could not attend. This was solved by the "reserve staff" at The Woods, that were to be "stand in's" and provide urgent help to groups that struggled now had to be producers in some of the groups. As this occurred at the last minute, literally the

same day as the camp started, this was the only solution. However, as these producers (from The Woods) originally were to be "spare" they were able to support the groups that were short of a producer. This is yet another example of being able to avoid crisis and bad reputation (Coombs, 2015).

The staff claim that they have been properly informed, and that they were clear about the "line of command". The introduction and information provided prior to the camp were interpreted as a bit boring, but as the camp progressed, they found the information useful. They claimed to know what to do on eventualities and if they were not able to solve the problem themselves, they knew who to contact.

This implies what we have suggested above; the knowledge sharing and sharing of what to the employees at The Woods have of tacit knowledge has been externalized, and the informants amongst the staff claim that they have understood (combined) and internalized the knowledge (Nonaka and Takeuchi, 1995, Nonaka, 1994).

In one case, there was an emergency as one of the places for staying overnight for the attendants to the music camp had trouble checking in the people arriving. Although this was originally taken care of by sharing lists and overviews of the distribution of sleeping spaces, it turned out that there were misinterpretations. This is a situation that may quickly have escalated to a crisis that potentially could have harmed The Woods' reputation (Coombs, 2007). However, it was rapidly solved by the representative calling the responsible from The Woods who arrived at the "hostel" a few minutes later and the matter was solved within a short time. It was also resolved by *apologies* (see table 1 in appendix), *reminders* and partially by *ingratiation* in the SCCT crisis respond table (see table 1 in appendix).

The examples above shows what Gangdal and Angeltveit (2014) suggest regarding enabling managers to be ahead of the problems and are allowed time and space to solve any emerging problems proves very useful. This is due to substantial planning and preparations, in combination with knowledge sharing and hands on management.

4.3 Posterior Actions

Posterior to the music camp, there have been several reflection meetings. One issue that arose that was unavoidable was the lack of producers at the music camp. According to the employees at The Woods, the learning they have from this is to offer courses for attendants that would like to become producers prior to the camp. This may solve any problems with lack of producers. This is an example of doing something with the reason for a possible crisis to emerge(Coombs, 2007) and strongly resemble double loop learning (Argyris and Schön, 1996). Also, the feedback from the participants at the music camp has been excellent and many of them have signed up for new camps at The Woods. Hence, their reputation may very well have been strengthened rather than damaged from the project.

A meeting with the other stakeholders (minus the participants) (such as the municipality, the university, etc.) is planned. This meeting may serve as a learning area for the rest of the stakeholders. This dissemination goes beyond the organization but may benefit the society and the involved parties at the Rena Song Fest.

5. Conclusions

The way knowledge has been managed by distributing and disseminating vital information and experiences, the management at Rena Song Fest have been able to avoid a lot of crises that would have emerged with less planning and preparations. The knowledge sharing has been vital and functioned as they hoped. The staff making up the "ad hoc" organisation has learned a lot from the project and the learning is kept and managed within the organisation (The Woods). The formidable undertaking had less "mishaps" than one could expect, due to the diligence of the employees at The Woods regarding preparations ahead of the Rena Song Fest. This has also resulted in participants at the Rena Song Fest signing up for more (ordinary) music camps at The Woods. The learning that the organization take away from this experience will benefit the organization as they will now have experiences with large music camps. As the number of participants exceeded what has been listed as "the worlds largest song camp", although only by three, Rena Song Camp is officially the largest song camp organized in the world.

Their approach to planning by "being better safe than sorry" has allowed the management to handle emergent crisis and also to avoid any major crisis to develop into e.g. reputations that could potentially be harmful.

References

ARGYRIS, C. & SCHÖN, D. 1996. *Organizational Learning II. Theory, Method, and Practice* New York, Addison-Wesley Publishing Company, Inc.

CASTELLANI, P., ROSSATO, C., GIARETTA, E. & DAVIDE, R. 2021. Tacit knowledge sharing in knowledge-intensive firms: the perceptions of team members and team leaders. *Review of managerial science,* 15**,** 125-155.

COOMBS, W. T. 2007. Protecting organization reputations during a crisis: The development and application of situational crisis communication theory. *Corporate reputation review,* 10**,** 163-176.

COOMBS, W. T. 2015. *Ongoing crisis communication : planning, managing, and responding,* Los Angeles, Sage.

CRESWELL, J. W. 2003. *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches,* Thousand Oaks, Sage Publications, Inc.

DAVENPORT, T. H. & PRUSAK, L. 1998. *Working knowledge: how organizations manage what they know,* Boston, Mass., Harvard Business School Press.

DENZIN, N. K. & LINCOLN, Y. S. 2005. *The Sage handbook of qualitative research,* Thousand Oaks, Calif., Sage.

FILSTAD, C. & BLÅKA, G. 2007. *Learning in organizations,* Oslo, Cappelen.

GANGDAL, J. & ANGELTVEIT, G. 2014. *Krise : forebygging, beredskap, håndtering, kommunikasjon,* Bergen, Fagbokforl.

GUBA, E. G. & LINCOLN, Y. S. 1989. *Fourth generation evaluation,* Newbury Park, Calif., Sage.

HISLOP, D. 2009. *Knowledge management in organizations : a critical introduction,* Oxford, Oxford University Press.

JACOBSEN, D. I. 2015. *How to conduct research? Introduction to social sciences research methods,* Oslo, Cappelen Damm akademisk.

JACOBSEN, D. I. & THORSVIK, J. 2002. *How organizations work; an introduction in organization and management,* Bergen, Fagbokforl.

MARSICK, V. J. & WATKINS, K. E. 1999. *Facilitating learning organizations: making learning count,* Aldershot, Gower.

MORGAN, G. 1998. *Images of Organization,* London, Sage Publications.

NONAKA, I. 1994. A Dynamic Theory of Organizational Knowledge Creation. *Organization Science,* 5**,** 14-37.

NONAKA, I. & TAKEUCHI, H. 1995. *The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation,* New York, Oxford University Press.

PATTON, M. Q. 2002. *Qualitative research & evaluation methods*.

POLANYI, M. 1967. *The tacit dimension,* Garden City, N. Y, Doubleday.

ÖRTENBLAD, A. 2018. What does “learning organization” mean? *The Learning Organization,* 25**,** 150-158.

Appendix

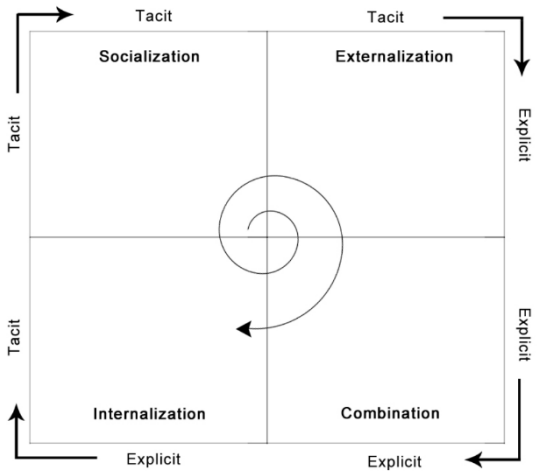


Figure 1: The SECI-model (Nonaka, 1994; Nonaka&Takeuchi, 1995)

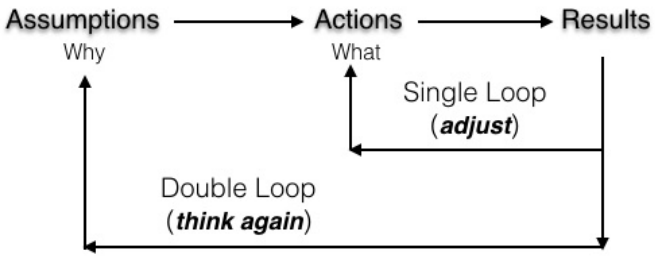


Figure 2: Single and Double loop learning (Argyris & Schön, 1996)

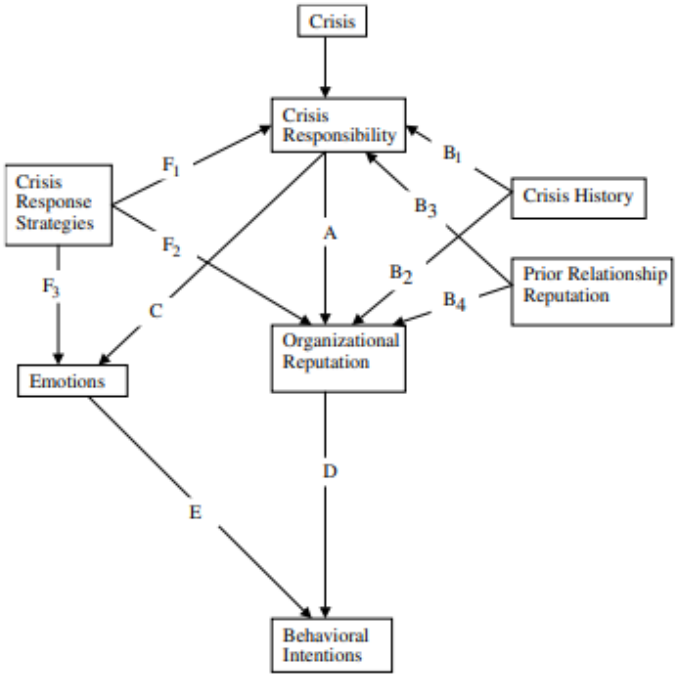


Figure 3: SCCT model (Coombs, 2007, p. 166)

The SCCT crisis response strategies are listed in this table:

Table 1: Table on SCCT crisis response strategies (Coombs, 2007, p. 170)

Primary crisis response strategies
Deny crisis response strategies
Attack the accuser: Crisis manager confronts the person or group claiming something is wrong with the organization.
Denial: Crisis manager asserts that there is no crisis.
Scapegoat: Crisis manager blames some person or group outside of the organization for the crisis.
Diminish crisis response strategies
Excuse: Crisis manager minimizes organizational responsibility by denying intent to do harm and/or claiming inability to control the events that triggered the crisis.
Justification: Crisis manager minimizes the perceived damage caused by the crisis.
Rebuild crisis response strategies
Compensation: Crisis manager offers money or other gifts to victims.
Apology: Crisis manager indicates the organization takes full responsibility for the crisis and asks stakeholders for forgiveness.
Secondary crisis response strategies
Bolstering crisis response strategies
Reminder: Tell stakeholders about the past good works of the organization.
Ingratiation: Crisis manager praises stakeholders and/or reminds them of past good works by the organization.
Victimage: Crisis managers remind stakeholders that the organization is a victim of the crisis too.

Making Tacit Knowledge Explicit: Disseminating Knowledge in a World Record Attempt

Tone Vold, Hanne Haave, Ole Jørgen Ranglund, Carl-Henrik Wahl and Linda Kiønig
Inland Norway University of Applied Sciences, Rena, Norway

Tone.vold@inn.no
Hanne.haave@inn.no
ole.ranglund@inn.no
carl-henrik.wahl@inn.no
Linda.kionig@inn.no

Abstract: The organizers of the world record attempt regarding gathering the largest number of singersongwriters in the world in a song writing camp (RENA SONG FEST 2024). From previous investigations, we know that there are certain steps in the development of a song, and that to develop a song that can be produced, they need to finish each step within a time frame. This has been a tacit knowledge. Hence, to organize for a vast number of groups they need to disseminate this knowledge to the ones that are to supervise and aid the groups towards a product that can be developed for production. In this paper we investigate how the managers at Woods developed a process for implementing and disseminating the knowledge needed to mentor the different groups taking part in the song writing camp. This two-tier mentorship will revisit the SECI-model and allow us to investigate if and how the organizers utilize this model to aid the supervisors in their work with the different songwriter groups.

Keywords: Tacit Knowledge, Explicit Knowledge, SECI-Model, Communities of Practice, Practical Knowledge, Ad-Hoc-Organization.

1. Introduction

Rena Song Fest 2024 was a world record attempt seeking to organize the largest songwriting camp. The theme of the camp was Eurovision Song Contest. As they managed to organize 153 participants, they are, for now, leading the competition. Rena Song Fest 2024 took place from the 27th to the 30th of June in Rena in Åmot municipality. This municipality holds approximately 5000 inhabitants in total of whom approximately 2000 lives in and around the centre called Rena.

Hosting such an event has required a lot of input from several stakeholders. The initiative was taken by the founder and managing director of The Woods, a music production company situated at Rena. The Woods have arranged approximately 90 music camps, but with less participants per camp. Hence, this world record attempt requires a different approach to organizing the camp and would be organized together with daWorks, BYRÅ and The Song Farm.

The goal of the music camp is to make as many songs as possible during the three days of the camp. This require that as many groups as possible can develop as many songs as possible.

The Woods have long and substantial experience regarding developing and producing songs utilizing song camps. The Woods have developed these camps from merely gatherings of people interested in making music to their professional and renowned music camps with different themes. They have used every song camp to improve on their professionalism. After each day of every camp, the staff that acts as supervisors for the different groups have reflected and discussed how to improve for the next camp. The experiences and thus knowledge base has increased for each camp held.

However, the size of the world record attempt required more supervisors than The Woods had access to. Hence, they needed to train more supervisors for this job. The experiences the supervisors at The Woods have gained are, however, not always explicit knowledge. The supervisors at The Woods have generally discussed without being recorded much of their acquired knowledge and this knowledge may thus be characterized as tacit knowledge. Our research question is: How did the Rena Song Fest organizers manage the process of implementing and disseminating the knowledge needed to supervise the different groups taking part in the song writing camp?

This paper shows how knowledge, both tacit and explicit can be shared in different tiers of a larger ad hoc organization. Through qualitative research we have investigated how the SECI-model (Nonaka and Takeuchi, 1995) developed by Nonaka and Takeuchi has been used to disseminate knowledge throughout the temporary organization for Rena Song Fest 2024.

2. Theoretical Foundation

Knowledge has been defined as: "the individual ability to draw distinctions within a collective domain of action, based on an appreciation of context or theory, or both" (Tsoukas and Vladimirou, 2001). This means that the individuals can make distinctions at the same time as they appreciate collective understandings and what is generally accepted as appropriate. Tsoukas and Vladimirou (2001) also claim that knowledge consists within a rule based context. The rules or the norms are determined within an organization by members of a Community of Practice (p. 980). This imply that the "individuals draw and act upon a corpus of generalizations in the form of generic rules produced by the organization" (p. 979). Further, the "community" must have a shared opinion and interpretation of these rules. They have to agree on what this means and how to apply it. Organizational rules allow for obtaining goals.

Lave and Wenger (1991) introduced the concept of a Community of Practice (CoP). They define CoP as a group of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly. This concept emphasizes that learning is a social process and occurs through participation in a community.

Polanyi (1967) claim that practical knowledge is personal, and involves personal participation to be generated. He further explains that we can learn to use a tool so well that we do not think about how we use it to perform an action or task, meaning that the use becomes tacit knowledge.

It is also worth noticing the importance of heuristic knowledge developed by employees while performing their tasks. This type of knowledge cannot be managed in the same way as formally available information because it relies heavily on employees' experiences, perceptual skills, social relationships, and motivation. Managing this aspect of organizational knowledge requires fostering a sense of community at work, encouraging employees to improvise and take initiatives, and actively maintaining a sense of corporate mission. In other words, managing heuristic knowledge involves more sensitive management of social relations rather than corporate digital information (Tsoukas, 1998). Additionally, effective management of organizational knowledge necessitates a reciprocal relationship between propositional and heuristic knowledge: while propositional knowledge is integrated into organizational members and becomes tacit through application, heuristic knowledge needs to be formalized (as much as possible) and made available within the organization.

The SECI-model is generally discussed and elaborated within the frames of organizational theory or learning organizations (Filstad and Blåka, 2007, Irgens, 2011, Jacobsen and Thorsvik, 2002). Nonaka and Takeuchi (1995) described how knowledge can be shared through socialization, externalization, combination and internalization. The model itself mainly focuses on how to make tacit knowledge explicit. Tacit knowledge is knowledge that is internalized and difficult to articulate (Polanyi, 1967) whilst explicit knowledge can be recorded and stored for sharing. The SECI-model show how tacit knowledge through socialization and externalization can become explicit and combined with the learners' previous knowledge and through working with this knowledge can internalize it. The figure (Figure 1) shows an overview of this process. The socialization and externalization are about discussing with others sharing circumstances and other information that enables the tacit knowledge to become possible to obtain by others. By testing and utilizing this information it is possible to combine the new knowledge with previous knowledge and then internalize it.

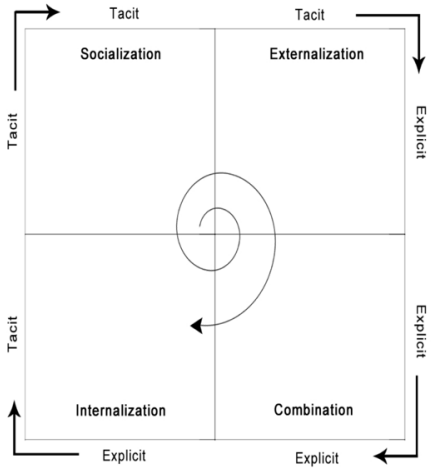


Figure 1: The SECI-model (Nonaka, 1994; Nonaka&Takeuchi, 1995)

However, this is contested by Cook and Brown (1999) as they use the example of riding a bike. When one has learned to ride the bicycle, this is tacit knowledge. It is, however, difficult to explain *how* to ride the bicycle. The explicit knowledge can be used to help acquire the tacit knowledge, but tacit knowledge, they claim, can never become explicit (Cook and Brown, 1999).

Also, there is a distinction between what each individual can do and what a group as a whole can do. The collective knowledge in a group thus consists of the individual's knowledge. The group's collective knowledge guides its actions, just like an individual's knowledge guides their actions. The work done by the group, based on its shared knowledge, is different from the work done by an individual based on their own knowledge (Cook and Brown, 1999).

3. Method of Inquiry

In this study we have had a qualitative approach. Data has mainly been collected by using semi-structured interviews (Patton, 2002, Dalen, 2011). This allows pursuing interesting statements that may enrich the data. We have interviewed the head of supervisors from The Woods and have also collected data from supervisors in the extended ad-hoc-organization. Since the interviews were registered on tape, we analysed the data by first listening to the recordings and sorting data into main categories and subcategories to identify patterns of the transition of knowledge in the ad-hoc organization. In order to secure validity and reliability, we have performed a checkback (Guba and Lincoln, 1989) presented the data to the interviewees.

4. Results and Discussion

The Woods and their partners have shown high ambitions in planning and going through with the Rena Song Fest. When planning Rena Song Fest, they were eager to avoid problems and "crises" as possible throughout the song camp. Due to the head managers insistence of preparing and planning rather than solving crises during the camp, they have been meticulous and detailed in their planning process. The head manager of Rena Song Fest insisted on establishing good relations with the stakeholders, the service providers and the staff. The staff, being a mixture of people hired by Rena Song Fest and "regular" employees at The Woods, thus needed to be as well trained as possible prior to the event.

We identified three stages in the process that supported the knowledge dissemination. The first was the importance of planning and being prepared by continuously asking themselves what could go wrong? They built an ad-hoc organization and delegated responsibility among the staff. In addition, they wanted to manage operate in a dynamic way to be prepared for unforeseen situations. This required communication and sharing of information. Both the participants of the Rena Song Fest and the members of the ad-hoc organization were very well informed about the "line of command" something they claim contributed to the management being closely updated on any undesired events. This in turn allowed the management to be "hands on" regarding solving the problems either by them selves or by delegating it to others.

Secondly, they arranged common meetings with the staff starting with a meeting ahead of camp start, "long and boring" according to the head supervisor. Here he presented all details regarding the camp. Thus, the whole group of supervisors were informed about "what, where, when and how". In this way all the mentors got the same information about what was going on. This gave them a basis for acting on possible problems arising during the event. These meetings, although "long and boring" contributed to the fact that all of the staff at the ad-hoc organization were informed as well as possible at all times. This allowed for the staff to feel included, as in a CoP (Lave and Wenger, 1991) and also a feeling of mastery (Senge, 1992) as they could answer questions from the participants of the camp.

Thirdly, The Woods head manager also shared with the group of new supervisors their knowledge about how to systematically run a song camp session, running the steps of the production processes, in a way that leads to a successful product. Daily evening evaluating meetings with the crew supported the group as a Community of Practice (Lave and Wenger, 1991).

The mentors from The Woods claim to have had quite substantial training during the previous camps. They each also claim to have developed their knowledge together with the others. An example they give is about timing and focus. Most artists want to make the perfect song with the perfect chorus and verses. However, the time limits do not always allow for finetuning of this. Hence, they must learn to settle for "the second best" in order to finish. They have also developed a model for what needs to be finished at approximately what time. This is they claim a result of reflection and being forced to explain what has become tacit knowledge.

This is an example of how they have utilized the SECI-model as described by Nonaka and Takeutchi (1995). By discussing and explaining amongst each other at the end of each day at the camp and after the camps they have been able to share this and make this a knowledge amongst the mentors.

The new mentors that have been trained has been taught about the timing but does not yet have this as their *internalized tacit knowledge.* This may be due to their lack of experiences regarding being mentors at several camps and thus have no other experiences to *combine* their new knowledge with other than having taken part in camps as participants. This thus supports the claim of Cook and Brown (1999) that tacit knowledge cannot become explicit.

The knowledge shared is decided by the group of mentors at The Woods. Hence, they may be viewed as a Community of Practice (Lave and Wenger, 1991) who set the rules for what is to be the governing interpretations and actions to be taken with this as a point of departure regarding what the new mentors are to work by. This is in line with what Tsoukas and Vladimirou (2001) states.

Posterior to the camps, the new mentors claim to have learned a lot not only from what they have been taught by the mentors at The Woods, but also from working as mentors at Rena Song Fest 2024. This is thus their own individual practical knowledge according to Polanyi (1967). If one consider the knowledge shared by the mentors from The Woods to be “a tool”, this also means that if they are able to utilize this more than this time, they may develop tacit knowledge on the mentorship (Polanyi, 1967).

In the aftermath an evaluation show that the experiences form the song camp is vital to both the daily production practice of the firms, but also has great significance for doing similar projects in the future.

4.1 Importance to Other Fields and Organizations

These investigations have been important as the outcome can be used in different settings as well as in new world record attempts when writing songs for the Eurovision Song Contest. It may also have significance regarding organizing supervisors in large groups for example in education both physically and online. Bringing this knowledge into such a setting provide guidelines for how to organize for developing supervisors for the purpose of for example educating within the frames of massive open online courses (MOOCS). Training supervisors for work in this type of setting thus require that there is a CoP of trained supervisors that set rules for what should be within the scope of what supervision should be about, and which is based on a common understanding drawn from the individuals’ tacit knowledge about supervision. Allowing the new supervisors to utilize their learning as “a tool” this may, combined with the experiences they obtain, become the new supervisor’s tacit knowledge.

5. Conclusion

The world record attempt called Rena Song Fest 2024 was a huge success. Not only did they manage to organize for the most participants ever on a song camp, but The Woods as the main organizer (together with daWorks, BYRÅ and The Song Farm), has gained valuable experience on how to perform song camps with large numbers of participants. The aim of this paper was to investigate the two-tier mentorship and how the knowledge development amongst the experienced and the new mentors would unfold.

The experienced mentors shared their knowledge which was based on the individuals’ tacit knowledge but what had been negotiated within the frames of what can be called a Community of Practice. This provided some rules and guidelines based on the collective knowledge. The new mentors were thus provided with “a tool” that they could use when executing mentorship in the groups they were assigned.

The experienced mentors used the SECI-model, but the new mentors need more experience in order to internalize the use of their “tools” (knowledge from the experienced mentors) and make this their tacit knowledge.

The outcome of this project may be applicable in different settings, for example in the education of large numbers of students.

References

COOK, S. D. N. & BROWN, J. S. 1999. Bridging Epistemologies: The Generative Dance Between Organizational Knowledge and Organizational Knowing. *Organization science (Providence, R.I.),* 10**,** 381-400.

DALEN, M. 2011. *Interview as research method,* Oslo, Universitetsforl.

FILSTAD, C. & BLÅKA, G. 2007. *Learning in organizations,* Oslo, Cappelen.

GUBA, E. G. & LINCOLN, Y. S. 1989. *Fourth generation evaluation,* Newbury Park, Calif., Sage.

IRGENS, E. J. 2011. *Dynamiske og lærende organisasjoner : ledelse og utvikling i et arbeidsliv i endring,* Bergen, Fagbokforl.

JACOBSEN, D. I. & THORSVIK, J. 2002. *How organizations work; an introduction in organization and management,* Bergen, Fagbokforl.

LAVE, J. & WENGER, E. 1991. *Situated learning - Legitimate peripheral participation,* Cambridge, Cambridge University Press.

NONAKA, I. & TAKEUCHI, H. 1995. *The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation,* New York, Oxford University Press.

PATTON, M. Q. 2002. *Qualitative research & evaluation methods*.

POLANYI, M. 1967. *The tacit dimension,* Garden City, N. Y, Doubleday.

SENGE, P. M. 1992. *The fifth discipline : the art and practice of the learning organization,* London, Century Business.

TSOUKAS, H. & VLADIMIROU, E. 2001. What is organizational knowledge? *Journal of management studies,* 38**,** 973-993.

Enhancing Teaching and Learning Through Digital KM at an Open University

Narubodee Wathanakom
Sukhothai Thammathirat Open University, Bangkok, Thailand

narubodee.wat@stou.ac.th

Abstract: This study investigates the utilisation of digital knowledge management (KM) in enhancing teaching and learning at an open university, with a particular focus on Sukhothai Thammathirat Open University (STOU) in Thailand. As a leading open university in Southeast Asia, STOU faces unique challenges in providing higher education opportunities to Thai people both locally and internationally. STOU recruits staff based on qualifications, attitude, and personal values to align with the open university mission and vision. STOU's mission requires its academic and non-academic staff to have differentiated competency, necessitating specialised skill sets in open education, including self-learning textbook writing, mastery of e-learning, and other digital resources planning. This study highlights STOU's capacity-building innovations in digital KM. Qualitative interviews were conducted with lecturers who participated in teaching and learning KM though qualitative interview with lecturers who participates in the KM on teaching and learning. The result of the study revealed that the key to success for enhancing teaching and learning was driven by the leveraging of a global standard framework called the UK Professional Standard Framework, together with certain KM activities such as face-to-face training, extensive online repository of resources, mentoring, and the utilisation of digital platforms. These initiatives equip academic staff with the necessary skills to effectively engage in the digital education landscape and encourage them to improve their teaching and learning. Robust KM practices at STOU significantly improve student passing rates, engagement, and satisfaction. The study offers practical recommendations to optimise digital KM via process-driven practices to contribute to the advancement of higher education in Southeast Asia.

Keywords: Knowledge Management, Open University, Digitalisation, Teaching and Learning

1. Introduction

In the 21st century, strategic knowledge management (KM) enables local and international organisations to create and sustain their unique business propositions and to gain a competitive edge by generating superior product quality, efficiency, and innovation (Almalki, & Al-Shammari, 2023). Knowledge is an intangible asset that increases an organisation's productive and adaptive capabilities (Marquardt, 2011). KM encompasses the efficient and systematic management of knowledge processes, extending beyond mere acquisition to include representation, storage, learning, sharing, reuse, creation, and innovation within an organisation or sector (Nawaz & Gomes, 2014). KM also facilitates the development of knowledge assets and in turn the achievement of organisational mission, goals, and objectives. State-of-the-art KM practices benefit organisations by encouraging knowledge sharing, creativity, and continuous improvement of product or services (Otundo, 2023). Further, KM is related to aligning people, technology, and business processes to create value for customers, as well as enable decision-making, risk management, quality enhancement, cost reduction, and improvement in service quality (Fan & Shum, 2023). This is because KM encourages a collaborative working environment through continuous exchange of information among stakeholders to augment organisational success (Saini, Jain, & Jain, 2023). KM design increasingly leverages new technologies such as crowd computing, AI, big data, the internet of things, and other digital tools (Safaee & Yadegari, 2022). Moreover, KM is associated with an organisation's learning culture (Priyadharshini & Lakshmi, 2021). A strong learning culture is necessary for effective KM, since employees who are more engaged and motivated tend to innovate and create new knowledge with the aim of improving existing working processes (Garvin, Edmondson, & Gino, 2008). Therefore, organisations must employ KM strategies to align people, processes, and culture to maximize its impact.

KM also plays important roles in both for-profit and non-profit organisations, including higher educational institutions. Petrides and Nodine (2003) mentioned that KM practices can empower faculty by helping them collect data and exchange information about which teaching methods work best in different learning settings. As knowledge-driven organisations in teaching, learning, research, publication, and community service (Fullwood & Rowley, 2017), the goal of every university is to produce highly capable graduates to meet the requirements of society and future employers (Umaroh, Putra, Fahrudin, & Arsyad, 2023). Sukhothai Thammathirat Open University (STOU), Thailand's premiere open university, aims to provide lifelong higher education opportunities for Thai people worldwide through distance learning (Sukhothai Thammathirat, 2024). Effectively leveraging the latest digital technology and educational innovations in service of the open university mission requires a unique set of competencies to support online students with diverse learning styles, including KM, pedagogical expertise, and online learning design (Bezuidenhout, 2015; Gulati, 2008); technological skills to

manage online learning tools (e.g., LMS) (Alvarez et al., 2009; Arinto, 2013); the ability to facilitate remote learning and keep distance learners engaged through student-centered learning (Berge, 2009; Chakraborty & Nafukho, 2014); and continuous professional development that keeps pace with the latest knowledge, trends, and technology to elevate KM learning experiences (Aziz & Selamat, 2016).

Previous research on KM in higher education has discussed KM processes, the utilisation of digital technology, cloud-based services, the influence of KM on academic staff satisfaction and teaching motivation, and KM culture (Dneprovskaya & Shevtsova, 2023; Younas, Noor, & Arshad, 2022; Hakiman, Munadi, & Ernawati, 2019; Duong, Kien, & Khoa, 2022; Shaukat, Ahmad, Naveed, & Rehman, 2023). However, there are gaps on the integration of processes, technology, and learning culture towards effective KM, especially in an open university where academic and non-academic staff requires unique competencies to provide teaching and learning in a KM learning environment. Drawing on the United Kingdom Professional Standard Framework (UKPSF) for higher education for the context of an open university, my article addresses this gap by presenting KM initiatives that integrate processes, technology, and learning culture.

2. Literature Review

Knowledge management was defined by Nonaka and Takeuchi (1995) as the process of creating, sharing, and utilising knowledge within an organisation to achieve a competitive advantage. They introduce the concepts of tacit and explicit knowledge and discuss the importance of converting the former (i.e., personal, experienced-based, and context-specific knowledge) into the latter (i.e., formalized and structured knowledge). They also highlight systematic storage and accessibility as aspects of effective KM.

Alavi and Leidner (2001) view KM as a structured, company-wide approach to gathering, organising, and sharing employee knowledge with the goal of making this information accessible throughout an organisation to improve individual performance and overall company effectiveness. They propose a comprehensive framework for KM within organisations that consists of four main processes: knowledge creation, knowledge storage and retrieval, knowledge transfer, and knowledge application. Knowledge creation is the process of generating new knowledge within an organization and includes the sharing of tacit knowledge through social interaction (e.g., face-to-face conversations, shared experiences, and apprenticeships) and converting tacit knowledge into explicit knowledge through articulation, dialogue, and documentation. Knowledge storage and retrieval emphasises the importance of organisational memory and involves capturing, organising, and storing organisational knowledge in repositories for future access and use. This process preserves valuable knowledge assets, such as databases, document management systems, expert systems, or knowledge repositories. These systems should be designed to facilitate easy access, retrieval, and maintenance of knowledge. Knowledge transfer is the process of sharing knowledge among individuals, groups, and organisations. This includes both formal knowledge transfer (e.g., training programs, documentation, knowledge-sharing platforms, and communities of practice) and informal knowledge transfer (e.g., social interactions, mentoring, and informal networks). Knowledge transfer can be cultivated through a culture of trust and collaboration, providing incentives for knowledge sharing, and investing in technological infrastructure that supports knowledge exchange. Knowledge application is the process of utilising knowledge to make decisions, solve problems, and improve organisational performance. The value of knowledge lies in its application, not just its possession. Knowledge application can occur at various levels within an organisation, from individual decision-making to team problem-solving and organisational strategy formulation. Organisations can enhance knowledge application by aligning KM initiatives with business objectives, providing training and support for knowledge users, and creating a culture that encourages experimentation and learning from failures. Knowledge application can also be facilitated by embedding knowledge into organisational processes, routines, and systems to make them more accessible and actionable.

The UK Professional Standards Framework (UKPSF) is a comprehensive set of guidelines and standards developed to enhance the quality and consistency of teaching and learning in higher education. It provides a universal framework for recognizing and benchmarking teaching excellence and professionalism among higher education practitioners. The UKPSF is managed by Advance HE, an organisation dedicated to supporting higher education institutions in their efforts to improve teaching and learning, and consists of three key domains: areas of activity, core knowledge, and professional values.

The first domain outlines five key areas of activity that higher education professionals are expected to engage in: design and plan learning activities, teach and support learning, assess and give feedback to learners, 4) develop effective learning environment, and engage in professional developments. The second domain, core

knowledge, refers to six areas to support teaching and learning: an understanding of subject, appropriate methods of teaching and learning, understanding of how students learn, use of appropriate learning technologies, methods for evaluating teaching effectiveness, and quality assurance and enhancement. The third domain, professional values, refers to core values that support teaching and learning: respect of individual learners, promotion of participation, evidenced-informed approaches, and wider contexts acknowledgement. The UKPSF plays a vital role in enhancing the quality of teaching and learning in higher education. By providing a structured and comprehensive framework for professional development, it supports educators in delivering high-quality education and fostering a positive learning experience for students. Because the open university manages KM learning in a highly diverse learning environment, the UKPSF is an appropriate framework. The UKPSF supports professional development for academic and non-academic staff, knowledge sharing and collaboration, usage of technology in KM, and the achievement of expected learning outcomes of the open university program.

3. Methods and Methodology

3.1 Population and Key Informants

The research population is comprised of lecturers who joined the UKPSF KM Program at Sukhothai Thammathirat Open University, which included 40 persons in 2022. Since this research focuses on the school of management science, the key informants are five lecturers from school of management science at STOU who successfully earned accreditation and a fellowship or a senior fellowship with the UKPSF in the first quarter of 2024.

3.2 Research Instruments

A semi-structured questionnaire was developed for this study concerning the KM practices and processes of UKPSF accreditation to propose a model to expand this practice further in other academic schools or universities with similar settings. All questions were reviewed by three subject matter experts to ensure content validity, passing an index of Item Objective Congruence (IOC) threshold score higher than 0.5. All questions received a score of one.

3.3 Data Collection

The data was collected through unstructured face-to-face interviews with five lecturers from school of management sciences who joined the KM program and could successfully earn UKPSF accreditation.

3.4 Data Analysis

After transcribing the recorded interview audio and validating the transcripts, I identified common themes that emerged across the interviews and coded the data accordingly. Following this, I summarised the findings according to each theme and identified key quotations from the informants. I then drew final conclusions according to the research objective.

4. Results

4.1 STOU KM Process

From the in-depth interview with lecturers who participated in the KM it was found that STOU relies heavily on their human capital to deliver quality education to a diverse student population. The research found that STOU placed a strong emphasis on KM and streamlined the whole process through a dedicated department of human resources development for KM learning, which became the center of excellence for KM. The center is involved in assessing development needs, providing new staff induction, teaching and learning capability enhancement, and allocating special funds for individual and team development. There two targets group of KM initiatives: academic staff and non-academic staff. The focus on these two groups is distinct, such that academic staff's KM goal is to enhance teaching and learning design and execution for online or KM learning environments, while non-academic staff needs to possess service skills to support students in the form of communication, customer service and technology guidance. The goal for both target groups is to enhance organisational learning to promote a culture of continuous learning and collaboration among academic and non-academic staff to deliver

best-in-class KM education to students. Since there are various initiatives for both groups, this article will focus on the KM initiatives for academic staff, specifically the case from the faculty members at the school of management science, the largest academic school in STOU by number of students, as well as academic staff.

As one of its key management initiatives over the past three years, the university has supported the school of management science to train 12 academic staff on the UK professional standards framework and get certified with appropriate levels of teaching and learning design experiences (associate fellowship, fellowship, senior fellowship and principal fellowship). This framework is proven to develop staff on the knowledge, skills, and values required for effective teaching and learning in higher education. The university has worked closely with this business school to execute KM, which the school has expanded upon by linking KM with the practical design and implementation of teaching and learning for lecturers. Based on my interviews with the key informants, I conceptualise effective digital teaching and learning KM for open universities as a four-step model, consisting of a technology-based training program, the creation of a community of practice, omni-channel mentorship programs, and assessment and certification of lecturers.

Step 1: Developing a Technology-Based Training Program. The kick-off training program aligns the UKPSF with KM processes and covers an introduction to the three dimensions of the UKPSF discussed above (areas of activity, core knowledge, and professional values) to ensure all lecturers understand the framework and its application in their practices. At STOU, training sessions were delivered through interactive workshops by senior lecturers who acquired senior fellowship status with practical activities, case studies, and group discussions to facilitate active learning and engagement. The participants were required to actively participate in the quizzes and teaching and planning writing activities. The participants reported that the session is very work-intensive yet inspiring. This is evident from the following participant quotes:

"I now have a clearer grasp of the different dimensions of teaching and learning, and how they interconnect with each other."

"The session helped me gain a deeper understanding of how effective teaching and learning practices should be in higher education in the context of open education."

"This kick-off session inspired my passion for continuous learning and professional growth. I am eager to develop my teaching skills to be a better teacher, aligned with the visions and missions of STOU to be the leading open university in the world."

"I learned how to design more engaging and inclusive learning experiences for my students with diverse backgrounds."

To support the learning of the participants, the training utilised e-learning modules and knowledge repositories in the form of a digital library, soft files, and video for specific topics/episodes, such as key steps to apply for UKPSF accreditation, the three UKPSF dimensions, and how to apply the UKPSF to the open university. that allow participants to review before the session and revisit after the session. The participants reported that these resources support their teaching and planning autonomy since they could not capture 100% of the content during the face-to-face training. These repositories are easily accessible and searchable, allowing lecturers to find relevant resources quickly through STOU e-services, such as intranet and Microsoft Team virtual rooms to facilitate communication and collaboration among participants. These platforms enhance the training experience through knowledge sharing, discussions, and peer support. This approach aligns with the UKPSF's emphasis on teaching and learning activity. Lecturers in STOU develop teaching and learning through writing self-study textbooks that must facilitate independent learning and cater to the unique needs of distance learners. The content must comprehensively cover all necessary information, explanations, and examples to enable students to learn independently. This means that the lecturer requires unique competency in analyse backgrounds of learners before designing the self-study textbooks. The textbook is supplemented with e-learning modules on STOU's Moodle LMS, online tutorials and workshops, and real-life case studies for students. To link the UKPSF with teaching and learning tasks in an open university context, subject matter experts ran a series of online snippet videos and workshops on writing a self-study textbook, preparing e-learning for students, conducting online tutorials, utilising educational technology, and developing effective formative and summative assessments. One of the most popular workshops for lecturers is how to use Class Point, an online engagement technology plugin to support learning and engagement, as well as using AI-based tools for education.

Step 2: Creating Communities of Practice. Communities of practice are groups of lecturers who share a similar interest and field of expertise to learn how to improve their teaching and learning through regular interaction. The CoPs are planned with regular (mainly virtual) meetings to discuss experiences, share insights, and provide

support among lecturers and guided by the master mentor who has achieved senior fellowship in the prior year. Some CoPs were organized during the afternoon as virtual coffee breaks where lecturers gather to discuss their teaching and learning practice where best practices were being shared to the rest of team as the inspiration. Participants reported they felt inspired by their peers' examples of new techniques with impressive results. This CoPs becomes the support system and source of comfort since they feel safe to share their concerns and ideas with the community. Apart from learning though their experiences, lecturers can also learn from their peer experiences to avoid some mistakes that could happen if they follow the same path.

"Through the community, I have been able to enhance my teaching skills, learn more about flipped classroom and project-based learning to apply for business management students."

"When I face challenges or problems or even doubts in my teaching, I know I can turn to the community for help and encouragement."

"I learnt from my peers that students may not turn on their camera during an online course because of their anxiety or discomfort with being on a camera."

"I adopted the new ways of supervising my MBA student dissertation with a weekly flipped classroom workshop with my students, helping them to progress with their research faster."

"I am new to STOU and have never written a self-study textbook before and I got peer guidance on the whole process from researching for a reference, preparing outlines, writing style, and pre- and post-test creation."

The CoPs support peer learning, where lecturers can learn from each other's experiences, case studies, common challenges, and collaboratively develop practical solutions on teaching and learning. This approach aligns with the UKPSF's emphasis on collaborative learning and professional values. In the CoPs, there is a master mentor and instructional design and technology experts who can provide guidance, answer questions, and share advanced knowledge. This access ensures that the learning is both deep and broad, covering all aspects of the UKPSF. During the CoP session, lecturers are encouraged to critically reflect about their practices via online reflective journal Microsoft team to document their experiences, challenges, and insights related to the three UKPSF dimensions. These journals can be shared within the CoPs, contributing to collective knowledge.

Step 3: Establishing an Omni-Channel Mentorship Program. Because effective mentorship supports professional development and knowledge transfer, STOU established a mentorship program aligned with the UKPSF that pairs mentors and mentees. These pairings consider compatibility in terms of subject matter, teaching style, and professional goals. The mentor is a senior lecturer with more than 5 years of experience who has been qualified at the minimum fellowship status. The mentee will be paired with a mentor in a related field in the subcategory of business management. The mentorship program is designed to provide a seamless experience through multiple channels, enhancing flexibility in terms of appointment scheduling and technology such as Line (the most popular social media platform in Thailand), Microsoft Teams, in-person discussion, and resource support in the form of videos and digital documents to cater to the diverse needs and preferences of lecturers in the program. The mentorship program can happen with a mix of face-to-face and online to suit the convenience and availability of mentor and mentee, but the only condition is that mentee should agree on the topic of discussion with pre-readings before the session to make it effective for both. The mentorship programs focus on providing support on teaching and learning practices of the participants and resolving some struggles or issues with empathy and co-created solutions. Sometimes, mentees invited mentors to join and observe their teaching class to provide comments and rooms for improvement. The mentorship program resulted in faster career progression and effective reflective practices, as evidenced by the following responses:

"Weekly meetings with my mentor have provided a structured space to reflect on my teaching experiences, critically analyse my methods, and identify areas for improvement. This mentorship process has helped me become more self-aware and proactive in seeking feedback from students and colleagues to continuously enhance my teaching effectiveness."

"I systematically evaluate my instructional strategies, assessment methods, and student engagement techniques in light of the framework's guidance."

"I have developed the habit of maintaining a reflective journal, documenting my teaching experiences, challenges faced, and lessons learned. This process lifted me up when I felt down and struggles with learning design issues."

Step 4: Assessing and Certifying Lecturers. This final step in the KM process focuses on the assessment and certification of educators under the UKPSF, which requires lecturers to develop portfolios that demonstrate their engagement with the UKPSF dimensions. These portfolios should include evidence of their activities, reflections, feedback, and any other relevant materials. The draft will be sent for internal peer review among certified senior lecturers. This robust process aims to improve teaching and learning, as well as reflective writing, with the goal of creating a safe learning environment for lectures to improve themselves. This helps improve the structure of participants' writing and allows them to develop their teaching and learning portfolio before submitting to UKPSF. Once the final version is ready, it will be sent to UKPSF to review and assess before certified under the appropriate category of the UKPSF (Associate Fellow, Fellow, Senior Fellow, Principal Fellow). This certification acknowledges their commitment to teaching excellence and professional development. Apart from getting the accreditation from UKPSF, the improved teaching and learning among participants resulted in a significantly higher passing rate of students, with 90% of research-based graduate students finishing their degree as planned with great results, as well as an increase in student satisfaction (4.5 out of 5.0) in key areas. A best-practices case of organising entrepreneurial marketing bootcamps was recognised and published in tier 1 Thai Journal called ThaiJo to disseminate the entire learning plan to the academic community.

5. Conclusions

The results of this study on STOU's teaching and learning KM demonstrate the efficacy of the UKPSF for organizing and replicating the KM process. However, the context of open universities is different from other universities; there is a need to customise KM processes to meet UKPSF requirements. Open university KM processes must also be flexible enough to meet the needs of diverse participants from different academic fields. Digital KM processes are especially critical to improving KM accessibility and flexibility. As a result, I propose the following four-step model for the effective organisation of digital KM for open universities, which can also be applied to other universities: Step 1: Developing a Technology-Based Training Program, Step 2: Creating Communities of Practice, Step 3: Establishing an Omni-Channel Mentorship Program, and Step 4: Assessing and Certifying Lecturers. Because KM continues to evolve, these steps can be enacted as an ongoing, circular process. This will help ensure that academic staff can continuously improve their teaching and learning to align with the mission and vision of the university. The primary contribution of this study to the field of KM is the proposed application of KM to enhance teaching and learning in the higher education context via the proposed digital teaching and learning KM model depicted in Fig 1.

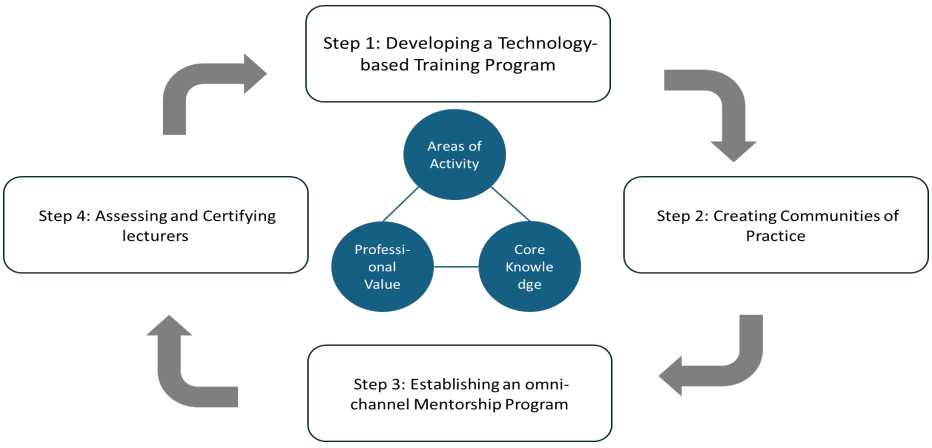


Figure 1: Proposed Digital KM Model for Teaching and Learning

Source: Prepared by the Author

References

Almalki, M. and Al-Shammari, M. (2023). 'Knowledge management and sustainable competitive advantage in the Kingdom of Bahrain.' *2023 8th International Conference on Business and Industrial Research (ICBIR)*, Bangkok, Thailand, 2023, pp. 332–335, doi: 10.1109/ICBIR57571.2023.10147640.

Alvarez, I., Guasch, T., & Espasa, A. (2009). 'University teacher roles and competencies in online learning environments: a theoretical analysis of teaching and learning practices'. *European Journal of Teacher Education*, 32(3), pp. 321–336.

Alavi, M., & Leidner, D. E. (2001). 'Review: knowledge management and knowledge management systems: Conceptual foundations and research issues'. *MIS Quarterly*, 25(1), pp. 107–136.

Arinto, P. B. (2013). 'A framework for developing competencies in open and distance learning'. *The International Review of Research in Open and Distributed Learning*, 14(1), pp. 167–185.

Aziz, F., & Selamat, M. N. (2016). 'Continuing professional development for open and distance learning instructors'. *International Journal of Management and Applied Science*, 2(12), pp. 57–61.

Bezuidenhout, A. (2015). Implications for academic workload of the changing role of distance educators. *Distance Education*, 36(2), 246–262.

Berge, Z. L. (2009). 'Changing instructor's roles in virtual worlds'. *Quarterly Review of Distance Education*, 9(4), pp. 407–414.

Chakraborty, M., & Nafukho, F. M. (2014). 'Strengthening student engagement: What do students want in online courses?'. *European Journal of Training and Development*, 38(9), pp. 782–802.

Dneprovskaya, N.V., and Shevtsova, I.V. (2023). 'A knowledge management system in the strategic development of universities'. *Business Informatics*, 17(2), pp. 20–40, DOI: 10.17323/2587-814X.2023.2.20.40.

Doung, P.N., Kien, D.T., and Khoa, B.T., (2022). 'Do knowledge management systems motivate and satisfy the academic staff in higher education institutions?'. *Journal of Applied Learning & Teaching*, 5(2), https://doi.org/10.37074/jalt.2022.5.2.16.

Garvin, D. A., Edmondson, A. C., & Gino, F. (2008). 'Is yours a learning organisation?'. *Harvard Business Review*, 86(3), pp. 109–116.

Fan, I.Y.H., and Shum, W.K.F. (2023). 'Knowledge management: The missing bonding discipline of STEM education'. *International Journal of Knowledge and Systems Science*, 14(1), pp. 1–17. DOI: 10.4018/IJKSS.323420.

Fullwood, R. and Rowley, J. (2017). An investigation of factors affecting knowledge sharing amongst UK academics'. *Journal of Knowledge Management*, 21(5), pp. 1254–1271, DOI: 10.1108/JKM-07-2016-0274.

Gulati, S. (2008). 'Technology-enhanced learning in developing nations: A review'. *The International Review of Research in Open and Distributed Learning*, 9(1), pp. 1–16.

Hakiman, H., Munadi, M., and Ernawati, F., (2019). 'Design of knowledge management implementation in Islamic universities'. *Humanities & Social Sciences Reviews*, 7(1), pp. 266–277, https://doi.org/10.18510/hssr.2019.7131.

Marquardt, M. J., (2011). *Building the learning organisation: Achieving strategic advantage through a commitment to learning*. 3rd ed. Boston, MA: Nicholas Brealey.

Nawaz, M.N. and Gomes, A.M. (2014). 'Review of knowledge management in higher education institutions'. *European Journal of Business and Management*, 6(7).

Nonaka, I., & Takeuchi, H. (1995). *The knowledge-creating company: How Japanese companies create the dynamics of innovation*. Oxford University Press.

Petrides, L. A., and Nodine, T. R., (2003). *Knowledge management in education: Defining the landscape.* Half Moon Bay, CA: Institute for the Study of Knowledge Management in Education.

Priyadharshini, L., and Lakshmi, D. (2021). 'The impact of knowledge management on organisational sustainability: Mediating role of organisational learning culture', *Turkish Online Journal of Qualitative Inquiry*, 12(8), pp. 9–23.

Otundo, J. (2023). 'Knowledge management for competitiveness and organisational performance'. *International Journal of Research in Education Humanities and Commerce*, 4(2), pp. 12–18. https://doi.org/10.37602/IJREHC.2023.4202.

Safaee, L., and Yadegari, R. (2022). 'Enhancing financial performance by applying knowledge management and new financial technologies in the banking industry'. *RISUS: Journal on Innovation and Sustainability*, 3(3), pp. 26–38.

Saini, P., Jain, R., Jain, N. (2023). 'Knowledge management'. *International Journal of Research in Applied Science & Engineering* Technology, 11(1), pp. 1786–1788.

Shaukat, R., Ahmad, S., Naveed, M.A., and Rehman, S.U. (2023). 'Impact of personality traits on knowledge sharing behavior of academicians: A case of University of Sargodha, Punjab, Pakistan'. *SAGE Open*, pp. 1–13. DOI: 10.1177/21582440231160984

Sukhothai Thammathirat Open University. (2024). 'STOU Vision 2037.' Retrieved on June 17th, 2024 from https://www.stou.ac.th/main/en/vision.html.

Umaroh, S., Putra, K.R., Fahrudin, N.F., and Arsyad, Z. (2023). 'Knowledge management and academic service quality on organisation performance'. *Electrotehnica, Electronica, Automatica*, 71(1), pp. 83–96, https://doi.org/10.46904/eea.23.71.4.1.1108009.

Younas, M., Noor, A.S.M., and Arshad, M. (2022). 'Cloud-based knowledge management framework for decision making in higher education institutions'. *Intelligent Automation & Soft Computing*, 31(1), DOI:10.32604/iasc.2022.018332.

Analysis of the Effectiveness of Technological KM Tools in the SME Sector Using the DEA Model

Dariusz Wielgórka
Częstochowa University of Technology, Faculty of Management, Częstochowa, Poland

dariusz.wielgorka@pcz.pl

Abstract: Knowledge management has emerged over the past decade as one of the key issues at the heart of modern organisations. The Industrial Age has been replaced by the Knowledge Age. It is a time when strategic management of knowledge and resources is a critical success factor for the organizations. Good Knowledge Management (KM) practices can equip the organizations to be more innovative and provide better integration and sharing of knowledge, which is the basis for starting new organizations or revitalizing mature organizations. The issue of knowledge management is primarily considered in the context of large organisations. In contrast, relatively little attention has been paid in the literature to the specifics of knowledge management in small and medium-sized enterprises. Small and Medium Enterprises (SMEs), the backbone of the economy, significantly benefit from KM practices. The operation of modern organizations in the SME sector requires constant adaptation of management methods and development strategies to new economic conditions. This is particularly important in the process of digital transformation, which has been making significant transformations in the area of economy for a few years now. This also applies to the issue of knowledge management in business organizations, which can be considered in the area of organizational structures, business processes, personnel, organizational culture, but also ICT technologies supporting this management. Advanced ICT solutions for knowledge management, understood as the systematic and organized use of its resources to improve the functioning of the organization, implemented within the framework of process orientation, come to the rescue. The article implies a research method based on a non-parametric DEA model, in particular CRS, identifying inputs and outputs and used to study the effectiveness of using technological tools for knowledge management in enterprises operating on the Polish SME market. In the literature, there is no use of the DEA method to study the effectiveness of technological tools for knowledge management in companies in the SME sector. The research objective of the article is to analyse the effectiveness of the use of technological tools for knowledge management in enterprises operating on the Polish SME market. The study was carried out using the non-parametric DEA method, which is based on a two-factor concept - technical efficiency (TE), meaning the ability of a company to produce maximum output (effects) for a given level of inputs, and allocative efficiency (AE), which in turn means that a company can use inputs in optimal proportion to individual prices (input costs). After analysing all possible inputs and effects, it was assumed that the following factors have a primary impact on the individual efficiency of technological KM in the SME sector: sales revenue, number of computer workstations, net profit included in effects, and fixed assets in the form of IT equipment, intangible assets in the form of software and the number of employees using technological KM tools included in inputs. Data for the survey was obtained using the CATI method among 600 randomly selected SMEs operating on the Polish market.

Keywords: Knowledge Management KM, SME, Technological Tools KM, DEA Model

1. Introduction to Technological Tools KM in SME Enterprises

The micro, small and medium-sized enterprise (SME) sector plays an important role in all economies around the world (Barroso, Ferreira, Meidute-Kavaliauskiene, Banaitiene, Falcao, Rosa, 2019). In Poland, there are 2.4 million non-financial enterprises, defined as active enterprises, of which 99.8% are enterprises included in the SME group (according to data for 2021 of the Polish Central Statistical Office (GUS). In recent years, entrepreneurship in Poland has been characterised by three distinct trends. Firstly, over the last few years it can be seen that the entrepreneurship of Poles is not waning. The number of enterprises is growing dynamically. Secondly, the quality of Polish entrepreneurship is improving. Polish companies as a group are contributing more and more to social welfare. The data show that they produce an increasing proportion of Polish GDP. The average company is growing steadily in economic terms. Its productivity, as measured by revenue, added value and production, is increasing. Trends also point to an improvement in the structure of companies from the point of view of legal forms. The share of companies as legal entities is increasing and that of physical persons is decreasing. Thirdly, the openness of entrepreneurs and their orientation towards growth is increasing. Companies, although still too seldom, are internationalising more and more - the proportion of exporters and the average value of exports are systematically increasing, as well as the use of the advantages of an online presence. Polish companies are also investing more and more and developing and implementing innovations, although the scale of development activities is still not high.

In the most general manner, knowledge management (Pritchard, 2010) is defined as a management method, the basic aim of which is the unconventional development of competitive advantage (Glabiszewski, Sudolska, 2009) by contemporary operating enterprises, including non-profit organisations (Perechuda, 2005). The great supporters of the knowledge management concept are T.H. Davenport and S.C. Völpel, who pointed out,

however, that knowledge management primarily plays an important role in improving methods of creating new knowledge, and then in its proper dissemination and use (Davenport, Völpel, 2001). Another definition of knowledge management is proposed by P. Murray and A. Myers, who presented it as a sum of processes enabling the creation, dissemination and use of knowledge, in order to achieve the goals set by the organisation (Ahmad, JianMing, Rafi, 2019) (Strojny, 2000). Knowledge management was also characterised by D.J. Skyrme, who described it as a precise and systematic management of knowledge resources and the related processes of creating, collecting, disseminating and using knowledge to ensure the organisation's proper functioning (Skyrme, 1999). Providing the right conditions to support the implementation of such a system into an organisation depends largely on a number of factors, among which the following stand out: adequate resources, the right management system and organisational structure (Liczmańska-Kopcewicz, 2017), appropriate organisational culture and communication, and a properly designed organisational strategy. For this reason, knowledge is still a resource that, when properly used, can contribute to a given company's competitive advantage in the market (Centobelli, Cerchione, Esposito, 2017) (Bamel, Pereira, Bamel, Cappiello 2021).

Knowledge in small and medium-sized enterprises cannot be created according to the same procedures as in large organisations, which results from the small potential in terms of human resources, capital, technology and development. The knowledge management system should prevent the loss of knowledge possessed by the organisation, but should also create knowledge within the existing resources. This system must be an attempt at a holistic approach to organisational phenomena and processes. The management of an organisation must independently create a knowledge management system in its organisation, adapted to the specifics of the enterprise and its human and financial capabilities. An attempt to comprehensively implement knowledge management in an SME must, taking into account the scale, cover such areas as the IT system, organisational culture and employee management. The functioning of modern SME organisations requires constant adaptation of management methods and development strategies to new business conditions. This is particularly important in the process of digital transformation, which has been making significant transformations in the area of the economy for some years now. This also applies to the issue of knowledge management in business organisations, which can be considered in the area of organisational structures, business processes, personnel, organisational culture, but also in the area of ICT supporting this management. This means that under conditions of extreme competitiveness as part of the digital transformation, the management methods used so far, which are aimed often aimed solely at ensuring stability and predictability. With help comes advanced ICT solutions for knowledge management (Preuss, Cordoba-Pachon ,2009), understood as systematic and knowledge, understood as a systematic and organised use of its resources to improve the functioning of the organisation, realised within the framework of the process orientation by (Unold, 2015):

- knowledge location and acquisition,
- collecting knowledge and processing it,
- its enrichment and sharing.

The knowledge management system consists of the following elements:

- knowledge management strategy - indicating priorities for action, defining the role of knowledge management in the process of achieving the organisation's strategic objectives,
- people and organisational culture - the willingness of employees to share knowledge, supported by organisational culture,
- business processes - the process orientation of the organisation to effectively collect, share and retrieve knowledge,
- information and communication technologies - these provide users with information and communication technologies - these provide users with effective collection, processing and sharing of data (transformed into information and further into knowledge).

In practical terms, this means the need for modern ICT solutions for knowledge management, enabling the support of business processes business processes as part of gaining and strengthening competitive capabilities. During evolution of the information society towards a knowledge society it boils down to treating modern enterprises as intelligent organisations intelligent. An intelligent organisation is one that bases its operating philosophy on the management of knowledge (Waltz, 2003). The term became widespread in the 1990s. due to the development of ICT, the dynamically changing economic environment and increased market competitiveness. An intelligent organisation is an organisation learning organisation, which has the ability to create, acquire, organise and share knowledge, use it to improve the efficiency of its operations and sharing it, using it to improve operational effectiveness and increase competitiveness in the global market. The idea of

such an organisation is based on a systemic approach to the organisation, i.e. treating it as a complex organism based on existing structures and implemented processes with particular emphasis on the role of knowledge. Attributes of smart organisations include (Beckford, 2016), (Grösser, Zeier, 2012), (Schwaninger, 2010):

- speed and flexibility of action,
- the ability to observe the environment,
- the ability to diagnose market signals early and respond to changes in the environment,
- the ability to quickly implement new knowledge-based solutions and thereby achieve the economic benefits.

The classification of tools supporting knowledge management due to the ambiguity of the terms causes many difficulties. In fact, the very definition of a "technological tools" in the knowledge management process is difficult to classify and raises many questions. Both the tools themselves and the functionalities they possess are not easy to classify. Many times the nomenclature of tools overlaps with the nomenclature of functionalities, and the functionality of a tool dedicated to one process is provided by another tool. In addition, technological trends are moving towards flexible tool design tools allowing a given tool to be used for multiple purposes depending on the depending on the concept of the organisation in question. Mechanisms to support knowledge management are based on three core technologies: database, network and web technology. Database technology - understood as the technology associated with the physical and logical structuring and storage of data. From a technological point of view, it is based database mechanisms and programming language systems. Network technology - understood as a set of network connections, mechanisms responsible for the coordination of all processes related to data exchange. This technology consists of two layers: a first hardware layer realised through. The first layer is hardware, implemented by servers, network connections and a number of tools related to synchronisation of the network synchronisation, and the second layer represented by software designed to implement the above-mentioned activities. Web technology - understood as a technology combining database technology. Web technology is implemented through websites and any mechanisms related to the representation of data on websites. The Websites present data, information, knowledge from various sources, often accumulated in many databases and files, sources, which are often combined in multiple databases and files. By means of web technology on websites equipped with the appropriate applications the web technology provides tools to share information and knowledge. Web technology provides tools for a range of knowledge management processes, such as: knowledge sharing between experts, discussion forums experts, discussion forums, corporate portals and many others. However, it is important to remember that the foundations of web technology most perceived by users are database technology and network technology.

Each of the aforementioned technologies enables the implementation of multiple knowledge management functionalities. Many times, knowledge management tools are based on all three technologies.

2. Methodology - Characteristics of an Efficiency Study Using the DEA Model

No studies of the effectiveness of using technological tools for knowledge management in the SME sector were found in the literature. However, a combination of DEA and KM approaches has been noted. Kuah and Wong used a two-level DEA model to measure the performance of Malaysian universities in relation to KM factors (Kuah, Wong, 2013) while Shirouyehzad, Rafiee, Berjis considered KM and safety management criteria as inputs and customer satisfaction and accident rates as outputs of a DEA model to evaluate the performance of 12 automotive companies in Esfahan (Shirouyehzad, Rafiee, Berjis, 2017). However, some studies can be found in which DEA has been applied to select, improve or evaluate Six Sigma projects. In the literature we also find the use of the hybrid DEA technique for the selection of six sigma projects (Hadi-Vencheh, Yousefi, 2018) (Wen, An, Xu, Chen, 2018). In the literature, we will also encounter the PCA-DEA approach to investigate the impact of the six sigma extension on key work characteristics in the automotive industry (Azadeh, Nasirian, Salehi, Kouzehchi, 2017). Therefore, the implication of the DEA method to study the effectiveness of technological tools for knowledge management in the SME sector is an important contribution.

Efficiency analysis using the non-parametric DEA method is based on a two-factor concept, with technical efficiency (TE) (Lang, Welzel, 1996), meaning the firm's capability to produce maximum output (effects) at a given level of inputs, and al-locative efficiency (AE) (Rogowski, 2008) meaning that the enterprise can use inputs in optimal proportion to individual prices (input costs). It is often used to study efficiency (Tavares 2002). The combination of TE and AE gives total economic efficiency (EE) (Sikora, Kulczycki, 2009). In the case of the concept of technical efficiency introduced by Farrell, the difference between the stated level of production of

the enterprise and the limit of its actual production capacity is taken into account (Welzel, 1996). Deviation from an efficient production plan means that the pro-duction of the outputs of a combination of inputs (the results obtained) could have been achieved with less input, which means a waste of resources (Welzel, Lang, 2005). The technical inefficiency caused by this fact increases in proportion to the distance from the effective production limit (Sheldon,1994). An important element in the study of corporate efficiency is the evaluation of economies of scale. Failure to take advantage of existing economies of scale results in efficiency losses for the enterprise (Wielgórka, 2008). From a general point of view, economies of scale illustrate the response of the level of outputs to a proportional increase in inputs. In the case of economies of scale, the quantity of outputs produced increases relatively faster than the level of inputs, which means that unit costs fall. In the opposite case, i.e., declining economies of scale (diseconomies of scale), unit costs rise as the level of outputs rises. In the situation of fixed scale effects, despite the increase in the number of outputs, the cost of producing one unit of outputs remains unchanged (Gospodarowicz, 2000). The DEA method makes it possible to determine the presence or absence of scale effects. Proponents of non-parametric methods, including the authors of the DEA method, are based on the concept of productivity, defining a measure of productivity as the quotient of a single output and a single input. By having one input (x) and one output (y), one can obtain an efficiency curve. This curve contains a set of objects with inputs (x) and outputs (y) that achieved the maximum possible outcomes, given a specific level of inputs. All combinations of inputs and technologically possible outputs lie between the OX axis and the efficiency curve (production frontier), i.e. the input-output relationship curve. DEA was developed specifically to over-come the drawbacks of parametric analyses, by evaluating efficiency based only on avail-able data on the magnitude of inputs and outputs without having to determine their functional relationship, which is very difficult when the number of factors is large. The units under evaluation in DEA are called decision-making units (DMUs) and a DMU is considered to be efficient when no other DMU can produce more outputs using an equal or lower amount of inputs (Ebrahimnejad, Tavana, Nasseri, Gholami, 2019) (Maleki, Ebrahimnejad, Kazemi, 2019). What makes the difference in DEA models is the concept of RTS. In the case of constant RTS, the CRS model will be used. Meanwhile, in terms of variable RTS, the BCC model should be used. Since recognizing the RTS is a long-term procedure, there is a need to collect data from different periods and analyze them (Amani, Valami, Ebrahimnejad, 2018), and regarding the limitations on data collection (we only were allowed to collect data in one period) we were not able to determine the RTS. Objects are considered technically efficient if they are on the efficiency curve, while those that are below the efficiency curve are technically inefficient. Decision making units (DMUs) are the objects of analysis in the DEA method. The main focus of the analysis is the efficiency with which a DMU transforms inputs into outputs. The relationship be-tween the efficiency of a given object and its maximum efficiency achievable under given technological conditions is taken as a measure of technical efficiency. Depending on model orientation, either input-oriented technical efficiency or output-oriented technical efficiency is calculated. The first point in evaluating efficiency using DEA is to define the ap-propriate technology that provides a baseline for the measurements to be made. For this purpose, a set of n decision making units that produce s outputs using m inputs is considered. For each DMU, the input and effect vectors are labelled and, respectively, with x > 0 and y > 0, which means that each decision making unit is assumed to have at least one input and one effect. The production technology thus defined:

$$T = \{(X,Y) : X \geq \sum_{j=1}^{n} \lambda j Xj, Y \leq \sum_{j=1}^{n} \lambda j Xj, \lambda j \geq 0\}$$

is subject to four fundamental assumptions [72]:

1) convexity - when (Xj, Yj) ε T, j - 1, ..., n, and λj ≥ 0 are non-negative scalars such that:

$$\sum_{j=1}^{n} \lambda j = 1$$

, then

$$(\sum_{j=1}^{n} \lambda_1 X_1, \sum_{j=1}^{n} \lambda j Yj) \in T$$

2) inefficiency

- when (X, Y) ε T and then

- when (X, Y) ε T and , then

3) constant economies of scale

- when $(X,Y) \in T$ (kX, kY) ε T for each k > 0

4) of minimum extrapolation, i.e. the condition that the technology must contain all possessed combinations of inputs and outputs.

The development of alternative DEA models has changed some of the assumptions.

In particular, the assumption of constant economies of scale was questioned in the further development of the methodology. The primary model of the DEA method is a non-linear (index) form, containing the weighted sums of inputs x and outputs y for a given DMU. The task of the model is to maximize this quotient assuming that it cannot be greater than 1 for any other decision making unit:

$$\max h_o = \frac{\sum_{r=1}^{s} u_r y_{ro}}{\sum_{i=0}^{m} v_1 x_{1o}} \qquad ST: \frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v, xi_j}$$

j = l, …, n; ur,; vi ≥ 0, r = 1, …, s; i l, …, m

After transformations, the normal linear form is obtained:

max Zo

$$ST: -\sum_{j=1}^{n} Y_{rj}\lambda_j + Y_{r0}Z_0 \le 0$$

$$\sum_{j=1}^{n} X_{ij}\lambda_j \le X_{10}$$

$$\lambda j \ge 0$$

r - l, …, s; i - l, …, m; j - l, …, n

Subsequent modifications result in a form of the basic input-oriented CRS model:

$$\min \Theta_0$$

$$ST: \sum_{j=1}^{n} x_{ij}\lambda_j \ge y_{r0}$$

$$X_{10}\Theta_0 - \sum_{j-1}^{n} x_{ij}\lambda_j \ge 0$$

$$\lambda j \ge 0, j = 1,\ldots,n$$

This model is designed to minimize the input demand up to the efficiency limit so that an input efficiency ratio is obtained. When the value of the coefficient is = l, the DMU is fully effective, which is expressed by the 100% transformation of its inputs into outputs. A proportional reduction of inputs is not an option in this case as it would imply a simultaneous loss of efficiency. A score lower than one suggests that the unit is inefficient, as it wastes (1-)*100% of inputs.

In economic terms, the technical efficiency (TE) of the enterprise, calculated by solving the CRS model refers to the situation of the presence of constant economies of scale. This means that a proportional increase in inputs entails a proportional increase in outputs. Companies aim to determine the volume of production at which costs reach the lowest possible level. In the long run, the efficiency curve will approach the shape of the curve with constant economies of scale.

3. Research on the Effectiveness of Technological KM Tools in the SME Sector Using the DEA Model

The research problem is the implication of the DEA method for assessing the effectiveness of the use of technological tools for knowledge management in companies operating on the Polish SME market. The implementation of this non-parametric method requires the definition of inputs and effects and then subjecting these factors to efficiency analysis. After analysing all possible inputs and effects, it was assumed that the following factors have a primary impact on the individual efficiency of technological KM in the SME sector: sales revenue, number of computer workstations, net profit counted as effects, and fixed assets in terms of IT equipment, intangible assets in terms of software and number of employed people using KM technological tools counted as inputs.

A comprehensive survey based on an interview questionnaire, classified as quantitative research, was conducted in 2022. Interviews were conducted with owners, co-owners and persons responsible for management in the segment of SME companies in Poland, from various industries. The survey involved 600 randomly selected SME companies operating on the Polish market, of which 40% were micro-enterprises employing up to 9 people, 30% small entrepreneurs employing up to 49 people and 30% medium-sized entrepreneurs employing up to 249 people. The structure of the survey was weighted to the structure of companies in Poland according to the regon database operator (Central Statistical Office). The research sample prepared in this way enables data analysis at the level of the entire SME population in Poland. The survey was conducted using the CATI (Computer Assisted Telephone Interview) method in 2022. This is one of the methods of collecting information in quantitative research.

Table 1: CRS TE performance measure statistics in the analysis of the effectiveness of technological KM tools in the SME sector from 2017 to 2021

Statistics CRS TE	2017	2018	2019	2020	2021
Standard deviation	0,17	0,19	0,17	0,19	0,20
Minimum value	0,20	0,19	0,23	0,24	0,22
Number of effective SMEs	228	246	258	288	294
Number of ineffective SMEs	372	354	342	312	306
% Effective SMEs	38%	41%	43%	48%	49%

The CATI survey was conducted using a special programme that assisted the caller to the respondent throughout the interview. The interview questionnaire consisted of a core part (essential questions) and a metric (classification questions). The core part of the questionnaire was designed to obtain information about knowledge management in SMEs. The questionnaire contained information about the surveyed enterprises: number of employees, revenue, balance sheet total, legal form, type of activity according to PKD, period of activity, official position of the person completing the questionnaire. One of the stages of the comprehensive study was to assess the effectiveness of the use of technological tools for knowledge management in enterprises operating on the Polish SME market using a non-parametric DEA model, in particular the CRS model assuming the presence of fixed economies of scale.

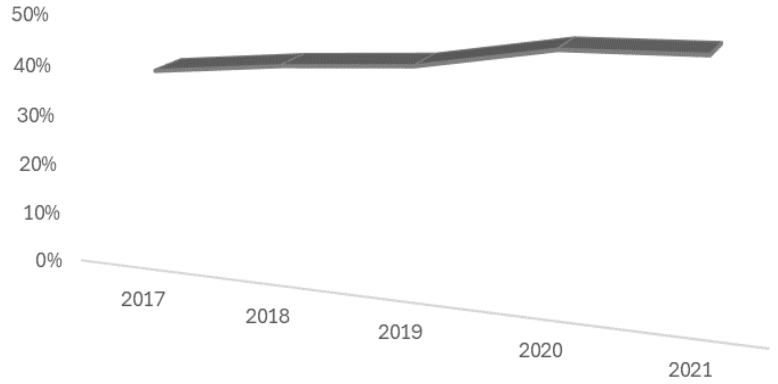


Figure 1: Level of SMEs effectively using technology tools for knowledge management 2017-2021

Measures derived from the estimation of input-oriented models will determine the ratio of the actual output of the SME to that which the SME should have had if it had effectively used the same amount of inputs. Over the period studied, the total number of efficient SMEs effectively using technological KM tools is increasing, which is a positive development (Figure 1).

By estimating the CRS model, technical efficiency (TE) can be calculated, which determines the possible amount of inputs that can be used under given technological conditions to produce at least the same amount of products. In 2021, only 49% of SMEs were effectively using technological KM tools (Figure 2).

In particular, the number of effective enterprises (i.e. effectively using technological tools for knowledge management) increased in the group of small and medium-sized enterprises reaching 52% and 63% of the total surveyed entities, respectively. In the microenterprise group, the number of effective entities represented only 32% in 2021. It should be inferred that larger companies in the SME group make more effective use of technological tools for knowledge management.

4. Conclusion

The research conducted investigated the implications of the non-parametric DEA method for quantifying the effectiveness of the use of technological tools for knowledge management in the SME sector.

The estimation of the DEA model in the area of efficiency coefficients that each SME could achieve ranged from 0 to 1. A coefficient value equal to 1 indicates an efficient SME, while an efficiency coefficient value lower than 1 indicates that the SME in question has room for improvement in the input-output ratio of technological KM tools. During the 2017-2021 period under review, it is important to note an increasing trend in the number of effective SMEs using technological KM tools. The increase in the number of effective SMEs is mainly related to the growing role and awareness of knowledge utilisation in SMEs. However, the lowest level of effective use of technological tools for knowledge management was noted in the microenterprise group. Larger enterprises in the SME group make more effective use of technological tools for knowledge management.

The effective use of technological knowledge management tools in SME companies plays a very important role today. It facilitates and streamlines organisational processes, supports business processes, shapes organisational culture by changing rules, forms, habits of cooperation and communication. Digital solutions are also helpful in building relationships with customers, enabling feedback on the quality of service or purchase preferences. There is huge potential in the SME sector, especially in the group of micro-enterprises which, lacking strong financial backing, are unable to meet the demands of the market. Therefore, it is important to build a financial support programme for SMEs, especially micro-enterprises, to increase the use of technological tools for knowledge management, which will improve the competitive position of this sector. The implication of the DEA method will allow it to be further used in subsequent studies on knowledge management in the SME sector.

References

Ahmad K., JianMing Z., Rafi M., (2019), Assessing the literature of knowledge management (KM) in the field of libraryand information science. Information Discovery and Delivery.

Amani N., Valami H. B., Ebrahimnejad A., (2018), Application of Malmquist productivity index with carry-overs in power industry, Alexandria Engineering Journal, vol. 57, no. 4, pp. 3151–3165.

Azadeh A., Nasirian B., Salehi V., Kouzehchi H., (2017) Integration of PCA and DEA for identifying and improving the impact of Six Sigma implementation on job characteristics in an automotive industry, Quality Engineering, vol. 29, no. 2, pp. 273–290.

Bamel N., Pereira V., Bamel U., Cappiello G. (2021), Knowledge management within a strategic alliances context: Past, present and future. Journal of Knowledge Management, 25(7), 1782–1810.

Barroso R. M., Ferreira F. A., Meidute-Kavaliauskiene I., Banaitiene N., Falcao P. F., Rosa A., (2019), Analyzing the determinants of e-commerce in small and medium-sized enterprises: a cognition-driven framework, Technological and Economic Development of Economy, Volume 25 Issue 3, pp. 496.

Beckford, J., (2016), The intelligent organization. Realising the value of information. London – New York: Routledge – Taylor & Francis Group.

Centobelli P., Cerchione R., Esposito E., (2017) Knowledge management in startups: Systematic literature review and future research agenda, Sustainability 9 (3), 361

Davenport T.H., Völpel S.C., (2001), The rise of knowledge towards attention management, “Journal of Knowledge Management”, no. 3.

Ebrahimnejad A., Tavana M., Nasseri S. H., Gholami O., (2019), A new method for solving dual DEA problems with fuzzy stochastic data, International Journal of Information Technology & Decision Making, vol. 18, no. 1, pp. 147–170.

Gerwin D., (1997), Manufacturing Flexibility: A Strategic Perspective., Manage. Sci., vol. 39, no. 4, pp.15.
Glabiszewski W., Sudolska A., (2009), Rola współpracy w procesie kształtowania konkurencyjności przedsiębiorstwa, „Organizacja i Kierowanie", nr 2 (136).
Gospodarowicz, M. (2000), Procedury analizy i oceny banków. Materiały i Studia NBP, Warszawa.
Grösser, S. N., Zeier, R., (2012), Systematic management for intelligent organizations. Berlin Heidelberg: Springer-Verlag.
Hadi-Vencheh A., Yousefi A., (2018), Selecting six sigma project: a comparative study of DEA and LDA techniques, International Journal of Lean Six Sigma, vol. 10, no. 2,
Kuah C. T. Wong K. Y., (2013) Data Envelopment Analysis modeling for measuring knowledge management performance in Malaysian higher educational institutions, Information Development, vol. 29, no. 3, pp. 200–216,
Lang, G.; Welzel P. (1996), Efficiency and technical progres in banking Empirical results for a panel of German cooperative banks. Banking and Finance.
Liczmańska-Kopcewicz K., (2017), Uczestnictwo konsumentów w tworzeniu innowacji poprzez media społecznościowe, „Przedsiębiorczość i Zarządzanie", Tom XIII, Zeszyt 4.
Maleki S., Ebrahimnejad A., Kazemi R., (2019), Pareto–Koopmans efficiency in two-stage network data envelopment analysis in the presence of undesirable intermediate products and nondiscretionary factors, Expert Systems, vol. 36, no. 3, Article ID e12393.
Oslo Manual, (2005), Proposal Guidelines for collecting and interpreting innovation data. Third edition.
Perechuda K., (2005), Zarządzanie wiedzą w przedsiębiorstwie, Wydawnictwo Naukowe PWN, Warszawa.
Preuss L., Cordoba-Pachon J.R. (2009), A knowledge management perspective of Corporate Social Responsibility, Corporate Governance, vol. 9 NO. 4 2009,
Rogowski, G. (2008), Metody analizy i oceny działalności banku na potrzeby zarządzania strategicznego. WSB, Poznań.
Shirouyehzad H., Rafiee F. M., and Berjis N., (2017), Performance evaluation and prioritization of organizations based on knowledge management and safety management approaches using DEA, Journal of Modelling in Management, vol. 12, no. 1, pp. 77–95,
Schwaninger, M., (2010), Intelligent organizations. Powerful models for systematic management. Berlin, Heidelberg: Springer-Verlag.
Sheldon, G. (1994), Nichtparametrische Messung des technischen Fortschritts im Schweizer Bankgewerbe. Schweizerische Zeitung für Volkswirtschaft und Statistik , no 130.
Sikora, D.; Kulczycki A. (2009), Efektywność oddziału banku detalicznego jako czynnik przewagi konkurencyjnej. CeDeWu.
Skyrme D.J., (1999), Knowledge Networking Creating the Collaborative Enterprise, Butterworth-Heinemnn, Oxford.
Strojny M., (2000), *Teoria i praktyka zarzadzania wiedzą*, „Ekonomika i Organizacja Przedsiębiorstwa", nr 10.
Tavares, G. (2002), A Bibliography of DEA (1978-2001). Rutcor Reasorch Report.
Unold, J., (2015), Zarządzanie informacją w cyberprzestrzeni. Warszawa: Wydawnictwo Naukowe PWN.
Waltz, E., (2003), Knowledge management in the intelligence enterprise. Boston: Artech House.
Wen Y., An Q., Xu X., Chen Y., (2018), Selection of Six Sigma project with interval data: common weight DEA model, Kybernetes, vol. 47, no. 7, pp. 1307–1324.
Welzel P. (1996), Kosten - und Größeneffizienz im Bankgewerbe - Data Envelopment Analysis der bayerischen Genossenschaftsbanken. In Jahrbuch für Wirtschaftswissenschaften, Göttingen.
Welzel P., Lang, G. (2005), Technology and cost efficiency in banking: A thick frontier analysis of German banking industry. Institute of Economics, University of Augsburg.
Wielgórka, D. (2008), Analiza finansowa działalności banku w okresie globalizacji. Nauka i Oświata, Ukraina Dniepropietrowsk.

Optimizing Educational Opportunities using AI to Ensure Accessibility at Public Sector Institutions in Poland

Anna Wiśniewska-Sałek
Czestochowa University of Technology, Częstochowa, Poland

anna.wisniewska-salek@wz.pcz.pl

Abstract: The use of artificial intelligence in education is a logical consequence of the potential it represents. The solutions offered by AI to eliminate barriers, e.g. for people with special educational needs, provide real help in communicating with them. However, the potential often does not equal the opportunity. It is necessary to check whether the environment in which AI solutions will be implemented is actually prepared for its application/use. The article indicates the main directions of AI development in education by analyzing the types of disabilities among learners. Finding real needs will allow you to optimize opportunities (using AI) for equal access to education. Public institutions were subjected to additional examination. Its aim is to check their actual digitization status, which creates the foundation for implementing modern solutions.

Keywords: Education, AI, People With Special Needs, Accessibility.

1. Introduction

The Constitution of the Republic of Poland adopted in 1997 (Constitution of the Republic of Poland, 1997) guarantees the right to education in Poland. It is provided by Article 70, which refers to, among others, having the right to education, while maintaining its compulsory education until the age of 18. It defines education in public institutions as free and emphasizes the obligation to ensure universal and equal access to education, which is guaranteed by public authorities while maintaining the autonomy of higher education institutions on the principles set out in the Act. Another legal document relating to education in Poland is the Act of December 14, 2016, Education Law (2023). Respects the principles contained in:

- the Constitution of the Republic of Poland,
- Universal Declaration of Human Rights,
- International Covenant on Civil and Political Rights
- Convention on the Rights of the Child.

The structure of the school, special units and counseling facilities and centers are described in Article 2 of this Act, while Article 4 in sections 2 and 3 defines a special unit, section 3 characterizes an individual educational and therapeutic program and section 4 organization of education and upbringing for special education. The special unit is intended for pupils with a certificate of need for special education and is described as a form of education (with reference to Article 127): "Special education covers children and youth who are disabled, socially maladjusted and at risk of social maladjustment, requiring the use of special organization of learning and methods of work. The global dimension of the issue of special education had its original place in the United States Congress in 1975: Public Low 94-142, 94th Congres, Education for All Handicapped Children Act of 1975 (Public Law 94-142, 1975).

In Poland, in accordance with the Education Law (Education Law, 2023), compulsory schooling (7 years) is preceded by one year of pre-school preparation (in the age of 6 years), and then the obligation to study until the age of 18, mainly in secondary schools. The education system also includes: educational and upbringing facilities, continuing education facilities, artistic institutions, psychological and pedagogical counseling centers, youth educational centers, institutions providing care and upbringing for pupils, teacher training institutions, pedagogical libraries, and colleges of social service workers. The stages of education also include in their structures special, integrated, with pre-school integration, special classes, job training, bilingual, sports and sports championship units/schools/kindergartens. Education is generally available, but only in the context of the absence of administrative barriers. In accordance with the Regulation of the Minister of National Education (2023) on the principles of organizing and providing psychological and pedagogical assistance in public kindergartens, schools and institutions, announced on September 5, 2023, the director of the educational unit is responsible for the organization of psychological and pedagogical assistance. (which is related to the limited budget, e.g. for eliminating architectural barriers). As a result, this forces young people with disabilities to choose a place of education depending on the degree of need for special education, and thus, to some extent, to choose, for example, a special school rather than an integrated school. Paragraph 2 of the above-mentioned regulation

specifies the situations qualifying a pupil for psychological and pedagogical assistance in a kindergarten, school or institution: 1) disability, 2) social maladjustment, 3) risk of social maladjustment, 4) behavioral or emotional disorders, 5) special talents, 6) specific learning difficulties, 7) deficit of competences and language skills disorders, 8) chronic diseases, 9) crisis or traumatic situations, 10) educational failures, 11) environmental neglect related to the living situation of the pupil and his family, the way of spending free time and environmental contacts, 12) adaptation difficulties related to cultural differences or changes in the educational environment, including those related to previous education abroad. In order to obtain the right to benefits ensuring equal access to education, a decision on the need for special education must be obtained, pursuant to Article 127 point 18 Education Law (2023).

2. Literature Review

2.1 Inclusive Education

The 1994 Salamanca Declaration recognizes the idea of inclusive education, and the definition of integrational education in the second chapter emphasizes the need to ensure that people with special educational needs have the opportunity to learn in traditional schools where teaching is tailored to their needs. This is an important step towards ensuring equal educational opportunities for all pupils and promoting social integration (UNESCO and Ministerio de Educación y Ciencia, 1994). Inclusive education aims to ensure that every student has equal opportunities for education, regardless of possible limitations such as disabilities or other attributes. The desire to ensure that everyone can benefit from education in a way tailored to their individual needs is the foundation of this approach (Florian, 2014). Inclusive education aims to create a more inclusive and tailored learning environment in which all pupils have equal access to learning and the opportunity to develop their skills. Through integration, the educational system aims to promote understanding, tolerance and acceptance among pupils, which contributes to creating a more diverse and friendly school community (Sharma et al, 2021; Moosa et al, 2022). Although it offers many benefits, integration education faces several obstacles, such as teacher shortages, lack of training for educators, and negative attitudes towards pupils with disabilities. Both pre-school and professional teachers' attitudes toward integration education are crucial to its effectiveness because they have a significant impact on the implementation and robustness of integration practices. Additionally, teachers' attitudes can shape relationships, activities, and teaching methods that directly impact all pupils, including those with special needs (Soeharto et al, 2024; De Boer et al, 2011).

Research conducted by (Unianu, 2013) clearly indicates the need to improve teachers' competences in the field of integration and promote good practices in this field. The quality of education is closely related to the quality of teachers' work, therefore it is crucial to introduce the principles of integrative teaching and develop strategies to support each pupil in achieving educational success. Adapting the teaching process to the individual needs and capabilities of pupils is a key element of optimizing the educational process. Inclusive education is crucial to ensuring equal opportunities and support for pupils with disabilities. This requires the involvement of teachers who have the appropriate knowledge and skills to adapt their teaching methods to the individual needs of pupils (Marimuthu and Cheong, 2015). The lack of an implemented practice of integrated education necessitates the need to take difficult actions to identify barriers and develop appropriate measures that will allow the development of such a model at all levels of the education system. Current efforts focus primarily on primary education, but it is important to expand these practices throughout the system to provide a more comprehensive, inclusive education that is an essential element of an inclusive society (Dimov et al, 2014). Monitoring the academic progress of Children With Disabilities (CWD) in inclusive classrooms is a key aspect of assessing the effectiveness of UN inclusion education policies. Understanding how CWDs achieve outcomes in low- and middle-income countries is important to achieving the goal of providing all children with high-quality primary education by 2030. It is important to ensure that education systems are equitable and appropriately responsive to the needs of children with disabilities, in line with the principles of the UN Convention on the Rights of Persons with Disabilities (Diaz-Sarachagaet al, 2018). However, there is a long-standing debate about whether people with disabilities underperform academically compared to their peers who study in integrated schools (McCoy and Banks, 2012). Researchers agree that pupils with severe disabilities can develop their academic, social and independence skills in an inclusive setting. This integration allows them to participate in the everyday life of the school and community, which contributes to their comprehensive development and greater acceptance by peers (Kurth et al, 2002).

2.2 AI in Education

Modern technologies such as Big Data, Machine Learning and Artificial Intelligence (AI) are used in global education systems, enabling a more personalized and student-centric approach. Thanks to these innovations, the modern education system is better able to meet the individual needs of pupils, which is a significant improvement compared to the often criticized traditional approach (Bhutoria, 2022). Thanks to the ability to analyze data and detect patterns, AI systems can optimize learning paths, tailoring content and teaching strategies to pupils' specific skills and preferences, which contributes to a more effective education process (Zhang and Begum, 2021). The development of education using artificial intelligence opens up significant opportunities for personalized learning for future generations, and the emerging challenges can no longer be underestimated. Issues related to data privacy, availability of digital resources, and accessibility limitations constitute significant obstacles that require attention and solutions for the effective implementation of AI technologies in educational practice (Ivanova et al, 2024).

Personalization of education is consistent with the practical solutions approach to teaching, because it is based on collected data regarding individual skills and needs of pupils. By analyzing this information, the educational system can adapt content and learning methods to specific requirements and goals, which in turn promotes a better learning process. Therefore, it is a practical approach based on research and evidence of the effectiveness of personalization in education (Yonezawa et al, 2012). Personalization in education has a long history and is crucial to effective teaching. Adapting content, activities and interventions to the needs of specific students aims to better understand problems and tailor the teaching process to individual needs, which can lead to better educational outcomes and pupil development. A thorough analysis of pupils' situations and needs is therefore a fundamental part of a personalized approach in education (Hwang et al, 2020). Artificial intelligence is playing an increasingly important role in innovative education systems, enabling interactive learning tailored to the individual needs of pupils. The use of modern tools supported by AI, such as virtual reality or intelligent teachers, allows for personalization of the teaching process and ensuring more effective knowledge transfer (Kabudi et al, 2021). In this context, there is growing interest in integrating artificial intelligence into educational systems to increase their efficiency and quality. Previous literature highlights the lack of research on AI in the context of education as a significant limitation and suggests the need for further research and practical implementation of AI technology in the education sector (Bhutoria, 2022). The integration of artificial intelligence in teaching is currently a dynamically developing field that is attracting more and more interest and investment due to the rapid development of AI technology and advances in education. Bibliometric research on this topic is becoming increasingly important to understand and track this dynamic process and innovation in the field of AI-powered education (Nja et al, 2023; Sajja et al, 2023; Farrelly and Baker, 2023; Bran et al, 2019; Nguyen et al, 2023).

As the education system evolves, there is a need to continually evaluate research and trends in education to adapt teaching methods to meet the needs of pupils. The integration of artificial intelligence technologies may prove to be a key factor in increasing the efficiency of the learning process and ensuring a personalized approach to learning. It is important to track these changes and adapt teaching programs to the new challenges that arise in the digital era (Dogan et al, 2023).

3. Characteristics of People With Special Needs in Polish Regions

The analysis of dynamics was carried out on the basis of data published by the Statistics Poland (Education, 2012; Local Data Bank, 212). The time scope of the study covered the years from the 2012/2013 school year to 2022/2023. The subject of the study are children with special educational needs studying in primary school (age range is 7-14 years) and young people attending secondary schools: general education profile (age range is 15-19 years) and technical secondary school (age range is 15-20 years). The research process used dynamics measures [9] to determine the direction and intensity of changes among pupils with selected types of disabilities over a 10-year period, broken down by school type, compared to the level from the previous period or the level adopted as the baseline (2012/2013).

Characteristics of the data used in the study (legend for charts 1, 2, 3 and table 1):

- Types of disabilities:

A-deaf;
B-hard of hearing;
C-blind;
D-vision impaired;
E-with impaired motor skills including aphasia;
F-with intellectual slight disability;

G- with autism including Asperger syndrome;
H-with multiple disability;
I- socially maladjusted;
J- -threatened with social maladjustment.

- Types of schools:

Primary-pupils with special educational needs by type of disability in primary schools;
General-students with special educational needs by type of disability in general secondary schools;
Technical-students with special educational needs by type of disability in technical secondary schools.

- Voivodeships in Poland:

DŚ: Dolnośląskie Voivodship;
KP: Kujawsko-Pomorskie Voivodship;
LB: Lubelskie Voivodship;
LS: Lubuskie Voivodship;
ŁD: Łódzkie Voivodship;
MP: Małopolskie Voivodship;
MZ: Mazowieckie Voivodship;
OP: Opolskie Voivodship;
PK: Podkarpackie Voivodship;
PD: Podlaskie Voivodship;
PM: Pomorskie Voivodship;
ŚL: Śląskie Voivodship;
ŚK: Świętokrzyskie Voivodship;
WM: Warmińsko-Mazurskie Voivodship;
WP: Wielkopolskie Voivodship;
ZP: Zachodniopomorskie Voivodship.

3.1 Analysis of Dynamics According to the Division Into Types of Disabilities

Figure 1 shows the medium-term rate of change according to selected types of disabilities in Poland, broken down by type of school in the analyzed period.

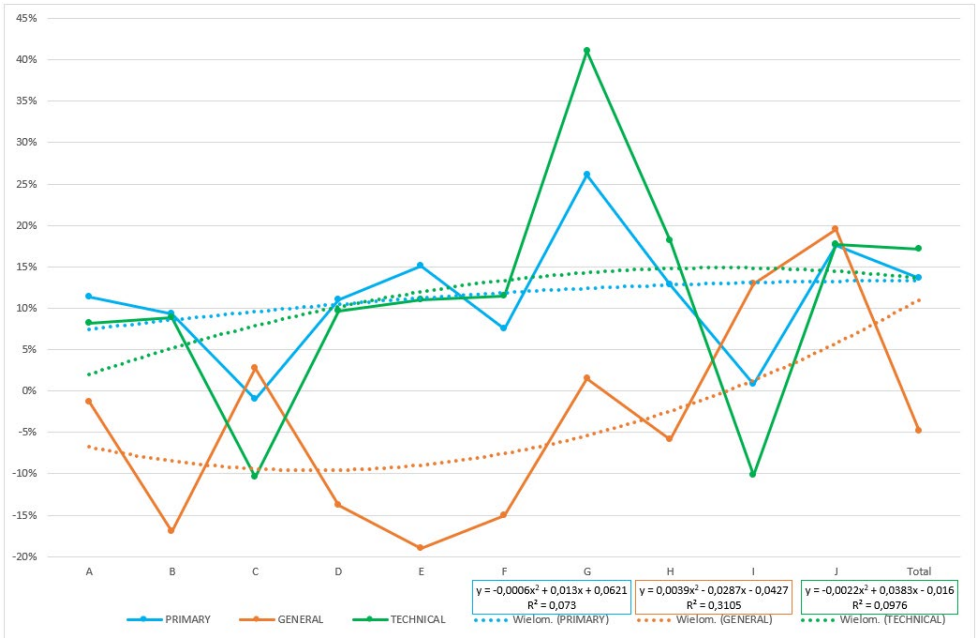


Figure 1: Dynamics of changes by types of disabilities and types of schools in 2012-2023

The dynamics analysis shows that the largest medium-term increases in the number of people diagnosed with autism spectrum disorders (including Asperger's syndrome) are in the group of school children and in the group of young people attending technical schools. The scale of changes in the case of this type of disability is analogously at the level of +912% and +4289% in the 2022-2023 school year compared to the base year (2012-

2013). In turn, the stable dynamics (increases and decreases at the level of the medium-term rate of change of 1%) covers blind people and people with a diagnosis of social maladjustment (for children aged 7-14) as well as deaf people (for young people aged 15-19). The size of these changes concerns a reduction by 18 in the number of blind people and by 168 in the number of people diagnosed with social maladjustment in primary schools (although in the case of social maladjustment, the medium-term rate of change was positive). In the technical secondary school, the decrease in the number of deaf people was 14.3%, which is 20 people (compared to the base year). In Fig. 1, a clear similarity can be seen in the nature of the dynamics of changes according to the types of disabilities for school children and youth in technical secondary schools. Here, the annual changes are in most cases positive. In turn, young people attending general schools show decreasing dynamics every year. One can also notice the relationship between the types of disabilities - those that record declines in the first group discussed show increases in the second group and vice versa. The basic indicator for examining the structure of people with specific types of disabilities is the same for the analyzed population of people aged 7-20 in the period after 2017. Since the 2017-2018 school year, the domination of autism judgments (including Asperger's syndrome) has been visible in all types of schools examined. In turn, in the five years preceding this period, motor disabilities (including aphasia) were most often diagnosed among young people (15-19 and -20), while among children attending primary school, mild intellectual disabilities were mostly diagnosed.

3.2 Analysis of the Dynamics of People With Disabilities - Administrative Division

Analysis of changes in the total number of people with disabilities in Poland, broken down by voivodeships and types of schools in 2012-2023, calculated using the medium-term rate of change (Figure 2).

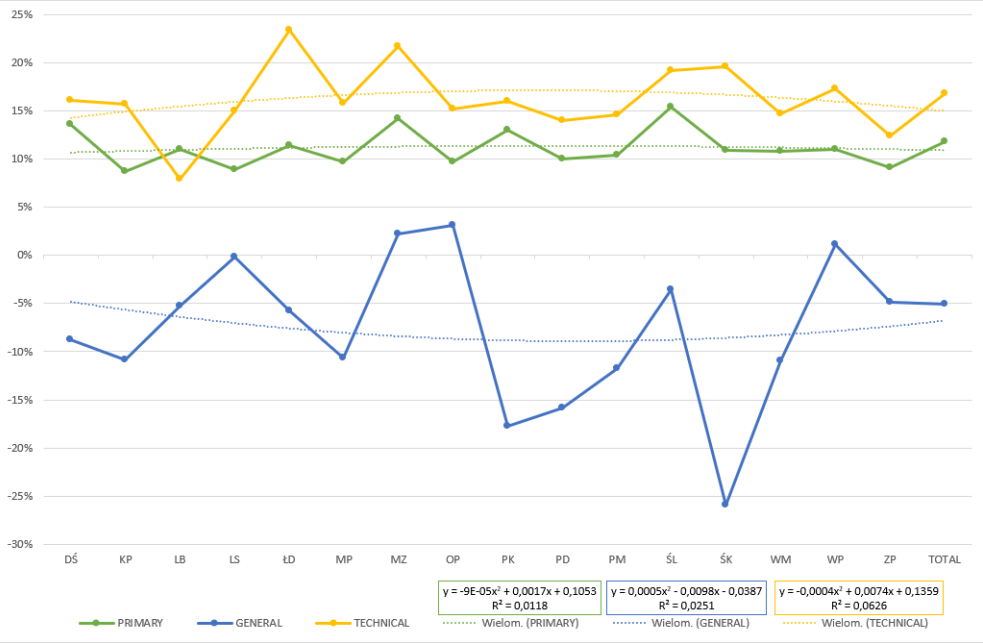


Figure 2: Dynamics of changes in people with disabilities by voivodeship in the analyzed period

The analysis of Polish regions in terms of the discussed types of disabilities allows us to notice similar relationships as in the case of study 3.1. The group of people aged 7-14 and 15-19 shows similar changes in dynamics (annual increases in the number of people with disabilities in individual voivodeships). In turn, the group of young people studying at technical secondary schools records a decline in dynamics and greater fluctuations for a given region in Poland. The highest positive dynamics of changes for primary schools and technical secondary schools occurs in the Mazowieckie and Śląskie Voivodeships (16,370 and 12,279 people with disabilities compared to the base year for primary schools and 1,323 and 1,291 for technical secondary schools, respectively). Youth aged 15-19 recorded the highest dynamics (compared to the base year) in the Pomorskie Voivodeship, and the highest average annual increases in the Mazoweckie Voivodeship (the number of people was -229 and +169, respectively). The analysis of the structure of the population of people requiring special educational needs showed that the largest share in Poland has the population of people learning in the Mazowieckie Voivodeship (on average 14%) and in the Śląskie Voivodeship (on average 12%).

3.3 Analysis of People With Disabilities Compared to Their Peers

The table below shows the percentage of the median of people with disabilities in the total number of people in the same age group in Poland, divided into voivodeships.

Table 1: Analysis of the median age structure

Polish region	Population in age group		
	aged 7-14	aged 15-19	aged 15-20
PL: Poland (total)	1,60%	0,18%	0,15%
DŚ	1,40%	0,20%	0,14%
KP	1,93%	0,19%	0,20%
LB	1,23%	0,14%	0,11%
LS	1,48%	0,17%	0,15%
ŁD	1,24%	0,17%	0,12%
MP	1,25%	0,12%	0,09%
MZ	1,78%	0,26%	0,16%
OP	1,67%	0,16%	0,18%
PK	1,51%	0,16%	0,17%
PD	1,56%	0,17%	0,20%
PM	1,86%	0,26%	0,15%
ŚL	2,05%	0,19%	0,22%
ŚK	1,44%	0,18%	0,17%
WM	1,97%	0,22%	0,21%
WP	1,31%	0,11%	0,11%
ZP	1,66%	0,19%	0,10%

The results of the share of people with disabilities in the total number of their peers indicate that in the Warmińsko-Mazurskie Voivodeship there are the most people in the age group of 7-20 years who require special educational needs, and the fewest in the Małopolskie Voivodeship. The analysis also shows the difference between children and adolescents. The median number of young people with disabilities is in the tens and hundreds, while children number in the thousands. For example, the lowest and highest numbers of people along with the corresponding voivodeship:

- children aged 7-14: min. 1187 (OP); max. 7911 (MZ);
- youth aged 15-19: min. 75 (OP); max. 685 (MZ);
- youth aged 15-20: min. 93 (LS); max. 539 (ŚL).

The analysis of the number of children in Poland in general shows that the highest median number of children is in the Mazowickie Voivodeship and the lowest in the Lubuskie Voivodeship, regardless of the division into children or youth.

4. Accessibility of Public Entities in Poland

Accessibility testing allows you to diagnose whether a facility/institution supports people with disabilities in their functioning in society. In Poland, the Accessibility Plus Program (APP, 2018-2025) has been implemented since July 2018, which is implemented in parallel with two acts: the Act of April 4, 2019 on the digital accessibility of websites and mobile applications of public entities (Journal of Laws “UDC”, 2019) and the Act of July 19, 2019 on ensuring accessibility for people with special needs (Journal of Laws “UzD”, 2019), obliges (mainly) public entities to conduct their activities in the digital sphere (including websites and mobile applications), architectural (including buildings free from barriers, horizontal and vertical communication spaces) and information and communication (including PJM translator, alternative access). The aim of such activities is to enable the use of the services of a given institution/entity, so that people with various types of disabilities (this also applies to people who are temporarily in a situation requiring support, such as pregnant women) can use them on their own.

The accessibility analysis was carried out on the basis of data published by the Ministry of Funds and Regional Policy in the "Report on the status of ensuring accessibility for people with special needs by public entities in Poland" (Report, 2021), presenting the status of accessibility of the surveyed entities as of January 1, 2021. The time range was as of January 1, 2021, but no later than March 31, 2021. The data was obtained using an electronic report form, which was made available on the reporting portal of the Statistics Poland. The acquired data were standardized to facilitate their comparison and interpretation, using the so-called accessibility index. This measure is expressed on a scale from 0 (no requirements met) to 1 (full fulfillment of requirements), and the percentage of elements that make up the whole (percentage of requirements met for the unit) expresses partial accessibility assurance or the percentage of units meeting the requirements for a given characteristic.

Characteristics of the data used in the study (legend for charts 3 and 4):

- Voivodeships in Poland (as specified in point 3 of the article).
- Types of accessibility indexes:

A-Accessibility;

A(Inf/Com)-Information and communication accessibility index;

A(Dig)-Digital accessibility index;

A(Arch)-Architectural accessibility index.

- Types of entities (schools):

A-Edu: Average accessibility index for Education;

Ns: Nursery schools;

Ps: Primary schools;

P-ps: Post-primary schools;

HEdu: Higher education.

4.1 Accessibility Index

Figure 3 presents the results of the analysis of the state of ensuring accessibility for people with special needs by public entities in Poland, broken down by region.

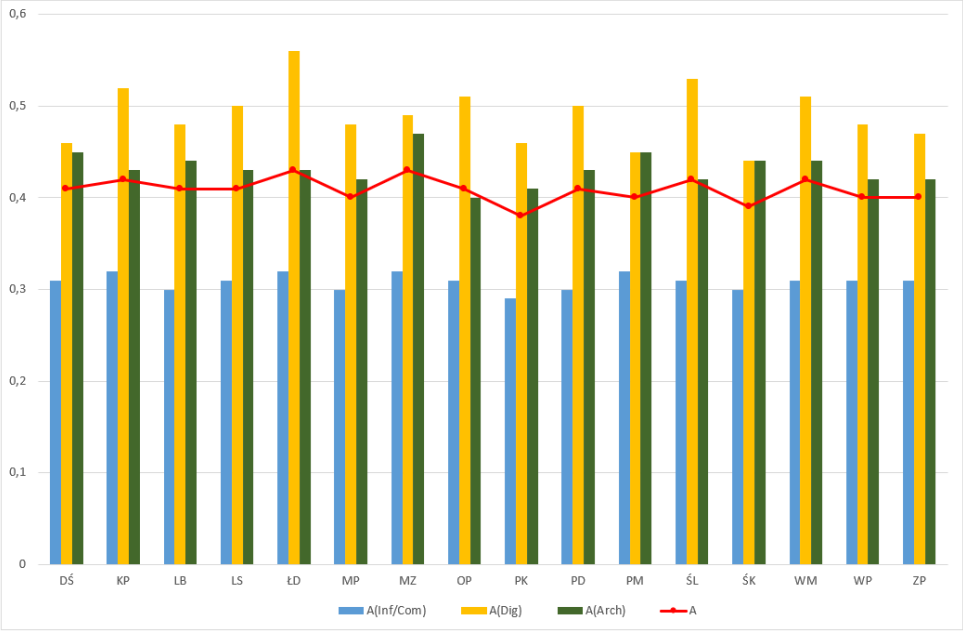


Figure 3: Level of accessibility of public entities located in Poland by voivodeship

The analysis of the accessibility index in public entities shows their small contribution to improving the everyday functioning of people with disabilities. Public institutions in Poland meet the minimum accessibility

requirements in accordance with the Act on ensuring accessibility for persons with special needs (UzD) at an average level of 40%. The requirements belonging to the information and communication group are the lowest met, at the level of 30%, and the highest (less than half on average) are the digital requirements. The Łódź and Mazowieckie Voivodeships are the leaders in the ranking of the overall accessibility index, while the Podkarpackie Voivodeship is at the bottom of the ranking. The Łódź Voivodeship also has the highest index in terms of digital accessibility and communication support. Architectural requirements are at the level of the average national indicator in general, and entities in the Mazowieckie Voivodeship are best adapted.

4.2 Digital and Information and Communication Accessibility Index in Education

The analysis of accessibility in the educational system in Poland, divided into types of schools, is presented in the chart below (Figure 4).

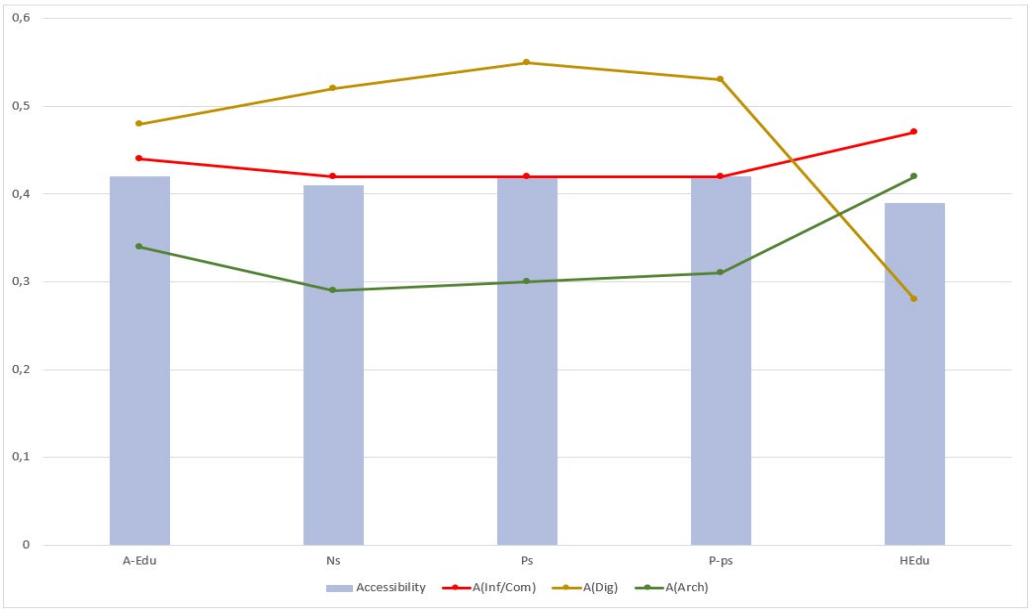


Figure 4: Level of accessibility in educational system institutions in Poland

The analyzed public entities directly related to education show an accessibility index of 0.4 on average, which is close to the national level. The highest ranking index is related to the website and mobile applications, which are compliant with the accessibility requirements specified in the UDC for kindergartens and schools. Public higher education units, unlike pre-school and school education, have a low digital accessibility rate. However, they show a proportionally higher indicator of architectural and information and communication accessibility.

4.3 Optimizing Education

Education to bring results to young people in the form of knowledge and skills is a challenge for both teachers and pupils themselves. Educating pupils with special educational needs is an even more difficult task for both parties, because very often the types of disabilities require dedicated tools and skills to educate them appropriately. However, thanks to technological progress that has led to the development of artificial intelligence, the possibilities of support for such students are increasing. This technology is already present in many aspects of our lives, and using it to assist in special education is an opportunity to optimize access to education. The use of advanced algorithms allows you to adapt the methods and pace of work to the pupil's needs, which creates the opportunity to take care of the child individually, without fear of exceeding his or her physical or intellectual abilities. The Government Education and Science Portal in Poland (ESP, 2023) on its website describes ChatGPT as one of the tools based on artificial intelligence that can support people:

- with visual impairments - no need to browse the websites, which often do not meet accessibility standards;
- with disabilities of the upper limbs - giving up the use of special keyboards, extending the time of searching for often scattered data;
- deaf people - shortening long texts that are difficult to translate into sign language
- with dyslexia - appropriate text reformatting;

- with intellectual disabilities - learning artificial intelligence to present data in the form of ETR (easy to read),
- sensitive to stimuli - removing barriers in browsing websites, such as distracting banners, widgets, or the so-called pop-ups) – all this effectively makes it difficult for people who are sensitive to stimuli to browse the website.

Artificial intelligence can also be helpful in a teacher's work (Czechowska, 2024):

- adapting teaching programs to individual difficulties through non-standard ideas for personalized tasks and materials, e.g. Khan Academy, Bing Chat, ScribeSense, Socratic by Google;
- supporting communication by using appropriate systems or applications, e.g. Replika, Cleverbot, Wordwall, Otter.ai, Braina;
- earlier detection of learning difficulties thanks to the analysis of test results or pupils' work, e.g. IBM Watson Education, immersive reader, DreamBox, One Note;
- support for remote learning by providing materials for homework, e.g. Chrome extensions, Quizizz, easy-to-read and understand texts ZPE or PSONI, Miro, Canva.

Professor Fazlagić (2022), in his publication describing the use of artificial intelligence in the education sector, reviews it according to subcategories:

- supporting the learning process;
- teacher support in administrative processes;
- management of the education system.

The teaching process can support the teacher by using artificial intelligence as a tutor in basic education, providing feedback on learning progress and knowledge/skill deficits, and replace it in consolidating the explained material, e.g. by departing from the standards in situations where the selected area requires improvement by, for example, increasing the intensity of testing tasks in the areas. This solution also allows for the elimination of social or emotional barriers, which are reflected, for example, in stress related to public ridicule resulting from a knowledge deficit. Artificial intelligence can support teachers in their administrative duties by performing automated (in whole or in part) assessment of learning outcomes or attendance. It may also, to some extent, act as a methodological advisor or provide feedback about the pupil to his or her parents/guardians. The administrative dimension itself can also be considered from the perspective of education management, where artificial intelligence verifies the criteria for professional advancement achieved by a teacher, or analyzes data sets affecting the quality of teaching or the education system itself.

5. Conclusions

The conducted research allows for a preliminary diagnosis of the situation of people with a judgment on the need for special education in Poland. Over the last 10 years, a relationship (similar dynamics of change reflected in the quantitative dimension of the study) can be observed between primary and general education, comparing them to the results of technical schools. In this context, there is a noticeable relationship with regard to the highest percentage of annual increases in disability resulting from diagnosed autism, including Asperger's syndrome, and the highest changes in dynamics observed in the region of the Mazowieckie and Śląskie Voivodeships. In turn, for pupils attending technical secondary schools, the highest average annual changes concerned the diagnosed risk of social maladjustment and the highest changes in the Mazowieckie and Pomorskie Voivodeships.

The analysis of time series in terms of their share in the structure of the studied population showed that the largest number of people diagnosed with the need for special education are in the Mazowieckie and Śląskie Voivodeships. However, the division by type of disability highlighted a breakthrough in 2017, after which all surveyed groups showed the highest share of people diagnosed with autism (including Asperger's syndrome). Before 2017, the disability of young people aged 15-19 and 15-20 resulted from the jurisprudence of motor disability (including Aphasia) and for pupils aged 7-14 from the jurisprudence of mild intellectual disability. Compared to peers in the context of the age group, the highest percentage of people with disabilities is among school children, and in the administrative context of the country in the Mazowieckie and Śląskie voivodeships.

Comparing the above research results with the analysis of accessibility, i.e. adapting the architectural, communication, digital and information infrastructure to the needs of people with disabilities, it can be noted that a small share of the accessibility index in Poland at the level of 40% (the highest is in the Łódź and

Mazowieckie Voivodeships) should meet the needs of a seemingly small percentage of people with a certificate, approximately 3% of the surveyed population. In the context of educational institutions, this indicator compares best with digital, which, in the perspective of the use of artificial intelligence in education (including special education), creates the possibility of equal access to education for all. Assuming that the development of education using the possibilities offered by artificial intelligence (both for healthy people and people with disabilities) will take place only among people aged 7-20, it can be estimated that this will allow for the elimination of barriers and equalization of opportunities in access to forms of education tailored to needs.

When building a long-term education strategy, the general situation of the country should also be taken into account, i.e. in the case of Poland, it is an aging society. Related activities aimed at activating seniors, or even the concept of lifelong learning, constitute a direction for further research on whether the accessibility requirements met at the current level will meet the needs of an ever-growing social group.

References

APP (2018-2025) "Accessibility Plus Program", [online] https://www.funduszeeuropejskie.gov.pl/dostepnoscplus?utm_source=SEARCH&utm_medium=CPC&utm_campaign=OTWORZSIE&gad_source=1&gclid=Cj0KCQjwudexBhDKARIsAI-GWYUoIUYHP65d5KoZCAme12h2UIKmyZMzf2UM-z3NX4lVtJN_b_MOGCIaAmJSEALw_wcB (04-05-2024).

Bhutoria, A. (2022) "Personalized education and Artificial Intelligence in the United States, China, and India: A systematic review using a Human-In-The-Loop model", *Comput. Educ. Artif. Intell.,* Vol. 3, 100068.

Bran, R.A., Grosseck, G. and Tiru, L.G. (2019) "Education for Sustainable Development: Evolution and Perspectives: A Bibliometric Review of Research, 1992 – 2018", *Sustainability*, Vol. 11, 6136.

Constitution of the Republic of Poland (1997) "Rozdział II. Wolności, Prawa i Obowiązki Człowieka i Obywatela", art. 70, [online] https://www.sejm.gov.pl/prawo/konst/ polski/kon1.htm (30-03-2024).

Czechowska, Z (2024), Sztuczna Inteligencja- jak wykorzystać w edukacji, w tym w pracy z uczniami ze SPE?, [online] https://nodnzytaczechowska.pl/sztuczna-inteligencja-jak-wykorzystac-w-edukacji-w-tym-w-pracy-z-uczniami-ze-spe/ (30.04.2024).

De Boer, A., Pijl, S.J. and Minnaert, A. (2011) "Regular primary schoolteachers' attitudes towards inclusive education: A review of the literature", *Int. J. Incl. Educ.,* Vol. 15, pp 331–353.

Diaz-Sarachaga, J.M., Jato-Espino, D. and Castro-Fresno, D. (2018) "Is the Sustainable Development Goals (SDG) index an adequate framework to measure the progress of the 2030 Agenda?", *Sustain. Dev.,* Vol. 26, pp. 663–671.

Dimov, B.C., Iliev, D. and Atanasoska, T. (2014) "Inclusive Education: Continuity of the Macedonian Reflective Teacher", *Procedia - Soc. Behav. Sci.,* Vol. 116, pp 3927–3929.

Dogan, M.E., Goru Dogan, T. and Bozkurt, A. (2023) "The Use of Artificial Intelligence (AI) in Online Learning and Distance Education Processes: A Systematic Review of Empirical Studies", *Appl. Sci.,* Vol. 13, 3056.

Education Law (2023) „Ustawa z dnia 14 grudnia 2016 r. Prawo oświatowe", Dz. U. z 2023 r. poz. 900, 1672, 1718 i 2005, [online] https://www.prawo.vulcan.edu.pl/przegdok.asp?qdatprz=akt&qplikid=4186 (30-03-2024).

ESP (2023), Portal Edukacji i Nauki, „SI jako wsparcie osób ze specjalnymi potrzebami" [online] https://edukacja.gov.pl/web/gov/si-jako-wsparcie-osob-ze-specjalnymi-potrzebami (30-03-2024).

Farrelly, T. and Baker, N. (2023) "Generative Artificial Intelligence: Implications and Considerations for Higher Education Practice", *Educ. Sci.,* Vol. 13, 1109.

Fazlagić, J. (2022) *Rozwój sztucznej inteligencji jako wyzwanie dla systemu edukacji*, pp.25-37, „Sztuczna inteligencja (AI) jako megatrend kształtujący edukację. Jak przygotowywać się na szanse i wyzwania społeczno-gospodarcze związane ze sztuczną inteligencją?", Warszawa: Instytut Badań Edukacyjnych, [online] https://kwalifikacje.edu.pl/wp-content/uploads/Sztuczna-inteligencja-jako-megatrend-7.06.pdf(30-03-2024).

Florian, L. (2014) "What Counts as Evidence of Inclusive Education?" *European Journal of Special Needs Education*, Vol. 29, No.3, pp 286–94.

Hwang, G.J., Sung, H.Y., Chang, S.C. and Huang, X.C. (2020) "A fuzzy expert system-based adaptive learning approach to improving students' learning performances by considering affective and cognitive factors", *Comput. Educ. Artif. Intell.,* Vol. 1, 100003.

Ivanova, M., Grosseck, G. and Holotescu, C. (2024) "Unveiling Insights: A Bibliometric Analysis of Artificial Intelligence in Teaching", *Informatics*, Vol. 11, No.1, 10.

Journal of Laws 'UDC' (2019) „Ustawa z dnia 4 kwietnia 2019r. o dostępności cyfrowej stron internetowych i aplikacji mobilnych podmiotów publicznych", Dz. U. 2019 poz. 848, [online] https://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU20190000848/T/D20190848L.pdf (04-05-2024).

Journal of Laws 'UzD' (2019) „Ustawa z dnia 19 lipca 2019 r. o zapewnianiu dostępności osobom ze szczególnymi potrzebami", Dz. U. 2019 poz. 1696, [online] https://isap.sejm.gov.pl/isap.Nsf/download.xsp/WDU20190001696/T/D20191696L.pdf (04-05-2024).

Kabudi, T., Pappas, I. and Olsen, D.H. (2021) "AI-enabled adaptive learning systems: A systematic mapping of the literature", *Comput. Educ. Artif. Intell*., Vol. 2, 100017.

Kurth, J.A., Morningstar, M.E. and Kozleski, E.B. (2002) “The Persistence of Highly Restrictive Special Education Placements for Students With Low-Incidence Disabilities”, *Res. Pract. Pers. with Sev. Disabil.,* Vol. 39, pp 227–239.

Marimuthu, S. and Cheong, L.S. (2015) “Inclusive Education for Social Transformation”, *Procedia - Soc. Behav. Sci.*, Vol. 172, pp 317–322.

McCoy, S. and Banks, J. (2012) “Simply academic? Why children with special educational needs don’t like school”, *Eur. J. Spec. Needs Educ.,* Vol. 27, pp 81–97.

Moosa, V., Shareefa, M., Adams, D. and Mohamed, A. (2022) “Assessing Teacher Readiness for Inclusive Education in Maldives: Instrument Modification and Validation”, *Int. J. Disabil. Dev. Educ.,* Vol. 69, pp 1888–1904.

Nguyen, T.T.K., Nguyen, M.T. and Tran, H.T. (2023) “Artificial intelligent based teaching and learning approaches: A comprehensive review”, *Int. J. Eval. Res. Educ*., Vol. 12, pp 2387–2400.

Nja, C.O., Idiege, K.J., Edet Uwe, U., Ndidi Meremikwu, A., Etop Ekon, E., Manyo Erim, C., Ukah Ukah, J., Okon Eyo, E., Ideba Anari, M. and Cornelius-Ukpepi, U.B. (2023) “Adoption of artificial intelligence in science teaching: From the vantage point of the African science teachers”, *Smart Learn. Environ*., Vol. 10, pp 1–19.

Public Law 94-142 (1975) “Education for All Handicapped Children”, Act of 1975, 20 USC 1401, Senate and House of Representatives of the United States of America, [online] https://www.govinfo.gov/content/pkg/STATUTE-89/pdf/STATUTE-89-Pg773.pdf (30-03-2024).

Regulation of the Minister of National Education (2017), „Rozporządzenie Ministra Edukacji Narodowej z dnia 9 sierpnia 2017r. w sprawie zasad organizacji i udzielania pomocy psychologiczno-pedagogicznej w publicznych przedszkolach, szkołach i placówkach”, Dz. U. z 2023 r. poz. 1798, [online] https://prawo.vulcan.edu.pl/przegdok.asp?qdatprz=akt&qplikid=4384 (30-03-2024).

Report (2021) "Report on the status of ensuring accessibility for people with special needs by public entities in Poland", [online] https://www.funduszeeuropejskie.gov.pl/strony/o-funduszach/fundusze-europejskie-bez-barier/dostepnosc-plus/koordynatorzy-dostepnosci/raport-o-zapewnieniu-dostepnosci/ (30-04-2024).

Sajja, R., Sermet, Y., Cwiertny, D. and Demir, I. (2023) “Platform - independent and curriculum - oriented intelligent assistant for higher education”, *Int. J. Educ. Technol. High. Educ.,* Vol. 20, pp 1–24.

Sharma, A.K., Bhandari, R., Pinca-Bretotean, C., Sharma, C., Dhakad, S.K. and Mathur, A. (2021) “A Study of Trends and Industrial Prospects of Industry 4.0”, *Materials Today: Proceedings,* Vol. 47, Part 10, pp 2364-2369.

Soeharto, S., Subasi Singh, S. and Afriyanti, F. (2024) “Associations between attitudes toward inclusive education and teaching for creativity for Indonesian pre-service teachers”, *Think. Ski. Creat.,* Vol. 51, 101469.

Statistics Poland. Education (2012), “Education in the school year 2011/2012 - Education in the 2022/2023 school year”, [online] https://stat.gov.pl/en/topics/education/education/education-in-the-20222023-school-year,1,19.html (30-03-2024).

Statistics Poland. Local Date Bank (2012), “Population in 2012-2023”, [online] https://bdl.stat.gov.pl/bdl/start (30-04-2024).

UNESCO and Ministerio de Educación y Ciencia (1994) “The Salamanca Statement and Framework for Action on Special Needs Education, [online] https://unesdoc.unesco.org/ark:/48223/pf0000098427 (12-04-2014).

Unianu, M.E. (2013) “Teachers’ Perception, Knowledge and Behaviour in Inclusive Education”, *Procedia - Soc. Behav. Sci.,* Vol. 84, pp 1237–1241.

Yonezawa, S., McClure, L. and Jones, M. (2012) *Personalization in schools* [online] https://www.researchgate.net/profile/Makeba-Jones/publication/265060024_Personalization_in_schools/links/564df6c108aefe619b0f2ce6/Personalization-in-schools.pdf (12-04-2024).

Zhang, K. and Begum, A. (2021) “AI technologies for education: Recent research & future directions”, *Comput. Educ. Artif. Intell*., Vol. 2, 100025.

A Cross-Disciplinary Knowledge Management Framework for Generative Artificial Intelligence in Product Management: A Case Study From the Manufacturing Sector

Aron Witkowski and Andrzej Wodecki
Warsaw University of Technology, Warsaw, Poland

aron.witkowski.dokt@pw.edu.pl
andrzej.wodecki@pw.edu.pl

Abstract: This paper presents a cross-disciplinary knowledge management framework designed to enhance the integration of Generative Artificial Intelligence (GenAI) in product management within the manufacturing sector. The framework focuses on designing, monitoring, and optimizing the business value of GenAI solutions by leveraging best practices from both knowledge management and artificial intelligence engineering disciplines. The study highlights the use of LLMOps methodology for continuous monitoring and multi-agent approach for continuous improvement. The research employs a qualitative case study methodology, focusing on a leading large international manufacturing firm that has implemented GenAI solutions in its product management. The study involves interviews with stakeholders and document collection and analysis. This case study contributes to the literature by providing a structured approach to incorporating GenAI into product management in the manufacturing sector, facilitating cross-disciplinary knowledge sharing. The study advances the understanding of using cross-disciplinary knowledge management framework for advanced AI applications in business projects and encourages further research. The framework serves also as a guide for manufacturing firms aiming to implement advanced AI providing actionable insights for designing, monitoring, and optimizing the business value of GenAI solutions. It underscores the potential of academic researchers as catalysts in such projects and proposes a method for continuous knowledge transfer and improvement through a knowledge flywheel.

Keywords: Knowledge Management, Generative Artificial Intelligence, New Product Development, Cross-Disciplinary Collaboration, Product management, Manufacturing

1. Introduction

Generative Artificial Intelligence (GenAI) plays a noticeable role in different industries, as evidenced by its potential in automating tasks, delivering novel goods, services or business models and generating valuable new content (Daugherty et al., 2023; Kanbach et al., 2024; Przegalinska and Jemielniak, 2023; Reznikov, 2024) The integration of GenAI in product management can potentially enhance innovation and streamline processes. Generative AI, particularly through large language models (LLMs) like the generative pretrained transformer (GPT), augments product processes including ideation, digital design and prototyping or product marketing (Bouschery et al., 2023; Bulut and Mahmoud, 2023; Choi et al., 2023).

The manufacturing sector, facing intense competition and the need for differentiation, can benefit from the integration of GenAI solutions in the product management process. Not only processes but also products undergo changes - one of the critical issues though in the manufacturing industry is the increasing difficulty in achieving hardware-based innovations (Smith, 2013). As a result, companies are shifting their focus towards additional services and connected products to maintain a competitive edge (Parida et al., 2014; Porter and Heppelmann, 2015). GenAI models can also be helpful here, but they come with their own challenges - hallucinations, data drift, ethical issues, and others, making it difficult to determine the business value of a GenAI (Bandi et al., 2023; Kalam et al., 2024; Samuelson, 2023).

This shift necessitates the development of new competencies among different stakeholders involved in product management to design and monitor the real business value generated by GenAI-driven solutions. Product managers must acquire certain new skills to effectively oversee the implementation, optimization and business evaluation of advanced AI-driven solutions. Data scientists, aiming to maintain the quality of GenAI models, must keep track of the latest solutions. However, the heavy workload and project overload often faced by product managers, IT engineers or data scientists pose challenges to acquiring these new competencies.

Therefore, the successful implementation of GenAI solutions requires a robust framework that supports the design, monitoring, and optimization of these technologies' business value. This framework can leverage best practices from knowledge management to ensure that the integration of GenAI not only enhances product management but also contributes to continuous learning and improvement within organizations. In the upcoming sections, we will explore a variety of insights and observations, primarily based on a case study of a leading manufacturing company, highlighting different facets of the relationship between knowledge

management, generative AI and product management. These insights will shed light on the challenges and opportunities encountered when integrating advanced AI solutions into product management processes and the importance of multidisciplinary teams in overcoming these challenges. We will examine the importance of communication and collaboration among various stakeholders, the necessity of aligning business goals with technology objectives, and the influence of emerging technologies on the development of new products. Finally, we will emphasize the lessons learned from these observations and their implications for both practitioners and researchers in the realms of knowledge management, generative AI and product management.

2. Business Value From Generative Artificial Intelligence for Product Management

In this section we focus on the Generative Artificial Intelligence (GenAI) solutions impact on the product success. There are numerous activities in which GenAI can support the product management process. Sentiment analysis and opinion mining are useful for generating new product ideas and designing products. GenAI solutions such as BERT, GPT, LSTM, and N-gram language models often form parts of larger sentiment analysis solutions (Li et al., 2023). These are used, for example, to identify important elements in user-generated content (Wang and Liu, 2023), improve opinion mining through text and emoji fusion (Sai et al., 2023), or detect fake news about products (Peng and Xintong, 2022). Tools like ChatGPT can also generate product ideas and often do so more effectively than humans (Bouschery et al., 2023). GenAI can also be applied to text summarization in various contexts, enhancing recommendation systems by integrating summaries from online reviews (Benham et al., 2022). In product design and development across different industries, GenAI solutions facilitate tasks such as fashion design (Choi et al., 2023), cosmetic color scheme development (Zhang et al., 2023) and bionic-inspired biomedical engineering (Deng et al., 2023). They also aid in IT system design (Van Bossuyt et al., 2023), user interface design (Gupta et al., 2024), and game development (Colado et al., 2023). GenAI also supports product quality control and defect detection, generating new artificial data and reducing testing time, cost and TTM (Time-To-Market) (Morizet et al., 2023). Generative AI solutions are also effective in product marketing and the optimization of products processes. In marketing, GenAI is used for creating targeted advertisements and generating keywords (Bulut and Mahmoud, 2023), as well as in the automatic generation of promotional videos, which significantly streamline the creation of marketing content (Ooi et al., 2023). Additionally, they support customer service by providing potential recommendations for products and services (Sun et al., 2023). GenAI solutions are also effective at the intersection of product management and knowledge management, enhancing the functionality of product databases (Abadi et al., 2023; Niemir and Mrugalska, 2023). These benefits of GenAI integration can only be fully realized if the implementation of GenAI is managed effectively, using appropriate methodologies and evaluation methods.

2.1 Product Success Evaluation Methods

When evaluating product success, two key aspects need consideration: the factors contributing to success and the measurement of success. General product success factors identified in the literature include innovative value, strategic approach, high-quality product development processes, market research, customer focus, and maintaining skilled employees with the necessary resources and infrastructure (Soltani-Fesaghandis and Pooya, 2018). McKinsey (2021) identified several categories that distinguish high-performing AI organizations from others, including clear AI solution management models, team skill development programs, and practical training for non-technical staff. Additionally, factors such as design thinking in developing AI solutions, harmonized data processes, and regular updates and understanding of AI models play a distinct role in the successful implementation of AI in product management.

When it comes to the measurement of success, evaluating the business value of GenAI solutions is crucial for understanding their impact on product success. Three primary evaluation methods can be used: statistical methods, business methods, and experimental methods. Each of these methods has its impact in assessing GenAI models:

Statistical Methods: Common evaluation metrics for generative models include Fréchet Inception Distance (FID) and Inception Score (IS), although these can be prone to biases and may not always provide accurate comparisons between different models (Bandi et al., 2023; Chong and Forsyth, 2020).

Business Methods: These methods focus on the actual impact of GenAI solutions on business processes and product success. Metrics include Key Performance Indicators (KPIs) such as product revenue, process efficiency or product quality, which are more aligned with business objectives.

Experimental Methods: Used to assess the real business value post-deployment through A/B testing or surveys/qualitative interviews and other experimental designs that compare the performance of GenAI-driven solutions with existing methods.

Overemphasis on one area can lead to an unbalanced focus, causing some issues. A predominance of statistical methods may result in evaluations that do not align with business needs or are not easily understood by business stakeholders. A predominance of business method may lead to an overload of business metrics, complicating GenAI model training, evaluation, validation, and experimentation. A predominance of experimental approaches can create challenges in formulating business cases based on historical data and in the training process.

2.2 Lack of Appropriate Methodology

As commercial GenAI solutions are still in their relatively early stages, there is no comprehensive set of guidelines for managing GenAI-based products tailored to specific products or sectors. Bosch, Olsson, and Crnkovic (2018) highlight that AI development is still in its infancy in many of the organizations they have studied, and they foresee a considerable amount of work needed to define systematic and repeatable methods for creating, developing, and maintaining systems using AI solutions. This implies that when introducing GenAI into the process, the organization should have a clear understanding of its goals, which may require a discussion about the organization's maturity in that area.

To address these challenges, continuous monitoring and adaptation of GenAI models are necessary. One potential solution is the implementation and maintenance of the models based on a feedback loop strategy, which helps product managers create less prescriptive product roadmaps and make more data-driven and AI-based decisions (Gurkan and de Véricourt, 2022). Techniques such as LLMOps (Large Language Models Operations) for continuous monitoring and multi-agent approach for ongoing improvement can be helpful in that area.

LLMOps involve the methodologies, strategies, and tools employed for the effective management and maintenance of large language models in production settings. LLMOps is essential for managing the complex lifecycle of LLM development, which includes data ingestion, prompt engineering, model fine-tuning, deployment, and monitoring. It ensures collaboration across teams and maintains operational rigor. LLMOps differ from traditional Machine Learning Operations (MLOps) by addressing the unique needs of managing LLMs. Key considerations include the substantial computational resources required for training and fine-tuning LLMs, often necessitating specialized hardware like GPUs. LLMs typically use transfer learning from foundation models, and human feedback, including reinforcement learning, is crucial for their performance. The development of LLM applications also frequently emphasizes constructing pipelines, created using tools like LangChain or LlamaIndex that integrate multiple calls with external systems, instead of developing new LLMs from scratch (Kulkarni et al., 2023; Shi et al., 2024).

An AI multi-agent system is a decentralized network consisting of multiple intelligent agents capable of sensing, learning, and acting independently to accomplish objectives. Agents utilize their interactions with nearby agents or their environment to learn new contexts and actions. They then apply this acquired knowledge to make decisions and take actions within the environment to accomplish their assigned tasks. Driven by artificial intelligence, these systems exhibit essential features such as flexibility that enables it to effectively address problems across different industries (Dorri et al., 2018; Shamshirband et al., 2013).

3. Knowledge Management Framework for Designing, Monitoring and Optimizing the Business Value of Generative Artificial Intelligence Solutions in Product Management

This chapter builds upon established principles of knowledge management and product management, integrating insights from previous research and best practices to create a comprehensive framework tailored for GenAI in product management.

3.1 Competency Framework

A successful implementation of GenAI solutions in product management necessitates a multidisciplinary team with a diverse set of competencies. Drawing from the competency profiles discussed in (Wodecki, 2023), the framework identifies four key competency groups: business (senior management and/or product managers in that case), data science, experiment design, and information technology. Each role within the project - ranging

from business representatives to data scientists and IT engineers - requires a unique blend of these competencies:

T-shaped Competencies: Business representatives should have deep business knowledge complemented by skills in data science and IT, allowing them to effectively plan business cases, monitor project execution, and manage business value comprehensively.

Pi-shaped Competencies: Data scientists need in-depth skills in data science and a robust understanding of business and software engineering. Experiment design skills are also crucial, forming a second vertical bar in their competency profile.

M-shaped Competencies: Either product or project managers must possess a wide array of horizontal competencies, including product management, project management, change management, and business acumen, along with vertical competencies in data science, IT, and experiment design.

Individuals involved in the project, including business owners, data scientists, IT engineers, and product/project managers, should possess a balanced mix of T-shaped, Pi-shaped, or M-shaped competencies. The success of the project depends on the effective flow of knowledge from these areas, both within the current project scope and by utilizing experiences from similar past endeavors. Imbalances in these skill sets can lead to errors in evaluating the business value of GenAI solution. Our observations reveal that while data science and IT competencies are gradually becoming widespread in mature organizations, expertise in experimental design and implementation remains a challenge for many. Therefore, as part of the knowledge management framework, it is beneficial to consider including external individuals in the team, such as representatives from academia. These individuals can introduce new ideas, methods, and techniques, and provide fresh perspectives on the problem, ultimately enhancing the quality of the solution. Moreover, mature experimental design and implementation methods from the scientific community can help address competency gaps in this area.

3.2 Knowledge Management Processes

The integration of Generative Artificial Intelligence (GenAI) solutions into product management projects involves different aspects of knowledge management, from knowledge creation to sharing and application. GenAI integration projects have distinct characteristics and potential as rich sources of knowledge. Methods for capturing, organizing, storing, and sharing knowledge are explored to provide insights into effective strategies for managing knowledge in this context. The integration of GenAI solutions in product management projects generates valuable knowledge due to their unique nature, addressing diverse business challenges with varied methods and technologies. Knowledge is created throughout the project, often during meetings, milestone summaries, documentation, and experimental results interpretation. Different methods such as automatic tagging, topic modeling or semantic embeddings are employed for knowledge organization. For storing knowledge, advanced methods like prompt retrieval, document embeddings, or pretrained generative model weights are suggested. Efficient knowledge sharing and application depend on accessible interfaces, and the use of conversational interfaces based on generative technologies can address the issue of scattered documents across various locations.

All the aforementioned processes can be evaluated in terms of their maturity, i.e., higher maturity of these processes can facilitate easier integration of GenAI solutions in product management. Different frameworks can be used to assess an organization's maturity in this area. For example, the CLIMB framework (Rossi and Terzi, 2017) is used to evaluate best practices in product management. The model was designed using a combination of theory-driven and practitioner-based approaches. The CLIMB model comprises five maturity levels (Chaos, Low, Intermediate, Mature, Best Practice), selected for their similarity to existing maturity models and assessment tools. The framework categorises 107 product management best practices, across eight areas: activities and flow, decision making, training, roles and collaboration, knowledge management processes, knowledge management techniques, methods, computerisation and software, respectively grouped into four categories: process, people, knowledge management and tools. A questionnaire with a five-point Likert scale can be used to evaluate each of the practices.

3.3 Knowledge Flywheel Framework for GenAI in Product Management

Considering previous discussions on the processes and maturity of knowledge management within organizations, different types of competencies, the involvement of academic representatives in projects requiring experimental design skills, the lack of appropriate methodology, and the use of loop strategies, and

drawing upon (Wodecki, 2023), we propose a knowledge management flywheel framework for GenAI solutions integration in product management utilizing the Business-Engineer-Academy triangle. A strategic flywheel effect is achieved through continuous iterations of knowledge flow among business representatives, engineers, and academic researchers. This iterative process enhances understanding and improves efficiency and maturity of the processes resulting in greater product success.

To determine the accuracy of this framework, it was assessed using semi-structured interviews and open-ended discussions with a mixed group of 12 practitioners. This validation step is based on the evaluation phase of Design Science Research (Peffers et al., 2006) and is a crucial step in the development of many models in the literature. The panel included a balanced mix of individual contributors and those with managerial responsibilities, all of whom had experience working in an AI team (as either product manager or an engineer) within the organization. Their insights on the usefulness, reliability, and effectiveness of the framework were gathered, as they are considered the primary users of this framework.

The triangle works as follows: the business owners identify key performance indicators (KPIs) expected to improve with the implementation of a GenAI solution, the engineering team (comprising data science and IT professionals) executes the technical implementation and the scientists propose and perform experiments, analyze results, validate hypotheses, and present key findings to business stakeholders. With the new insights, the business suggests further experiment iterations and refines success metrics.

A well-structured Knowledge Management (KM) flywheel ensures continuous enhancement of managing the value of GenAI solutions integration in product management, moving beyond just model monitoring and diagnostics. This is achieved through systematic processes for generating, capturing, organizing, storing, and sharing knowledge throughout the project lifecycle (improving knowledge management maturity) and the application of methods such as multi-agent approach to optimize business experiments.

Thus, an exemplary KM flywheel (shown in Figure 1) might operate as follows:

1. New experiments lead to new insights…
2. …facilitating a better understanding of the business and thus…
3. …enhancing:
    a. business efficiency,
    b. internal KM processes and its maturity,
    c. product management process resulting in higher product value and…
4. …motivating the organization to undertake further experiments.

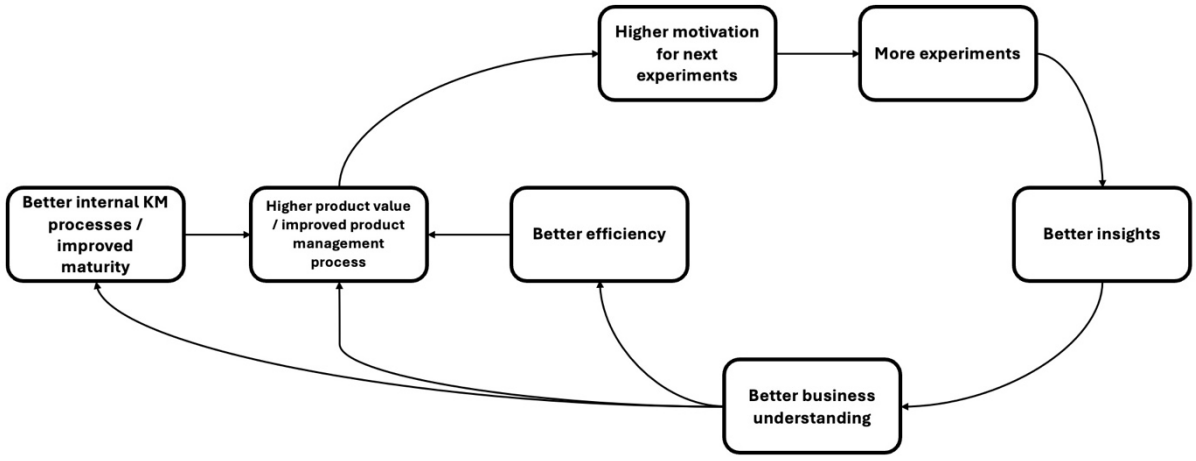


Figure 1: An exemplary Knowledge Management strategic flywheel for GenAI integration in product management process. Source: own elaboration.

4. Case Study

This case study examines the implementation of the proposed knowledge management framework for Generative Artificial Intelligence (GenAI) in product management at XYZ, a leading company in the manufacturing sector, present in all global markets, with locations in more than 30 countries. The study explores

the processes and strategies employed by XYZ to integrate GenAI solutions into their product management practices, highlighting the challenges faced and the adopted path.

XYZ is a globally recognized leader in the production of industrial machinery. The company has a long history of innovation and has consistently invested in advanced technologies to maintain its competitive edge. Recognizing the potential of GenAI, XYZ embarked on a strategic initiative to integrate GenAI solutions into its product management processes.

Product management encompasses both operational tasks (e.g., delivering a product to market) and strategic tasks (e.g., predicting sales for a given product portfolio, creating a product roadmap for the coming years). For certain strategic tasks, such as predicting sales for a product portfolio, "simple" machine learning predictive models can assist by integrating data from different sources (historical sales data, product availability in stock, upcoming major projects).

Interviews conducted within company XYZ identified one primary issue related to strategic tasks, which became the focus of this study. The issue pertains to developing a unified roadmap for multiple diverse product portfolios that utilize the same resources (both engineering and marketing). It was found that many New Product Development (NPD) projects experience significant delays, which continue to escalate. Insufficient engineering resources led, for example, to engineers switching from project to project without having adequate time to fully understand the requirements, resulting in the creation of products with technical issues (failing to pass required tests).

The consideration of hiring additional personnel to increase available human resources proved challenging for several reasons. Firstly, this specific manufacturing sector is quite niche, and finding and onboarding new employees, particularly in engineering roles, is estimated to take 1-2 years, and in extreme cases, up to 3 years before the employee starts making a noticeable impact. Secondly, the high market dynamics result in scenarios where hiring may be feasible in one year, but cost-cutting measures may be necessary the following year, jeopardizing employee retention. Therefore, alternative methods were explored to enhance the efficiency of existing teams in developing roadmaps for various product portfolios, without increasing headcount.

To this end, a collaboration with academia was initiated, not only to alleviate the burden on the current team, already handling multiple projects, but also to approach the problem from a different perspective. This project was spearheaded by the product director (acting as a project manager, overseeing several product managers) and included the academic representative, selected product managers (responsible for different product portfolios), dedicated data scientists, and IT engineers. Each company representative (product managers, engineers) was able to dedicate a few hours weekly to work with the academic representative.

The first challenge encountered was data access. The academic representative had to define the scope of data usage and sign a non-disclosure agreement (NDA). Another challenge was the company's approach to GenAI; the company sought to implement GenAI responsibly. Currently, access to tools such as ChatGPT is blocked on all employee computers to prevent the use of company data in interactions with the chat, as the data processing methods are unknown.

At the design stage, it was decided to experimentally assess the business value of the GenAI solution. Consequently, it was necessary to develop an experiment plan and prepare the appropriate IT architecture. Considering the aforementioned restrictions, the academic representative proposed that, instead of building separate infrastructure within the company, the GenAI model would be hosted on a separate server prepared by the representative, over which the company's IT engineers would have supervision. This proposal was accepted.

The planning of the experiment largely focused on selecting the documents and determining which information the GenAI model should utilize to address the problem. This was done through the analysis of documents available in the organization (various product-related files, previous product roadmaps, and other information) as well as through interviews with stakeholders. Efforts were made to gather as much information as possible, ranging from the team structure to details about the construction of current products from each portfolio.

The selection of an appropriate evaluation method and metric, which would help assess the business value of the model, was also crucial. Choosing between statistical, business, and experimental evaluation methods, the scientist proposed using the experimental evaluation method due to the experimental nature of the implementation. The metric suggested by the scientist was a survey with a net promoter score for the solution proposed by the GenAI model, along with space for additional comments. Specifically, all project participants

(product managers, engineers) would rate the responses of the GenAI model on a scale of zero to ten. The experiment would be repeated, adding new information or incorporating new requirements, until the average score of all ratings exceeds eight. This proposal was accepted.

Collecting information and establishing the metric served as a test of the effectiveness of the internal knowledge management processes. Upon completing the planning stage, the company was assessed using the CLIMB framework by the scientist, who filled out a questionnaire based on interviews with product managers. The company achieved the third maturity level (out of five) overall, as well as the third level in the knowledge management category. According to the scientist, based on the responses and the achieved score (level three corresponds to the Intermediate level), the organization could consider implementing GenAI solutions in the product management process without any noticeable process changes. However, it also helped the organization identify areas needing improvement, particularly in managing knowledge when introducing changes to the process rather than developing a new product. This was evident from the beginning when integrating data from some sources proved challenging.

During the implementation and evaluation phase of the model, the scientist proposed using the LLMOps methodology for effective model management and maintenance, as well as a multi-agent approach to increase efficiency and optimize computational resources. The use of the open-source tool LangChain was suggested due to its extensive capabilities, including support for multi-agent systems. Five agents proposed answers, and an assessor agent, considering the evaluation of each answer along with the given requirements and provided knowledge, presented the final answer. This was then evaluated by project members. A total of three iterations were conducted, and in the third iteration, the average rating exceeded the threshold of eight.

The proposed by the model solution to a problem focused largely on creating technological (both software and hardware) building blocks that could be utilized by products and services from diverse portfolios. Given that these products and services targeted different markets with varying price points, different variants were proposed, ranging from the most feature-rich to the least feature-rich versions. This approach allowed the most complex variant (worst-case scenario from an approval perspective) to be tested during agency approval processes, thereby streamlining subsequent work on the other variants.

This solution enabled engineers to concentrate on building these building blocks by considering the requirements of the other variants, instead of switching between different technological projects. It also enhanced the flow of knowledge, both among engineers and between product managers. It is currently estimated that the Time-To-Market for new products will improve by at least twofold. The use of this solution also encouraged the team to apply it again in later stages of developing the discussed building blocks.

5. Conclusions

This study explores the integration of Generative Artificial Intelligence (GenAI) solutions in product management enhanced by the knowledge management framework. Drawing from the case study from the manufacturing sector, this has highlighted four key insights: 1. The influence of experimental approaches on the processes of assessing the business value of GenAI solutions, 2. The benefit of incorporating external expertise in the integration of advanced AI solutions during the product management process, 3. The impact of external experts on improving internal knowledge management processes and determining the maturity of these processes, and 4. The importance of having team members with diverse competency profiles, including T-shaped, Pi-shaped, and M-shaped skills.

Involving external experts, such as academic representatives, in the integration process of GenAI solutions can bring fresh perspectives and innovative (experimental) methods. This collaboration can enhance and simplify the development of the model and addresses competency gaps within the organization. Also, effective knowledge management is beneficial for the successful integration of GenAI. Practitioners should focus on developing and refining knowledge management processes, employing methods for capturing, organizing, storing, and sharing knowledge. Using frameworks like CLIMB can help assess and improve organizational maturity in this area. Having team members with diverse competency profiles (T-shaped, Pi-shaped, and M-shaped skills) is essential for the successful implementation and management of GenAI solutions. Organizations should invest in developing these competencies across their teams to ensure a well-rounded and effective integration process.

Future research should focus on the long-term impact of GenAI integration in product management, examining how these solutions evolve over time and their sustained effects on business value and process efficiency. Also,

comparative studies across different industries can provide insights into how GenAI solutions can be tailored and optimized for specific sectors, highlighting unique challenges and opportunities.

References

Abadi, A.N., Nayeem, M.T., Rafiei, D., 2023. Product Entity Matching via Tabular Data. Presented at the International Conference on Information and Knowledge Management, Proceedings, pp. 4215–4219. https://doi.org/10.1145/3583780.3615172

Bandi, A., Adapa, P.V.S.R., Kuchi, Y.E.V.P.K., 2023. The Power of Generative AI: A Review of Requirements, Models, Input–Output Formats, Evaluation Metrics, and Challenges. Future Internet 15. https://doi.org/10.3390/fi15080260

Benham, N., Gao, S., Ng, Y.-K., 2022. A Hybrid Approach for Summarizing User Reviews Based on KL-Divergence and Deep Learning. Presented at the Proceedings - International Conference on Tools with Artificial Intelligence, ICTAI, pp. 325–333. https://doi.org/10.1109/ICTAI56018.2022.00054

Bosch, J., Olsson, H.H., Crnkovic, I., 2018. It takes three to tango: Requirement, outcome/data, and AI driven development. Presented at the Workshop on Software-intensive Business.

Bouschery, S.G., Blazevic, V., Piller, F.T., 2023. Augmenting human innovation teams with artificial intelligence: Exploring transformer-based language models. Journal of Product Innovation Management 40, 139–153. https://doi.org/10.1111/jpim.12656

Bulut, A., Mahmoud, A., 2023. Generating Campaign Ads & Keywords for Programmatic Advertising. IEEE Access 11, 43557–43565. https://doi.org/10.1109/ACCESS.2023.3269505

Choi, W., Jang, S., Kim, H.Y., Lee, Y., Lee, S.-G., Lee, H., Park, S., 2023. Developing an AI-based automated fashion design system: reflecting the work process of fashion designers. Fashion and Textiles 10. https://doi.org/10.1186/s40691-023-00360-w

Chong, M.J., Forsyth, D., 2020. Effectively unbiased FID and inception score and where to find them. Presented at the Proceedings of the IEEE Computer Society Conference on Computer Vision and Pattern Recognition, pp. 6069–6078. https://doi.org/10.1109/CVPR42600.2020.00611

Colado, I.J.P., Colado, V.M.P., Morata, A.C., Píriz, R.S.C., Manjón, B.F., 2023. Using New AI-Driven Techniques to Ease Serious Games Authoring. Presented at the Proceedings - Frontiers in Education Conference, FIE. https://doi.org/10.1109/FIE58773.2023.10343021

Daugherty, P.R., Wilson, H.J., Narain, K., 2023. Generative AI Will Enhance — Not Erase — Customer Service Jobs. Harvard Business Review.

Deng, Z.G., Lv, J., Liu, X., Hou, Y.K., 2023. Bionic Design Model for Co-creative Product Innovation Based on Deep Generative and BID. International Journal of Computational Intelligence Systems 16. https://doi.org/10.1007/s44196-023-00187-9

Dorri, A., Kanhere, S.S., Jurdak, R., 2018. Multi-Agent Systems: A Survey. IEEE Access 6, 28573–28593. https://doi.org/10.1109/ACCESS.2018.2831228

Gupta, S., Sharma, P., Chaudhary, S., Kumar, V., Singh, S.P., Lourens, M., Beri, N., 2024. Study on the Beneficial Impacts and Ethical Dimensions of Generative AI in Software Product Management. International Journal of Intelligent Systems and Applications in Engineering 12, 251–264.

Gurkan, H., de Véricourt, F., 2022. Contracting, Pricing, and Data Collection Under the AI Flywheel Effect. Management Science 68, 8791–8808. https://doi.org/10.1287/mnsc.2022.4333

Kalam, K.T., Rahman, J.M., Islam, M.R., Dewan, S.M.R., 2024. ChatGPT and mental health: Friends or foes? Health Science Reports 7. https://doi.org/10.1002/hsr2.1912

Kanbach, D.K., Heiduk, L., Blueher, G., Schreiter, M., Lahmann, A., 2024. The GenAI is out of the bottle: generative artificial intelligence from a business model innovation perspective. Rev Manag Sci 18, 1189–1220. https://doi.org/10.1007/s11846-023-00696-z

Kulkarni, Akshay, Shivananda, A., Kulkarni, Anoosh, Gudivada, D., 2023. LLMs for Enterprise and LLMOps, in: Kulkarni, Akshay, Shivananda, A., Kulkarni, Anoosh, Gudivada, D. (Eds.), Applied Generative AI for Beginners: Practical Knowledge on Diffusion Models, ChatGPT, and Other LLMs. Apress, Berkeley, CA, pp. 117–154. https://doi.org/10.1007/978-1-4842-9994-4_7

Li, H., Wang, J., Lu, Y., Zhu, H., Ma, J., 2023. Chinese Multicategory Sentiment of E-Commerce Analysis Based on Deep Learning. Electronics (Switzerland) 12. https://doi.org/10.3390/electronics12204259

McKinsey, 2021. Global survey: The state of AI in 2021 | McKinsey, https://www.mckinsey.com/capabilities/quantumblack/our-insights/global-survey-the-state-of-ai-in-2021 (accessed 29.03.24).

Morizet, N., Desforges, P., Geissler, C., Pahon, E., Jemei, S., Hissel, D., 2023. Time to market reduction for hydrogen fuel cell stacks using Generative Adversarial Networks. Journal of Power Sources 579. https://doi.org/10.1016/j.jpowsour.2023.233286

Niemir, M., Mrugalska, B., 2023. Data Science Challenges of Automated Quality Verification Process in Product Data Catalogues. Presented at the Materials Research Proceedings, pp. 390–399. https://doi.org/10.21741/9781644902691-45

Ooi, K.-B., Tan, G.W.-H., Al-Emran, M., Al-Sharafi, M.A., Capatina, A., Chakraborty, A., Dwivedi, Y.K., Huang, T.-L., Kar, A.K., Lee, V.-H., Loh, X.-M., Micu, A., Mikalef, P., Mogaji, E., Pandey, N., Raman, R., Rana, N.P., Sarker, P., Sharma, A., Teng,

C.-I., Wamba, S.F., Wong, L.-W., 2023. The Potential of Generative Artificial Intelligence Across Disciplines: Perspectives and Future Directions. Journal of Computer Information Systems 0, 1–32. https://doi.org/10.1080/08874417.2023.2261010

Parida, V., Sjödin, D.R., Wincent, J., Kohtamäki, M., 2014. Mastering the transition to product-service provision: Insights into business models, Learning activities, and capabilities. Research Technology Management 57, 44–52. https://doi.org/10.5437/08956308X5703227

Peffers, K., Tuunanen, T., Gengler, C.E., Rossi, M., Hui, W., Virtanen, V., Bragge, J., 2006. The Design Science Research Process: A Model for Producing and Presenting Information Systems Research, in: DESRIST International Conference on Design Science Research in Information Systems and Technology, Claremont, CA, USA, February 24-25, 2006. pp. 83–106.

Peng, X., Xintong, B., 2022. An effective strategy for multi-modal fake news detection. Multimedia Tools and Applications 81, 13799–13822. https://doi.org/10.1007/s11042-022-12290-8

Porter, M.E., Heppelmann, J.E., 2015. How Smart, Connected Products Are Transforming Companies. Harvard Business Review 31.

Przegalinska, A., Jemielniak, D., 2023. Strategizing AI in Business and Education: Emerging Technologies and Business Strategy, Elements in Business Strategy. Cambridge University Press, Cambridge. https://doi.org/10.1017/9781009243520

Reznikov, R., 2024. LEVERAGING GENERATIVE AI: STRATEGIC ADOPTION PATTERNS FOR ENTERPRISES. https://doi.org/10.2139/ssrn.4851632

Rossi, M., Terzi, S., 2017. CLIMB: maturity assessment model for design and engineering processes. International Journal of Product Lifecycle Management 10, 20–43. https://doi.org/10.1504/IJPLM.2017.082998

Sai, P.T., Sri, G.H., Lakshmi Surekha, T., 2023. Extraction of Emojis and Texts to Intensify Opinion Mining using Machine Learning and Deep Learning Models. Presented at the 2nd International Conference on Automation, Computing and Renewable Systems, ICACRS 2023 - Proceedings, pp. 829–837. https://doi.org/10.1109/ICACRS58579.2023.10404790

Samuelson, P., 2023. Generative AI meets copyright: Ongoing lawsuits could affect everyone who uses generative AI. Science 381, 158–161. https://doi.org/10.1126/science.adi0656

Shamshirband, S., Anuar, N.B., Kiah, M.L.M., Patel, A., 2013. An appraisal and design of a multi-agent system based cooperative wireless intrusion detection computational intelligence technique. Engineering Applications of Artificial Intelligence 26, 2105–2127. https://doi.org/10.1016/j.engappai.2013.04.010

Shi, C., Liang, P., Wu, Y., Zhan, T., Jin, Z., 2024. Maximizing user experience with LLMOps-driven personalized recommendation systems. ACE 64, 101–107. https://doi.org/10.54254/2755-2721/64/20241353

Smith, D.J., 2013. Power-by-the-hour: The role of technology in reshaping business strategy at Rolls-Royce. Technology Analysis and Strategic Management 25, 987–1007. https://doi.org/10.1080/09537325.2013.823147

Soltani-Fesaghandis, G., Pooya, A., 2018. Design of an artificial intelligence system for predicting success of new product development and selecting proper market-product strategy in the food industry. International Food and Agribusiness Management Review 21, 847–864. https://doi.org/10.22434/IFAMR2017.0033

Sun, X., Holm, H., Molavipour, S., Gebre, F.G., Pawar, Y., Radnosrati, K., Shalmashi, S., 2023. Recommendation System for Product Test Failures Using BERT. Presented at the International Joint Conference on Knowledge Discovery, Knowledge Engineering and Knowledge Management, IC3K - Proceedings, pp. 206–213. https://doi.org/10.5220/0012160800003598

Van Bossuyt, D.L., Hale, B., Arlitt, R., Papakonstantinou, N., 2023. Zero-Trust for the System Design Lifecycle. Journal of Computing and Information Science in Engineering 23. https://doi.org/10.1115/1.4062597

Wang, J., Liu, Y.-L., 2023. Deep learning-based social media mining for user experience analysis: A case study of smart home products. Technology in Society 73. https://doi.org/10.1016/j.techsoc.2023.102220

Wodecki, A., 2023. A Cross-Disciplinary Knowledge Management Framework for Artificial Intelligence in Business Projects. ECKM 24, 1471–1480. https://doi.org/10.34190/eckm.24.2.1371

Zhang, W., Zhang, J., Zhao, T., Tong, W., 2023. A color style fusion design method based on generative adversarial networks. Presented at the Proceedings - 2023 3rd International Conference on Frontiers of Electronics, Information and Computation Technologies, ICFEICT 2023, pp. 338–343. https://doi.org/10.1109/ICFEICT59519.2023.00063

Collective Transformation: Fostering Peer-Driven Transformational Leadership in Communities of Practice

Xueying Zhang
Ritsumeikan University, Osaka, Japan

ba0747xp@ed.ritsumei.ac.jp

Abstract: While transformational leadership (TL) thrives in uncertain environments through knowledge exploration, research often focuses on the top-down dynamics between managers and employees. This study analyzes peer-driven TL within communities of practice (CoPs). Effective TL involves personal changes that trigger similar transformations in others. With their emphasis on knowledge creation and innovation, CoPs facilitate TL development, community growth, and reliable environments that engender transformative responses among members. Through a comprehensive literature review, detailed analyses, and semi-structured interviews, this study examines the conditions that foster CoPs as facilitators for mutual TL among peers. A novel perspective on TL within CoPs is revealed, shifting focus from unidirectional manager–employee dynamics to peer-to-peer leadership emergence. By nurturing the conditions of role equality and shared narratives, organizations can pursue collective growth, empower employees, and propel organizational transformation through a network of decentralized leadership.

Keywords: Communities of Practice, Transformational Leader, Transformational Leadership, Role Equality

1. Introduction

Transformational leadership (TL) inspires individuals and communities to reach new heights through a shared sense of mission, stimulating learning and provoking new thinking (Hater and Bass, 1988). Traditionally, studies have focused on managers' driving employee performance through TL (Dung and Hai, 2020). However, leadership can emerge organically within communities, with shared goals and collective learning fostering change (Ospina and Sorenson, 2006), suggesting TL potential is for managers and employees. Although TL's effectiveness in response to uncertainty is known (Donate and Sánchez de Pablo, 2015), research often relies on follower evaluations and neglects the leader's perspective (Stock et al, 2023). This study bridges this gap by exploring how communities of practice (CoPs)—collaborative knowledge hubs—can nurture environment-dependent TL. CoPs facilitate innovation, cooperation, and trust, which are vital for TL (Gui, Lei and Le, 2024; Nguyen, Shen and Le, 2022; Scuotto et al, 2022). Studies have shown CoPs' effectiveness in developing leaders (Smith et al, 2018) and promoting informal learning (Zia et al, 2022), aligning well with TL's emphasis on growth and adaptability. Therefore, this study examines the specific elements CoPs can offer to cultivate TL among members. Through a comprehensive literature review, detailed analyses, and semi-structured interviews, it investigates how CoPs can empower individuals to become transformational leaders and drive positive changes within and beyond their communities.

2. Literature Review

2.1 Transformational leadership

Recent research on TL focuses on (1) manager (supervisor) and employee interaction (improving performance and empowerment (Jensen, Potočnik and Chaudhry, 2020), organizational culture (Nguyen et al, 2023), and organizational change (Faupel and Süß, 2019); (2) impact on individual employees self-efficacy (Gao, Murphy and Anderson, 2020), increased creativity (Nguyen et al, 2023), reduced negative emotions (Karatepe and Türkmen, 2023), and identity building (Mulla and Krishnan, 2022); and (3) promoting innovation through the application of knowledge in the organization (organizational learning; Mahmud, 2022), knowledge management (KM) (Gui, Lei and Le 2024), and knowledge sharing (Kim and Park, 2020).

2.1.1 TL: Beyond Manager-Employee Dynamics

TL involves inspiring individuals and communities to reach new heights through a shared vision, learning, and innovation. While extant research focuses on manager-employee interactions (Nugroho et al, 2020), TL's potential extends beyond this dyad. Organizational culture plays a crucial role in this process. TL fosters innovation-supportive (Jung et al, 2003) and HRD cultures, driving positive performance (Nguyen et al, 2023). Asbari (2020) describes TL as a "radar" for organizational realities and a "moral compass" guiding ethical choices. This visionary nature equips organizations for change amidst uncertainty (Faupel and Süß, 2019; Pesut, 2019).

However, several research gaps remain in this field. Understanding how individuals develop into transformational leaders is crucial. Although development needs have been recognized (Pesut, 2019), methods are often underexplored. Siganga (2019) emphasizes the importance of meeting higher human needs, such as self-esteem and actualization, for successful TL. Thus, clarifying the path to self-realization can help nurture effective, authentic transformational leaders.

2.1.2 Transformational Leadership's Impact on Individual Employees

Beyond manager-employee dynamics, TL directly benefits individual employees. Studies show that TL boosts self-efficacy (Gao, Murphy and Anderson, 2020) and creativity (Nguyen et al, 2023), mitigate negative emotions, reduces stress (Karatepe and Türkmen, 2023), prevent turnover and loneliness (Kloutsiniotis et al, 2022), and positively affects overall well-being (Schmitz et al, 2023).Recent research has investigated follower identity and its connection with TL. Mulla and Krishnan (2022) find that supervisors' TL increases recruits' self-transcendent values and reduces their self-enhancing values, fostering value congruence. Similarly, Bakker et al (2023) show that TL promotes follower strength and initiative, improving work engagement and performance. Djourova et al (2020) highlight the link between TL and well-being, demonstrating that inspirational motivation and individual attention directly affect self-efficacy, creating a pathway from leadership style to well-being through self-efficacy and resilience. These studies demonstrate managers' TL's positive impact on their employees. However, research on the effects of TL exhibited by employees, both on themselves and their surroundings, is lacking. Le and Lei (2018) explore the impact of TL and trust on knowledge sharing among members, hinting at the potential of employee-driven TL. Similarly, Alvesson (2020) emphasizes that leadership roles are not always neatly defined, and "followers" can also exhibit leadership qualities.

Therefore, future research should explore employee-driven TL and investigate its impact on individuals, teams, and organizational cultures. By recognizing the potential of leadership beyond traditional hierarchies, we can realize a broader spectrum of talent and create more empowered, thriving workplaces.

2.1.3 Transformational Leadership and Intra-Organizational Knowledge: Fostering Innovation and Learning

TL plays a crucial role in promoting innovation by applying internal knowledge. Research highlights its impact on learning, knowledge creation and practice, and organizational co-optation. Mahmud (2022) emphasizes the mediating effect of TL between learning culture and knowledge application, demonstrating its ability to bridge the gap between knowledge and practical use. Donate and Sánchez de Pablo (2015) propose a "knowledge-oriented leadership" that combines elements of both transformational and transactional styles, emphasizing the need for effective communication and motivation alongside KM practices. This suggests TL can handle KM's creation and communication, while transactional leadership can cater to storage and application.

Studies have explored the specific conditions under which TL fosters innovation. Gui, Lei, and Le (2024) show that while TL enhances innovation capability through knowledge management competence (KMC), its effectiveness depends on the organization's existing innovative climate. Similarly, Nguyen et al (2022) find that KMC and collaborative culture influence the impact of TL on different aspects of innovation capability. Le and Le (2023) demonstrate that TL's effect on exploratory innovation (seeking new ideas) is stronger than that on exploitative innovation (refining existing ideas).

Beyond innovation, TL also influences knowledge sharing, a crucial element of KM. Kim and Park (2020) assert that knowledge sharing mediates the relationship between TL and organizational learning, highlighting TL's ability to encourage knowledge exchange and collaborative learning. Shahzad et al (2022) further show that knowledge sharing strengthens the positive impact of TL on corporate performance, demonstrating its multifaceted contribution to organizational success.

However, TL's effectiveness depends on certain environmental factors. Trust between leadership, members, and among members is crucial (Le and Lei, 2018; Scuotto et al, 2022). Additionally, Gui, Lei and Le (2024) and Nguyen et al (2022) highlight the importance of fostering an innovative and collaborative culture to optimize TL's impact.

While the evidence is clear on TL's potential to enhance knowledge utilization and innovation, a gap exists in defining the specific environments and conditions in which it thrives. Future research must analyze this question, identifying the optimal contexts for utilizing TL's full potential to drive knowledge-based success within organizations.

2.2 Community of Practice

A CoP is a space where people with shared interests, problems, and enthusiasm for a subject come together to enhance their knowledge and skills through ongoing interaction (Wenger, 1998, p. 32). Learning in CoPs is structured into four elements: community, practice, meaning, and identity, which are "deeply interrelated and mutually defining" (p. 5) (Wenger, 1998).

In CoPs, it is "a means for the evolution of practice and the inclusion of newcomers, as well as for identity development and transformation" (Wenger, 1998; p. 13). Consequently, relevant research on CoP is mainly divided into (i) how it leads to identity development and transformation (e.g., knowledge sharing and creation) and (ii) what kind of identity development and transformation it has achieved (e.g., expertise and self-efficacy).

2.2.1 Connecting Communities of Practice to Identity Development and Transformation

CoPs are valuable tools for knowledge sharing and professional development within organizations. Their core role lies in facilitating informal learning and collaborating on shared interests. Jeon, Kim and Koh (2011) highlight the interplay of extrinsic and intrinsic motivations in driving knowledge sharing within CoPs. Budrytė and Vainauskienė (2023) further demonstrate the potential of virtual CoPs in promoting international knowledge exchange and remote collaboration. Furthermore, CoPs play a crucial role in shaping individual and community identities. Aljuwaiber (2016) emphasizes how CoPs foster informal professional learning, create shared identities, and give meaning to professional practice. This is particularly relevant for tacit knowledge, which thrives on dialogue and the informal learning processes often nurtured within CoPs.

Recent research has shifted focus toward the members, recognizing them as the driving force behind continuous knowledge creation and CoP evolution. Choi et al (2020) highlight the significance of CoPs in organizational innovation and improvement. They view CoP members as valuable assets and key players in KM, emphasizing their role in developing knowledge activities, enhancing competitiveness, and strengthening organizational culture. Similarly, Haas et al. (2021) investigated the factors influencing participation in virtual CoPs and found a positive correlation with work engagement. Bolisani et al (2021) explore how CoPs can act as agile responders to crises by fostering deeper connections, a sense of belonging, and community empowerment.

Overall, CoPs research is moving toward a more nuanced understanding of member interactions and their impact on individual and organizational development. Although studies have explored knowledge sharing and collaboration within CoPs, further research is required to examine the intricate dynamics of internal interactions among employees within these communities. Examining how CoPs influence individual identity development and transformation, particularly concerning professional identity, can offer valuable insights into maximizing the potential of these dynamic learning ecosystems.

2.2.2 Identity Development and Transformation in Communities of Practice

While research on CoPs in management often focuses on knowledge-sharing and collaboration, educational studies emphasize their impact on member identities. CoPs provide an ideal environment for building integrated knowledge and pedagogical expertise. This environment fosters critical thinking to prevent groupthink (Li et al, 2009), democratic cooperation (DePalma and Teague, 2008), and trust, which allows for failure and growth (Fitzgerald et al, 2023). Sadiq (2021) emphasizes the sense of unity and security CoPs offer in uncertain environments. McLaughlan (2021) identifies four key facilitators of CoP development for International Graduate Teaching Assistants: social connectedness, confident English teaching, pedagogical support, and self-efficacy in teaching.

Numerous studies demonstrate the positive impact of CoPs on member identities. Lee and Shaari (2012) highlight increased professionalism and autonomy, whereas Goodwin (2019) underscores the development of self-efficacy and career optimism. The post-pandemic context and challenges of building diverse societies have further highlighted the evolving role of CoPs. Ruzycki (2021) demonstrates how cross-disciplinary faculty CoPs foster resilience, adaptability, and an emergent learning framework. Similarly, Johnson (2023) demonstrates the effectiveness of CoPs in developing knowledge and resources for sustainable LGBTQ+ inclusivity.

In addition to individual growth, CoPs contribute to broader educational settings. Retna and Ng (2011) emphasize how mutual involvement facilitates acquiring new knowledge and transferable solutions beyond specific situations. Abedini, Abedin and Zowghi (2021) probe online CoPs for adult learners and find them independent, experience-centered, and self-motivated individuals seeking lifelong learning and professional outcomes.

2.3 Communities of Practice as Incubators for Transformational Leadership in Organizations

By reviewing the defining characteristics of transformational leaders (visionaries, facilitators of learning, and agents of change), we can observe how CoPs may develop transformational leaders.

First, they foster the qualities expected of transformational leaders. Schultze and Stabell (2004) emphasize that CoPs value internal learning, knowledge circulation, and action-oriented knowledge application. This aligns perfectly with the TL's focus on empowering individuals to tap into their inner potential and translate knowledge into meaningful actions. Second, CoPs offer an ideal environment for honing TL skills. Mulla and Krishnan (2022) highlight the importance of training for effective TL, whereas Pesut (2019) views it as a skill that requires development. Smith et al (2018) demonstrate that CoPs can serve as effective leadership development programs. Abedini, Abedin and Zowghi (2021) assert that online CoPs contribute toward lifelong learning and knowledge formation through shared experiences. Third, CoPs nurture essential traits of transformational leaders. Pesut (2019) and Djourova et al (2020) emphasize the need for leaders to cultivate foresight, resilience, and the ability to navigate change. Wenger (2000) defines CoPs as "a way for communities to contemplate their repertoire, identify hidden possibilities, and reveal the power to move forward." This introspective and future-oriented environment aligns perfectly with developing crucial leadership qualities. Finally, CoPs offer a unique space for peer-to-peer interaction, which Siganga (2019) identifies as a critical but understudied aspect of TL development. Unlike traditional hierarchical relationships, CoPs promote horizontal knowledge exchange and mutual learning, fostering employees' self-actualization of leadership potential.

3. Methodology

Descriptive and interpretive narrative approaches were used for data collection and analysis through a semi-structured interview survey. The narrative approach focuses on dialogue, revealing the discontinuity between the subject's story and experience (Sandelowski, 1991).

The suitability of this study for the growth of individuals in CoPs is evidenced in previous studies (Baran and Cagiltay, 2010; Fitzgerald et al, 2023). Moreover, they indicate an over-reliance on questionnaires as a shortfall in TL-related research progress identified by Stock et al. (2023), who state what behaviors produce the desired results to train leaders to be transformational. They emphasize the importance of TL research and mention that most research has merely been followers' evaluations of leaders through questionnaires. Hence, they suggest biases may exist in objective behavioral measures and questionnaires, and that coverage from other approaches is also needed to reduce bias. Thus, this qualitative study of the behavior of transformational leaders can be covered by other approaches.

3.1 Sampling

Regarding the sampling criteria, the study selected four individuals with transformational leader characteristics from four CoPs: painters, badminton, nail design, and IT gadgets. The CoPs were chosen based on the definition of CoP by Wenger (1998), with the criteria of coming together around a common interest or theme, ongoing activities to promote the development of that theme for at least two years, and a minimum of 10 participants. The selection of transformational leaders in the CoPs was then made through interviews with members of each CoP. In each CoP, random members were asked to describe transformational leader behavior (TLB) (Stock et al, 2023) and to "name someone who fits that characteristic." TLB is defined as teaching life lessons, introducing developmental opportunities, providing different perspectives, seeking perspectives, questioning critical assumptions, and speaking affirmatively (Stock et al, 2023). The interviews identified those who fit the TLB as painters (2), badminton (2), nail designers (1), and IT gadgets (1), of which one from each CoP was interviewed.

3.2 Data Collection

This study comprises several one-on-one semi-structured interviews with four transformation applicants from November to January 2023. Each interview lasted 1 hour and was conducted face-to-face or via an online call. The interviews were primarily reflective and used the interviewees' work and community events as guides. Each interview was audio recorded and transcribed verbatim, and the individual confirmed the content.

3.3 Data analysis

The interview data were analyzed using Steps for Coding and Theorization (SCAT) (Otani, 2011, author's translation). Additionally, in studies in education (Villeneuve and Hutchinson, 2013) and social work (Takahashi,

2016), data collection using the narrative approach and data analysis using SCAT allows the subject's theoretical descriptions. SCAT systematizes theories by extracting their commonalities and characteristics from the "theory descriptions" (Otani, 2008). The SCAT steps ensured each interview response was coded, relationships between codes were identified, and two common categories were derived. For validation, the results of the SCAT analysis were shared with the interviewees, and their views were sought. The results confirmed that no new categories were derived, and data were saturated.

3.4 Ethical Considerations

During the survey, the purpose and content of the study were explained to the participants, and their consent was obtained before the interviews. Personally identifiable information was anonymized and carefully collected to protect the participants' privacy, while audio and transcription data obtained from the survey were stored securely. After the data storage period, a specialized company properly disposed of the data.

4. Findings

4.1 Role-Based Equality

Unlike traditional organizations with predefined structures and assigned leadership roles, CoPs present a fascinating alternative. Interviews in this study reveal a key difference: in CoPs, members come first, and leadership emerges organically. While frameworks may exist, they serve as guidelines, not dictates, for the dynamic interplay of individuals. This "role-based equality" challenges the notion of leadership as a singular position. Knowledge creation and application in CoPs stem from egalitarian interactions in which all members contribute and share ownership. As expressed by interviewees, leadership "is not given, but shared," often surprising individuals chosen by their peers. These leaders do not view themselves as superior but as temporary facilitators fulfilling a specific need. They operate out of a sense of reciprocity and community spirit, recognizing the equal value of each member's role. One interviewee stated, "I organize events not out of responsibility but to give back what I get from the CoP." This mutual trust and respect foster a dynamic environment where leadership roles shift based on context and expertise. Members learn from and complement each other, continuously expanding their horizons while recognizing their limitations. Specifically, CoPs nurture a collective leadership model in which knowledge creation and transformation emanate from shared experiences and contributions.

4.2 Shared Narrative of Transformation

While Wenger's (1998) theory of CoPs emphasizes strengthening identity through professional development, this study offers a deeper insight: CoPs serve as mirrors for self-discovery. This quest is fueled by shared narratives of transformation. Members do not simply exchange information; they share personal stories of growth. These stories become anchors of "positive identity-shaping," demonstrating individual capabilities and impacting personal lives. In these narratives within CoPs, each member plays a crucial role in enriching the collective story through interactions, which include answering community questions, enhancing communication skills, and strengthening the overall narrative. The impact of individual stories extends beyond personal growth. They inspire others to form powerful mutual support systems. High-impact stories can elevate owners to temporary leadership roles, showcasing the dynamic nature of leadership in Cops. Ultimately, weaving individual transformation stories fuels CoP's growth and evolution. This egalitarian sharing of experiences ensures knowledge creation and fosters a supportive environment where everyone feels empowered to contribute to and discover their potential. This study highlights the transformative power of CoPs beyond professional development. By providing platforms for sharing stories about individual journeys, CoPs have become catalysts for self-discovery, mutual inspiration, and collective growth.

5. Conclusion

This study examined creating a CoP environment that promotes TL among employees. The findings suggest that role-based equality and a shared narrative of transformation enable employees to practice TL, deepen self-understanding, and experience personal growth. This can lead to deeper employee connections, collective transformation, and a mutually trusting, evolving organization, benefiting CoPs, TL, and transformational learning.

The study also highlights the role of leadership in collaborative projects within CoPs, fostering self-discovery and

leadership roles not imposed by programs but through authentic CoP engagement. Additionally, the research reveals that TL and transactional leadership are crucial for knowledge creation and exchange, with individuals collectively demonstrating the power of collaboration. Further investigation into leveraging TL principles within CoPs is needed.

Acknowledgment

This work was supported by JST SPRING, Grant Number JPMJSP2101.

References

Abedini, A., Abedin, B. and Zowghi, D. (2021) "Adult Learning in Online Communities of Practice: A Systematic Review", British Journal of Educational Technology, Vol 52, No. 4, pp 1663–1694.

Aljuwaiber, A. (2016) "Communities of Practice as an Initiative for Knowledge Sharing in Business Organisations: A Literature Review", Journal of Knowledge Management, Vol 20, No. 4, pp 731–748.

Alvesson, M. (2020) "Upbeat Leadership: A Recipe for – or Against – "Successful" Leadership Studies", The Leadership Quarterly, Vol 31, No. 6, p 101439.

Asbari, M. (2020) "Is Transformational Leadership Suitable for Future Organizational Needs?", International Journal Of Social, Policy And Law, Vol 1, No. 1, pp 51–55.

Bakker, A.B., Hetland, J., Olsen, O.K. and Espevik, R. (2023) "Daily Transformational Leadership: A Source of Inspiration for Follower Performance?", European Management Journal, Vol 41, No. 5, pp 700–708.

Baran, B. and Cagiltay, K. (2010) "Motivators and Barriers in the Development of Online Communities of Practice", Egitim Arastirmalari-Eurasian Journal of Educational Research, Vol 39, pp 79–96.

Bolisani, E., Fedeli, M., Bierema, L. and De Marchi, V. (2021) "United We Adapt: Communities of Practice to Face the Coronavirus Crisis in Higher Education", Knowledge Management Research & Practice, Vol 19, pp 454–458.

Budrytė, M. and Vainauskienė, V. (2023) "Virtual Communities of Practice as a Knowledge Sharing Tool: Recommendations for International Business", Management of Organizations: Systematic Research, Vol 89, No. 1, pp 15–30.

Choi, H.J., Ahn, J.C., Jung, S.H. and Kim, J.H. (2020) "Communities of Practice and Knowledge Management Systems: Effects on Knowledge Management Activities and Innovation Performance", Knowledge Management Research & Practice, Vol 18, No. 1, pp 53–68.

DePalma, R. and Teague, L. (2008) "A Democratic Community of Practice: Unpicking all those Words", Educational Action Research, Vol 16, No. 4, pp 441–456.

Djourova, N.P., Rodríguez Molina, I., Tordera Santamatilde, N. and Abate, G. (2020) "Self-efficacy and Resilience: Mediating Mechanisms in the Relationship Between the Transformational Leadership Dimensions and Well-being", Journal of Leadership & Organizational Studies, Vol 27, No. 3, pp 256–270.

Donate, M.J. and Sánchez de Pablo, J.D. (2015) "The Role of Knowledge-Oriented Leadership in Knowledge Management Practices and Innovation", Journal of Business Research, Vol 68, No. 2, pp 360–370.

Dung, L.T. and Hai, P.V. (2020) "The Effects of Transformational Leadership and Job Satisfaction on Commitment to Organisational Change: A Three-Component Model Extension Approach," The South East Asian Journal of Management, Vol 14, No. 1, Article 6.

Faupel, S. and Süß, S. (2019) "The Effect of Transformational Leadership on Employees During Organizational Change—An Empirical Analysis", Journal of Change Management, Vol 19, No. 3, pp 145–166.

Fitzgerald, A., Parr, G., Williams, J., Williams, J., Howard, B., Zandes, S. and Diug, B. (2023) "Interfaculty Collaboration for Improving International Mobility Experiences: Sustaining a Dialogue Across Difference", Teaching in Higher Education, Vol 28, No. 1, pp 51–65.

Gao, R., Murphy, W.H. and Anderson, R.E. (2020) "Transformational Leadership Effects on Salespeople's Attitudes, Striving, and Performance", Journal of Business Research, Vol 110, pp 237–245.

Goodwin, K. (2019) "Developing Self-Efficacy and Career Optimism Through Participation in Communities of Practice Within Australian Creative Industries", Australian Journal of Career Development, Vol 28, No.2, pp 122–131.

Gui, L., Lei, H. and Le, P.B. (2024) "Fostering Product and Process Innovation Through Transformational Leadership and Knowledge Management Capability: The Moderating Role of Innovation Culture", European Journal of Innovation Management, Vol 27, No. 1, pp 214–232.

Haas, A., Abonneau, D., Borzillo, S and Guillaume, L.P. (2021) "Afraid of Engagement? Towards an Understanding of Engagement in Virtual Communities of Practice, Knowledge Management Research & Practice", Vol 19, No. 2, pp 169–180.

Hater, J.J. and Bass, B.M. (1988) " Superiors' Evaluations and Subordinates' Perceptions of Transformational and Transactional Leadership", Journal of Applied Psychology, Vol 73, pp 695–702.

Jensen, M., Potočnik, K. and Chaudhry, S. (2020) "A Mixed-Methods Study of CEO Transformational Leadership and Firm Performance", European Management Journal, Vol 38, No. 6, pp 836–845.

Jeon, S.H., Kim, Y. and Koh, J. (2011) "An Integrative Model for Knowledge Sharing in Communities-Of-Practice", Journal of Knowledge Management, Vol 15, No. 2, pp 251–269.

Johnson, B. (2023) "Creating and Sustaining LGBTQ+ Inclusive Communities of Practice in UK Primary Schools: An Interpretative Phenomenological Analysis", Journal of LGBT Youth, Vol 20, No. 3, pp 545–560.

Jung, D.I., Chow, C. and Wu, A. (2003) "The Role of Transformational Leadership in Enhancing Organizational Innovation: Hypotheses and Some Preliminary Findings", The Leadership Quarterly, Vol 14, No. 4-5, pp 525–544.

Karatepe, H.K. and Türkmen, E. (2023) "Serial–Multiple Mediation of Transformational and Clinical Leadership in the Relationship Between Work Overload and Quality of Work Life Among Nurses: A Job Demands-Resources Framework", Collegian, Vol. 30, No. 4, pp 521–529.

Kim, E.-J. and Park, S. (2020) "Transformational Leadership, Knowledge Sharing, Organizational Climate and Learning: An Empirical Study", Leadership & Organization Development Journal, Vol 41, No. 6, pp 761–775.

Kloutsiniotis, P.V., Mihail, D.M., Mylonas, N. and Pateli, A. (2022) "Transformational Leadership, HRM Practices and Burnout During the COVID-19 Pandemic: The Role of Personal Stress, Anxiety, and Workplace Loneliness", International Journal of Hospitality Management, Vol 102, Article 103177.

Le, P.B. and Le, H.M. (2023) "Stimulating Exploitative and Exploratory Innovation Through Transformational Leadership and Knowledge Management Capability: The Moderating Role of Competitive Intensity", Leadership & Organization Development Journal, Vol 44, No. 8, pp 1037–1056.

Le, P.B. and Lei, H. (2018) "The Mediating Role of Trust in Stimulating the Relationship Between Transformational Leadership and Knowledge Sharing Processes", Journal of Knowledge Management, Vol 22, No. 3, pp 521–537.

Lee, D. and Shaari, I. (2012) "Professional Identity or Best Practices? —An Exploration of the Synergies Between Professional Learning Communities and Communities of Practices", Creative Education, Vol 3, pp 457–460.

Li, L.C., Grimshaw, J.M., Nielsen, C., Judd, M., Coyte, P.C. and Graham, I.D. (2009) "Evolution of Wenger's Concept of Community of Practice", Implementation Science: IS, Vol 4, No. 11, pp 11–18.

Mulla, Z.R. and Krishnan, V.R. (2022) "Impact of Employment on Newcomer's Values: Role of Supervisor's Transformational Leadership", IIMB Management Review, Vol 34, No. 3, pp 228–241.

Nguyen, N.P., Hang, N.T.T., Hiep, N. and Flynn, O. (2023) "Does Transformational Leadership Influence Organisational Culture and Organisational Performance: Empirical Evidence from an Emerging Country", IIMB Management Review, Vol 35, No. 4, pp 382–392.

Nguyen, T.N., Shen, C.H. and Le, P.B. (2022) "Influence of Transformational Leadership and Knowledge Management on Incremental and Radical Innovation: The Moderating Role of Collaborative Culture", Kybernetes, Vol 51, No. 7, pp 2240–2258.

Nugroho, Y., Asbari, M., Purwanto, A., Basuki, S., Sudiyono, R., Fikri, M., Hulu, P., Mustofa, M., Chidir, G., Ospina, S. and Sorenson, G. (2006) "A Constructionist Lens on Leadership: Charting New Territory", In G. Goethals and G. Sorenson (Eds.), The Quest for a General Theory of Leadership (pp. 188-204), Edward Elgar, Cheltenham.

Otani, T. (2008) ""SCAT" A Qualitative Data Analysis Method by Four-Step Coding: Easy Startable and Small-Scale Data-Applicable Process of Theorization", Nagoya University: Bulletin of the Graduate School of Education and Human Development. (Educational Sciences), Vol 54, No. 2, pp 27–44.

Otani, T. (2011) "SCAT: Steps for Coding and Theorization – A Qualitative Theorization Method with Explicit Procedures, Easy to Initiate and Applicable to Small-scale Theorists", Journal of Japan Society of Kansei Engineering, No. 10, pp 155–160.

Pesut, D.J. (2019) "Anticipating Disruptive Innovations with Foresight Leadership", Nursing Administration Quarterly, Vol 43, No. 3, pp 196–204.

Retna, K.S. and Ng, P.T. (2011) "Communities of Practice: Dynamics and Success Factors", Leadership & Organization Development Journal, Vol. 32, No. 1, pp 41–59.

Sadiq, K. (2021) "Communities of Practice as a Multidisciplinary Response in Times of Crisis: Adapting to Successful Online Learning Practices", Accounting Research Journal, Vol 34, No. 2, pp 134–145.

Sandelowski, M. (1991) "Telling Stories: Narrative Approaches in Qualitative Research", Image: The Journal of Nursing Scholarship, Vol 23, No. 3, pp 161–166.

Schmitz, M.L., Antonietti, C., Consoli, T., Cattaneo, A., Gonon, P. and Petko, D. (2023) "Transformational Leadership for Technology Integration in Schools: Empowering Teachers to Use Technology in a More Demanding Way", Computers & Education, Vol 204, Article 104880.

Schultze, U. and Stabell, C. (2004) "Knowing What You Don't Know? Discourses and Contradictions in Knowledge Management Research", Journal of Management Studies, Vol 41, No. 4, pp 549–573.

Scuotto, V., Nespoli, C., Tran, P.T. and Cappiello, G. (2022) "An Alternative Way to Predict Knowledge Hiding: The Lens of Transformational Leadership", Journal of Business Research, Vol 140, pp 76–84.

Shahzad, M.A., Iqbal, M.A., Jan, N.M. and Zahid, M. (2022) "The Role of Transformational Leadership on Firm Performance: Mediating Effect of Corporate Sustainability and Moderating Effect of Knowledge-Sharing", Frontiers in Psychology, Vol 13, Article 883224.

Siganga, S. (2019) "Developing a Transformational Leadership Style to Fit the 21st Century",Journal of Management & Administration, Vol 2019, No. 2, pp 141–159.

Smith, S., Kempster, S. and Wenger-Trayner, E. (2018) "Developing a Program Community of Practice for Leadership Development", Journal of Management Education, Vol 43, No. 1.

Stock, G., Banks, G.C., Voss, E.N., Tonidandel, S. and Woznyj, H. (2023) "Putting Leader (Follower) Behavior Back into Transformational Leadership: A Theoretical and Empirical Course Correction", The Leadership Quarterly, Vol 34, No. 6, Article 101632.

Suroso, S. and Xavir, Y. (2020) “Transformational Leadership and Employees’ Performances: The Mediating Role of Motivation and Work Environment”, EduPsyCouns: Journal of Education, Psychology and Counseling, Vol 2, No. 1, pp 438–460.

Takahashi, K. (2016) “Research on the Growth of Caregivers through Struggles —Focusing on the Life Story of Psychiatric Social Workers”, Japanese Journal of Social Welfare, Vol 57, No. 3, pp 41–55.

Villeneuve, M. and Hutchinson, N.L. (2013) “Enabling Outcomes for Students with Developmental Disabilities Through Collaborative Consultation”, The Qualitative Report 2012, Vol 17, No.97, pp 1–29.

Wenger, E. (1998) Communities of Practice: Learning, Meaning and Identity, Cambridge University Press, Cambridge.

Wenger, E. (2000) “Communities of Practice and Social Learning Systems”, Organization, Vol 7, No. 2, 225–246.

Zia, M.Q., Decius, J., Naveed, M. and Anwar, A. (2022) “Transformational Leadership Promoting Employees’ Informal Learning and Job Involvement: The Moderating Role of Self-efficacy”, Leadership & Organization Development Journal, Vol. 43, No. 3, pp 333–349.

Knowledge Transfer Across Borders in Multinational Companies

Gang Liu[1], Yixiao Zhao[1*] and Muhammad Saleem Sumbal[2]
[1]Student Career Development Center, Business School, Shenzhen Technology University, China
[2]Hong Kong Polytechnic University, Hong Kong, China

liugang3@sztu.edu.cn
gang.liu@connect.polyu.hk
ZHAO.YIXIAO@outlook.com
saleemkhan.sumbal@polyu.edu.hk

Abstract: Hong Kong S.A.R., China is one of the most economically prosperous areas in the world, with numerous multinational companies (MNCs) operating here. It is of vital importance for MNCs to leverage their knowledge across the entire organization, including both the head office and overseas branches. However, many MNCs struggle with knowledge transfer across borders due to the differences in national cultural and institutional factors. Therefore, this research seeks to explore these factors affecting knowledge transfer in MNCs in the Hong Kong S.A.R., China. Six semi-structured interviews with professional practitioners were carried out. Knowledge is transferred in MNCs mainly by three processes, namely, on-the-job training, knowledge-sharing sessions, and knowledge retention of leaving employees. Cultural differences including language differences, geography differences and power distance, technical factors, and institutional differences, including organizational structure differences, senior management support, and employee motivation do affect knowledge transfer of MNCs. This study adds new insights into knowledge transfer issues across the boundaries of MNCs in Hong Kong. It provides significant managerial implications that are helpful to these multinational organizations to achieve effective knowledge management in the global context to overcome cultural and institutional obstacles.

Keywords: Knowledge Transfer, Knowledge Management, Multinational Companies (Mncs), National Culture, Institutional Differences

1. Introduction

Knowledge management (KM) can be defined as a process involving a variety of activities, such as knowledge transfer, knowledge sharing, knowledge creation, knowledge retention, etc. (Alavi & Leidner, 2001). Such activities can generate value from an organization's knowledge assets (Mahalakshmi & Ally Sornam, 2012). Innovation in knowledge-intensive industries has an expected positive impact on job creation, the digital economy, and environmental protection (Grigorescu et al., 2020). By actively implementing KM, the quality of services can be improved, new methods can be created, and unnecessary costs can be reduced (World Bank, 2018). The knowledge transfer involves mobilization, assimilation, and exploitation of knowledge resources (Maurer et al., 2011) and encompasses a wide range of actions between individuals and groups; within, between, and among groups, and from groups to organizations to share the "know-how" of the best experts in a given domain (Paulin & Suneson, 2012). Transferring knowledge among employees benefits organizations and individuals by enhancing their capabilities (Sharifuddin & Rowland, 2004). However, KM becomes similar to a “bottleneck” as the managers do not have enough cognitive understanding of KM (Subanidja & Hadiwidjojo, 2017).

Knowledge transfer is one of the important processes of KM (Alavi & Leidner, 2001) that attracts much attention from scholars and practitioners, especially regarding knowledge transfer across borders. For example, Pérez-Nordtvedt et al (2008) examined 102 US organizations and found that the quality of the relationship between the source and the recipient has a strong positive impact on both the efficiency and effectiveness of cross-border knowledge transfer. Dinur et al (2009) revealed that contextual dissimilarity was an obstacle to best-practice transfers, such contextual factors including differences in culture, strategy, decision-making, environment, and technology. Sapuarachchi (2021) conducted an exploratory study by interviewing 15 employees in a US headquarter and its Sri Lankan subsidiary of the MNC. He showed that organizational knowledge transfer was influenced by cultural distance. By examining China-based MNC subsidiaries in the IT industry, Qin et al (2017) showed that cultural distance moderates the relationship between knowledge transfer and subsidiary performance. While other scholars examined the impacts of knowledge characteristics on knowledge transfer across borders. For instance, Argote and Ingram (2000) argue that the knowledge-embedded in people, tasks, and tools is the most difficult to transfer as such knowledge is least likely to fit the new context. In addition, some studies have focused on the key factors that affect knowledge transfer. Organizational culture, structure, knowledge recipients, types of knowledge play an important role in effective knowledge transfer. Social capital dimensions, such as network ties, network configuration, work stability, shared goals, shared culture, and trust

influence the effectiveness (Inkpen & Tsang, 2005) and speed Chen & Lovvorn, 2011) of knowledge transfer. Argote (2024) claims that some factors, including opportunities, knowledge characteristics, knowledge transfer mechanisms and motivation, and the depth of knowledge will affect the success of knowledge transfer.

Despite widespread recognition of the importance of knowledge flows in international organizations, it is necessary to examine the factors influencing knowledge transfer in different cultural and institutional contexts. In addition, Hong Kong S.A.R., China, serving as a financial center in South Asia attracts thousands of MNCs to open up their subsidiaries there, however, limited attention has been paid to examine the factors affecting knowledge transfer in these organizations in Hong Kong S.A.R., China. On the other hand, Hong Kong is recognized as a modern city where Western and Eastern cultures are well merged. Therefore, it is necessary to examine potential factors that could affect knowledge transfer of MNCs in Hong Kong to offer new insights into KM literature. This study aims to investigate:

- How do MNCs transfer their knowledge?
- What are the factors that affect knowledge transfer in MNCs?

2. Methodology

The qualitative data analysis was adopted since this method is appropriate as it provides an “up-close grounded” perspective (Shaw & Luiz, 2018). This involved in-depth interviews with practitioners who have extensive relevant experience and knowledge to obtain primary data. The researchers developed a semi-structured interview guide to capture a range of personal experiences, including open-ended questions asking about various aspects of KM practices. Six qualified interviewees were selected from international companies in Hong Kong, China. Each of them has extensive working experience in MNCs, with an average of over 15 years in the practice. All interviews were carried out in English by face-to-face interviews or online meetings and audiotaped.

The data collected was analyzed using content analysis following Mayring (2000). The interviews' audio tapes were verbatim transcribed. After transcription, the data was coded. Each statement of transcriptions was broken down into smaller textual units for analysis and coded each interview line by line based on the knowledge offered by the reviewers. Different colors were used for the coding items to identify key similarities across the interviews. Similar codes were merged and combined together to form higher-level categories to create themes. The research team met regularly to demonstrate the coding process, discuss coding discrepancies, and clarify any ambiguities in the coding process to ensure reliability and validity.

3. Findings

3.1 Knowledge Transfer Process in MNCs

Knowledge is transferred mainly by three processes, namely, on-the-job training, knowledge-sharing sessions, and knowledge retention of leaving employees.

On-the-job training. On-the-job training typically occurs when new employees or management trainees enter the company on a rotational basis. These training initiatives transfer knowledge to employees focusing on skill development, and compliance requirements through a blend of online modules, face-to-face sessions, and e-learning platforms. By providing training programs, organizations empower staff to enhance their capabilities and adapt to changing roles. According to participant D from a nationalized commercial bank:

> Normally if a staff member joins our company or bank, intensive training would be [D-01-KTM-OTB].

Knowledge sharing session. MNCs hold knowledge-sharing sessions from time to time for knowledge transfer and sharing activities. Different MNCs have different formats for knowledge-sharing sessions, including seminars, workshops, labs, and coffee sessions. Knowledge-sharing sessions play a role in sharing expertise, discussing industry trends, and fostering cross-functional collaboration. These sessions promote a culture of knowledge transfer, encourage collaboration, and nurture a learning community within the organization. Participant A from a major commercial bank, who is the initiator of the internal knowledge-sharing session in his MNC, explained this:

> … organize some team meetings… we…share about what they do of the week. It's like a PC lab meeting [A-01-KTM-KS].

knowledge retention of leaving employees. Knowledge and information are passed from departing employees—

due to retirement, resignation, or relocation—to their successors within MNCs. It helps in capturing tacit knowledge, experiences, and insights of leaving staff before they leave the organization. Organizations prioritize this transition of knowledge, job-related insights, and key contacts to mitigate the impact of staff turnover on business operations. Although multinational organizations have a knowledge retention mechanism for leaving employees, they still lack standardized procedures to transfer knowledge. According to participants E and D:

> They usually try their best to arrange a transition period for the departing staff, transition over to the new staff, to hand over important account matters or any Excel models [E-01-KTM-DKT].

3.2 Influence Factors to Knowledge Transfer in MNCs

Three groups of factors that affect knowledge transfer in MNCs are identified, namely, culture differences factors, technical and process factors, and institutional factors.

3.2.1 Cultural Differences

Cultural differences impact knowledge transfer in MNCs by three factors, first, l*anguage differences and geography differences.* Language significantly impacts communication and cooperation within teams. Language differences result in communication not being smooth and teamwork being hindered, creating communication barriers and thus hindering knowledge transfer across boundaries in organizations. This is particularly evident in MNCs. Participant B expressed as:

> … consultants from Morocco speak French. In this way, communication and knowledge transfer were hindered [B-02-C-LG].

Second, geographical differences also impact knowledge transfer, partly due to the disconnection in teamwork interactions caused by time zone differences. According to participant A:

> It's like, it's my morning, you must take my calls. But that's my night…[A-02-C-G].

Third, power distance in MNCs can hinder the knowledge transfer process. Hierarchical structures and cultural norms, for example, the UK and Hong Kong subsidiaries may lead to a sense of self-limitation among employees and hinder close interaction with the team. This may manifest itself in communication patterns such as lengthy explanations in emails, reflecting the need to justify their behavior due to a perceived power differential, thus the efficacy of knowledge transfer within the organization. Participant A exemplified it as follows:

> UK still sends the air of hierarchy right to Hong Kong……there's also going to be power distance in the cultural aspects as well…... people have a sense of self-limiting, that's a sort of a power distance between people and perception……for example, if you work with India team sometimes they write long emails explaining things and explaining why not and all that stuff [A-02-C-PW].

3.2.2 Technical Factor

The lack of specialized platforms and standardized tools is a significant barrier for MNCs to transfer their knowledge. Platforms such as Microsoft 365 and Zoom are commonly used for communication and collaboration within companies. Existing platforms are mainly used for training and documentation rather than as comprehensive knowledge databases to facilitate organizational knowledge sharing and transfer. According to participants B and E:

> We don't have any specialized IT platforms for knowledge sharing, just simply use Microsoft 365 [B-02-SP-P].

> The platforms are designed and only used for training…there is no platform or knowledge database where you can look up easily for information and knowledge [E-02-SP-P].

In terms of tools, MNCs face challenges in centralizing the use of the same tool for all staff across national boundaries, due to the varying needs of different teams and the market challenges associated with replacing systems. There are differences in the level of understanding of analytics and use of tools, as well as varying levels of capacity and sophistication in different locations.

3.2.3 Institutional Differences

Institutional differences are reflected by organizational structure differences, senior management support, and

employee motivation.

There are clear structural differences within Hong Kong multinational organizations, particularly in terms of communication and knowledge transfer between the headquarters and the branch office. The staff of headquarters work independently and have limited interaction with branch staff. The lack of formal reporting and communication channels between the head office and branches has resulted in knowledge and information transfer being compromised due to the organizational design. Despite being part of the same organization, regulatory differences between nations create barriers to effective knowledge exchange. According to participant D:

> There is no official exchange for cross-border branches, we have less chance to the head office to learn from them……it is in two borders, the regulations and regulators are different, for many reasons or situations, it is not easy to exchange or transfer for knowledge……that means the knowledge there (headquarter) and the knowledge here (branch) it's not quite overlap [D-02-I-OS].

In addition, we found a lack of specialized KM teams in large multinational organizations, resulting in insufficient leadership support for KM practices. Senior management prioritizes profitability over KM. Senior management support for knowledge transfer appears to be driven more by profitability considerations than by clear delegation of authority, causing delays in workflow and impeding the effective implementation of knowledge transfer. According to participant B:

> There's no defined knowledge management team, there's no knowledge manager per se for this team…They (Senior managers) are more concerned about if the Commission is making profits. They're not much concerned about knowledge management [B-02-I-SMS].

Employees' motivation to learn new knowledge and share knowledge can affect knowledge transfer in multinational organizations. As employees of MNCs, they may be reluctant to learn new knowledge on their own but rather expect the company to provide training. Many bank employees prefer to wait for formal training rather than actively seek knowledge. Some employees may not be interested in learning about new systems or technologies. Employees may feel hesitant or unwilling to share knowledge unless prompted or in line with the team culture. These employee motivations hinder knowledge transfer in the organization. Participant F mentioned:

> If you don't ask and I (volunteer to) share it (knowledge) with you, I think I'm a little bit weird about that. I won't take the initiative to say [F-02-I-EM].

The factors that influence knowledge transfer in MNCs are shown in Figure 1.

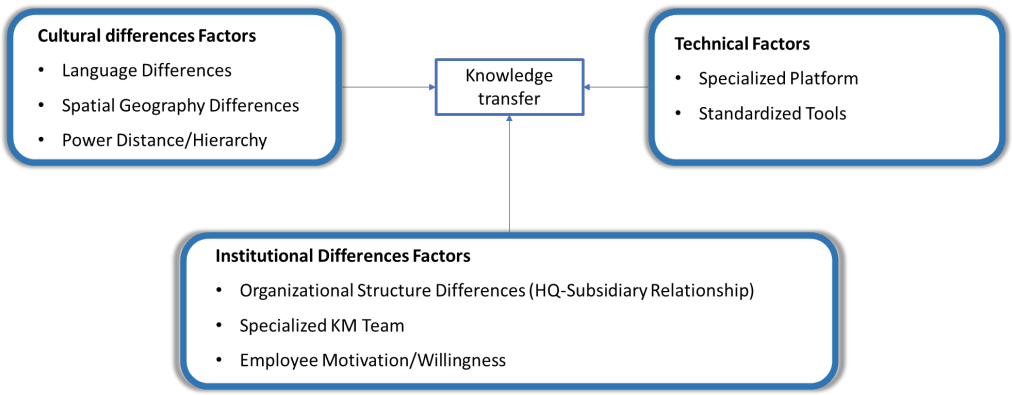


Figure 1: Factors affecting knowledge transfer in MNCs

4. Discussion

Knowledge transfer across boundaries is of vital importance to MNCs (Sharma & Phookan, 2022). However, many multinational organizations are not actively practicing knowledge transfer. Our findings show that MNCs primarily transfer knowledge through on-the-job training, and knowledge-sharing sessions and try to arrange a transition period for departing staff members. These limited approaches to knowledge transfer may impede the organization's ability to effectively transfer and retain critical knowledge assets (Liu, Farzad, et al., 2022; Sumbal et al., 2023). To enhance knowledge transfer within MNCs, organizations need to develop more comprehensive

strategies and mechanisms for transferring knowledge across borders and institutional areas.

The results suggest factors affecting knowledge transfer within MNCs, as well as across borders, including a range of challenges. In line with Gaur et al. (2019), at country level, cultural differences and linguistic barriers, such as differences in communication styles and fluency issues; geographic differences and time zone communication barriers; power distances affecting hierarchies and communication norms; formal and informal institution; structural deficiencies in standardized processes and knowledge transfer mechanisms; these factors largely hinder knowledge transfer across boundaries (Cuervo-Cazurra & Rui, 2017; Liu, Tsui, et al., 2022b). In response to these findings, existing research mentioned that organizations need the formalization and standardization of processes to provide support for their effectiveness as facilitators of consistent knowledge transfer (Zeng et al., 2018). Addressing power distance issues through cultural sensitivity training, fostering open channels of communication can help MNCs transfer and share knowledge more effectively. Besides, MNCs have difficulties in standardizing tools and platforms across locations, limited specialized knowledge platforms lead to differences in capacity and access to resources. A KM system should be developed (Liu, Kianto, et al., 2022) and emerging technologies, such as generative artificial intelligence (Nazeer et al., 2023) can be applied to transfer knowledge in MNCs. Therefore, organizations need to pay more attention to these standardized tools and platforms to create better conditions for effective knowledge transfer and improve organizational performance (Liu, Farzad, et al., 2022; Liu, Kianto, et al., 2022a).

Institutional differences impede cross-border knowledge transfer. MNCs have institutional borders within the organizations, for instance, knowledge transfer from the headquarter to subsidiaries as well as between subsidiaries across borders prevents knowledge exchanges between branches and headquarters (Zeng et al., 2018). Thus, knowledge transfer necessitates a culture of cooperation and collaboration between sources and recipients (Martins, 2016). On the other hand, lack of a specialized KM team and senior management support, and reluctance to learn independently cannot be ignored. Therefore, organizations need to focus on building a knowledge-friendly culture to provide environmental support for knowledge transfer (Liu et al., 2021).

5. Conclusion

This research revealed the issues of knowledge transfer in MNCs under the cross-border and cross-cultural contexts in Hong Kong. It reveals the impact of cultural differences such as power distance, language and geographical disparities on knowledge transfer in MNCs. This study also emphasizes the importance of establishing regulated knowledge transfer mechanisms, formalizing knowledge management processes, and utilizing formal knowledge management platforms and tools across institutions. This study contributes to KM literature by offering a framework that identifies factors that influence knowledge transfer in MNCs, especially in Hong Kong S.A.R., China. Managers can take actions to mitigate the impacts of these factors to achieve effective knowledge transfer in their organizations, for example, building a KM team, developing a knowledge-friendly organizational culture, and initiating KM systems.

There are also several limitations in this research. First, only a small number of employees of major MNCs in the Hong Kong S.A.R., mainly in the financial sector were interviewed, which affects the generalizability of our findings. Within the financial sector, further classification of financial institutions based on their company size, geographical location, and service provision can help to have a better comprehensive understanding of knowledge transfer processes. Research should also be conducted in other regions with a large number of multinationals to understand the relevance of different cultural and institutional differences in knowledge transfer in different regions. The use of different research methods and personnel, e.g. surveying departed employees involved in knowledge transfer transitions, are also recommended.

References

Alavi, M., & Leidner, D. E. (2001). Review: Knowledge management and knowledge management systems: Conceptual foundations and research issues. *Management Information Systems Quarterly, 25,* 107-136. https://doi.org/10.2307/3250961

Argote, L. (2024). Knowledge Transfer Within Organizations: Mechanisms, motivation, and consideration. *Annual Review of Psychology*, *75*, 405-431. https://doi.org/10.1146/annurev-psych-022123-105424

Argote, L., & Ingram, P. (2000). Knowledge transfer: A basis for competitive advantage in firms. *Organizational Behavior and Human Decision Processes*, *82*(1), 150-169. https://doi.org/10.1006/obhd.2000.2893

Chen, J. S., & Lovvorn, A. S. (2011). The speed of knowledge transfer within multinational enterprises: The role of social capital. *International Journal of Commerce and Management*, *21*(1), 46-62. https://doi.org/10.1108/10569211111111694

Cuervo-Cazurra, A., & Rui, H. (2017). Barriers to absorptive capacity in emerging market firms. *Journal of World Business, 52*(6), 727-742. https://doi.org/https://doi.org/10.1016/j.jwb.2017.06.004

Dinur, A., Hamilton Iii, R. D., & Inkpen, A. C. (2009). Critical context and international intrafirm best-practice transfers. *Journal of International Management*, *15*(4), 432-446. https://doi.org/10.1016/j.intman.2008.07.003

Gaur, A. S., Ma, H., & Ge, B. (2019). MNC strategy, knowledge transfer context, and knowledge flow in MNEs. *Journal of Knowledge Management*, *23*, 1885-1900. https://doi.org/10.1108/JKM-08-2018-0476

Grigorescu, A., Zamfir, A.M., & Mocanu, C. (2020). Emerging trends and drivers for knowledge-intensive economy. *Management & Marketing. Challenges for the Knowledge Society*, *15*(2), 172-185, https://doi.org/10.2478/mmcks-2020-0011

Inkpen, A. C., & Tsang, E. W. K. (2005). Social capital networks, and knowledge transfer. *Academy of Management Review*, *30*(1), 146-165. https://doi.org/10.5465/AMR.2005.15281445

Liu, G., Farzad, S., Liu, L., & Zhao, Y. (2022). Knowledge management challenges in start-up companies in China's Great Bay Area. *European Conference on Knowledge Management*, *23*, 764-767. https://doi.org/10.34190/eckm.23.2.575

Liu, G., Kianto, A., & Tsui, E. (2022a). Knowledge management technologies and organizational performance: a meta-analytic study. *Industrial Management & Data Systems*, *123*(2), 386-408. https://doi.org/10.1108/imds-02-2022-0121

Liu, G., Tsui, E., & Kianto, A. (2021). Knowledge-friendly organisational culture and performance: A meta-analysis. *Journal of Business Research*, *134*, 738-753. https://doi.org/10.1016/j.jbusres.2021.05.048

Liu, G., Tsui, E., & Kianto, A. (2022b). How knowledge management differs across national cultures. In Chen J. Nonaka I. (Eds.), *The Routledge Companion to Knowledge Management* (1st ed., pp.211-235). Taylor & Francis Group. https://doi.org/10.4324/9781003112150-17

Martins, J. D. M. (2016). Factors in the effective transfer of knowledge from multinational enterprises to their foreign subsidiaries: A Mozambican case study. *International Journal of Training and Development*, *20*, 224-237. https://doi.org/10.1111/IJTD.12077

Maurer, I., Bartsch, V., & Ebers, M. (2011). The value of intra-organizational social capital: How it fosters knowledge transfer, innovation performance, and growth. *Organization Studies, 32*(2), 157-185. https://doi.org/10.1177/0170840610394301

Mayring, P. (2000). Qualitative content analysis. *Forum: Qualitative Social Research*, *1*(3). https://doi.org/https://doi.org/10.17169/fqs-1.2.1089

Nazeer, S., Sumbal, M. S., Liu, G., Munir, H., & Tsui, E. (2023). The next big thing: role of ChatGPT in personal knowledge management challenges and opportunities for knowledge workers across diverse disciplines. *Global Knowledge, Memory and Communication*. https://doi.org/10.1108/GKMC-07-2023-0246

Paulin, D., & Suneson, K. (2012). Knowledge transfer, knowledge sharing and knowledge barriers—Three blurry terms in KM. *Electronic Journal of Knowledge Management, 10*(1), 81-91.

Pérez-Nordtvedt, L., Kedia, B.L., Datta, D.K. and Rasheed, A.A. (2008), Effectiveness and efficiency of cross-border knowledge transfer: An empirical examination. *Journal of Management Studies*, 45: 714-744. https://doi.org/10.1111/j.1467-6486.2008.00767.x

Qin, C., Wang, Y., & Ramburuth, P. (2017). The impact of knowledge transfer on MNC subsidiary performance: Does cultural distance matter. *Knowledge Management Research and Practice*, *15*(1), 78-89. https://doi.org/10.1057/kmrp.2015.24

Sapuarachchi, D. B. (2021). Cultural distance and inter-organizational knowledge transfer: A case study of a multinational company. *Journal of Knowledge Management*, *25*(9), 2316-2333. https://doi.org/10.1108/JKM-06-2020-0439

Sharifuddin, S.-I. S. O., & Rowland, F. (2004). Knowledge management in a public organization: A study on the relationship between organizational elements and the performance of knowledge transfer. *Journal of Knowledge Management, 8,* 95-111. https://doi.org/10.1108/13673270410529145

Sharma, R. R., & Phookan, H. (2022). Interpersonal knowledge transfer within the multinational enterprise: Incorporating identity based quasi-formal knowledge governance mechanisms. *Cross Cultural and Strategic Management*, *29*(2), 448-468. https://doi.org/10.1108/CCSM-08-2021-0143

Shaw, B., & Luiz, J. M. (2018). The impact of distance (external) and organizational factors (internal) on the knowledge chain of multinational corporations: South Africa as a host country. *Thunderbird International Business Review*, *60*(3), 295-311. https://doi.org/https://doi.org/10.1002/tie.21892

Subanidja, S. & Hadiwidjojo, D. (2017). The influence of knowledge management “bottleneck” on company’s performance. *Management & Marketing. Challenges for the Knowledge Society, 12*(3), 402-415. https://doi.org/10.1515/mmcks-2017-0024

Sumbal, M. S., Ključnikov, A., Durst, S., Ferraris, A., & Saeed, L. (2023). Do you want to retain your relevant knowledge? The role of contextual factors in the banking sector. *Journal of Knowledge Management*, *27*, 2414-2433. https://doi.org/10.1108/jkm-02-2022-0128

World Bank. (2018). *Knowledge management at the World Bank.* World Bank Group. Retrieved from https://www.worldbank.org/en/research/brief/knowledge-management-at-the-world-bank

Zeng, R., Grøgaard, B., & Steel, P. (2018). Complements or substitutes? A meta-analysis of the role of integration mechanisms for knowledge transfer in the MNE network. *Journal of World Business, 53*(4), 415-432. https://doi.org/https://doi.org/10.1016/j.jwb.2018.02.001

Knowledge Management and Resilience in SMEs Sector

Krzysztof Zieba
Gdansk University of Technology, Gdansk, Poland

kzieba@zie.pg.gda.pl

Abstract: Purpose: The aim of this paper is to investigate the role of resilience in surviving major disruptions, such as pandemic or war. This problem is especially vital for small and medium-sized enterprises (SMEs), as they often lack both resources needed for survival during prolonged economic hardship and knowledge management (KM) practices which are useful for developing the necessary business resilience. Methodology: The paper uses literature review approach to investigate the current knowledge on resilience and its dimensions as well as the links between KM, resilience and operational efficiency. Systems Thinking approach is proposed to be used to show the complexity of mechanisms behind those phenomena and the impact they have on business competitiveness in the SMEs sector. Findings: Because of their nature, SMEs were particularly severely hit by the COVID-19 crisis. SMEs now have to adjust to the new reality of the post-crisis phase by developing their business resilience. KM practices prove to offer high potential in resilience creation and resilience maintenance. Specific features of SMEs, if combined with operational agility and resilience, may allow them to successfully face challenges of their turbulent environment. Research limitations: This paper is of a preliminary, conceptual nature. Its further development includes investigation of various aspects of KM relevant to strengthening business resilience in SMEs. More data is still needed to develop and test full Systems Thinking model based on the framework proposed here. Practical implications: SMEs owners and managers may benefit from this paper, as they may use it as a guidance in the process of developing business resilience in their organisations. The insights provided in this paper may be useful for decision makers and also for businesses offering knowledge-based services, offering them a deeper understanding of the presented phenomena and relations between them. Originality/value: The paper is focused on SMEs, which are rarely investigated when it comes resilience creation and benefits it offers. The framework presented here provides important insights, which can be useful to numerous stakeholders.

Keywords: Knowledge Management, Resilience, Smes, COVID-19 Pandemic

1. Introduction

COVID-19 pandemic remains a major global disruption of the XXI century. Its scale was unprecedented (Fernandes, 2020) and its characteristics proved to be very complex (Donthu and Gustafsson, 2020).The pandemic significantly influenced and transformed several aspects of everyday life, education, business operations – to name just a few (van Bavel *et al.*, 2020). It is considered to be an intense example of a black swan event, which had a profound impact on virtually all sectors of economy. Most of them were adversely affected (e.g. healthcare, education, tourism and hospitality) with a few exceptions (e.g. telecommunications) (Ahmad, Kutan and Gupta, 2021). Although the impact of COVID-19 currently fades away, there are still numerous threats to global stability: the war in Ukraine, the instability in the Near East, including the intervention in Gaza zone and the tension between Israel and Iran, as well as the problematic situation between China and Taiwan.

In these turbulent times, the concept of resilience appears to be a critical issue for survival and development of business organisations. The original meaning of this concept, which is over 50 years old, comes from ecology and refers to the ability of an ecosystem to respond to unexpected environmental changes and swiftly return to the original state (Holling, 1973). Resilience became a multi-faceted concept used in a range of scientific disciplines. In the so-called VUCA (Volatility, Uncertainty, Complexity, Ambiguity) world the significance of resilience for all organisations is growing, although there is no one single commonly accepted definition of business resilience nor a universal scale to measure it (Kantur, 2015). Additionally, although small and medium-sized enterprises (SMEs) are often referred to as the backbone of contemporary economies (Cowling *et al.*, 2014), the topic of SMEs resilience is greatly under-researched (Alberti, Ferrario and Pizzurno, 2018).

This papers addresses the following research questions: 1. What is the contribution of resilience to SMEs efficiency? 2. How knowledge management (KM) may be used in SMEs for building their resilience? This paper will aim at answering this question by the application of Systems Thinking theory approach and the usage of Vensim PLE tool. The paper develops as follow. First, the concept of resilience is discussed, particularly in the context of turbulent environment, and SMEs characteristics. Second, the System Thinking approach is discussed and its applicability to analysing complex relationships is justified. Then, the proposed framework of SMEs resilience is presented and explained. In the concluding part of the paper, the role of KM in resilience creation is discussed. The paper is then summarised, theoretical and practical contributions are presented, paper limitations are listed, and avenues for the future research are shown.

2. Knowledge Management and Resilience of SMEs

KM is not so often researched in the context of SMEs. This claim made by Hutchinson and Quintas (2008) remains quite true even today. In the earlier days, SMes were not expected to possess awareness, abilities and resources to manage knowledge, despite of potential benefits they could gain. Hutchinson and Quintas proved however that SMEs not only manage knowledge in the informal way (without use of the language and concpets of KM and formal KM structures), but some of them also engage in formal KM, although more occassionally. KM in SMEs remains limited and the major focus is on KM implementation, KM perception, and knowledge transfer rather than knowledge identification, knowledge storage/retention, and knowledge utilisation (Durst and Edvardsson, 2012). Those three last issues seem to be particularly applicable when it comes to SMEs resilience.

The concept of resilience is rooted in ecology and for a few decades it remained absent in social sciences. At the beginning of the XXI century first papers on a more general application of resilience were published (Hamel and Välikangas, 2003), including those related to supply chain management. Considering resilience in the context of supply chain management was a response to September 11, 2001 events, which crippled many American companies dependent on their just-in-time discipline. Subsequent events, such as the train bombings in Madrid (March 11, 2004) and the London's transportation system bombings on July 2005 just added more to this picture (Sheffi and Rice, 2005). The real trigger for analysing resilience in a broader economic context, exceeding just supply chain problems, was the financial crisis of 2008/2009. From that time on, resilience research focuses on such research streams, as organisational responses to external threats, organisational reliability, employee strengths, adaptability of business models and designing principles that may reduce supply chain vulnerability and impact of disruptions (Linnenluecke, 2017). It also became evident that contextualisation of the resilience concept must take into account also SMEs. (Dahles and Susilowati, 2015). They are more vulnerable than their bigger counterparts, as they have less resources to tackle the encountered problems. SMEs face recurrent and multifaceted problems ranging from natural disasters and economic crises to market access challenges, political turmoil and institutional failures (Littlewood and Holt, 2018). It is evident that the majority of publications on resilience are focused on event-driven disruptions (like the above-mentioned ones or the latest COVID-19 pandemic) and most of the studies evaluate such event-driven disruptions in the attempt to propose improvements to business resilience (Kantur, 2015). We still lack a more general understanding of the resilience concept that would emerge from those single disruptions (Littlewood and Holt, 2018).

This general understanding of resilience is difficult to achieve for a number of reasons. Firstly, the concept of resilience would differ across various disciplines. In engineering or physical science the feature of resilience is based on the ability of the system to return to the previous, original state after having experienced a disruption (Dahlberg and Guay, 2015). This original state is the equilibrium of the system and in this approach the system has just one equilibrium state. In other sciences, however, resilience is often focused more on adaption. In psychology, resilience is about the ability to achieve positive performance during unfolding disruption, suggesting that multiple equilibria are possible (Linnenluecke, 2017). This "single equilibrium" approach does not seem appropriate for analysing resilience of SMEs, as it is limited to a "machine view" of organisations with oversimplified cause-and-effect dynamics (Tognazzo, Gubitta and Favaron, 2016). The resilience of SMEs should differ from "engineering resilience" (Conz, Denicolai and Zucchella, 2017), as it incorporates adaptability and ability to keep positive performance a mid of continuing disruptions and challenges and does not cling on to the same state of the business, external relations, internal processes, etc. Additionally, the resilience of SMEs may be substantially different from the resilience of large enterprises. It is a common mistake to assume that conceptual frameworks and organisational theories developed by researching large enterprises may be successfully used for SMEs (Ates and Bititci, 2011; Sullivan-Taylor and Branicki, 2011). Small businesses are not "little big businesses" and apart from obvious quantitative differences they also differ in qualitative way from large organisations. For the need of this paper, the SMEs resilience concept is defined as "not just the one about minimising and managing the impact of the disaster, but also about creating the agility needed to adapt to unexpected challenges and the ability to seize opportunity from adversity" (Alberti, Ferrario and Pizzurno, 2018). Both SMEs resilience and also their competitiveness are shaped by three groups of factors: internal – organisational behaviour, managerial characteristics and overall quality; external – globalisation, and enabling – use of technology, generation of capital, location and marketing, and supply chain integration (Gunasekaran, Rai and Griffin, 2011). In particular, creating resilient SMEs requires knowledge retention through a flexible workforce, proper strategic managerial thinking, but also personal relationship, networking ability, organisational structure and people management (Alberti, Ferrario and Pizzurno, 2018).

3. Systems Thinking Approach to Resilience Research

Systems Thinking is a term having a few meanings (Cabrera, Colosi and Lobdell, 2008). It can be treated as a perspective, a language or as a set of tools, which include causal loop diagrams. Systems Thinking is defined as opposite to linear thinking and offers holistic approach to the analysed phenomena. Its possible applications span across various fields and disciplines (Monat and Gannon, 2015). Systems Thinking is particularly useful when dealing with complexity, as it involves uncertainty, perceiving things form various perspectives, lack of a singular "right answer". Complexity also defies linear logic, leading to various possible outcomes (Kay, 2008).

Systems Thinking approach has already been quite widely used with application to ecology, which is characterised by high level of complexity and interrelations within ecological systems and between them (Hogan and Weathers, 2006; Davis and Stroink, 2016). This wide use of Systems Thinking for investigating ecological issues contributed to gradual adoption of this approach to other scientific areas, such as sustainability and sustainability management (Williams *et al.*, 2017) and broad socio-technical problems (Davis *et al.*, 2014).

Papers that utilise Systems Thinking approach to investigate resilience are relatively scarce. Some of them are of rather general nature, triggered by the COVID-19 pandemic (Hynes *et al.*, 2020; Saulnier *et al.*, 2021). There are also streams of papers focused on community resilience (Mavhura, 2017; Helfgott, 2018), on urban resilience (Connolly, 2018; Robbins, 2022) and supply chain management (Tsolakis, Zissis and Tjahjono, 2023; Wieland *et al.*, 2023). The most promising paper on business resilience research using Systems Thinking draws viewpoints from ecology, physics, sociology, psychology and disaster management to develop a research framework for enterprise resilience (Wright *et al.*, 2012), although it does not adopt the perspective of SMEs.

To sum up, the fundamental systems-thinking perspectives and approaches include: attention to how new knowledge is gained, managed, exchanged, interpreted, integrated, and disseminated, a network-centric approach based on building relations among and between individuals and organizations, the development of models and projections, using a variety of analytic approaches (Leischow *et al.*, 2008). Systems thinking is also perceived as a valuable methodology, particularly suitable for Knowledge Management-related considerations (Rubenstein-Montano *et al.*, 2001; Cavaleri, 2005), offering new ways of thinking and a useful toolbox on different levels and phases of Knowledge Management for practical knowledge users (Gao, li and Nakamori, 2002). The current economic situation is multifactorial, dynamic and nonlinear, hence compartmental knowledge originating from scientific silos is likely to obstruct understanding of the inter-relations among all the significant variables (Leischow *et al.*, 2008). Therefore, the Systems Thinking approach can be considered as the one offering adequate tools for analysing business operations with respect to resilience, efficiency and the role of KM in shaping their relations.

4. SMEs Resilience in Turbulent Times of Globalisation

Globalisation made business world much more turbulent than ever before. Disruptions resulting from natural and man-made disasters are no longer of local or regional scale, as they are transmitted globally through the system of world economy. Increased complexity in the supply chains result in unexpected problems in production and sales. Those risks cannot be avoided, but they can be mitigated or even successfully for improving business performance used through resilience-building in companies (Yu *et al.*, 2019; Wong *et al.*, 2020). Trying to do so became a top priority for business executives in large organisations and SMEs should follow that path.

As can be seen in Figure 1., the impact of disruption on operational efficiency of businesses depends on how severe disruptions are and how often businesses are hit by disruptions. The frequency of disruptions is growing because organizations live and compete in a world that is increasingly interconnected both socially and technologically, making them prone to the so-called "butterfly effect" which is likely to appear in wide interconnected networks of companies. Disruptions are likely to cripple operational efficiency of businesses, leading to lower competitiveness, losing market shares and even business discontinuation. Positive role of resilience in increasing operational efficiency is not obvious, especially in the short run (Gölgeci, Yildiz and Andersson, 2020). On way of creating resilience is building redundancies in the company. Redundancies would operate as a buffer during a disruption (Disruption Absorption), but building and maintaining them is costly. Those additional costs are likely to lower operational efficiency of a business, leading to loosing competitiveness. Another dimension of operational resilience is recoverability. It may be partly based on redundancies representing cost increase, but also – to a greater extent – on flexibility. Unlike redundancies, flexibility yields a number of additional, day-today benefits (Sheffi and Rice, 2005).

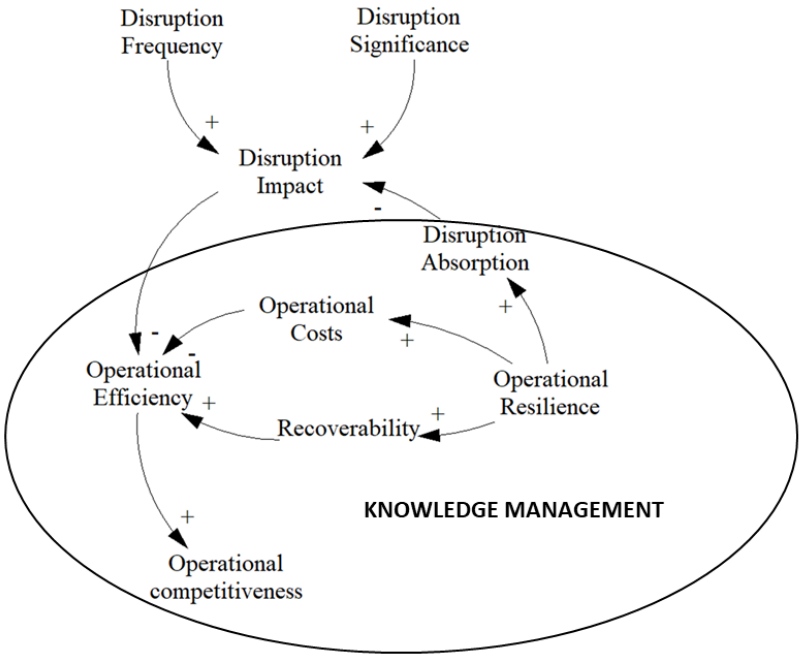


Figure 1: The role of resilience in surviving in turbulent environment (own elaboration using Vensim PLE).

Studies show that both disruption absorption and recoverability have positive, yet unique effects on operational efficiency under varying disruption conditions (Essuman, Boso and Annan, 2020). Although SMEs are more vulnerable to disruptions because of more limited resources, they also have some advantages regarding building resilience. Due to their characteristics they can benefit from less formal procedures and bureaucracy, short decision chains resulting in rapid decision-making, natural flexibility of small and more informal organisation and capacity of fast learning, if only they aspire to operate as a learning organisation (Alberti, Ferrario and Pizzurno, 2018).

5. KM in Resilience Creation

Knowledge is acknowledged as a vital aspect for improving resilience capabilities (FardH and Fani, 2015). As a consequence, Knowledge Management seems to be a very useful tool to build and enhance resilience. In the educational context, Knowledge Management Process, Knowledge Management System Infrastructure, and Knowledge System Quality proved to be effective, resilient strategies that allowed to convert challenges into opportunities during COVID-19 pandemic. In particular, Knowledge Management Process was positively and significantly associated employee commitment and performance, while knowledge sharing, accessibility and application further contributed to increased resilience (Sivagnanam *et al.*, 2023) Higher education institutions are knowledge intensive; their employees – faculty – can be considered as knowledge workers (Bratianu, 2014; Cegarra-Navarro, Garcia-Perez and Bedford, 2020). Therefore, KM practices may be easier to conduct in such a environment. The use of KM practices in SMEs is probably more challenging, but the applicability of the model developed by Sivagnanam (2023) in the context of SMEs is very likely.

In the context of healthcare systems and their response to the COVID-19 pandemic, research suggests that Knowledge Management serves as a significant predictor of organisational resilience and agility. Acquiring, sharing and applying new knowledge results in increased proactivity, adaptivity, agility and resilience (Ibrahim Ismael, Mamdouh El-kholy and Saeed Ahmed Abd-Elrhaman, 2021). Those findings corroborate with earlier results obtained in business context, namely in the banking sector. Knowledge creation process proved to enhance resilience capabilities, contributing to improvement in business performance. Knowledge creation and knowledge sharing activities also develop organisational agility and innovativeness (Alharthy, Sohaib and Hawryszkiewycz, 2018).

One of the possible ways that KM may positively influence business resilience is its link to social capital improvement. Recent research suggests that social capital can be a critical resource of both resilience in the times of crises and disruptions (when it is really needed) and also of efficiency under calmer conditions, when resilience is less useful (Sözbilir, 2018; Gölgeci and Kuivalainen, 2020). Being an element of social capital, social

networks also offer avenues for increased mobilization and transfer of knowledge, dissemination of innovative activities, which in turn increase the resilience of companies (Demmer, Vickery and Calantone, 2011).

The resilience of SMEs is constrained by their behavioural and organisational characteristics, accompanied also by limited access to resources. In order to develop the resilience of SMEs, they should place emphasis on soft aspects of change management (including people, organisational and cultural aspects), planning, preparation and embedding phases of the change process, driving the change internally and adopting proactive rather than reactive attitude (Ates and Bititci, 2011). Knowledge management practices may prove to be an invaluable tool for achieving most of those issues.

6. Conclusions

Research on resilience in business context is still rather fragmented. The concept of resilience lacks clear and common definition, measurement scale and theoretical framework. Yet, resilience becomes more and important for contemporary businesses in their struggle to survive and develop in their increasingly competitive and unstable environment. Although SMEs may be perceived as more vulnerable in this respect, they have also their advantages over bigger counterparts, such as less bureaucracy, the possibility of rapid decision-making and rapid communication, as well as shorter processes.

The potential of Knowledge Management in the area of resilience creation and maintenance is high and still not fully researched, especially with regard to SMEs. The aim of this paper is to shed some light on the possible role of Knowledge Management in making SMEs more resilient. The major limitation of the paper is that at this stage of development, the whole model of KM role in SMEs resilience creation is just preliminarily sketched. It will be further developed and completed using causal loop diagrams. Once completed, it will offer food-for-thought for various stakeholders, including SMEs owners and managers, institutions that support small business development and policy makers.

References

Ahmad, W., Kutan, A. M. and Gupta, S. (2021) 'Black swan events and COVID-19 outbreak: Sector level evidence from the US, UK, and European stock markets', *International Review of Economics & Finance*, 75, pp. 546–557. doi: https://doi.org/10.1016/j.iref.2021.04.007.

Alberti, F. G., Ferrario, S. and Pizzurno, E. (2018) 'Resilience: Resources and strategies of SMEs in a new theoretical framework', *International Journal of Learning and Intellectual Capital*. Inderscience Publishers, 15(2), pp. 165–188. doi: 10.1504/IJLIC.2018.091969.

Alharthy, A., Sohaib, O. and Hawryszkiewycz, I. (2018) 'The impact of knowledge creation on organizational resilience towards organizational performance', in *Proceedings of the 27th International Conference on Information Systems Development: Designing Digitalization, ISD 2018*. Available at: https://aisel.aisnet.org/isd2014/proceedings2018/ISDevelopment/10 (Accessed: 8 May 2024).

Ates, A. and Bititci, U. (2011) 'Change process: A key enabler for building resilient SMEs', *International Journal of Production Research*. Taylor & Francis Group, 49(18), pp. 5601–5618. doi: 10.1080/00207543.2011.563825.

van Bavel, J. J. *et al.* (2020) 'COVID-19 pandemic response', *Nature Human Behaviour*. Springer US, 4(May), pp. 460–471. doi: 10.1038/s41562-020-0884-z.

Bratianu, C. (2014) 'Intellectual capital of the European universities', in *Handbook of research on trends in European higher education convergence*. IGI Global, pp. 24–43.

Cabrera, D., Colosi, L. and Lobdell, C. (2008) 'Systems thinking', *Evaluation and Program Planning*. Pergamon, 31(3), pp. 299–310. doi: 10.1016/j.evalprogplan.2007.12.001.

Cavaleri, S. A. (2005) 'Systems Thinking for Knowledge', *World Futures*. Routledge, 61(5), pp. 378–396. doi: 10.1080/026040290500606.

Cegarra-Navarro, J.-G., Garcia-Perez, A. and Bedford, D. (2020) 'Contextual Enablers and Behaviour Outputs for Action of Knowledge Workers', *International Journal of Economics and Management Engineering*, 14(12), p. 7.

Connolly, J. J. T. (2018) 'From Systems Thinking to Systemic Action: Social Vulnerability and the Institutional Challenge of Urban Resilience', *City and Community*. Blackwell Publishing Ltd, 17(1), pp. 8–11. doi: 10.1111/CICO.12282/ASSET/CICO.12282.FP.PNG_V03.

Conz, E., Denicolai, S. and Zucchella, A. (2017) 'The resilience strategies of SMEs in mature clusters', *Journal of Enterprising Communities*. Emerald Group Publishing Ltd., 11(1), pp. 186–210. doi: 10.1108/JEC-02-2015-0015.

Cowling, M., Liu W., Ledger A., N Zhang N. (2014) 'What really happens to small and medium-sized enterprises in a global economic recession? UK evidence on sales and job dynamics', *http://dx.doi.org/10.1177/0266242613512513*. SAGE PublicationsSage UK: London, England, 33(5), pp. 488–513. doi: 10.1177/0266242613512513.

Dahlberg, R. and Guay, F. (2015) 'Creating resilient SMEs: is business continuity management the answer?', in *WIT Transactions on The Built Environment*. WIT Press, pp. 975–984. doi: 10.2495/sd150852.

Dahles, H. and Susilowati, T. P. (2015) 'Business resilience in times of growth and crisis', *Annals of Tourism Research*. Pergamon, 51, pp. 34–50. doi: 10.1016/J.ANNALS.2015.01.002.

Davis, A. C. and Stroink, M. L. (2016) 'The Relationship between Systems Thinking and the New Ecological Paradigm', *Systems Research and Behavioral Science*. John Wiley & Sons, Ltd, 33(4), pp. 575–586. doi: 10.1002/sres.2371.

Davis, M. C., Challenger R., Jayewardene D.N.W., Clegg C.W. (2014) 'Advancing socio-technical systems thinking: A call for bravery', *Applied Ergonomics*. Elsevier, 45(2), pp. 171–180. doi: 10.1016/J.APERGO.2013.02.009.

Demmer, W. A., Vickery, S. K. and Calantone, R. (2011) 'Engendering resilience in small-and medium-sized enterprises (SMEs): A case study of Demmer Corporation', *International Journal of Production Research*. Taylor & Francis Group, 49(18), pp. 5395–5413. doi: 10.1080/00207543.2011.563903.

Donthu, N. and Gustafsson, A. (2020) 'Effects of COVID-19 on business and research', *Journal of business research*. 2020/06/09. Elsevier Inc., 117, pp. 284–289. doi: 10.1016/j.jbusres.2020.06.008.

Durst, S. and Edvardsson R. I. (2012), "Knowledge management in SMEs: a literature review", *Journal of Knowledge Management*, Vol. 16 No. 6, pp. 879-903. https://doi.org/10.1108/13673271211276173

Essuman, D., Boso, N. and Annan, J. (2020) 'Operational resilience, disruption, and efficiency: Conceptual and empirical analyses', *International Journal of Production Economics*, 229, p. 107762. doi: https://doi.org/10.1016/j.ijpe.2020.107762.

FardH, D. and Fani, A. A. (2015) 'Knowledge management and organizational resilience in Iranian public organizations', in *Information and knowledge Management*, pp. 32–43.

Fernandes, N. (2020) *Economic effects of coronavirus outbreak (COVID-19) on the world economy*, *SSRN Electronic Journal, ISSN 1556-5068, Elsevier BV,*.

Gao, F., li, M. and Nakamori, Y. (2002) 'Systems thinking on knowledge and its management: Systems methodology for knowledge management', *Journal of Knowledge Management*. MCB UP Ltd, 6(1), pp. 7–17. doi: 10.1108/13673270210417646.

Gölgeci, I. and Kuivalainen, O. (2020) 'Does social capital matter for supply chain resilience? The role of absorptive capacity and marketing-supply chain management alignment', *Industrial Marketing Management*. Elsevier, 84, pp. 63–74. doi: 10.1016/j.indmarman.2019.05.006.

Gölgeci, I., Yildiz, H. E. and Andersson, U. (2020) 'The rising tensions between efficiency and resilience in global value chains in the post-COVID-19 world', *Transnational Corporations*, 27(2), pp. 127–141. doi: 10.18356/99b1410f-en.

Gunasekaran, A., Rai, B. K. and Griffin, M. (2011) 'Resilience and competitiveness of small and medium size enterprises: An empirical research', *International Journal of Production Research*. Taylor & Francis Group, 49(18), pp. 5489–5509. doi: 10.1080/00207543.2011.563831.

Hamel, G. and Välikangas, L. (2003) 'The Quest for Resilience', *Harvard Business Review*, pp. 355–358. Available at: https://revistas.comillas.edu/index.php/revistaicade/article/view/7226 (Accessed: 6 May 2024).

Helfgott, A. (2018) 'Operationalising systemic resilience', *European Journal of Operational Research*. North-Holland, 268(3), pp. 852–864. doi: 10.1016/J.EJOR.2017.11.056.

Hogan, K. and Weathers, K. C. (2006) 'Psychological and Ecological Perspectives on the Development of Systems Thinking', in *Understanding Urban Ecosystems*. Springer, New York, NY, pp. 233–260. doi: 10.1007/0-387-22615-x_15.

Holling, C. S. (1973) 'Resilience and Stability of Ecological Systems', *Annual Review of Ecology, Evolution, and Systematics*. Annual Reviews, 4(Volume 4, 1973), pp. 1–23. doi: 10.1146/ANNUREV.ES.04.110173.000245.

Hutchinson, V., & Quintas, P. (2008). Do SMEs do Knowledge Management?: Or Simply Manage what they Know? *International Small Business Journal*, 26(2), 131-154. https://doi.org/10.1177/0266242607086571

Hynes, W. Trump B., Love P., I Linkov I. (2020) 'Bouncing forward: a resilience approach to dealing with COVID-19 and future systemic shocks', *Environment Systems and Decisions*. Springer, 40(2), pp. 174–184. doi: 10.1007/s10669-020-09776-x.

Ibrahim Ismael, Z., Mamdouh El-kholy, S. and Saeed Ahmed Abd-Elrhaman, E. (2021) 'Knowledge Management as a predictor of Organizational Resilience and Agility', *Egyptian Journal of Health Care*. Egypts Presidential Specialized Council for Education and Scientific Research, 12(4), pp. 1397–1412. doi: 10.21608/ejhc.2021.209025.

Kantur, D. (2015) 'Measuring Organizational Resilience: A Scale Development', *Pressacademia*. PressAcademia, 4(3), pp. 456–456. doi: 10.17261/pressacademia.2015313066.

Kay, J. J. (2008) 'An introduction to systems thinking', *The ecosystem approach: Complexity, uncertainty, and managing for sustainability*. Columbia University Press: New York, NY, USA, pp. 3–13.

Leischow, S. J., Best A., Trochim W.M., Clark P.I., Gallagher R.S., Marcus S.E., Matthews E. *et al.* (2008) 'Systems thinking to improve the public's health', *American journal of preventive medicine*. Elsevier, 35(2), pp. S196–S203.

Linnenluecke, M. K. (2017) 'Resilience in Business and Management Research: A Review of Influential Publications and a Research Agenda', *International Journal of Management Reviews*. John Wiley & Sons, Ltd, 19(1), pp. 4–30. doi: 10.1111/IJMR.12076.

Littlewood, D. and Holt, D. (2018) 'Social enterprise resilience in sub-Saharan Africa', *Business Strategy and Development*. John Wiley & Sons, Ltd, 1(1), pp. 53–63. doi: 10.1002/bsd2.11.

Mavhura, E. (2017) 'Applying a systems-thinking approach to community resilience analysis using rural livelihoods: The case of Muzarabani district, Zimbabwe', *International Journal of Disaster Risk Reduction*. Elsevier, 25, pp. 248–258. doi: 10.1016/J.IJDRR.2017.09.008.

Monat, J. P. and Gannon, T. F. (2015) 'What is systems thinking? A review of selected literature plus recommendations', *American Journal of Systems Science*, 4(1), pp. 11–26.

Robbins, M. (2022) 'Urban Resilience: Moving from Idealism to Systems Thinking', *The Palgrave Encyclopedia of Urban and Regional Futures*. Palgrave Macmillan, Cham, pp. 2066–2071. doi: 10.1007/978-3-030-87745-3_17.

Rubenstein-Montano, B., Liebowitz J., Buchwalter J., McCaw D., Newman B., Rebeck K. (2001) 'A systems thinking framework for knowledge management', *Decision Support Systems*, 31(1), pp. 5–16. doi: https://doi.org/10.1016/S0167-9236(00)00116-0.

Saulnier, D. D. *et al.* (2021) 'A health systems resilience research agenda: moving from concept to practice', *BMJ Global Health*. BMJ Specialist Journals, 6(8), p. e006779. doi: 10.1136/bmjgh-2021-006779.

Sheffi, Y. and Rice, J. B. (2005) 'A supply chain view of the resilient enterprise', *MIT Sloan Management Review*. Available at: https://sloanreview.mit.edu/article/a-supply-chain-view-of-the-resilient-enterprise/ (Accessed: 6 May 2024).

Sivagnanam, P., Pillai A.R., Elangovan R., Parayitam S. (2023) 'Knowledge management process, infrastructure, and system quality as resilient strategies to respond to COVID-19 pandemic challenges: Evidence from higher educational institutions in India', *Knowledge and Process Management*. John Wiley & Sons, Ltd, 30(4), pp. 333–354. doi: 10.1002/kpm.1722.

Sözbilir, F. (2018) 'The interaction between social capital, creativity and efficiency in organizations', *Thinking Skills and Creativity*. Elsevier, 27, pp. 92–100. doi: 10.1016/j.tsc.2017.12.006.

Sullivan-Taylor, B. and Branicki, L. (2011) 'Creating resilient SMEs: Why one size might not fit all', *International Journal of Production Research*. Taylor & Francis Group, 49(18), pp. 5565–5579. doi: 10.1080/00207543.2011.563837.

Tognazzo, A., Gubitta, P. and Favaron, S. D. (2016) 'Does slack always affect resilience? A study of quasi-medium-sized Italian firms', *Entrepreneurship and Regional Development*. Routledge, 28(9–10), pp. 768–790. doi: 10.1080/08985626.2016.1250820.

Tsolakis, N., Zissis, D. and Tjahjono, B. (2023) 'Scrutinising the interplay between governance and resilience in supply chain management: A systems thinking framework', *European Management Journal*. Pergamon, 41(1), pp. 164–180. doi: 10.1016/j.emj.2021.11.001.

Wieland, A., Stevenson M., Melnyk S.A., Davoudi S., Schultz L. (2023) 'Thinking differently about supply chain resilience: what we can learn from social-ecological systems thinking', *International Journal of Operations and Production Management*. Emerald Publishing, 43(1), pp. 1–21. doi: 10.1108/IJOPM-10-2022-0645.

Williams, A., Kennedy S., Philipp F., Whiteman G. (2017) 'Systems thinking: A review of sustainability management research', *Journal of Cleaner Production*, 148, pp. 866–881. doi: https://doi.org/10.1016/j.jclepro.2017.02.002.

Wong, C. W. Y., Lirn T.C., Yang C.C, Shang K.C. (2020) 'Supply chain and external conditions under which supply chain resilience pays: An organizational information processing theorization', *International Journal of Production Economics*. Elsevier, 226, p. 107610. doi: 10.1016/j.ijpe.2019.107610.

Wright, C., Kiparoglou V., Williams M., Hilton J. (2012) 'A framework for resilience thinking', in *Procedia Computer Science*. Elsevier, pp. 45–52. doi: 10.1016/j.procs.2012.01.012.

Yu, W., Jacobs M.A., Chavez R., Yang J. (2019) 'Dynamism, disruption orientation, and resilience in the supply chain and the impacts on financial performance: A dynamic capabilities perspective', *International Journal of Production Economics*. Elsevier, 218, pp. 352–362. doi: 10.1016/J.IJPE.2019.07.013.

Knowledge Management Impact on Corporate Social Responsibility: A Systematic Literature Review

Ludovica Zoccali, Alessia Talarico, Antonio Lorena and Rocco Reina
University Magna Græcia of Catanzaro, Catanzaro, Italy

ludovica.zoccali@studenti.unicz.it
alessia.talarico2@studenti.unicz.it
antonio.lorena87@gmail.com
rreina@unicz.it

Abstract: In the past few years, in the current organisational context, the impact of Knowledge Management (KM) on Corporate Social Responsibility (CSR) has become increasingly important for companies in all sectors, as many of them are acting on a larger scale to be competitive in the global marketplace. In fact, KM helps generate sustainable innovation through inclusive CSR implementation practices (Shih, 2024). Companies are required to have a correct approach to Sustainable Knowledge Management (SKM) in order to practice the CSR model. SKM practices promote responsible and ethical knowledge sharing between different stakeholders (Alghamdi et al, 2023) and include several benefits. Promoting innovation and facilitating continuous learning, they ensure the effective and efficient use of KM. That is why this trend focuses on the development and application of innovative technologies. Based on that, this study aims to understand how KM influences CSR considering the role of Technology. The methodological approach is based on a systematic literature review (Tranfield et al, 2003). Particularly, this research was conducted in the three international and multidisciplinary databases – Google Scholar, Scopus and Web of Science – using query strings given by combinations of the keywords: "Knowledge Management", "Corporate Social Responsibility," "CSR," and "Tech*". Subsequently, the resulting scientific documents were selected following the PRISMA guidelines (Moher et al, 2015; Xiao and Watson, 2019), and the data were examined using inductive content analysis. In this article, the authors draw on current literature to identify plausible gaps and discuss future implications of a new perspective. Although the topic is relevant, the findings suggest that academics have many opportunities to examine it.

Keywords: Knowledge Management, Corporate Social Responsibility, CSR, Tech*

1. Introduction

In the past few years, in the current organisational context, the impact of Knowledge Management (KM) on Corporate Social Responsibility (CSR) has become increasingly important for companies in all sectors. Many of them are acting on a larger scale to be competitive in the global marketplace and are including the principles of sustainable development in their business strategies.

In fact, KM helps generate sustainable innovation through inclusive CSR implementation practices (Shih, 2024).

Following the most relevant studies on KM, it is possible to describe it as the process through which an organisation generates, shares, and utilizes knowledge to achieve its objective (Nonaka and Takeuchi, 1995).

The importance of this essential classification underscores the dynamic and interactive nature of KM, highlighting the ongoing process of knowledge creation and application in an organizational context.

More specifically, it is also possible to theorize that KM involves the creation, storage, transfer and application of knowledge within organisations (Alavi and Leidner, 2001). This approach captures the entire spectrum of KM activities, from the initial knowledge generation to its eventual use in decision-making and innovation process. A more comprehensive view identifies KM as a systematic practice of acquiring, organising, and communicating employee knowledge to make it available, actionable, and useful (Davenport and Prusak, 1998). This outlook outlines the structured and methodical approach required for effective KM practices, assuring that valuable insights are available within the organization.

On the contrary, defining CSR is more complex because CSR concept has evolved over the decades, changing its defining boundaries (Carroll, 1999). Using a modernized formulation, it could be defined as the summation of "organizational actions and policies that consider several types of stakeholders and the triple bottom line of economic, social, and environmental performance" (Aguinis, 2011). Simplifying, as a management orientation integrating an organisation's desire to eliminate or reduce the negative effects of its activities on the environment and society through ethically sound strategic visions.

According to these theoretical premises, companies are required to have a correct approach to Sustainable Knowledge Management (SKM) in order to practice the CSR model. SKM practices promote responsible and

ethical knowledge sharing between different stakeholders (Alghamdi et al, 2023) and include several benefits. They ensure that KM is being used efficiently and effectively, promoting innovation and facilitating continuous learning. That is why this trend focuses on developing and applying new technologies.

Understood in this way, Technology includes practical applications of scientific knowledge to improve organisational and operational processes (Daft and Armstrong, 2021). This definition includes a wide range of technological tools and systems that can optimize efficiency and effectiveness in different organizational areas. As described by Drucker (1999), Technology is seen as the set of tools, machinery and procedures used to solve specific problems and improve operational efficiency.

Additionally, it is possible to reveal the transformative potential of digital technology in business models and innovation: digital advancements are not only enhancing existing processes but also creating new opportunities for business growth and competitive advantage through innovative applications. Therefore, Technology, especially digital technology, is essential for transforming business models and driving innovation (Porter and Heppelmann, 2014).

Nowadays, “global economic development based on sustainability is only possible through broadly understood knowledge” (Krawczyk, 2022) and understanding how KM practices are more relevant to CSR is a new critical challenge. The challenges faced by current organisations have changed significantly compared to the past due to global processes, new environmental and ethical issues, and the advent of new technologies in organisational functioning. Therefore, the public interest that governmental and institutional pressures promote leads organisations to adopt a sustainable economic development model that can satisfy the needs of current stakeholders without compromising the needs of future generations.

Combined with the concept of innovation, sustainability is part of a binomial supporting corporate competitive advantages. In fact, companies adopting a CSR model with the goal of creating sustainable value cannot ignore technological innovation processes: to pursue a sustainable competitive advantage, increasing both productivity and environmental protection, enterprises continuously apply new technologies and their ability to transform knowledge into new technologies is relevant (Krawczyk and Kokot-Stępień, 2023).

Related to this, KM is crucial because it is capable of encouraging the development of innovation and facilitates continuous learning. Its relevance for organisational success is widely recognized in literature (Drucker, 1993; Grant, 1991; Nonaka and Takeuchi, 1995).

Despite the acknowledged intensity of the connection between KM and CSR, recent studies have argued that "there is a paucity of management programmes on CSR, which creates a knowledge gap in the implementation of CSR by modern organisations" (Krawczyk, 2022).

Moving from these considerations and considering this gap, this research aims to understand KM's influence on CSR and discover the role of Technology in this relationship.

After this brief introduction and the identification of the research purpose (1), the authors develop the remainder of this study into the following paragraphs: “Methodological design” sets out the theoretical backgrounds and the methodological steps followed in the systematic literature review and data collection process (2); "Findings and discussions” presents the most relevant results obtained during research activity (3); “Stimuli and implications, limitations and future research directions” discusses the results, main limitations and implications for future research (4).

2. Methodological Design

This study offers a theoretical framework on the topic above, applying a methodological approach based on a systematic literature review (Tranfield et al, 2003).

Specifically, the main methodological goal of this article is to review and systemize available academic information to answer the following questions:

1. What Is The Impact Of KM On CSR?
2. What Is The Role Of Technology In The KM-CSR Relationship?

A frame of reference to the theoretical background used for the systematic literature review is helpful in achieving this specific objective. Of the various types of literature reviews that could be referred to for the methodological design of this study, the systematic review was preferred to the other typologies as it is more suitable for its compliance with defined methodological criteria (Xiao and Watson, 2019) and it is coherent with

the need to understand the progress of studies on this topic. Indeed, it outlines possible new directions for further research, which could lead to a broader understanding of the phenomenon and an innovative framework.

Moreover, it is a very businesslike methodology for academics and researchers, managers, business professionals and entrepreneurs. In fact, according to Tranfield et al (2003), "a good systematic review should make it easier for the practitioner to understand the research by synthesizing extensive primary research papers from which it was derived" and also “systematic review can be argued to lie at the heart of a pragmatic management research, which aims to serve both academic and practitioner communities”.

Against this background, the following two sub-sections illustrate the systematic approach used to outline the collected academic contributions, which proves a reliable and repeatable process.

2.1 Methodological Steps

Before investigating the state of the literature on the defined research questions and evaluating the studies included in the selection, the authors developed an inclusive review protocol of the criteria and strategies for searching, evaluating and synthesizing the data. During this phase, they identified keywords based on the search questions and they chose reference databases; subsequently, they designated selection criteria.

The research was conducted in the three international and multidisciplinary databases: Google Scholar (GS), Scopus, and Web of Science (WoS), using query strings given by combinations of the following keywords: "Knowledge Management", "Corporate Social Responsibility", "CSR", and "Tech*".

In particular, the choice of the databases GS, Scopus and WoS depended on several factors: 1) they are the databases widely used by academic scholars; 2) they are international and multidisciplinary sources of data and knowledge (in particular, the multidisciplinary allows the researcher to easily search outside of his discipline); 3) neither database is inclusive but each complements the other (Burnham J., 2006). Particularly, the specific choice to also use the GS database was due to its more extensive numerical availability of contributions on the topic researched. In fact, according to Walters (2007), “GS might be expected to provide especially good coverage of the literature due to its size and interdisciplinary scope”, despite its lack of possibility to filter results with regard to subject area.

Instead, in relation to the choice of keywords, the authors preferred to filter the keyword "Knowledge Management" instead of other knowledge management classifications in order to include all KM practices in the search. With the aim of amplifying the results relating to the Corporate Social Responsibility, the expression was considered both in its extension "Corporate Social Responsibility" and in its acronym "CSR". In addition, the keyword “Tech*” was chosen as the root of the term “Technology” with the intention of including all declinations of the term without altering its meaning.

Scientific documents were extracted in April 2024 and a subsequent follow-up update was carried out in July 2024 in order not to exclude additional contributions and new evidence that could have influenced the research results.

Specific inclusion and exclusion criteria were incorporated in each database. More particularly, in the WoS database (www.webofknowledge.com), the scientific documents were selected for the first time using the following string: "Knowledge Management" (Topic) AND "CSR" (All Fields) AND "Tech*" while, afterward, using a combination of the keywords: "Knowledge Management" (Topic) AND "Corporate Social Responsibility" (All Fields) AND "Tech*"(All Fields). In both cases, the Web of Science categories – “Management”, “Business”, “Economics”, and “Social Science Interdisciplinary” – were filtered out, and only articles written in English were considered. The first research generated 21 results, while 38 papers emerged from the second research, for a total of 59 papers.

In the Scopus database (www.scopus.com), the same two strings were repeated: 1. (TITLE-ABS KEY ("knowledge management") AND TITLE-ABS-KEY ("CSR") AND TITLE-ABS-KEY ("Tech*")) and 2. (TITLE-ABS-KEY ("knowledge management") AND TITLE-ABS-KEY ("corporate social responsibility") AND TITLE-ABS-KEY ("tech*")). Also, for the investigation of the study through this second database, filters were also applied, and these were defined according to the subject areas “Business, Management and Accounting”, “Social Sciences” and “Economic, Econometrics and Finance” and limited to “article” type articles written in English. In total, 18 papers were collected: 7 articles with the first search string and 11 papers using the second keyword combination.

Lastly, also in the GS database (https://scholar.google.com/), the strings given by the combination of keywords – "Knowledge Management" and "CSR" and "Tech*" – and by the combination of keywords – "Knowledge Management" and "Corporate Social Responsibility" and "Tech*" – were included. As in previous research, the criteria selected have included scientific documents written in English. Both search strings generated significantly higher results than the other two databases: while 589 articles were derived from the first search string, 807 articles were derived from the second combination, for a total of 1396 articles.

Overall, 1473 results were obtained. All data were saved in CSV format and all records were extracted, exported, and coded into Microsoft Excel documents, combining the two strings for each database, sorting the titles alphabetically, and eliminating 451 duplicate items both, at first, within each database and, subsequently, among the three databases.

Therefore, 1022 articles were screened. After this step, the titles and abstracts of the articles found were reviewed and those that were not pertinent to the research questions were also excluded. From the total number of studies admitted for retrieval, 106 of them were admitted to the eligibility phase. They were all read to examine the coherence with the objective of this research and 37 studies were considered in the final survey and included in the systematic review.

2.2 Data Collection Process

Throughout the data collection process, the resulting scientific documents were selected following PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) Guidelines (Moher et al, 2015; Xiao and Watson, 2019) and the data were examined using inductive content analysis.

The authors opted to use the PRISMA checklist because it guarantees the survey's transparency and replicability. In fact, they could aggregate all data from the obtained findings and select them through three phases: 1) identification, 2) screening & eligibility and 3) included. The methodological steps described in the previous paragraph have been included in each phase.

Figure 1 shows the PRISMA flow diagram used during the systematic literature review process.

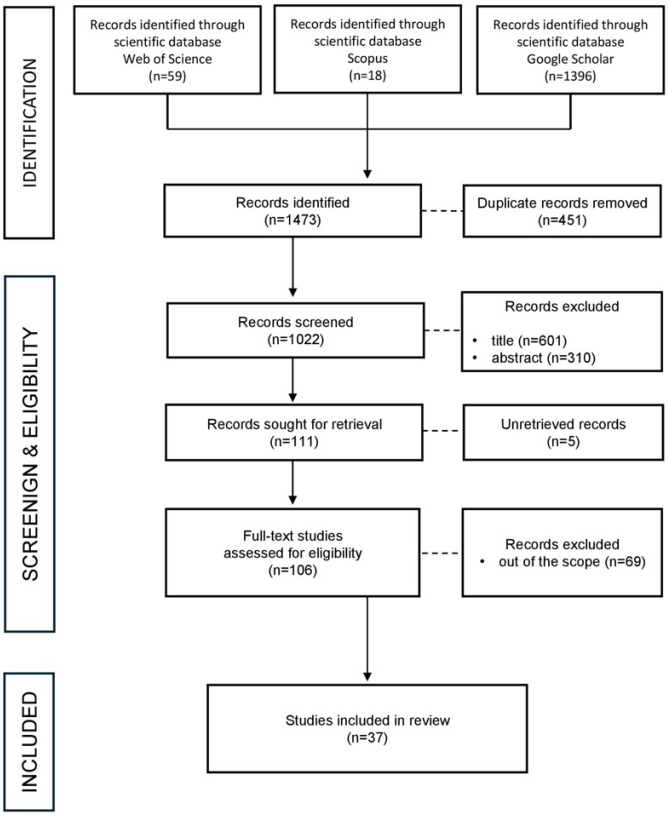


Figure 1: Systematic literature review process adopting PRISMA Guidelines

The studies included in the synthesis discovered different study variables, revealing the presence of various currents of thought in the existing literature.

3. Findings and Discussions

This section highlights the most relevant research findings and spaces for discussion on the topic. On the one hand, it confirms that the CSR-KM relationship is relevant and that technology plays a decisive role in it. On the other hand, it emphasizes a gap in the literature on the topic, resulting in the need for further investigation.

Concerning the CSR-KM relationship, KM practices can enhance the innovation and sustainability variables underlying CSR (Guadamillas-Gómez and Donate-Manzanares 2011) and KM can be a moderator of the influence of CSR on organisational performance (Ling, Y.H., 2019). For example, knowledge improvement inspires employees' sense of responsibility for corporate ESG goals (Solaimani, 2024). The ability of an organisation to implement sustainable innovation, closely related to its CSR and green entrepreneurial orientation, is influenced by KM practices, Technology, and Innovation (Acevedo et al, 2024, Tuncer and Korchagina, 2024, Martínez-Falcó et al 2023; Newaz 2022).

KM practices, in particular knowledge creation (Batista et al, 2017) and knowledge sharing (Areed et al, 2020), have an effect on CSR orientations because of their sustainable competitive advantage (Mahdi et al, 2011) and related studies have confirmed that benefits can be derived from this (Mayarni et al, 2023).

However, integrating the survey with the role of technology and considering the integration of sustainable business models with the prospects of digital technology (Brenner, 2018), it is necessary to consider that technology can improve knowledge management processes (De Bernardi et al, 2020) and that an intelligent organisation with a correct ethical approach, maximising continuous learning processes, use technology to pursue competitive advantage (Godlewska-Majkowska, 2019; Direction, 2011). Technological evolution has made knowledge a key determinant of innovation, contemplating new production and consumption systems that are environmentally friendly, economically sustainable, and socially responsible among the long-term goals (Buchmeister, 2013).

Integrating KM strategies with CSR improves corporate innovation capacity, especially in the renewable energy sector, where technological innovation is particularly important (Gonzáles-Ramos et al, 2023). Some studies have shown that in other sectors technology and knowledge are also important in terms of sustainability. For example, in the agribusiness sector, which is technologically dynamic (Morea, D. et al, 2023), CSR is recognized as a catalyst for the development of the circular economy (Depetris et al, 2023) and also in the health-hospital sector both KM practices and the application of new technologies have been considered relevant to sustainable policies (Borges de Oliveira and De Oliveira, 2022).

Another important result concerns the technological implications on corporate sustainability following the Covid-19 pandemic as the need for digital transformation has emerged (Su et al, 2022), given also the importance of technologies in meeting the demand for sustainable products (Cegarra-Navarro et al, 2021) and its ability to shape human action during a pandemic crisis (Hysa et al, 2024). Both technology and a proper approach to CSR policies can help organisations to deal with complex situations, such as an epidemic, by facilitating knowledge exchanges (Jain et al, 2022).

In addition, Industry 4.0, characterized by artificial intelligence (Panu, 2021) and inclusive of major technological changes, could also support corporate sustainability. In order to achieve greater levels of eco-sustainability, organizations are also resorting to digital platforms (Nemilentseva et al, 2024), as well as the adoption of blockchain technology (Sun et al, 2022). However, few studies deal with sustainable Industry 4.0. These include the study by Anshari et al. (2022), which states that its impact has yet to relate to KM practices.

Affecting CSR orientation positively on technological innovation performance (Anzola-Román, 2024), technology plays a decisive role in sustainable innovation, dominated by KM practices. Presently, managers' perceptions of rapidly changing factors such as technology induce companies to increase their investments in CSR (González-Ramos et al., 2023) while investments in ICT and the recruitment of specialized employees in its use contribute to greater innovation in organisations (Ayestarán Echeberría et al, 2023). Finally, SMEs, which compose most of the industrial fabric of developed and developing countries, can benefit from technology transfer in innovation processes (Scanlan, 2017).

Therefore, new research spaces are configured in the CSR-technological innovation relationship (Yang et al, 2024) and it is clear that there is a need to explore this issue further, better defining the SDGs Research Gap Technology, Innovation and Knowledge (Castro et al, 2021).

4. Stimuli and Implications, Limitations and Future Research Directions

This systematic literature review does not aim to complete the gaps in the state of the art on the investigated subject but its goal is to define them to allow researchers to explore them more thoroughly in the future and discuss new perspectives. In fact, it offers new stimuli for academics and researchers in the sector and similarly raises relevant implications for managers, practitioners, entrepreneurs, and policymakers engaged in developing new business directions and strategies.

The topic is relevant and there might be more opportunities to examine it. Actually, the results of this study open up different lines of multidisciplinary research as they outline possible new directions for further research, which in turn could lead to a broader understanding of the phenomenon and an innovative framework.

In terms of practice, both implicitly and explicitly with reference to the KM and ecodesign relationship (Lima et al, 2024), it has emerged that technology plays a decisive role in the relationship KM-CSR and, consequently, that it would be appropriate to explore it in depth.

Regarding its limitations, our article mentions several constraining factors. Firstly, it is based on the analysis of articles contained only in three scientific databases and in specific sub-areas. On the other hand, the choice of keywords and the inclusion and exclusion criteria defined ex-ante in the search strings may have also influenced the results. Therefore, additional studies should be conducted using other databases, sub-areas and inclusion or exclusion criteria or expanding the keywords and their combinations.

Consequently, the authors believe that this research does not exhaust the investigated topic but could serve as a starting point for future research development, whose directions could be oriented towards the interception of further relevant contributions in the literature concerning the impact of KM on CSR and the role of Technology in the relationship between these two concepts. The specificity of the two research questions and the dependency of the second from the first have conditioned the transition from the "eligibility" to the "included" phases, determining a substantial number of studies excluded as unrelated to the research aim.

In conclusion, on the assumption that literature review knowledge is an essential feature of academic research and knowledge advancement must be built on prior existing work (Xiao and Watson, 2019), future research should investigate the topic, extending the state of the art regarding the challenges approached in this study and exploring which KM practices and the further technological advancements could have the greatest impact on organisational sustainability processes.

References

Acevedo, L.I., Pigosso, D.C., and McAloone, T.C. (2024) “Exploring the Landscape of Contemporary Sustainability Philosophies: Origins, Synergies and Corporate Applications”, *Circular Economy and Sustainability*, pp. 1-37.

Aguinis, H. (2011) *Organizational responsibility: Doing good and doing well*, in S. Zedeck, ed., *APA handbook of industrial and organizational psychology,* Vol. 3. Maintaining, expanding, and contracting the organization, American Psychological Association, Washington, DC, pp. 855–879.

Alavi, M. and Leidner, D.E. (2001) “Knowledge management and knowledge management systems: Conceptual foundations and research issues”, *MIS quarterly,* pp. 107-136.

Alghamdi, A.M., Pileggi, S.F. and Sohaib, O. (2023) “Social Media Analysis to Enhance Sustainable Knowledge Management: A Concise Literature Review”, *Sustainability*, 15(13), p. 9957.

Anshari, M., Syafrudin, M., and Fitriyani, N.L. (2022) “Fourth industrial revolution between knowledge management and digital humanities”, *Information*, 13(6), p. 292.

Anzola-Román, P., Garcia-Marco, T., and Zouaghi, F. (2024) “The influence of CSR orientation on innovative performance: Is the effect conditioned to the implementation of organizational practices?”, *Journal of Business Ethics*, 190(1), pp. 261-278.

Areed, S., Salloum, S.A. and Shaalan, K. (2020) “The role of knowledge management processes for enhancing and supporting innovative organizations: a systematic review”, *Recent advances in intelligent systems and smart applications*, pp.143-161.

Ayestarán Echeberría, S., Gómez Serrano, D., Martínez Moreno, E., Lira, E. M., and Da Costa Dutra, S.C. (2022) “A Model of Knowledge-sharing for the 21st Century Organizations”, *Journal of Work and Organizational Psychology*, 38(3), pp. 175-187

Batista, F.F., Massaro, M., Dal Mas, F. and Garlatti, A. (2017) “The relationship between knowledge management and innovation in large companies: A structured literature review”, in *18th European Conference on Knowledge Management (ECKM 2017)*. Academic Conferences and Publishing Ltd.

Borges de Oliveira, K. and De Oliveira, O.J. (2022) “Making hospitals sustainable: Towards greener, fairer and more prosperous services”, *Sustainability*, 14(15), p. 9730.

Brenner, B (2018). "Transformative sustainable business models in the light of the digital imperative—A global business economics perspective", *Sustainability*, 10(12), p. 4428.

Buchmeister, B., Leber, M., Palcic, I. and Vujica Hercog, N. (2013) "Future development trends and challenges in production and social systems", in *DAAAM International Scientific Book*, pp. 111-133.

Burnham, J.F. (2006) "Scopus database: a review", *Biomedical digital libraries*, 3, pp.1-8.

Carroll, A.B. (1999) "Corporate social responsibility: Evolution of a definitional construct", *Business & Society*, 38(3), pp. 268-295.

Castro, G.D.R., Fernandez, M.C.G. and Colsa, A.U. (2021) "Unleashing the convergence amid digitalization and sustainability towards pursuing the Sustainable Development Goals (SDGs): A holistic review", *Journal of Cleaner Production*, 280, p. 122204.

Cegarra-Navarro, J.G., Kassaneh, T.C., Caro, E.M., Martínez, A.M., and Bolisani, E. (2021) "Technology assimilation and embarrassment in SMEs: the mediating effect on the relationship of green skills and organizational reputation", *IEEE Transactions on Engineering Management*, 70(12), pp. 4278-4286.

Daft, R.L. and Armstrong, A. (2021) *Organisation theory and design*. Cengage, Canada.

Davenport, T.H. and Prusak, L. (1998) *Working knowledge: How organizations manage what they know*. Harvard Business Press.

Depetris-Chauvin, N., Fernandez Olmos, M., Hu, W., and Malorgio, G. (2023) "Costs and benefits of sustainability-oriented innovation in the agri-food industry: A review", *New Medit*, 22(3), pp. 23-45.

De Bernardi, P., Forliano, C. and Bertello, A. (2020) "Digital transformation in SMEs: a systematic review and future directions", *in EUROMED ACADEMY OF BUSINESS CONFERENCE BOOK OF PROCEEDINGS*, EuroMed Press, pp. 306-323.

Direction, S. (2011) "Doing well by doing good: Strategic development of socially responsible behavior can build reputation, strengthen knowledge management and drive innovation", Strategic Direction, Vol. 27 No. 11, pp. 30-32.

Drucker, P.F. (1999) "Knowledge-worker productivity: The biggest challenge", *California management review,* 41 (2), pp. 79-94.

Grant, R.M. (1991) "The resource-based theory of competitive advantage: implications for strategy formulation", *California management review,* 33(3), pp.114-135.

Godlewska-Majkowska, H. (2019) "Creating an intelligent organisation as a source of competitive advantages: conditions and dilemmas", *Przedsiębiorczość-Edukacja,* 15(2), pp.7-23.

González-Ramos, M.I., Donate, M.J., and Guadamillas, F. (2023) "The interplay between corporate social responsibility and knowledge management strategies for innovation capability development in dynamic environments", *Journal of Knowledge Management,* 27(11), pp. 59-81.

González-Ramos, M.I., Guadamillas, F. and Donate, M.J. (2023) "The relationship between knowledge management strategies and corporate social responsibility: Effects on innovation capabilities", *Technological Forecasting and Social Change*, 188, p. 122287.

Guadamillas-Gómez, F. and Donate-Manzanares, M.J. (2011) "Ethics and corporate social responsibility integrated into knowledge management and innovation technology: A case study", *Journal of Management Development,* 30(6), pp. 569-581.

Hysa, E., Manta, O., Ailincă, A.G., Piciu, G.C., and Yue, X.G. (2024) "Digitalization as an instrument in support of covering the circularity gap in the European Union economy", *Environment, Development and Sustainability*, pp. 1-21.

Jain, N., Thomas, A., Gupta, V., Ossorio, M., and Porcheddu, D. (2022) "Stimulating CSR learning collaboration by the mentor universities with digital tools and technologies–an empirical study during the COVID-19 pandemic", *Management Decision*, 60(10), pp. 2824-2848.

Krawczyk, P. (2022) "Knowledge management and corporate social responsibility interactions in theory and practice", in *European Conference on Knowledge Management (ECKM 2022),* Vol. 23, No. 1, pp. 654-661.

Krawczyk, P. and Kokot-Stępień, P. (2023) "Business Environment Institutions as a Catalyst for Knowledge and Technology Transfer", in *European Conference on Knowledge Management*, Vol. 24, No. 1, pp.692-699.

Lima, P.A.B., Furlan, M., Leoni, L., Domingues, A.M., Jorge, C.F.B. and Jugend, D. (2024) "Relationships between knowledge management and ecodesign: a theoretical analysis", *Knowledge Management Research & Practice*, pp. 1-13.

Ling, Y.H. (2019) "Influence of corporate social responsibility on organizational performance: Knowledge management as moderator", *VINE Journal of Information and Knowledge Management Systems*, 49(3), pp. 327-352.

Mahdi, O.R., Almsafir, M.K. and Yao, L. (2011) "The role of knowledge and knowledge management in sustaining competitive advantage within organizations: A review", *African Journal of Business Management,* 5(23), p. 9912.

Martínez-Falcó, J., Marco-Lajara, B., Zaragoza-Sáez, P. and Millán-Tudela, L.A. (2023) "Analyzing the effect of Corporate Social Responsibility on Green Innovation Performance in the Spanish wine industry: A structural equation modeling analysis", *Agribusiness*, 39(4), pp. 985-1006.

Mayarni, M., Syahza, A., Siregar, S.H., Khoiri, A., Hariyani, E., Nasution, M.S. and Sulistyani, A. (2023) "The influence of community economic development and peat area governance on Society 5.0", *Journal of Infrastructure, Policy and Development,* 7(2), p. 1843.

Moher, D., Shamseer, L., Clarke, M., Ghersi, D., Liberati, A., Petticrew, M., Shekelle, P. and Stewart, L.A., "PRISMA-P Group (2015) Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement", *Systematic Reviews*, 4(1), pp. 1-9.

Morea, D., Fortunati, S., Cappa, F. and Oriani, R. (2023) "Corporate social responsibility as a catalyst of circular economy? A case study perspective in Agri-food", *Journal of Knowledge Management,* 27(7), pp. 1787-1809.

Nemilentseva, M., Tariq, A., Tariq, W., Aghajani, D., and Torkkeli, M. (2024) "A Review of Digital Platform and Circular Economy: Opportunities and Challenges for Developing Countries", *Human Perspectives of Industry 4.0 Organizations,* pp. 38-67.

Newaz, M.N. (2022) "Factors of Organizational Innovativeness: A Systematic Literature Review", *International Journal of Advances in Engineering and Management*, pp. 182-216.

Nonaka, I. and Takeuchi, H. (1995) *The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation*. Oxford University Press, New York.

Panu, J. (2021*) The Potential of Artificial Intelligence in Utilizing Circular Business Models: A Systematic Literature Review*, Master of Science in Economics and Business Administration Thesis, School of Technology and Innovation, University of Vaasa.

Porter, M.E., and Heppelmann, J.E. (2014) "How smart, connected products are transforming competition", *Harvard business review,* 92(11), pp. 64-88.

Scanlan, J. (2017) "Technology Transfer: How SMEs Build Relationships to Advance Open Innovation", in *Seventh International Engaged Management Scholarship Conference (2017)*.

Shih, T.Y. (2024) "Exploring the effects of prospective corporate social responsibility on firm performance: the mediating role of innovation", *Technology Analysis & Strategic Management*, 36(2), pp. 293-305.

Solaimani, S. (2024) "From Compliance to Capability: On the Role of Data and Technology in Environment, Social, and Governance", *Sustainability,* 16(14), p. 6061.

Sun, Y., Shahzad, M. and Razzaq, A. (2022) *Sustainable organisational performance through blockchain technology adoption and knowledge management in China. Journal of Innovation & Knowledge, 7(4),* p.100247.

Su, R., Obrenovic, B., Du, J., Godinic, D., and Khudaykulov, A. (2022) "COVID-19 pandemic implications for corporate sustainability and society: A literature review", *International Journal of Environmental Research and Public Health,* 19(3), p. 1592.

Tranfield, D., Denyer, D. and Smart, P. (2003) "Towards a methodology for developing evidence-informed management knowledge by means of the systematic review", *British journal of management,* 14(3), pp. 207-222.

Tuncer, B., and Korchagina, E. (2024) "A Systematic Literature Review and Conceptual Framework on Green Entrepreneurial Orientation", *Administrative Sciences,* 14(6), p. 109.

Walters, W.H. (2007) "Google Scholar coverage of a multidisciplinary field", *Information processing & management,* 43(4), pp. 1121-1132.

Xiao, Y. and Watson, M. (2019) "Guidance on conducting a systematic literature review", *Journal of planning education and research,* 39(1), pp. 93-112.

Yang, H., Shi, X., Bhutto, M.Y. and Ertz, M. (2024) "Do corporate social responsibility and technological innovation get along? A systematic review and future research agenda", *Journal of Innovation & Knowledge,* 9(1), p. 100462.

Knowledge Management in Social Organizations During a Humanitarian Crisis

Zbigniew Zontek and Ewa Lipianin-Zontek
University of Bielsko-Biala, Faculty of Management and Transport, Department of Management, Bielsko-Biala, Poland

zzontek@ubb.edu.pl
elipianin@ubb.edu.pl

Abstract: This paper presents an overview of issues related to the role of knowledge management in social organizations. Chosen aspects of knowledge management theory in voluntary not-for-profit groups, operating during a humanitarian crisis, are here addressed. The paper aims to demonstrate the determinants of knowledge management, using as an example, events at the Poland/Ukraine border - in the period 2022-2023. The additional aim is to show how to identify common processes underlying knowledge management, and how it was acquired, managed and transferred, in disparate organizations. The authors of this paper took part in the humanitarian action in the first few weeks of the conflict - both independently and in co-operation with non-governmental organizations. This allowed for the collection of extensive material during the first stage of the research, and creation of a database of NGO's, used for the second stage of the research. During preparations for the survey a hypothesis was established: When sudden emergencies arise, a variety of information and knowledge is collected, dispersed, widely shared, and belongs to many different organizations. Therefore, a coherent information system is needed for the dissemination and sharing of knowledge for effective assistance to people affected by the crisis. The methodology of participatory observation and surveys was used for the research. It was found that knowledge was transferred in and out of the organizations, and expertise from earlier experiences was also applied and transferred, thus becoming explicit. Managerial skills and methods were applied in new organizational contexts. Knowledge acquisition, transfer and sharing were clearly identifiable across in a wide spectrum of research, as was organizational learning and the subsequent usage of it. Knowledge management in a crisis situation encompasses all activities aimed at improving preparatory and executive actions. One of the key elements of knowledge management, which determines its success, is effective acquisition, information handling and delivery to the relevant organizations involved. This is essential for the response of individual organisations, whether at the level of local government or national non-profit organizations.

Keywords: Knowledge Management, Humanitarian Crisis, NGO Organizations

1. Introduction

Effective Knowledge Management (KM) serves as a vital instrument for organizations, enabling them to preserve, cultivate, structure, and utilize accumulated knowledge efficiently. Scholars and practitioners alike recognize the potential and significance of knowledge management for organizational success, as underscored by Karamat (2018). Essentially within the dynamic landscape of social organizations in Poland, which boasts substantial knowledge reservoirs, it is imperative that good knowledge management becomes even more essential. Various strategies must exist for the formal recording, transfer, and utilization of knowledge within social organizations.

Non-governmental organizations (NGOs) assume a significant role in ameliorating the adverse ramifications of humanitarian crises. By operating in close proximity to affected populations and directly engaging with the environment, NGOs are adept at accurately identifying emergent issues. Moreover, they often possess more suitable means and methodologies to address the challenges at hand-compared to other entities. Based on independent decisions, NGOs exhibit a heightened awareness of crisis situations, enabling them to operate swiftly and effectively, to reach affected individuals. This results in a more efficient mitigation of the crisis's detrimental effects on individual stakeholders and enhances societal protection.

Non-governmental organizations exhibit a varied approach to crisis situations, potentially fostering mutual trust and nurturing interpersonal relationships during challenging times (Egger and Schopper, 2022).

Haaland and Wallevik (2019) underscore the crucial role of citizens in executing aid activities, asserting that in extensive humanitarian crises involving a substantial number of individuals in distress, the efforts of governmental and non-governmental organizations alone may prove insufficient. Rabiei et al. (2023) similarly highlight the significance of "spontaneous volunteers" in crisis situations, identifying the primary challenge as the effective allocation of volunteers during disasters. Taouktsis and Zikopoulos (2024) emphasize the organizational aspect of knowledge management in crisis situations, proposing enhancements in humanitarian logistics. Mena and Hilhorst (2022) isolate a critical facet of crisis management, noting the shift from development and disaster reduction to humanitarian aid.

Despite an extensive body of literature on knowledge management during crises in developed nations, there remains a notable dearth of research on KM implementation amid humanitarian crises, especially within the Polish context. In the wake of the humanitarian crisis on the Polish-Ukrainian border, Poland found itself in the nascent stages of crafting a knowledge management strategy, encountering numerous challenges, barriers, and deficiencies in the implementation process. This study aims to identify and analyse the factors influencing the efficacy of knowledge management, as well as the obstacles and gaps hindering its successful implementation.

2. The Role of Social Organizations in Managing Humanitarian Crises

As per the Organization for Economic Co-operation and Development (OECD) definition, social organizations are institutions dedicated to activities benefiting the community or public interest, with their primary aim being to foster social or public welfare rather than private financial gain (Lettieri et al., 2004). These entities can manifest in various forms, including non-profit organizations, non-governmental organizations (NGOs), foundations, associations, and other entities dedicated to social good. This sector is characterized by its diversity, encompassing a broad spectrum of endeavours ranging from charitable works to social and educational initiatives. Moreover, social organizations frequently engage in humanitarian efforts, addressing crises and needs within both local and global communities.

In academic literature, the term "Non-Governmental Organization" (NGO) is commonly used internationally as a synonym for social organizations. Additionally, terms such as "non-profit organizations" or "public service organizations" are employed interchangeably to describe these entities. These varying designations underscore the overarching principle that the endeavours of social organizations should be oriented towards addressing diverse social needs at a public level, transcending the individual interests of founders, board members, or organization constituents themselves (Supra-Markowska, 2015).

Within the realm of humanitarian crises, social organizations play a pivotal role in extending aid to affected populations, safeguarding civilian well-being, orchestrating relief efforts, conducting educational initiatives, and bolstering local communities. Additionally, they undertake measures to address the root causes of crises (OECD, 2024). Through their active involvement, the alleviation of suffering among crisis-affected individuals becomes feasible, facilitating their rehabilitation and recovery in the aftermath of disasters or other humanitarian emergencies (Singh, 2023).

As per the OECD's (2019) delineation, humanitarian organizations are entities dedicated to providing assistance in crisis scenarios, encompassing natural calamities, armed conflicts, poverty, and other exceptional circumstances posing threats to individual or community life, health, or safety. These organizations are committed to both pre-emptive measures and crisis response. A cornerstone of their endeavours lies in advocating for human rights, humanitarian principles, and universal values.

Humanitarian organizations operate across a spectrum of scales, ranging from the international level (e.g., the Red Cross, Red Crescent, UNICEF) to the local, regional, and national levels. Within Poland, prominent humanitarian entities include the Polish Red Cross (PCK), Caritas Poland, Polish Humanitarian Action (PAH), The “Ocalenie” Foundation, and similar organizations. These entities frequently collaborate among themselves and with governmental bodies, UN agencies, and local communities to deliver impactful humanitarian aid to those facing the most acute vulnerabilities. Such collaborative efforts not only enhance the efficacy of assistance but also foster the development of innovative solutions (Williams, 2012, pp. 550-560).

3. The Contribution of Polish Social Organizations in Delivering Aid Amidst the Humanitarian Crisis on the Polish-Ukrainian Border

Polish humanitarian organizations have played a crucial role in providing aid during various crises along the Polish-Ukrainian border (Stępień-Załucka & Uliasz, 2023). The armed conflict in Ukraine, initiated in February 2014, stemmed from preceding events, including the Maidan Revolution in Kiev in November 2013 and the ousting of President Viktor Yanukovych in February 2014. The direct catalyst for the conflict was Russia's annexation of Crimea in March 2014 and escalating tensions in eastern Ukraine, particularly in the Donetsk and Luhansk oblasts, where separatist movements emerged, advocating for independence from Kiev. This conflict evolved into an open armed confrontation between Ukrainian forces and pro-Russian separatists, backed by Russia. Subsequently, ongoing hostilities in eastern Ukraine have resulted in tragic consequences for civilians and have contributed to regional destabilization (United Nations, 2022; Freedman, 2023).

Throughout the Ukrainian crises, Poland emerged as a pivotal contributor to humanitarian assistance, driven by several key factors. Firstly, its geographical situation next to Ukraine, positions Poland as a natural ally in extending humanitarian aid during crisis scenarios. Proximity facilitates the logistical organization and transportation of aid to affected regions. Secondly, Poland boasts considerable expertise in humanitarian endeavours, both domestically and internationally. Leveraging this expertise, Polish humanitarian organizations and the governmental Agency for Technical and Programmatic Assistance (Polish Aid, 2024) possess the requisite knowledge and resources to orchestrate humanitarian initiatives effectively. Thirdly, Poland and Ukraine share a profound historical bond, marked by intertwined destinies and enduring relations. Despite historical challenges, a profound sense of solidarity prevails between the two nations, with Poland exhibiting particular empathy and support towards Ukraine during crises and hardships. Provision of humanitarian aid serves as a tangible manifestation of this solidarity and compassion. Lastly, Poland actively champions Ukraine's political, economic, and social transformation efforts. Humanitarian aid stands as a vital component of this multifaceted collaboration, aimed at bolstering democracy, rule of law, and stability within Ukraine (Stępień-Załucka & Uliasz, 2023).

According to Office of the United Nations High Commissioner for Human Rights (OHCHR), Poland assumes a pivotal role in delivering humanitarian aid, offering crucial support to the Ukrainian populace during times of adversity and aiding in alleviating the repercussions of humanitarian crises in the region (OHCHR, 2022). Below are excerpts from sources discussing initiatives undertaken by Polish humanitarian organizations.

Following Russia's annexation of Crimea in 2014, numerous individuals from Crimea were compelled to flee their homes and seek refuge in Poland. In response to this exigency, humanitarian organizations extended material aid, psychological counselling, and assistance in job placement and acclimatization to new living conditions (Patel and Erickson, 2022). During the period of 2014-2015, amid the armed conflict in Eastern Ukraine, thousands sought sanctuary in Poland. Polish humanitarian entities provided vital support to refugees, furnishing them with shelter, sustenance, clothing, medical attention, and psychological counselling (Asmussen, 2014).

Since the onset of 2022 and the escalation of the armed conflict, Polish humanitarian organizations have consistently offered aid to migrants and individuals in distress along the Polish-Ukrainian border. This aid again includes provision of sustenance, clothing, hygiene essentials, medical care, and psychological assistance to individuals navigating challenging circumstances while crossing the border. Additionally, aid includes facilitating transportation to accommodation sites and furnishing comprehensive support in the refugees' newfound places of residence (Patel & Erickson, 2022).

4. Knowledge Management Practices Within Social Organizations

Knowledge serves as vital intellectual capital, underpinning the growth of both individuals and organizations. It plays a structural role, providing a cohesive framework for data and information processing (Zins, 2007), thereby facilitating the derivation of meaning and deeper comprehension. Furthermore, knowledge transcends mere factual contexts, evolving into a wellspring of wisdom through synthesis and reflection upon accumulated content.

In terms of fundamental classification, knowledge can be delineated into two primary categories: explicit and tacit (Smith, 2001; Collins, 2019). Explicit knowledge, being overt and tangible, is readily articulated through defined concepts, figures, or facts. However, it represents only the visible portion of the knowledge reservoir, akin to the tip of an iceberg. Conversely, tacit knowledge, constituting the majority of our knowledge base, proves elusive to capture and express. As observed by Michael Polanyi, we may possess knowledge that eludes clear articulation (Polanyi, 2009).

Another important categorization of knowledge extends to include implicit knowledge (Ahmed et al., 2002). While tacit and implicit knowledge are often used interchangeably, it's important to distinguish that tacit knowledge refers to the type of knowledge an individual may possess without realizing it. This knowledge is typically acquired through experience and practice and may not always be consciously expressed (Chmielewska-Banaszak, 2010). Alternatively, a slightly different perspective on tacit knowledge (Sternberg et al., 2000.) defines it as knowledge that is not directly expressed and is acquired through individual human experience. Tacit knowledge exhibits three distinct characteristics: 1) It is autonomously acquired by the individual; 2) It is primarily procedural in nature, based on skills and methods of conduct; 3) It is directly applicable in practice, meaning it is relevant to specific operational contexts.

This approach underscores the specialized nature of tacit knowledge, which is intricately linked to specific contexts, encompassing effective action methods within particular situations. The context for such knowledge may encompass both an individual's personal experiences and the professional environment in which they operate. Moreover, rich tacit knowledge serves as a springboard for various combinations of established procedures, facilitating its flexible adaptation to new circumstances. This entails the creative utilization of developed patterns and procedures acquired during the knowledge acquisition process, alongside integration of new information (Wąsowska, 2018).

In social organizations, knowledge management endeavours are geared towards fostering continuous learning, enhancing human resource development, and cultivating intellectual capital, to effectively carry out community-oriented initiatives and fulfil organizational missions (Siawsh et al., 2023). As outlined by the Organization for Economic Co-operation and Development (OECD, 2019), knowledge management in social organizations encompasses processes, strategies, and practices aimed at adeptly gathering, utilizing, and disseminating knowledge to advance organizational objectives and cater to the needs of members and stakeholders. This entails the identification, creation, collection, storage, analysis, sharing, and application of knowledge to enhance decision-making, foster innovation, streamline processes, and attain organizational excellence.

The cornerstone of successful knowledge management lies in the seamless collaboration among three sectors: public organizations, non-governmental organizations, and businesses. This management approach hinges on the harnessing of intangible assets, primarily knowledge and human capital (Hislop et al., 2018), complemented by modern information technologies (Karamitri et al., 2020). Possessing human intellectual capital and knowledge spanning not only organizational management but also the latest advancements in technology and contemporary science, is pivotal component of effective knowledge management. Da Silva Avanzi, et al. (2017) propose Disaster Response Management System, supporting aspects of knowledge management such as: knowledge acquisition, organisation and assessment.

Thus, as outlined above, in humanitarian organizations, effective knowledge management serves as a linchpin for enhancing operational efficacy, facilitating information exchange (McGill et al., 2023), mitigating redundancies, and fostering continual improvement. Consequently, this enables more adept crisis response and the provision of efficient humanitarian assistance.

5. Selected Aspects of Knowledge Management During Humanitarian Crises: Insights From Research

The study focused on representatives of charitable organizations engaged in aiding refugees during the humanitarian crisis on the PL/UA border, specifically during the initial weeks of the armed conflict in Ukraine and immediately thereafter. Two distinct phases of the crisis were identified for research purposes: the initial phase, characterized by assistance provision at border reception sites for individual refugees, and the subsequent phase involving aid delivery to refugees at their places of residence in Poland.

As previously mentioned, the hypothesis posited that during sudden emergencies, a plethora of information and knowledge is amassed, disseminated, widely shared, and owned by numerous organizations. Hence, the necessity for a cohesive information system to effectively disseminate and share knowledge in order to aid those affected by the crisis.

As already indicated, the authors of the paper actively participated in a humanitarian operation during the initial weeks of the crisis, both independently and in collaboration with non-governmental organizations, occurring in February and March 2022. Subsequently, during this timeframe and immediately thereafter, phase 1 of the research was conducted. The research employed a methodology encompassing participant observation and a diagnostic survey administered through a questionnaire.

The aim of the study was to explore the potential for establishing knowledge management standards during humanitarian crises. The research utilized a survey questionnaire administered directly in locations where humanitarian operations were underway. A purposive sampling method was employed, with volunteers from organizations actively engaged in assisting on the Polish-Ukrainian border invited to participate in the study. A total of 123 correctly completed questionnaires were collected during the initial phase of the crisis. Subsequently, in 2023, the research was replicated with the same methodological framework. Following the second phase of the crisis, 217 correctly completed questionnaires were obtained.

This paper presents the results of research on the need to use an information system in the dissemination and sharing of knowledge (results from two phases of the research are presented). Another analysed issue is the assessment of aspects of knowledge management in a crisis situation. This question was asked in the second round of research because it was considered that a time distance would be necessary to make the first assessments.

Table 1: Valuing the need to use an information system in the dissemination and sharing of knowledge (2022, n=123)

No.	Specification	0	1	2	3
1.	It is necessary to use an IT system to manage knowledge.	0%	3.3%	14.6%	82.1%
2.	The introduction and use of an information system increases the effectiveness of assistance.	0%	12.2%	13.0%	74.8%
3.	It is necessary to introduce a database of good practices.	0%	0.8%	16.3%	82.9%
4.	A coherent system of recording current activities of charitable organizations is needed.	34.2%	35.7%	17.1%	13.0%
5.	A coherent information system for the exchange of experiences (forums and discussion groups) is needed.	0%	47.2%	47.9%	4.8%
6.	A coherent information exchange system for the group of experts is needed.	24.4%	55.3%	18.7%	1.6%
7.	A coherent nationwide portal is needed where refugees from Ukraine can find various forms of support.	0%	1.6%	14.7%	83.7%
8.	A coherent nationwide portal is needed where helpers (volunteers and charities) can find a variety of information.	0%	8.2%	3.3%	88.6%

Where: 0 - disagree 1 - slightly agree 2 - moderately agree 3 - strongly agree

Source: Own elaboration based on a survey

Tables 1 and 2 depict the findings from the research regarding the significance of individual aspects of the information system in disseminating and sharing knowledge during crisis situations. The results indicate that the passage of time between both phases of the study influenced certain outcomes.

Across both studies, the consensus regarding the necessity of employing a cohesive IT system for knowledge management during crisis situations remained steadfast, with over 80% of respondents strongly agreeing with this proposition. Moreover, support for the notion that such a system would enhance aid effectiveness saw a marginal increase, with the percentage of those strongly in agreement rising from 74.8% to 79.3%. Conversely, backing for the implementation of a database of good practices experienced a decline, decreasing from 82.9% to 71.9% respectively.

Table 2: Valuing the need to use the information system in the dissemination and sharing of knowledge (2023, n=217)

No.	Specification	0	1	2	3
1.	It is necessary to use an IT system to manage knowledge.	0.0%	1.4%	12.9%	85.7%
2.	The introduction and use of an information system increases the effectiveness of assistance.	0.0%	5.5%	15.2%	79.3%
3.	It is necessary to introduce a database of good practices.	3.2%	6.9%	18.0%	71.9%
4.	A coherent system of recording current activities of charitable organizations is needed.	18.9%	28.6%	35.0%	17.5%
5.	A coherent information system for the exchange of experiences (forums and discussion groups) is needed.	10.1%	18.9%	30.0%	41.0%
6.	A coherent information exchange system for the group of experts is needed.	14.7%	29.0%	40.1%	16.1%
7.	A coherent nationwide portal is needed where refugees from Ukraine can find various forms of support.	0.0%	1.8%	14.7%	83.4%
8.	A coherent nationwide portal is needed where helpers (volunteers and charities) can find a variety of information.	3.2%	18.0%	28.1%	50.7%

Where: 0 - disagree 1 - slightly agree 2 - moderately agree 3 - strongly agree

Source: Own elaboration based on a survey

Over time, as aid organizations coordinated their efforts, there was a notable increase in support for a cohesive system to document the ongoing activities of charitable organizations, with the combined indications for moderate and strong agreement rising from 30.1% to 52.5%. This increase was even more pronounced for specific facets of the information system: 1) The percentage of respondents indicating moderate and strong endorsement for a unified system to document the current activities of charitable organizations increased by

approximately 17.5%; 2) There was an 18.3% increase in support for the notion of establishing a platform for exchanging experiences, encompassing forums and discussion groups.

While the percentage of respondents fully supporting a nationwide portal for individuals in need remained steady, slightly above 80%, there was a notable decrease in support for a comparable system designed for aid institutions. In 2022, 88.6% strongly agreed with this concept, but by 2023, this figure dropped to 50.7%. This trend indicates that over time, aid organizations established their own methods for coordination and collaboration.

Table 3 illustrates the findings from the assessment of individual aspects of knowledge management during a crisis situation, conducted during the second phase of the research. Analysis of the results reveals a significant improvement in the rating of access to up-to-date information during the post-crisis phase. Specifically, 44.7% of respondents indicated a rating of 4, while 26.3% indicated a rating of 5. In contrast, during the crisis situation, only 8.8% and 6% of respondents provided ratings of 4 and 5, respectively. However, access to central knowledge databases was rated low during the crisis, with the most frequently selected rating being 2 (40.1% of responses). Similarly, the presence of up-to-date information in these databases received low ratings, with 2 being the most frequently selected rating (35.9% of responses).

Table 3: Assessment of knowledge management aspects in a crisis situation (2023, n=217)

No.	Specification	1	2	3	4	5
1	Availability of up-to-date information during the crisis	11.1%	21.7%	52.5%	8.8%	6.0%
2	Availability of up-to-date information in the post-crisis phase	3.7%	5.5%	19.8%	44.7%	26.3%
3	Access to the central knowledge base during a crisis	16.6%	40.1%	20.7%	16.1%	6.5%
4	Up-to-date information available in the knowledge base	19.8%	35.9%	30.9%	7.8%	5.5%
5	The speed of response of public authorities to a suddenly emerging problem	14.7%	20.7%	41.0%	12.4%	11.1%
6	The speed of the organization's adaptation to a dynamically changing situation	0.9%	14.3%	14.7%	24.9%	45.2%
7	Effectiveness of communication between NGOs	4.1%	8.3%	33.6%	29.0%	24.9%
8	Effectiveness of communication between NGOs and public services	9.7%	22.1%	41.0%	11.1%	16.1%
9	Cooperation and coordination of aid activities	12.4%	18.0%	36.4%	24.9%	8.3%
10	The usefulness of the external knowledge sources	3.7%	15.7%	31.3%	26.7%	22.6%
11	Long-term learning from the experience of the first phase of the crisis	6.5%	11.1%	33.2%	20.3%	29.0%

Where: 1- the lowest mark; 5-the highest mark

Source: Own elaboration based on a survey

The response speed of public authorities to the sudden emergence of a problem received an average rating, with 3 being the most frequently indicated rating (41%). Conversely, the response speed of non-governmental organizations (NGOs) garnered higher ratings, with the majority of respondents selecting the highest rating (45.2%). The effectiveness of communication among NGOs was rated positively, with 53.9% of respondents indicating ratings of 4 and 5, compared to the effectiveness of communication between NGOs and public organizations, where only 27.2% of respondents rated it as 4 or 5.

Assessment of the cooperation and coordination of aid activities and the usefulness of external sources of information yielded average ratings, with 36.4% and 31.3% of respondents respectively indicating a rating of 3.

A crucial criterion for evaluating effectiveness is the ability to engage in long-term learning based on experiences from the initial phase of the crisis. Half of the respondents evaluated this aspect positively, with 20.3% selecting a rating of 4 and 29% selecting a rating of 5. This distribution of responses suggests that NGOs are better equipped to handle potential future crises.

The findings from participant observation aligned with the aforementioned results, revealing that during the initial phase of the crisis, the effectiveness of knowledge acquisition from institutions and organizations was relatively constrained. Given the dynamic nature of the situation on the Polish-Ukrainian border at that time, information was not consistently available on internet information websites. Nonetheless, participants engaged in aid activities expressed a strong desire to acquire such knowledge.

These findings also underscored the significance of informal groups as a means of managing knowledge and facilitating its transfer. Informally provided information often proved to be the sole available knowledge source,

offering real-time updates, reliability, and alignment with recipients' needs. Overall, a notable willingness among volunteers and other stakeholders to share knowledge during the crisis was observed. However, the implementation of a unified knowledge management system during that period could have significantly enhanced aid activity coordination.

6. Conclusions

Several compelling reasons underscore the importance of knowledge management in humanitarian organizations. Firstly, operational effectiveness: Humanitarian organizations frequently operate in crisis environments where rapid decision-making is imperative for saving lives and mitigating suffering. Efficient knowledge management facilitates the optimal utilization of resources, identification of effective strategies, and swift adaptation to evolving conditions. In contemporary contexts, the efficacy of knowledge management is often enhanced through the integration of artificial intelligence and modern information technologies (Al Mansoori et al., 2020).

Secondly, information exchange: Humanitarian organizations employ people with different specializations and experiences, often from different countries and cultures. Knowledge management facilitates effective exchange of information between various departments of the organization, which promotes better understanding of the situation and taking appropriate actions (Golba, 2015).

Thirdly, avoiding repetitions: In crisis situations, time is precious, so it is important to avoid repetitions and use existing knowledge and experiences. Effective knowledge management allows for the collection and sharing of information about previous interventions and best practices (Hall & Andriani, 2003).

Lastly, skill development and activity enhancement: Analysing activities conducted across diverse humanitarian missions yields invaluable insights into their effectiveness and areas necessitating improvement. Knowledge management facilitates the collection of these insights, enabling their utilization to enhance processes and train organization employees.

The results initially supported the hypothesis, demonstrating that knowledge during the analysed humanitarian crisis was widely dispersed among various organizations. The evident need for an efficient knowledge management system underscored the importance of swiftly identifying knowledge gaps while continuously assessing information requirements. However, the presented research results have certain limitations concerning the selection of studied issues. Therefore, to fully verify the assumed hypothesis, further extended research is necessary. Converting accumulated tacit knowledge into accessible and comprehensible information for all individuals involved in the assistance efforts is crucial, and future research should illustrate methods to achieve this.

References

Ahmed, P.K., Lim, K.K., & Loh, A.Y.E. (2002*), Learning Through Knowledge Management*, Butterworth – Heineman, Oxford.

Al Mansoori, S., Salloum, S. A., & Shaalan, K. (2020) "The impact of artificial intelligence and information technologies on the efficiency of knowledge management at modern organizations: a systematic review", *Studies in Systems, Decision and Control Recent Advances in Intelligent Systems and Smart Applications*, pp. 163-182.

Asmussen, J. (2014) "International Crisis Management and Human Security in the Framework of 'Hybrid Wars' and Unrecognized States: Lessons Learned from Ukraine", *Security and Human Rights*, Vol. 25(3), pp. 287-297.

Chmielewska-Banaszak, D. (2010) "Wiedza milcząca w nauce. Koncepcja Michaela Polanyi'ego", *Zagadnienia Naukoznawstwa*, 1(183).

Collins, H. (2019) *Tacit and explicit knowledge*, The University of Chicago Press.

Da Silva Avanzi, D., Foggiatto, A., dos Santos, V.A., Deschamps, F., de Freitas Rocha Loures, E., "A framework for interoperability assessment in crisis management", *Journal of Industrial Information Integration*, Vol. 5, pp 26-38.

Egger, C., & Schopper, D. (2022) "Organizations Involved in Humanitarian Action: Introducing a New Dataset", *International Studies Quarterly*, Vol 2, No 66.

Freedman, L. (2023) "Humanitarian Challenges of Great Power Conflict: Signs from Ukraine", *Dædalus*, Vol. 152(2), pp 40-51.

Golba, D. (2015), "Wolontariat pracowniczy a dzielenie się wiedzą w organizacji", *Rynek, Społeczeństwo, Kultura*, Vol. 3 (15).

Haaland, H., & Wallevik, H. (2019) "Beyond crisis management? The role of Citizen Initiatives for Global Solidarity in humanitarian aid: the case of Lesvos", *Third World Quarterly*, 40(10), pp 1869-1883.

Hall, R., & Andriani, P. (2003) "Managing knowledge associated with innovation", *Journal of Business Research*, Vol. 56(2), pp 145-152.

Hislop, D., Bosua, R., & Helms, R. (2018), *Knowledge management in organizations: A critical introduction*, Oxford University Press.

Karamat, J., Shurong, T., Ahmad, N., Waheed, A., & Khan, S. (2018) "Barriers to knowledge management in the health sector of Pakistan", *Sustainability*, Vol. 10(11), pp 1-22.

Karamitri, I., Kitsios, F., & Talias, M. A. (2020) "Development and validation of a knowledge management questionnaire for hospitals and other healthcare organizations", *Sustainability*, Vol. 12(7), pp 27-30.

McGill, E., Halliday, E., Egan, M., & Popay, J. (2023) "Knowledge exchange in crisis settings: A scoping review", *PLoS ONE* 18(2)

Mena, R. & Hilhorst, D. (2022) "The transition from development and disaster risk reduction to humanitarian relief: the case of Yemen during high-intensity conflict", *Disasters*, Vol. 46(4), pp 1049−1074.

OECD (2019), *OECD Policy Framework for Effective and Efficient Humanitarian Action*, OECD Publishing, Paris.

OECD (2024), *DAC Recommendation on the Humanitarian-Development-Peace Nexus*, OECD/LEGAL/5019, https://legalinstruments.oecd.org/public/doc/643/643.en.pdf (Accessed: 13 February 2024).

OHCHR, (2022), *Ukraine civilian casualty Update*, United Nations, December, 5, 2022.

Patel, S. S., & Erickson, T. B. (2022) "The new humanitarian crisis in Ukraine: Coping with the public health impact of hybrid warfare, mass migration, and mental health trauma", *Disaster medicine and public health preparedness*, Vol. 16(6), pp 2231-2232.

Polanyi, M. (2009) *The tacit dimension. In Knowledge in organisations*, The University of Chicago Press.

Polish Aid, (2024) https://www.gov.pl/web/polishaid (Accessed: 13 February 2024).

Rabiei, P., Arias-Aranda, D., Stantchev, V. (2023) "Introducing a novel multi-objective optimization model for volunteer assignment in the post-disaster phase: Combining fuzzy inference systems with NSGA-II and NRGA, *Expert Systems With Applications*, Vol 226, 120142.

Siawsh, N., Peszynski, K., Vo-Tran, H., Young, L. (2023) "Toward the creation of disaster-resilient communities: The Machizukuri initiative – The 2011 Tōhoku Great East Japan Earthquake and Tsunami", *International Journal of Disaster Risk Reduction*, Vol. 96.

Singh, A. (2023) "Policy Implementation and Best Practices in Disaster Management", in: Singh, A. (eds) *International Handbook of Disaster Research*, Springer, Singapore.

Smith, E. A. (2001) "The role of tacit and explicit knowledge in the workplace", *Journal of knowledge Management*, Vol. 5(4), pp 311-321.

Stępień-Załucka, B., & Uliasz, J. (2023) "The right to humanitarian aid and human dignity. Observations against the background of the law on assistance to Ukrainian citizens in Poland", *Probation*, Vol. 3, pp 53-80.

Sternberg, R.J., Forsythe, G.B., Hedlung, J., Horvath, J.A., & Wagner R.G. (2000), *Practical Intelligence in Everyday Life*, Cambridge University Press, Cambridge.

Taouktsis, X. & Zikopoulos, Ch., "A decision-making tool for the determination of the distribution center location in a humanitarian logistics network", *Expert Systems With Applications*, Vol. 238, 122010.

United Nations (2022), *Conflict, Humanitarian Crisis in Ukraine Threatening Future Global Food Security as Prices Rise, Production Capacity Shrinks, Speakers Warn Security Council*, https://press.un.org/en/2022/sc14846.doc.htm (Accessed: 13 February 2024).

Wąsowska, A. (2018) "Zarządzanie wiedzą w organizacjach pożytku publicznego czynnikiem ich sukcesu", *Zeszyty Naukowe Politechniki Częstochowskiej. Zarządzanie*, Vol. 31, pp 282-293.

Williams, P. M. (2012) "Integration of health and social care: a case of learning and knowledge management", Health & social care in the community, 20(5), pp. 550-560.

Zins, C. (2007) "Conceptual approaches for defining data, information, and knowledge", *Journal of the American society for information science and technology*, Vol. 58(4), pp 479-493.

Internet Treatment is a Blessing or a Curse: Health Knowledge Management

Justyna Żywiołek
Faculty of Management, Czestochowa University of Technology, Czestochowa, Poland

justyna.zywiolek@wz.pcz.pl

Abstract: The social distancing, isolation and shortage of health workers, as well as the COVID-19 pandemic, as well as the ageing of the society requiring healthcare, influenced the fast pace of digital innovation and the implementation of new technologies and even digital services in healthcare health. Is this transformation a blessing or a curse for healthcare? To answer this question, we conducted a literature review on new technologies, innovations in medicine and e-health. A research survey was also carried out in three countries and the Servqual analysis made it possible to estimate the trust in modern technologies for e-health and the trust of surveyors in these methods.

keywords: E-Health, Online Telecommunication Knowledge, Health Knowledge Management

1. Introduction

The growing number of health and social problems worsens the health of our society and thus threatens the existence of future generations. The period of the Covid-19 pandemic showed how dependent we are on healthcare (Akrich and Méadel 2009; Brown et al. 2014), often squander resources by purchasing internet products that are labeled as "healthy" or "cost-saving," despite the fact that they are neither pharmaceuticals nor supplements (Bessant 2019). Most consumers ignore the dangers resulting from the deteriorating health situation and rarely visit doctors' offices or undergo check-ups (Chretien et al. 2015). It is also very difficult for Europeans to admit the need for psychological or psychiatric treatment (El Morr and Eftychiou 2017; Doxey 2021), which was also greatly influenced by the pandemic, home office and social isolation. The shame caused by diseases related to the human psyche and mental problems causes unfortunately the abandonment of treatment or looking for home remedies, advice from people with similar diseases on forums, chat rooms or more and more often online advice from unverified "specialists" (Engel et al. 2020; Hays 2021b).

The terms "innovation" and "innovative" are buzz words that are used widely in many different fields, including healthcare (Bessant 2019). So far, however, there is no comprehensive and generally accepted definition of innovation (Wald et al. 2007), and different sciences (Simon 2016)(e.g. economics, public health, geography, sociology) use slightly different concepts (Thoër et al. 2017; van Leijen-Zeelenberg 2015). Schumpeter was one of the first economists to recognise the importance of innovation in any economic system, from a single business unit to entire economies and the world economy (Żywiołek and Schiavone 2021).

He described innovation as any change in the method of production, the production of new products, company structures or entry into a new market, and as "creative destruction" that is the basis of all advances in a capitalist market regime (Żywiołek et al. 2021).

In the health sector, improvements in quality come from service and quality of life innovations (Żywiołek and Schiavone 2021; van Leijen-Zeelenberg 2015), but they are also a constant challenge for existing healthcare providers and systems (Broom 2005). Advances in medicine require new technologies (Slametiningsih et al. 2020)(e.g. drugs, implants and devices), procedures (e.g. new surgical techniques) or forms of organisation (e.g. palliative medicine as an innovative form of care) (Simon 2016; U et al. 2022).

The aim of the literature review was to search for scientific publications that would: present model patient behaviours from the perspective of multiple ailments and access to the Internet (Beck et al. 2014; Boer et al. 2007). The authors conducted extensive literary studies based, among others, on publications on innovation, digitization and digitization of healthcare, e-health development in a very careful way over the past 10 years. The literature review shows that the main focus of the management science issue is the characteristics and behaviour of patients who are consumers at the same time (Chen et al. 2021). Doctors are experts in the field of health (Brown et al. 2014), while patients / consumers are responsible for managing their time (Archambault et al. 2013), health, access to health information and knowledge (Żywiołek et al. 2021). The authors of this paper found that the solutions provided to patients and the typical consumer behaviour of patients were of particular interest.

The National Institute of Health and Care Excellence in the United Kingdom classifies digital medical technologies according to features such as system services (e.g., electronic prescription systems) (Barker and Barker 2022),

active monitoring applications that connect to sensors (Haar and Ernst 2016), and wearable devices that are designed to enable remote monitoring of patients by healthcare professionals, and advanced artificial intelligence programs that use data to guide diagnostic decisions (J. Zywiołek et al. 2021; J. Żywiołek et al. 2021).

There is so much choice today that healthcare organisations must be able to (J. Żywiołek and F. Schiavone 2021; Krishna and Thompson 2021; Moore et al. 2021):ensure that the digital technologies they implement are functional, safe and effective. Websites have been set up across Europe to focus on a comprehensive, innovation-driven approach to this with the overarching goal of increasing the health life expectancy of European Union (EU) citizens by two years by 2020. It is still unclear whether this goal has been achieved. achieved but efforts are ongoing (Smit et al. 2021).

Regarding the WHO, universal health insurance cannot be achieved without the support of e-health because digitization enables the delivery of scalable solutions to many people, even remotely (Chen et al. 2021; Chretien and Kind 2013). The rapid development of new digital technologies in healthcare, the current COVID19 pandemic, and the heavy burden on healthcare systems around the world are fuelling the digitization of healthcare. How does digitization affect diagnostics, pharmacotherapy, psychotherapy, the doctor-patient relationship, and administrative tasks in psychiatry? Is digitization? blessing or glue?

However, the proposed solutions are either too general or incomplete. Here are some examples of such findings.

The considerations show the following about the patient / consumer (Chen et al. 2021):

- want to be served at the highest level,
- are focused on the future,
- health is more important to them than service time,
- seek to control the impact of their health efforts,
- try to minimise the negative impact of access to technology and knowledge on their health.

The following hypotheses were developed as a result of the specified goal, together with literature study and practical observations connected to online treatment awareness and knowledge:

Hypothesis (H1). The amount of understanding of online treatments boosts trust in these treatments and therapies.

Hypothesis (H2). Modern e-health technologies have increased accessibility to online therapy and treatment.

The text illustrates the intricate interplay between social health challenges and innovation in healthcare. It highlights society's dependence on healthcare systems, especially evident during crises like the COVID-19 pandemic, emphasizing the need for innovative solutions to address existing issues and adapt to changing circumstances. Consumer behaviour, influenced by factors such as stigma surrounding mental health treatment and the desire for convenience, shapes the demand for innovative healthcare solutions. These innovations, ranging from digital technologies to new care models, aim to improve healthcare quality, service delivery, and patient outcomes while addressing complex health challenges. Overall, the rapid digitization of healthcare presents opportunities and challenges, with efforts focused on achieving specific goals such as increasing life expectancy and expanding access to care.

2. Materials and Methods

The researchers in this study implemented the following research methodology: creating a model customer/consumer profile and delineating its behaviours and traits, specifically those pertaining to e-health. The profile of the patient or consumer is presented in the second section of the article. The authors built it based on their own unique concept. The second phase of the study process necessitated empirical investigation. The objective of the study was to ascertain the perspectives and sentiments of patients and consumers who utilise internet solutions for health and treatment. In order to accomplish the established study objective, we have devised a research strategy, executed the investigation, synthesised the findings, scrutinised them, and subsequently derived conclusions. We conducted the study in the latter half of 2021. The study involved patients reporting the utilisation of contemporary technologies in the realm of healthcare and therapy. The individuals ranged in age from 18 to 70 and were from Poland, UK, and Sweden. As a result of the ongoing COVID-19 outbreak, we have discontinued in-person interactions with managers. Alternatively, we employed the survey methodology. We employed a questionnaire as the study instrument. In order to get patient feedback, we employed an online survey and examined a total of 13,6157 individuals residing in these specific nations. The

authors of the publication determined that the use of the research method and research tool in the form of a survey should use a 5-point Likert scale (Sayili et al. 2024), which will allow obtaining reliable research results. The majority of respondents, at 34%, fell between the age range of 40 and 49.

The study questionnaire had twenty-three inquiries sent to patients with the aim of resolving the research quandary. A point scale indicated the answers to each question. The research is centred around studying individuals' preferences and their anticipated actions in the future, as well as the acquisition of knowledge and the establishment of trust. The study centred on individuals' preferences and behaviours and was carried out using representative methodology. The sample fulfils the condition of being representative, although the absence of a breakdown of the data by particular countries is due to their similar geographic location and the comparable level of social awareness regarding the availability of e-health, which is present in 33% of the population across all countries. They have common objectives, strategies, and presumptions in relation to this matter. Encouraging proper conduct within their communities and providing individuals with education result in favourable societal reactions. European inhabitants share comparable levels of economic development and cultural characteristics. The ability to freely migrate between European Union or Schengen zone countries allows for the sharing of knowledge, perspectives, and ideas on problem-solving. The second phase of the investigation involved nine specific inquiries utilising the Servqual approach. To demonstrate the similarities in the behaviour and organisation of national health systems across different countries, the authors have compiled an overview. Although countries vary in size, a notable shared characteristic is the level of knowledge, forces, and resources that each country dedicates. Table 1 displays the parameters that were evaluated to determine the similarities in prevalence as well as the proportion of nation involvement and the utilisation of society.

Table 1: The similarities in the use of e-health methods and the percentage of use by society. (data from 2021)

Health factors	Poland		UK		Sweden	
	Average Value					
Source of e-Health financing - public funds		77%		77%		77%
eHealth capacity building:						
Health sciences students		50-75%		<25%		25-50%
Health professionals		25-50%		25-50%		<25%
	know	use	know	use	know	use
Applications, national programs	84%	79%	89%	84%	91%	82%
Social media and health	86%	83%	93%	83%	93%	90%
Big data and health	78%	63%	82%	76%	89%	88%
Electronic Health Records (EHRs) (year of creation)		2009		1978		1996

Source: Own study based on WHO data from 2021 (; ;).

Table 1 shows the structure of the country's involvement in e-health activities. Knowledge and use of these new forms of access to "health" are manifestations of service consumerism and public awareness. The huge interest in accessing health services and advice also raises problems, as shown in Figure 1.

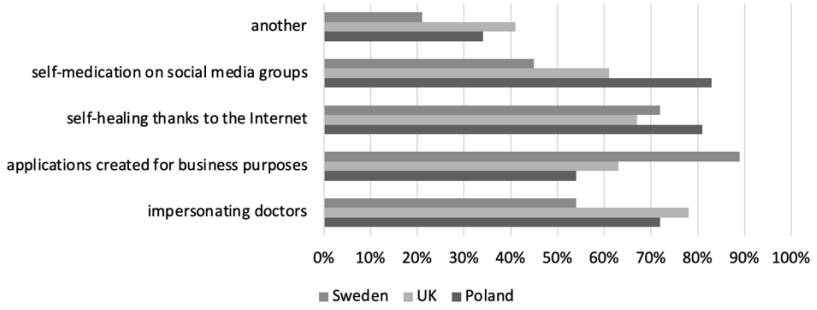


Figure 1: E-health problems in selected countries.

Source: WHO data from 2020 (; Hays 2021a).

3. Results

The identification of barriers and problems made it possible to define the method of proceeding to solve the problem. The scope and effectiveness of self-treatment with the use of the Internet, online treatment, support methods, and applications supporting the treatment are presented in Table 1. The descriptive statistics for all analysed constructs in the article are related to each other in terms of the effectiveness of the activities carried out on the management of remote treatment methods. Based on the results in Table 2, we can see the moderate mean value for the construction of knowledge and information in the field of treatment (3.53). The mean values for the remaining four constructs that measure the range of remote treatment management methods are low to moderate at best. Average values are: responsibility for treatment (2.83), implementation of solutions (2.90), availability of information and creation of knowledge (2.87), treatment support, and modern methods (2.89). Our part of the research focused on taking action for e-health.

Table 2: Mean values and Cronbach's α coefficient.

Variable	Average value	Cronbach's α
Online treatment knowledge	3,53	0,82
Responsibility for management	2,83	0,87
Implementation of solutions	2,90	0,76
Availability of information creating knowledge	2,87	0,81
Treatment support, modern methods	2,89	0,85
Improved communication	4,43	0,69
High awareness among patients	5,53	0,79
Strengthened cooperation in the field of applied treatments	3,59	0,71

The initial phase of the study was establishing the presence and magnitude of the relationship. In the initial stage of the Servqual study, we calculated the discrepancies between the levels of energy management perception and consumer awareness and the expected levels for the five dimensions. Table 3 presents the outcomes.

Table 3: Differences in perceptual levels were studied using Servqual.

	Features	P	E	Servqual Results "SS" Is the Level of Satisfaction SS = E − P
Online treatment knowledge				
Average Servqual: 0,81				
1	Patient involvement in treatment	9	9,24	0,31
2	Constant monitoring of the health level and disease progression	8	8,16	0,22
3	Knowledge of online treatment options	9	8,52	-0,21
4	Patient involvement in changing attitudes	9	9,49	0,63
Responsibility for e-health management				
Average Servqual: 2,68				
5	Access to information and knowledge	7	6,77	-0,11
6	Usefulness and ease of interpretation of information and knowledge	9	9,38	0,39
7	Patient's level of knowledge	7	8,36	1,24
8	Possibility of combining different treatments	7	8,51	1,38
Availability of information creating knowledge, improved communication				
Average Servqual: 0,21				
9	Alternative ways of communication	8	7,78	-0,39
10	Information systems enabling the search for help	7	5,98	-0,41
11	Organizational activities to disseminate information and knowledge	6	5,56	-0,72

	Features	P	E	Servqual Results "SS" Is the Level of Satisfaction SS = E − P
12	Online treatment culture	9	9,51	0,62
13	Managing medications and supplements	7	7,59	0,81
High awareness among patients				
Average Servqual: 0,52				
14	A high level of self-healing confidence	7	7,89	0,67
15	Trust in online therapy / treatment	9	9,73	0,75
16	Patient information campaigns	8	7,39	-0,41
17	Monitoring applications	6	5,22	-0,43
Strengthened cooperation in the field of applied treatments				
Average Servqual: 0,37				
18	Errors in reasoning and application of solutions	6	6,26	0,32
19	Lack of trust	8	6,27	-1,59
20	Use of medications and therapy based on similar symptoms of friends / family	8	8,46	0,58
21	Ignorance / fear of alternative treatments	6	6,16	0,43
22	Online search for symptoms and self-treatment	6	6,19	0,26
23	Fear of a serious disease	7	6,48	-0,52
24	No treatment	7	7,06	0,13

A graph was produced based on the Table 3 data, which included the results of the Servqual method of perception and expectancies analysis. Figure 3 depicts the graphical representation of the Servqual method's outcomes.

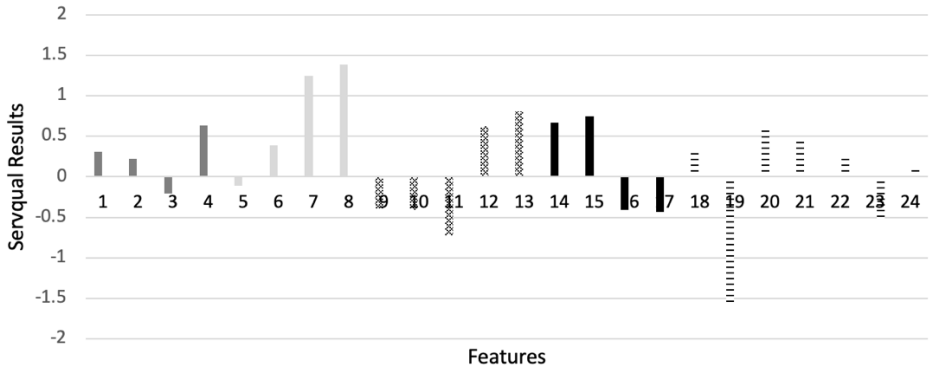


Figure 3: Results of the Servqual analysis.

The results show that 15 of the 24 feasible scenarios achieved satisfaction, whereas the other cases showed no level of satisfaction with the actions associated with information systems aimed at patient assistance. For knowledge dissemination organisations, health monitoring applications, loss of trust in treatments and doctors, and fear of disease, dissatisfaction is critical. However, as you can see, the sources of discontent were lack of understanding, anxiety, and maybe a terrible treatment experience. As a result, it's safe to infer that they're a good area to run social marketing and gain patients' confidence and knowledge. Taking action on your own, such as taking drugs or supplements like people who have similar symptoms, is a very risky phenomenon. It's just as risky to try to heal yourself by typing your symptoms into a search engine. The findings of the study allowed for the identification of the factors that influence the determination of what constitutes online treatment.

4. Discussion and Conclusions

The study showed that a change in approach is necessary, and knowledge in this area has increased awareness of caring for one's health. Older people constitute an increasingly important and growing part of the general population. Digital health and wellness programmes offer the potential to strengthen and facilitate support and

healthy prevention strategies (J. Żywiołek and F. Schiavone 2021). Using a digital health platform that includes integrated functions for both health recommendations and accountability (e.g., by a behavioural trainer) can be a unique feature to encourage patients to be motivated and accountable (Żywiołek 2018; Matsushita 2021; Mann et al. 2020). Future work should build on the concept of a "user-centric" approach, using both qualitative data (e.g., focus groups and surveys) and other data-driven approaches to identify key aspects of eHealth.

It was vital to make adjustments in the medical services industry at a time when societies are ageing at an alarming rate and hospitals and public institutions are unable to absorb patients (Shaheen 2004; Zywiolek et al. 2021). Modern health technology has been employed to take effective measures leading to patient care and access to a specialist. The purpose of the modern approach to raising patient awareness and providing new chances to support the battle against sickness and self-healing via the Internet is to integrate these elements.

The findings are negative, revealing widespread illiteracy, a lack of information, and a fear of taking drugs without contacting a doctor. Future research on this topic should focus on the following areas:

- the adaptation of e-health management methods for different age groups, knowledge and social campaigns to help patients acquire skills,
- activities to better prepare the younger generation to use e-health services,
- the inclusion of sustainable development in educational programs.

The results of qualitative and quantitative research on treatment and therapy in terms of distance and modern instruments utilized in the investigated nations are presented in this article. The employment of specific approaches was linked to the fact that quantitative research allows for the creation of a broad picture of the research topic. Qualitative research, on the other hand, allows you to obtain additional understanding about the identification of components associated with the investigated area and their relationships. The survey's preparation also necessitated the acquisition of specialised knowledge as well as the identification and comprehension of certain components and their relationships (Żywiołek et al. 2021; Simon 2016; Menvielle et al. 2017). This necessitated the application of qualitative research methods. Quantitative research allows for generalisations, but qualitative research based on the principle of ethnographic study allows for a greater grasp of the intricacies of non-human phenomena. The application of research is inextricably linked to the emergence of unique issues and limits. The inability to compare the data to another research period was a weakness of this study. The authors decided that this is a viable research topic for the future and plan to perform a comparison study within the next 2–3 years.

References

Available at: https://www.euro.who.int/en/health-topics/Health-systems/digital-health (Accessed 4 January 2022).

Available at: https://www.who.int/publications/i/item/9789241565219 (Accessed 6 February 2022).

Available at: https://www.euro.who.int/en/health-topics/noncommunicable-diseases/pages/who-european-office-for-the-prevention-and-control-of-noncommunicable-diseases-ncd-office/data-publications-and-tools/latest-publications/factsheet-tackling-noncommunicable-diseases-with-digital-solutions-2021 (Accessed 12 January 2022).

Akrich, M. and Méadel, C. (2009), Les échanges entre patients sur l'Internet, *Presse medicale (Paris, France 1983)* 38: 1484–1490.

Archambault, P.M., van de Belt, T.H., Grajales, F.J., Faber, M.J., Kuziemsky, C.E., Gagnon, S., Bilodeau, A., Rioux, S., Nelen, W.L.D.M. and Gagnon, M.-P., et al. (2013), Wikis and collaborative writing applications in health care: a scoping review, *Journal of Medical Internet Research* 15: e210.

Barker, G.G. and Barker, E.E. (2022), Online therapy: lessons learned from the COVID-19 health crisis, *British Journal of Guidance & Counselling* 50: 66–81.

Beck, F., Richard, J.-B., Nguyen-Thanh, V., Montagni, I., Parizot, I. and Renahy, E. (2014), Use of the internet as a health information resource among French young adults: results from a nationally representative survey, *Journal of Medical Internet Research* 16: e128.

Bessant, J. (2019), The future of responsible innovation. In Iakovleva, T., Oftedal, E. and Bessant, J. (Eds.), *Responsible Innovation in Digital Health*, Edward Elgar Publishing, pp. 232–250.

Boer, M.J. de, Versteegen, G.J. and van Wijhe, M. (2007), Patients' use of the Internet for pain-related medical information, *Patient Education and Counseling* 68: 86–97.

Broom, A. (2005), Virtually he@lthy: the impact of internet use on disease experience and the doctor-patient relationship, *Qualitative Health Research* 15: 325–345.

Brown, J., Ryan, C. and Harris, A. (2014), How doctors view and use social media: a national survey, *Journal of Medical Internet Research* 16: e267.

Chen, Z., Tarazi, J.M., Salem, H.S., Scuderi, G.R. and Mont, M.A. (2021), The Utility of Telehealth in the Recovery From the COVID-19 Pandemic, *Surgical technology international* 39.

Chretien, K.C. and Kind, T. (2013), Social media and clinical care: ethical, professional, and social implications, *Circulation* 127: 1413–1421.

Chretien, K.C., Tuck, M.G., Simon, M., Singh, L.O. and Kind, T. (2015), A Digital Ethnography of Medical Students who Use Twitter for Professional Development, *Journal of General Internal Medicine* 30: 1673–1680.

Doxey, C.H. (Ed.) (2021), *The Controller's Toolkit*, Wiley.

El Morr, C. and Eftychiou, L. (2017), Evaluation Frameworks for Health Virtual Communities. In Menvielle, L., Audrain-Pontevia, A.-F. and Menvielle, W. (Eds.), *The Digitization of Healthcare*, Palgrave Macmillan UK, London, pp. 99–118.

Engel, N., Meershoek, A. and Krumeich, A. (Eds.) (2020), *Science, Technology, and Innovation for Sustainable Development Goals*, Oxford University Press.

Haar, J. and Ernst, R. (Eds.) (2016), *Innovation in Emerging Markets*, Palgrave Macmillan UK, London.

Hays, P. (Ed.) (2021a), *Advancing Healthcare Through Personalized Medicine*, Springer International Publishing, Cham.

Hays, P. (2021b), Alliances: Knowledge Infrastructures, and the Digitization of Precision Health. In Hays, P. (Ed.), *Advancing Healthcare Through Personalized Medicine*, Springer International Publishing, Cham, pp. 99–139.

J. Zywiołek, J. Rosak-Szyrocka and B. Jereb (2021), Barriers to Knowledge Sharing in the Field of Information Security, *Management Systems in Production Engineering* 29.

J. Żywiołek and F. Schiavone (2021), Perception of the quality of smart city solutions as a sense of residents' safety, *Energies* 14.

J. Żywiołek, J. Rosak-Szyrocka and M. Mrowiec (2021), Knowledge management in households about energy saving as part of the awareness of sustainable development, *Energies* 14.

Krishna, A. and Thompson, T.L. (2021), Misinformation About Health: A Review of Health Communication and Misinformation Scholarship, *American Behavioral Scientist* 65: 316–332.

Mann, D.M., Chen, J., Chunara, R., Testa, P.A. and Nov, O. (2020), COVID-19 transforms health care through telemedicine: Evidence from the field, *Journal of the American Medical Informatics Association JAMIA* 27: 1132–1135.

Matsushita, H. (Ed.) (2021), *Health Informatics, Translational Systems Sciences*, Vol. 24, Springer Singapore, Singapore.

Menvielle, L., Audrain-Pontevia, A.-F. and Menvielle, W. (2017), *The Digitization of Healthcare*, Palgrave Macmillan UK, London.

Moore, E., Stanton, T.R., Traeger, A., Moseley, G.L. and Berryman, C. (2021), Determining the credibility, accuracy and comprehensiveness of websites educating consumers on complex regional pain syndrome accessible in Australia: a systematic review, *Australian journal of primary health* 27: 485–495.

Sayili, U., Siddikoglu, E., Turgut, D., Arisli, H.E., Ceyhan, B., Gunver, M.G., Ozel Yildiz, S., Yurtseven, E. and Erginoz, E. (2024), Does categorizing scale scores with cutoff points affect hypothesis-testing results?, *Discover mental health* 4: 14.

Shaheen, S.I. (2004), E-healty in egypt: challenges and opportunities. In *Proceedings. 2004 International Conference on Information and Communication Technologies: From Theory to Applications, 2004, 19-23 April 2004,* Damascus, Syria, IEEE, pp. 35–36.

Simon, F. (2016), Health-Care Innovation in Emerging Markets. In Haar, J. and Ernst, R. (Eds.), *Innovation in Emerging Markets*, Palgrave Macmillan UK, London, pp. 233–252.

Slametiningsih, S., Yunitri, N., Hendra, H., Nuraenah, N. and Kamil, A.R. (2020), IMPROVING HEALTCARE SERVICES USING MOBILE TECHNOLOGY: NEEDS AND EXPECTATION ASSESSMENT FOR THE DEVELOPMENT OF MOBILE HEALTH APPS FOR MENTAL HEALTH SERVICES IN TECHNOLOGY, *IJNMS* 4: 170–176.

Smit, D., Vrijsen, J.N., Groeneweg, B., Vellinga-Dings, A., Peelen, J. and Spijker, J. (2021), A Newly Developed Online Peer Support Community for Depression (Depression Connect): Qualitative Study, *Journal of Medical Internet Research* 23: e25917.

Thoër, C., Millerand, F. and Duque, N. (2017), When Medicine Is Becoming Collaborative: Social Networking Among Health-Care Professionals. In Menvielle, L., Audrain-Pontevia, A.-F. and Menvielle, W. (Eds.), *The Digitization of Healthcare*, Palgrave Macmillan UK, London, pp. 119–134.

U, A.S., F, A. and Philip, F.M. (2022), Using IoTs-Based Monitoring System in a Smart Ambulance for E-Healtcare Applications. In Giannoccaro, I., Salunkhe, S., Hussein, H.M.A.M. and Davim, J.P. (Eds.), *Applications of Artificial Intelligence in Additive Manufacturing*, *Advances in Computational Intelligence and Robotics*, IGI Global, pp. 42–67.

van Leijen-Zeelenberg, J.E. (2015), *Healthcare quality improvement by redesign*.

Wald, H.S., Dube, C.E. and Anthony, D.C. (2007), Untangling the Web--the impact of Internet use on health care and the physician-patient relationship, *Patient Education and Counseling* 68: 218–224.

Zywiolek, J., Molenda, M. and Rosak-Szyrocka, J. (2021), Satisfaction with the Implementation of Industry 4.0 Among Manufacturing Companies in Poland, *ERSJ* XXIV: 592–603.

Żywiołek, J. (2018), Monitoring of information security system elements in the metallurgical enterprises, *MATEC Web Conf.* 183: 1007.

Żywiołek, J., Rosak-Szyrocka, J. and Jereb, B. (2021), Barriers to Knowledge Sharing in the Field of Information Security, *Management Systems in Production Engineering* 29: 114–119.

Żywiołek, J. and Schiavone, F. (2021), Perception of the Quality of Smart City Solutions as a Sense of Residents' Safety, *Energies* 14: 5511.

Knowledge-Driven Sustainability: Leveraging Technology for Resource Management in Household Operations

Justyna Żywiołek
Faculty of Management, Czestochowa University of Technology, Czestochowa, Poland

justyna.zywiolek@wz.pcz.pl

Abstract: Conserving energy is a worldwide dilemma for nations as well as individual households. Data indicates that European nations face a significant issue in this regard. Energy conservation is a global issue that both nations and individual households must address. Statistics reveal that European nations face a significant issue in this regard. The literature study revealed that several studies primarily focus on energy conservation, whereas there is a dearth of research examining social consciousness and user proficiency. A report outlines the study findings, aiming to ascertain the level of awareness across various generations about the resources, information, and expertise required for energy management. The objective of the paper was to examine the use of the Internet of Things as a technological instrument for residential energy management in Poland, Portugal, and Italy. We administered an online survey to a total of 18,683 customers from February 2022 to February 2023. The survey used a kind of sampling known as convenience sampling. The research used a survey that included 26 inquiries about customers' awareness and behaviour in the field of energy conservation. Research indicates that the elderly population struggles with vocabulary and often lacks comprehension of instruments. This suggests that they are unable to effectively control the energy use in their households, resulting in inefficient measures. Additionally, future research endeavours were established to explore knowledge acquisition, solution utilisation, and proficient utilisation of technologies for conserving and controlling energy within residential settings.

Keywords: Energy Saving, Sustainable Household, Household Resources, Knowledge Management

1. Introduction

Today's technology development, including the Internet of Things (IoT) and related technologies, finds further applications for this solution, including primarily in enterprises and organisations (Carpino et al. 2018; Amine Chatti 2012), but also in the immediate environment of an employee, client, or user. This necessitates conducting research on how companies and employees perceive IoT technology and devices, as well as establishing a model that verifies the acceptance factors of IoT in private applications by consumers. The purpose of this article is to try to explain and illustrate the acceptance of IoT technologies by different generations of consumers using constructs relating to consumer confidence in these IoT technologies and devices. Employees of different ages accept new technologies to a different degree (Fawkes 2017), which allows us to recognise the studied phenomenon in different age groups but also determines the size of the company or industry.

2. Literature Review

The IoT is not a new concept, as it was invented and proposed in 1999 (Khan et al. 2022), while it was implemented as a practical solution approx. 7–10 years later, but for 3–4 years it has been gaining applications with an ever wider range and is currently experiencing a period of development, and a dynamic one at that . More broadly, we can conceptualize the IoT as an ecosystem where items equipped with sensors interact with computers, both manually and automatically, primarily through wireless networks (Żywiołek 2019). Taking into account the variety of technologies connecting devices included in the IoT category, the very concept of IoT is defined in various ways. K. Ashton, who described the IoT as a sophisticated system where devices communicate with sensors to gather environmental data, provides the most common definition in scientific research. This communication concerns computers and objects connected by ICT networks, mainly the Internet (Tiwari et al. 2022; Himeur et al. 2020). Internet-connected gadgets with advanced intelligence capabilities form the Internet of Things (IoT) system. These gadgets use integrated sensors, processors, and communication equipment to gather, process, and transmit data. IoT devices transmit sensor data by establishing a connection with an IoT gateway or similar device. Typically, the cloud receives this data for analysis (Sayed et al. 2022; Żywiołek et al. 2022b; Shang et al. 2024). The devices do most of the work without user intervention, although it is possible for people to interact with them (Alsalemi et al. 2022). The specific IoT applications implemented and supported by the Internet largely determine connectivity, network, and communication protocols (Krishnan and Jacob 2022). This article categorizes consumer applications into four main groups: wearables, "connected" home appliances, including "smart" home appliances, and consumer building automation. "Intelligent" personal medical devices (personal health), as well as "connected" cars, remain beyond the author's area of interest due to the different specifics of their application (Razip et al. 2022).

The author, when preparing to conduct the study, set a goal for it and then divide it into a theoretical part illustrating the social acceptance of such a solution for energy saving and a practical goal obtained through a qualitative study, giving a practical picture of the level of awareness with particular attention to the older generation. Conversely, the research aims to foster sustainable societies that utilize resources in a comprehensible and mindful manner.

3. Materials and Methods

For the majority of service providers, determining the quality of their offerings is a difficult task because it substantially differs depending on factors including cultural variations, demographics, and individual circumstances (Rosak-Szyrocka and Żywiołek 2022). The individuals involved, their behaviour, and their understanding of the quality of service can also have an impact on how satisfied a client, patient, or city resident is. In conclusion, a number of variables served as the catalyst for this research investigation. (Żywiołek et al. 2022c). First, few studies have measured the quality of services, but this did not apply to city dwellers or the use of media for the functioning of the household. This study focused on filling the gap in urban service quality research, in particular in households.

The analysis of the literature based on research in the field of the use of IoT solutions using the Servqual methods allowed the author to identify research gaps and indicate actions to fill them, as shown in Figure 1.

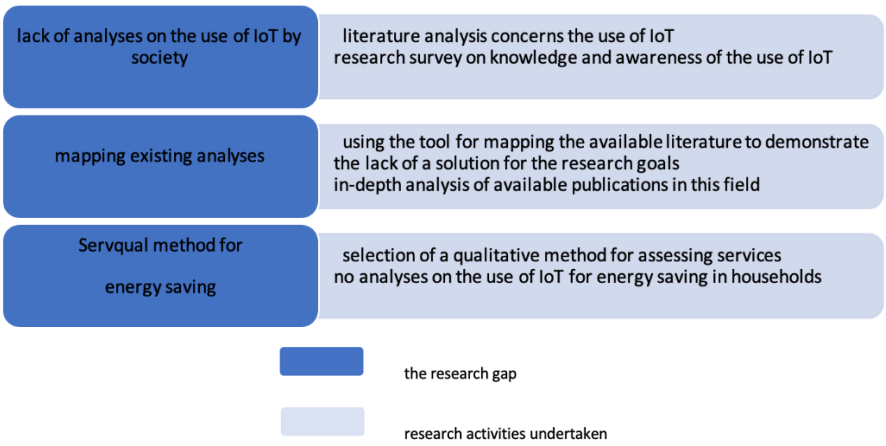


Figure 1: Identifying research gaps and research activities undertaken.

Identification of research gaps and determining what research activities will be undertaken made it easier to conduct them. The sequence of actions was adopted as shown in Figure 1, because it made it possible to achieve individual assumptions, and each subsequent step made it possible to state that the adopted methodology was correct and verified the adopted assumptions. While preparing the literature analysis, the authors made science mappings and found 826 manuscripts concerning the quality of services and the Servqual method. With the use of Vosviewers prop-programming, Figure 2 relating to keywords and Figure 2 relating to the countries in which research is conducted on this subject have been prepared.

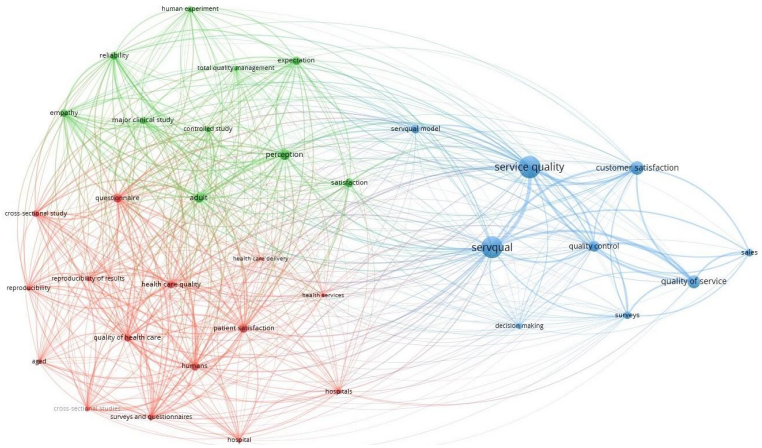


Figure 2: Analysis of keywords that appear in publications in 2019-2022 on quality and the Servqual method.

The completed study in Poland reveals that the quality and Servqual technique are also published. An examination of the publication's keywords suggests that customer satisfaction holds significant importance, and urban residents are also consumers. It is important to focus on those who oversee homes, since they are the ones responsible for determining the effectiveness of energy-saving measures.

The Green Deal for Europe, proposed at the conclusion of 2019, sets the stage for a very ambitious programme aimed at safeguarding the environment. We expect Europe to achieve carbon neutrality by 2050 (Alberg Østergaard et al. 2010). The European Union has implemented a sequence of measures (Żywiołek et al. 2022a; Zografakis et al. 2012). The Green Deal aims to facilitate a sustainable green transition for enterprises and communities in Europe, enabling them to reap its benefits. The ideas, along with a first "roadmap" outlining crucial policies, tackle several concerns, such as reducing emissions, financing cutting-edge research and development, and protecting Europe's ecology (Żywiołek et al. 2021; Valerio-Ureña and Rogers 2019). Implementing the "Green Deal for Europe" initiative would enable EU countries to achieve energy self-sufficiency, potentially leading to significant effects on the energy market and their regional policies. Furthermore, it is expected that achieving climate neutrality in the economy would improve its competitiveness and facilitate its vigorous expansion.

The introduction of the aforementioned legislation in EU states fuelled an increase in the adoption of renewable energy across the entire community. In 1990, renewable sources accounted for 3.8% of the EU-28's overall energy consumption. This figure increased to 5.1% in 2000 and further rose to 10.2% in 2019. The household sector's use of renewable energy sources (RES) accounted for 8.5% of total home final energy consumption in 1990, increased to 10.8% in 2004, and further rose to 7.4% after 16 years. This indicates that the household sector plays a significant role in the utilisation of RES. The construction industry in Europe has a carbon dioxide (CO2) emission rate that is 36% higher and consumes 40% more energy compared to other sectors. The European Union's framework for decreasing energy consumption in buildings encompasses various policy initiatives, such as the Energy Performance of Construction Directive (EPBD), the Energy Efficiency in Buildings Directive (EED), the Sustainable Design Directive, Energy Labelling Compliance, and the aforementioned Renewable Energy Directive (RED) (Di Foggia 2018; Żywiołek and Schiavone 2021; Tezde et al. 2019).

Ultimately, the policies implemented in European Union countries have progressively increased the importance and role of renewable energy sources (RES) in the energy sector's organisation since the 1990s. The National Energy Efficiency Action Plan 2020 (Varlamis et al. 2022) encompasses all the strategies and initiatives devised to achieve the predicted targets.

The approach to achieving national renewable energy objectives varies across countries and is formulated at various levels, which influences the utilisation of renewable energy sources in residential settings. Energy resources have consistently played a vital role in the survival and development of humanity. Energy resources have a significant influence on both social and economic progress. The advancement of technology, utilisation of energy, and growth in the global population are interconnected to some extent. Ensuring an adequate supply of energy resources for entities such as residential dwellings is vital to meeting fundamental societal requirements. Energy use accounts for a significant portion of household consumer expenditure.

With the rise in environmental consciousness, income levels, the number of children, and solar radiation intensity, there is a greater likelihood that individuals may contemplate investing in renewable energy sources (RES). Compared to the elderly, males and those with higher levels of education had a greater likelihood of engaging in RES initiatives. Age, education, gender, income, and the type of building occupied all affect how socially acceptable renewable energy is. The demographic categories most accepting of RES installation were men, those aged 30-49, those with a secondary technical degree, those with low incomes, and those residing in single-family homes. The justification for RES installation was the anticipated long-term savings, but the biggest barrier was a lack of funding (Appel-Meulenbroek et al. 2018; Yi 2009).

The literature frequently discusses sustainable development, which is crucial for energy management. Most of the current publications contain research on technological solutions or describe in detail a solution promoting a given technology. The table contains the research topic, a specific research gap, or a lack thereof. Table 2 presents the latest research and indicates the gap because none of the research shows the social part, the knowledge of people managing households.

In order to identify the research problem, the data available in the reports of the European Union was thoroughly analysed (Yeo and Marquardt 2015). The data analysis covered the five previous years. In order to define the research problem, technical and statistical reports, as well as available research results, were analysed. Defining

a research problem that represents the opportunities and barriers that the use of the IoT brings for home users A survey was conducted among household representatives in Poland, Italy, and Portugal to determine whether consumer behaviour in terms of electricity consumption supports the assumptions of using IoT. The decision on the selection of countries for the study resulted from statistical reports; in the countries mentioned, the highest user involvement in the use of IoT tools for renewable energy sources has been recorded in the last 5 years (Perumal and Sreekumaran Nair 2021; Di Foggia 2018). Only EU countries were taken into account, and the utilisation rate ranged from 27% to 0%. The most frequently reported share in the use of IoT for energy savings is 0%. The survey was conducted among 18,683 consumers in the period using an online survey. The data for the study were collected during the COVID-19 pandemic; however, the method of collecting data via an online form and the subject of households indicate that the pandemic had no impact on the collection of data or the result of the study. The respondents were guaranteed anonymity and voluntary participation in the study. The respondents were selected to participate in the study using a convenient sampling technique. The survey questionnaire used in the study consisted of 26 questions concerning the knowledge and behaviour of consumers related to energy saving. For the purposes of this study, questions related to electricity consumption in households were used. The research group is described in Table 1.

Table 1: Description of the research group

	Description of the Research Group				
1	Sex	Man 67%		Woman 33%	
2	Age	18-29 years	21%	18-29 years	11%
		30-39 years	28%	30-39 years	38%
		40-49 years	34%	40-49 years	32%
		Over 50 years	17%	Over 50 years	19%
3	Education	high school 42%		higher education 58%	
4	Using any source of renewable energy	Yes 100%		No 0%	
5	The level of knowledge about technologies for energy saving	Low 3%	Middle 31%	Higher 38%	Expert 28%

Male respondents account for as much as 67% of those surveyed, but this does not result from EU social statistics; it results from statistics on the gender of the person managing the household in the field of bills and savings. EU statistical results in the years 2020–2023 say that this result is from 65% to 70%, where men manage households in the selection of heating, energy bills, and saving (MALINOWSKI 2012; Du et al. 2022; Carpino et al. 2018).

After doing the study, the results were gathered, analysed, and conclusions made. The poll was divided into many sections, and participants were required to score their opinions on a 7-point scale, where 1 represents full disagreement and 7 represents entire agreement. The first section of the survey focused on consumers' familiarity with renewable energy sources for residential use and aimed to assess their understanding of such sources. The second section of the questionnaire verified which individual in the family is responsible for energy management and energy use. The subsequent section included inquiries on investments in farm-centric solutions that provide advantageous outcomes. This segment also encompassed inquiries about information technology solutions, such as apps. The poll also focused on the accessibility of IoT-related solutions, collaboration between users and producers via assistance, and the adoption of these solutions in homes. People's preferences and future behaviour were evaluated using a 7-point Likert scale. The implementation of this scale enabled the classification of respondents into three categories: low, medium, or high levels of pro-ecological and pro-social attitudes. This classification served as the basis for identifying possibilities and obstacles for various groups of individuals with varied levels of awareness. This division facilitated the development of inferences about their future conduct and the potential for further utilisation of IoT. The research focused on the decisions and future behaviour of future generations. The study included individuals

between the ages of 26 and 50, with 54% being male and 46% being female. The sample was deemed to be typical of the population.

Given the following parameters: significance level = 0.01, maximum estimate error d = 1% (u = 3.1426), and assuming that the probability of success p is unknown, European Union member nations, known for their cohesive approach to energy management and conservation, conducted the research. This is evident in their apparent collaboration and comparable level of planning and assumptions.

Utilising diverse question types and the seven-point Likert scale enables the evaluation of citizens' and residents' awareness, facilitating the identification of both challenges and prospects. The writers express their professional aspirations and expectations about the energy economy, primarily emphasising the avoidance of financial losses. Hence, the authors directed their attention towards examining the accessibility of consumer information and their inclination to develop not just tangible abilities but also intangible ones that are embedded inside their knowledge. The research further included an evaluation of client satisfaction with the implemented solutions using the Servqual methodology. We examined the data gathered in a Google spreadsheet using Microsoft Excel, Statistica, and SmartPLS3 for analysis. The authors choose to use qualitative techniques, namely the Servqual approach, together with statistical methods like the student's t-test and SmartPLS3 software, to analyse the data.

4. Empirical Results

These constructs are interrelated in terms of the success of actions taken for managing energy resources and consumer awareness, including According to the findings in Table 2, the average value of increasing consumer knowledge in the area of energy management is moderate (4.11). The other four structures that gauge how well energy is managed have mean values that are, at best, low to moderate. Average values include being responsible for managing energy (2.83), putting solutions into practice (2.37), having access to information and producing knowledge (3.05), and using the Internet of Things (3.12). Our contribution to the study focused on the utilisation of IoT, conducting analyses across a range of age groups, and the effectiveness of energy management while assuming varied levels of awareness. Participants in energy management initiatives are required to disclose their involvement in the survey.

This could potentially influence the perception that current energy management efforts, particularly those that emphasize the use of IoT, are effective. However, we found a range of values for the measured performance constructs. The average values are as follows: adept energy management, high social awareness, improved use-related cooperation, and use of IoT-related solutions. The values demonstrate that varying levels of activity are required to use the IoT for energy management. In reality, the actions of the analysed group of firms demonstrate a modest level of efficacy. Table 2 displays the findings of the complete international survey.

Table 2: Mean values and Cronbach's α coefficient

Variable	Average value	Cronbach's α
Consumer awareness	4,11	0,88
Responsibility for energy management	2,83	0,89
Implementation of solutions bringing economic benefits	3,05	0,81
Availability of information using the Internet of Things	2,87	0,93
Availability of energy management application solutions	2,97	0,89
Improved communication	4,53	0,80
Use of renewable energies	5,79	0,95
Strengthened cooperation on the measures used	3,71	0,86
Better learning	3,69	0,71

The Internet of Things has made it feasible for customers to be more involved and knowledgeable in household energy management, which helps to increase elder consumers' awareness and expertise while simultaneously

making it easier for younger consumers to understand how applications and systems work. The Internet of Things is extremely important in this regard because of the expanding accessibility of contemporary systems and the development of a culture of energy conservation. Using the qualitative analyses and the research that has been done, SEM structural equations were also prepared, which determine the relationships between the tested factors (Fig. 3). The main study's findings underwent analysis. First, we determined the total number of ratings for each statement. We used these data to conduct a study on the associations between individual summaries, taking into account the ratings provided (Table 3). The next stage was calculating the standardised Cronbach's alpha using the determined correlations.

Table 3: Relationships between factors.

	I1	I2	I3	H1	H2	H3	C1	C2	C3	G1	G2	G3	M1	M2	M3	M4
I1	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
I2	0.933	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-
I3	0.86	0.76	1.00	-	-	-	-	-	-	-	-	-	-	-	-	-
H1	0.68	0.62	0.59	1.00	-	-	-	-	-	-	-	-	-	-	-	-
H2	0.51	0.67	0.61	0.54	1.00	-	-	-	-	-	-	-	-	-	-	-
H3	0.24	0.48	0.27	0.13	0.07	1.00	-	-	-	-	-	-	-	-	-	-
C1	0.17	0.38	0.34	0.11	0.09	0.46	1.00	-	-	-	-	-	-	-	-	-
C2	0.29	0.45	0.17	0.56	0.19	0.06	0.31	1.00	-	-	-	-	-	-	-	-
C3	0.34	0.43	0.28	0.04	0.19	0.02	0.18	0.13	1.00	-	-	-	-	-	-	-
G1	0.21	0.03	0.39	0.08	-0.02	0.42	0.61	0.17	0.51	1.00	-	-	-	-	-	-
G2	-0.04	0.26	0.47	0.11	-0.06	0.37	0.08	-0.02	0.38	0.09	1.00	-	-	-	-	-
G3	0.13	0.02	0.24	0.01	0.11	-0.08	0.18	0.05	0.02	-0.09	0.11	1.00	-	-	-	-
M1	0.03	-0.09	0.12	0.18	0.32	0.16	0.25	0.43	0.01	0.29	-0.03	-0.11	1.00	-	-	-
M2	0.17	0.31	0.16	-0.08	-0.12	0.21	-0.16	-0.21	0.14	0.08	0.18	0.22	-0.06	1.00	-	-
M3	0.05	-0.08	0.27	0.06	0.18	0.38	-0.19	-0.07	-0.12	-0.16	-0.05	0.08	0.14	0.22	1.00	-
M4	0.03	0.22	-0.04	0.11	0.07	0.34	0.01	-0.09	-0.17	0.04	0.38	0.06	0.13	0.39	0.17	1.00

We began examining the results using scale statistics. The variance, mean and standard deviation of a scale made up of all five examined items are shown in Table 4. The adopted scale accepts values ranging from 1 to 75. Average 53,2187 on the scale, or almost 2/3 of the total, seems to be relatively high and reflects respondents' positive attitudes towards environmental preservation and RES.

Table 4: The scale statistics.

Mean	Variance	Standard Deviation
51,06127	96,28315	8,90153

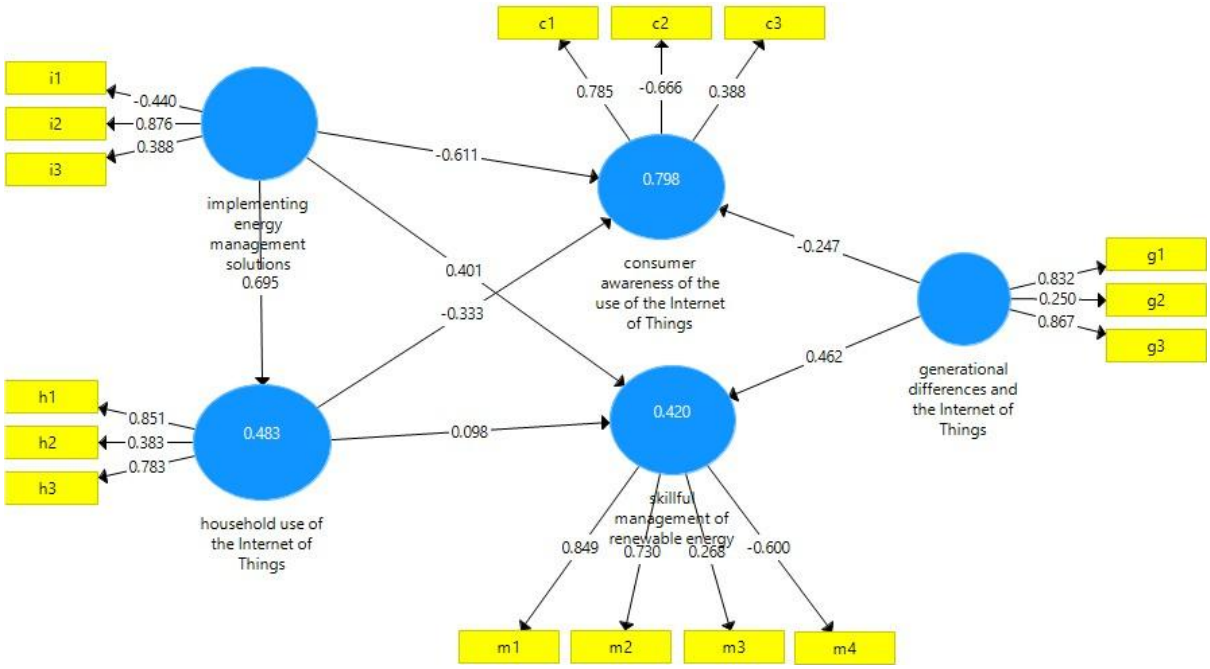


Figure 3: SEM structural equations for renewable energy in households.

Table 4:

Implementing energy Management solutions		Household use of the Internet of things		Consumer awareness Of the use of the internet of things		Skillful management of Renewable energy		Generational differences And the internet of things	
I1	Access to information and knowledge	H1	Choosing the right source of renewable energy	C1	Choosing the right source of renewable energy	M1	Cost management	G1	Generational differences
I2	The use of modern technological solutions	H2	Apps	C2	Level of knowledge	M2	Knowledge of energy management	G2	IT resources
I3	Continuous learning in the field of energy management of your household	H3	Consumer involvement in changes in the way energy is managed	C3	Errors in reasoning and using the application	M3	Safety culture	G3	Incorrect reading or interpretation of measurements
						M4	Lack of trust in IT systems		

5. Conclusions

Given that the precision of energy-saving and energy-saving management solutions reflects a favourable stance towards the sustainable operation of society, we can infer from our research that there are statistically significant correlations between energy-saving behaviour and methods of conserving energy, as well as energy-saving management and attitudes towards fostering a sustainable household. These findings align with previous research findings documented in the existing body of literature.

The energy-saving behaviour shown by individuals is a clear demonstration of the environmentally conscious mindset prevalent in this age. Naturally, the prominence of these fundamentals varies to some extent depending on the generation. The findings of our research validate the inclination of young individuals to allocate more

funds towards consumption and exhibit superior proficiency in saving. According to the research review, older individuals tend to engage less in these activities owing to variables such as reduced social awareness, limited interest in technical advancements, and a lack of understanding about saving possibilities. While all the energy-saving behaviours we examined had a substantial influence on their adoption of energy-efficient home management systems, it is worth noting the conspicuous omission of considering the user's technical skills. This research aims to address this gap. The findings align with research suggesting that the degree of knowledge among young individuals on the need to conserve energy is substantial. (Bogers 2011; Himeur et al. 2021). The results of our study show that although the percentage of users declaring pro-ecological behaviour in all surveys is still growing, there is a lack of education in this area and low social awareness.

References

Alberg Østergaard, P., Mathiesen, B.V., Möller, B. and Lund, H. (2010), A renewable energy scenario for Aalborg Municipality based on low-temperature geothermal heat, wind power and biomass, Energy 35: 4892–4901.

Alsalemi, A., Himeur, Y., Bensaali, F. and Amira, A. (2022), An innovative edge-based Internet of Energy solution for promoting energy saving in buildings, Sustainable Cities and Society 78: 103571.

Amine Chatti, M. (2012), Knowledge management: a personal knowledge network perspective, Journal of Knowledge Management 16: 829–844.

Appel-Meulenbroek, R., Weggeman, M. and Torkkeli, M. (2018), Knowledge sharing behaviour within organisations; a diary-based study of unplanned meetings between researchers, Knowledge Management Research & Practice 16: 267–279.

Bogers, M. (2011), The open innovation paradox: knowledge sharing and protection in R&D collaborations, Euro Jrnl of Inn Mnagmnt 14: 93–117.

Carpino, C., Fajilla, G., Gaudio, A., Mora, D. and Simone, M. de (2018), Application of survey on energy consumption and occupancy in residential buildings. An experience in Southern Italy, Energy Procedia 148: 1082–1089.

Di Foggia, G. (2018), Energy efficiency measures in buildings for achieving sustainable development goals, Heliyon 4: e00953.

Du, L., Chen, H., Fang, Y., Liang, X., Zhang, Y., Qiao, Y. and Guo, Z. (2022), Research on the Method of Acquiring Customer Individual Demand Based on the Quantitative Kano Model, Computational intelligence and neuroscience 2022: 5052711.

Fawkes, S. (Ed.) (2017), Outsourcing Energy Management, Routledge.

Himeur, Y., Alsalemi, A., Bensaali, F. and Amira, A. (2020), A Novel Approach for Detecting Anomalous Energy Consumption Based on Micro-Moments and Deep Neural Networks, Cogn Comput 12: 1381–1401.

Himeur, Y., Ghanem, K., Alsalemi, A., Bensaali, F. and Amira, A. (2021), Artificial intelligence based anomaly detection of energy consumption in buildings: A review, current trends and new perspectives, Applied Energy 287: 116601.

Khan, A.I., Alsolami, F., Alqurashi, F., Abushark, Y.B. and Sarker, I.H. (2022), Novel energy management scheme in IoT enabled smart irrigation system using optimized intelligence methods, Engineering Applications of Artificial Intelligence 114: 104996.

Krishnan, P.R. and Jacob, J. (2022), An IOT based efficient energy management in smart grid using DHOCSA technique, Sustainable Cities and Society 79: 103727.

MALINOWSKI, S. (2012), TOWARDS MODERNITY - CAWI AS A RESEARCH METHOD IN THE SCIENCE OF DEFENSE - SELECTED ISSUES, SBN 3: 403–409.

Perumal, S. and Sreekumaran Nair, S. (2021), Impact of views about knowledge and workplace relationships on tacit knowledge sharing, Knowledge Management Research & Practice: 1–12.

Razip, M.M., Savita, K.S., Kalid, K.S., Ahmad, M.N., Zaffar, M., Abdul Rahim, E.E., Baleanu, D. and Ahmadian, A. (2022), The development of sustainable IoT E-waste management guideline for households, Chemosphere 303: 134767.

Rosak-Szyrocka, J. and Żywiołek, J. (2022), Qualitative Analysis of Household Energy Awareness in Poland, Energies 15: 2279.

Sayed, A., Himeur, Y., Alsalemi, A., Bensaali, F. and Amira, A. (2022), Intelligent Edge-Based Recommender System for Internet of Energy Applications, IEEE Systems Journal 16: 5001–5010.

Shang, Y., Zhou, S., Zhuang, D., Żywiołek, J. and Dincer, H. (2024), The impact of artificial intelligence application on enterprise environmental performance: Evidence from microenterprises, Gondwana Research 131: 181–195.

Tezde, E.I., Okumus, H.I. and Savran, I. (2019), Two-Stage Energy Management of Multi-Smart Homes With Distributed Generation and Storage, Electronics 8: 512.

Tiwari, S., Rosak-Szyrocka, J. and Żywiołek, J. (2022), Internet of Things as a Sustainable Energy Management Solution at Tourism Destinations in India, Energies 15: 2433.

Valerio-Ureña, G. and Rogers, R. (2019), Characteristics of the Digital Content about Energy-Saving in Different Countries around the World, Sustainability 11: 4704.

Varlamis, I., Sardianos, C., Chronis, C., Dimitrakopoulos, G., Himeur, Y., Alsalemi, A., Bensaali, F. and Amira, A. (2022), Smart fusion of sensor data and human feedback for personalized energy-saving recommendations, Applied Energy 305: 117775.

Yeo, R.K. and Marquardt, M.J. (2015), To share or not to share? Self-perception and knowledge-sharing intent, Knowledge Management Research & Practice 13: 311–328.
Yi, J. (2009), A measure of knowledge sharing behavior: scale development and validation, Knowledge Management Research & Practice 7: 65–81.
Zografakis, N., Karyotakis, K. and Tsagarakis, K.P. (2012), Implementation conditions for energy saving technologies and practices in office buildings: Part 1. Lighting, Renewable and Sustainable Energy Reviews 16: 4165–4174.
Żywiołek, J. (2019), Determinants of the safety of railway passengers using the internet in Poland, Multidisciplinary Aspects of Production Engineering 2: 508–514.
Żywiołek, J., Rosak-Szyrocka, J., Khan, M.A. and Sharif, A. (2022a), Trust in Renewable Energy as Part of Energy-Saving Knowledge, Energies 15: 1566.
Żywiołek, J., Rosak-Szyrocka, J. and Mrowiec, M. (2021), Knowledge Management in Households about Energy Saving as Part of the Awareness of Sustainable Development, Energies 14: 8207.
Żywiołek, J. and Schiavone, F. (2021), Perception of the Quality of Smart City Solutions as a Sense of Residents' Safety, Energies 14: 5511.
Żywiołek, J., Trigo, A., Rosak-Szyrocka, J. and Khan, M.A. (2022b), Security and Privacy of Customer Data as an Element Creating the Image of the Company, Management Systems in Production Engineering 30: 156–162.
Żywiołek, J., Tucmeanu, E.R., Tucmeanu, A.I., Isac, N. and Yousaf, Z. (2022c), Nexus of Transformational Leadership, Employee Adaptiveness, Knowledge Sharing, and Employee Creativity, Sustainability 14: 11607.

PhD Research Papers

Conceptual Model of Knowledge Management Implementation in the Heavy Equipment Industry to Enhance Innovation and Productivity

Ahmad Anwari and Amalia Suzianti
University of Indonesia, Depok, Indonesia

ahmad.anwari@ui.ac.id
suzianti@eng.ui.ac.id

Abstract: Productivity and innovation are two components that are very important for the progress of a company. Business competition, rapidly changing situations and the increasingly short life cycle of a product require companies to be able to carry out exploration and exploitation in order to achieve high performance and at the same time maintain business continuity. Knowledge plays an important role in improving exploration and exploitation capabilities, so every company needs to pay special attention to how to manage knowledge so that it can be utilized optimally. Therefore, the role of knowledge management becomes very important. From the research of previous researchers, the implementation of knowledge management in various knowledge-intensive industries has been widely carried out. The heavy equipment industry, which has its own character and uniqueness, also requires a knowledge management model. This research is aimed at developing a conceptual model of knowledge management in the heavy equipment industry based on knowledge management models that have been introduced by previous researchers. It is hoped that the results of this research can help companies operating in the heavy equipment industry to implement knowledge management so that they can increase their innovation capabilities and productivity

Keywords: Conceptual Model, Heavy Equipment Industry, Knowledge Management System, Productivity and Innovation.

1. Introduction

Productivity and innovation are two components that are very important for the sustainability of a company. Innovation is the introduction of a new product, process, solution, or idea that can change the way a business operates or meets customer needs. Innovation allows businesses to stay relevant and competitive in an ever-changing market. Meanwhile, productivity is a term that refers to the way an organization manages its resources, including labor, equipment, and processes, to increase operational efficiency and produce more output with the same or fewer resources.

Increasingly fierce competition, a rapidly changing and disruptive environment, and increasingly short product life cycles are several factors that require companies to be able to carry out exploration and exploitation in order to survive and achieve successful performance (Filippini et al., 2012). Ambidexterity has become an important strategy for companies to solve the dilemma between exploration and exploitation that exists in a highly competitive environment. When a combination of exploitation and exploration occurs in a company, it is called organizational ambidexterity (OA) (Fernández-Pérez De La Lastra et al., 2022). The concept of ambidexterity is applied to organizations that are able to simultaneously engage in competitive strategies, both in knowledge exploration and knowledge exploitation. (Simeoni et al., 2020)

Knowledge is a fundamental basis in Organizational Ambidexterity (Nahapiet and Ghoshal, n.d.). Knowledge plays an important role in improving exploration and exploitation capabilities, so every company needs to pay special attention to how to manage knowledge so that it can be utilized optimally. Therefore, the role of knowledge management becomes very important.

From research by previous researchers, the implementation of knowledge management in various knowledge-intensive industries has been widely carried out (Arling and Chun, 2011; Calitz and Cullen, 2017; Hossain et al., 2022; Hsieh et al., 2020; Masa'deh et al. , 2019; Samuel and Justina, 2023; Yu et al., 2017). This emphasizes the importance of implementing knowledge management in knowledge-intensive industries.

The research question developed in this study is what is the ideal knowledge management model for the heavy equipment industry to increase innovation capabilities and productivity?

The Knowledge Management Model (KMM) is important in responding to the challenges faced by the heavy equipment industry. KMM offers a systematic approach to measuring how effectively knowledge assets are managed within a company. By understanding the level of KM maturity, a heavy equipment industry company can identify areas that need improvement and develop strategies to achieve these goals.

2. Literature Review

2.1 Heavy Equipment

Heavy equipment or heavy machinery is large mechanical equipment designed to carry out construction functions such as earthworks, road construction, building construction, agriculture and mining (Jaya et al., 2022). Various types of heavy equipment used for industrial activities are categorized based on their function and role, and all heavy equipment has the same purpose as operational support (Jaya et al., 2022). In large-scale construction projects, heavy equipment plays a crucial role. The use of heavy equipment makes tasks easier and more efficient, resulting in faster project results (Mandira and Damayanti, 2023). Industries involving heavy equipment play an important role in the economic development of many countries in the world. The mining industry contributes significantly to GDP and offers employment to millions of people (Hamilton et al., 2022).

Maintaining high-performance heavy equipment is essential due to demands for higher product quality, faster production times, and increased operating efficiency in an environment of ever-changing consumer demands (Saputra et al., 2023). The importance of maintaining machine performance cannot be ignored. High product quality, fast production times and increased operational efficiency are key demands in today's competitive business environment. Without effective knowledge management, achieving the expected level of performance becomes difficult (Saputra et al., 2023). By implementing KM concepts, heavy equipment industry companies can ensure that knowledge of best practices, latest technology and operational efficiency strategies is available to everyone in the organization. This allows them to continuously improve their performance and remain competitive in an ever-changing market (Bougoulia and Glykas, 2023).

On the other hand, because heavy equipment usually operates in environments that have never been inhabited by humans, the heavy equipment industry is faced with several specific challenges such as extreme work site conditions, both in terms of land contours and weather. Construction and mining activities generally take place in harsh environments, ranging from remote deserts to remote mountains. In these situations, machines must continue to operate effectively, even when exposed to extreme heat, dust and even other extreme weather conditions. These conditions will directly put significant pressure on heavy equipment performance. Therefore, the need for proper knowledge in operating, maintaining and repairing equipment in difficult conditions like these is very important so that the equipment can operate with optimal performance.

The next challenge is the problem of limited human resources both in quantity and quality. Workers in the field often face complex situations that require precise knowledge to overcome the problems that arise. However, with a limited number of qualified technicians and operators, ensuring that any problems are handled quickly and efficiently becomes a challenge. By applying the KM concept, heavy equipment industry companies can build a centralized knowledge base that can be accessed by all employees, enabling them to obtain the information they need quickly and effectively, even if they do not have direct experience with the problems they face.

Another challenge is the issue of fuel efficiency. According to the International Council on Mining and Metals (ICMM), fuel costs account for 32% of total energy costs in mining. This implies that for large-scale mining operations, diesel fuel costs can be an important factor in overall company profitability (Figueiredo et al., 2023). Knowledge Management can assist in identifying, storing, and disseminating this knowledge throughout the organization, allowing each unit to manage their equipment efficiently.

2.2 Knowledge Management (KM)

Knowledge has emerged as a company's most strategically significant asset (Grant, 1996). Organizations continue to look for innovative ways to exploit the benefits of their knowledge assets (Lyu et al., 2016) where the essence of the analysis of competitive advantage and sustainability lies in the issue of the ability to imitate knowledge (Spender and Grant, 1996).

Knowledge Management is the planned and sustainable management of tools, processes, systems, structures, and culture to improve the creation, sharing, and use of knowledge that is important for decision making and competitiveness. Knowledge Management is a valuable strategic tool, because it can be a key resource in decision making, especially for the formulation of alternative strategies to achieve a series of capabilities to increase competitiveness (Carneiro, 2000). Two goals of Knowledge Management (Wiig, 1997): (1) Make the organization act as intelligently as possible to ensure its survival and overall success; (2) To realize the best value from its knowledge assets.

Knowledge plays an important role by facilitating better decision making, improving the quality of work, and driving innovation. The application of knowledge management produces significant benefits, including increased efficiency, improved decision quality, stimulation of innovation, and enrichment of employee knowledge (Astarika, 2022).

A knowledge management model serves as a structured framework used to operationalize knowledge management initiatives, providing comprehensive guidance and structure while assisting organizations in selecting appropriate tools and techniques. The Knowledge Management Model helps determine the right starting point, implementation steps, and resource requirements to drive long-term company development (Hsieh et al., 2009).

2.3 Knowledge Management, Innovation and Productivity

In their research, Chen et al. says that Knowledge Management is responsible for a company's efficiency, effectiveness and innovation (Chen and Yan, 2022). In the innovation literature, knowledge is considered a key component in the recombination process that drives innovation (Galunic and Rodan, 1998). In emerging distributed organizations, success is closely related to effective knowledge sharing between individuals, teams, and units (Alavi and Leidner, 2001). Knowledge exchange is considered to play an important role in growing organizational capabilities, such as innovation, which is fundamental to driving company performance (Kogut and Zander, 1996). Organizations' interest in Knowledge Management (KM) is motivated by the potential for further benefits such as increased creativity and innovation in products and services (Darroch, 2005) Knowledge plays an important role in fostering creative thinking and encouraging innovation. This explains why innovation is considered the most significant area of impact resulting from KM initiatives (Majchrzak et al., 2004). Knowledge creation, knowledge integration, and knowledge application facilitate innovation and performance (Mardani et al., 2018)

Effective Knowledge Management has a positive impact on productivity and makes workers more innovative and makes a meaningful contribution in strengthening the company's competitive advantage and growth (Torabi and El-Den, 2017). Therefore, Knowledge Management is an important factor to ensure sustainability and increase productivity in organizations..

3. Conceptual Model

Heavy equipment companies with unique operational characteristics and challenges require the implementation of an appropriate knowledge management system to support various operational activities and assist management decision making. The implementation of a knowledge management system in heavy equipment companies is expected to increase operational efficiency. In addition, this system can encourage collaboration between teams and departments, speeding up the innovation process through a more structured exchange of ideas. Therefore, optimal implementation of a knowledge management system that suits the specific characteristics and needs of companies operating in the heavy equipment industry is very necessary.

Knowledge management has a maturity level that is used to measure how far an organization has developed and adopted knowledge management practices. This maturity level is measured through practice-related activities that directly or indirectly support the application of knowledge management.

Corporate culture is a convention of values that influences interactions between workers in a company as well as interactions between management and workers (Nguyen et al., 2019). The similarities in values and habits between workers that occur over time will naturally form organizational culture. Culture is the most important factor in increasing company productivity. Several studies have also concluded that there is a positive and significant relationship between corporate culture and knowledge management. When a company has a constructive work culture (a culture that emphasizes values related to encouragement, affiliation, achievement, and self-actualization), they tend to achieve greater success in Knowledge Management (KM) (Leidner et al., 2006) . Culture can support teamwork and collaboration, which can increase productivity levels. Additionally, culture can stimulate new ideas to encourage innovation.

In addition, a clear organizational structure can facilitate the flow of information, making decision making easier. Flexible organizations that support new ideas can drive corporate innovation. As organizational structures become more decentralized, KM will increase. High centralization inhibits interaction between organizational members and hinders creative solutions to problems (Mahmoudsalehi et al., 2012). The more complex the organizational structure, the greater the increase in KM. Higher complexity implies greater functional differences

in terms of goals, task orientation, and autonomy. Knowledge management has a positive effect on organizational performance; the better the knowledge management, the higher the organizational performance.

From several studies it was also found that ethical leadership behavior is related to the creation and development of knowledge, codification and storage of knowledge, as well as the use and utilization of knowledge (Çelik and Sağsan, 2022). Visionary leadership will be able to transform the ambitions and preferences of their followers into a cohesive whole. Leadership is a person's capacity to persuade others to do or not do something to achieve predetermined goals. This skill is useful for motivating and influencing subordinates, building enthusiasm for work, increasing the spirit of collaboration, and having a disciplined attitude to achieve certain goals systematically.

Another factor that is no less important is Social Capital. In various studies, many academics are increasingly considering the importance of social capital factors where social capital acts as a binding force that keeps institutions in place (Agyapong et al., 2017). In an organization, social capital is critical because it contributes to organizational knowledge and provides opportunities to understand its network structure, both of which are important for a company's success. The level of trust is a key indicator of social capital. Agyapong et al. 2017, in his research stated that social capital has a positive effect on innovation and innovation has a positive relationship with performance (Agyapong et al., 2017)

With respect to effective management practices, technology plays an important role in increasing the level of knowledge management maturity in companies by providing decision support tools and human-machine interfaces to measure company performance during digital transformation. Additionally, technology plays an important role in supporting these efforts. In realizing innovative ideas and increasing human productivity, technology can facilitate goals more efficiently. For example, technology can automate processes, improve communications, and meet customer needs during periods of high demand and over time. Technology can reduce the possibility of errors occurring in work processes and eliminate the possibility of product defects. Hosseini revealed that processes and technology have a significant influence on Knowledge Management (Hosseini et al., 2014)

From the results of a review of relevant literature, the study proposes a conceptual knowledge management model to answer research problems related to the implementation of knowledge management for the heavy equipment industry (Fig. 1). The conceptual model consists of five variables, namely Culture, Organization, Leadership, Social Capital and Technology. These variables are based on theories from previous research and adapted to the characteristics of the heavy equipment industry so that these variables are believed to be the main success factors in implementing KM in the heavy equipment industry to increase productivity and innovation capabilities.

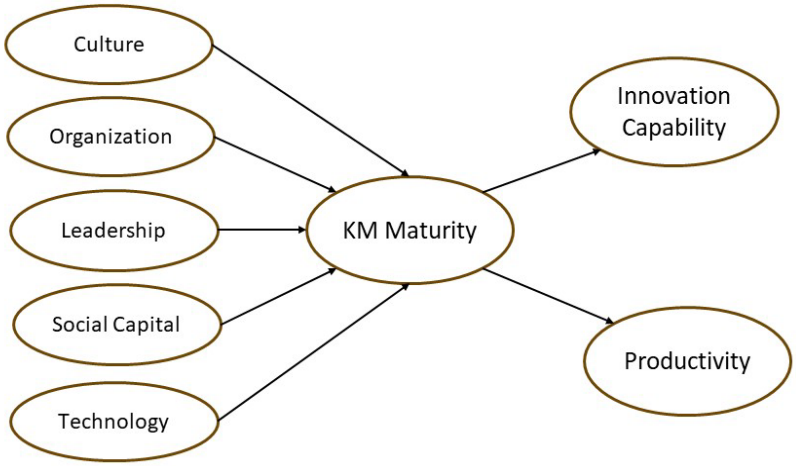


Figure 1: Conceptual Model Framework

Effective KM practices play an important role in increasing a company's productivity and driving innovation by ensuring that knowledge is systematically collected, organized and stored in a way that facilitates its future utilization.

4. Conclusion

With a better understanding of how to manage knowledge effectively, companies can optimize the utilization of their resources, improve product quality, and increase their competitiveness in global markets. Therefore, the application of KM concepts is not only important but also urgent for the long-term success of the heavy equipment industry.

Each industry has its own characteristics so that the variables that influence the effectiveness of knowledge management implementation are also different. Heavy equipment which mostly operates in isolated locations, faces extreme environments and demands for minimal breakdown levels requires a specific approach to knowledge management variables. Based on relevant literature studies, Culture, Organization, Leadership, Social Capital and Technology are variables that need more serious attention to increase the effectiveness of KM implementation in the heavy equipment industry or other industries that have similar characteristics.

Culture will support teamwork and collaboration, which can increase productivity levels. Additionally, culture can stimulate new ideas to encourage innovation. The formal organizational structure in a company influences interactions between employees which directly or indirectly will influence knowledge management within the company. A flexible organizational structure will encourage interaction between employees. Leadership style also influences the implementation of knowledge management in the company. Leaders who frequently recognize their employees' contributions to the company's success will improve performance through the knowledge management process. In an organization, social capital is very important because it contributes to organizational knowledge and provides opportunities to understand its network structure. Apart from that, technology plays an important role in supporting the implementation of knowledge management. In realizing innovative ideas and increasing human productivity, technology can facilitate goals more efficiently.

5. Limitation and Direction for Future Research

Research related to the implementation of knowledge management in various knowledge-intensive industries has been widely carried out. This research was conducted with a focus on several variables that influence knowledge management and which are in accordance with the characteristics of the heavy equipment industry and heavy equipment applications in general. Therefore, future research can be carried out for more specific heavy equipment application industries such as mining, forestry, agroindustry and construction. This research may be applied to other industries that have similar characteristics.

References

Agyapong, F.O., Agyapong, A., Poku, K., 2017. Nexus between social capital and performance of micro and small firms in an emerging economy: The mediating role of innovation. Cogent Bus. Manag. 4, 1309784. https://doi.org/10.1080/23311975.2017.1309784

Alavi, M., Leidner, D.E., 2001. Review: Knowledge Management and Knowledge Management Systems: Conceptual Foundations and Research Issues. MIS Q. 25, 107. https://doi.org/10.2307/3250961

Arling, P.A., Chun, M.W.S., 2011. Facilitating new knowledge creation and obtaining KM maturity. J. Knowl. Manag. 15, 231–250. https://doi.org/10.1108/13673271111119673

Astarika, R., 2022. RELATIONSHIP BETWEEN ORGANIZATIONAL LEARNING, ORGANIZATIONAL INNOVATION, KNOWLEDGE MANAGEMENT, AND BUSINESS ORGANIZATIONAL PERFORMANCE 3.

Bougoulia, E., Glykas, M., 2023. Knowledge management maturity assessment frameworks: A proposed holistic approach. Knowl. Process Manag. 30, 355–386. https://doi.org/10.1002/kpm.1731

Calitz, A., Cullen, M., 2017. The Application of a Knowledge Management Framework to Automotive Original Component Manufacturers. Interdiscip. J. Inf. Knowl. Manag. 12, 337–365. https://doi.org/10.28945/3897

Carneiro, A., 2000. How does knowledge management influence innovation and competitiveness? J. Knowl. Manag. 4, 87–98. https://doi.org/10.1108/13673270010372242

Çelik, Ö., Sağsan, M., 2022. The Impact of Ethical Leadership on Knowledge Management Processes: An Empirical Study on Healthcare Professionals in Turkey during the Pandemic Period. Eur. Conf. Knowl. Manag. 23, 159–170. https://doi.org/10.34190/eckm.23.1.556

Chen, W., Yan, S., 2022. The decoupling relationship between CO2 emissions and economic growth in the Chinese mining industry under the context of carbon neutrality. J. Clean. Prod. 379, 134692. https://doi.org/10.1016/j.jclepro.2022.134692

Darroch, J., 2005. Knowledge management, innovation and firm performance. J. Knowl. Manag. 9, 101–115. https://doi.org/10.1108/13673270510602809

Fernández-Pérez De La Lastra, S., Martín-Alcázar, F., Sánchez-Gardey, G., 2022. Developing the ambidextrous organization. The role of intellectual capital in building ambidexterity: An exploratory study in the haute cuisine sector. J. Hosp. Tour. Manag. 51, 321–329. https://doi.org/10.1016/j.jhtm.2022.04.002

Figueiredo, R.L., Da Silva, J.M., Ortiz, C.E.A., 2023. Green hydrogen: Decarbonization in mining - Review. Clean. Energy Syst. 5, 100075. https://doi.org/10.1016/j.cles.2023.100075

Filippini, R., Güttel, W.H., Nosella, A., 2012. Ambidexterity and the evolution of knowledge management initiatives. J. Bus. Res. 65, 317–324. https://doi.org/10.1016/j.jbusres.2011.04.003

Galunic, D.C., Rodan, S., 1998. Resource recombinations in the firm: knowledge structures and the potential for schumpeterian innovation. Strateg. Manag. J. 19, 1193–1201. https://doi.org/10.1002/(SICI)1097-0266(1998120)19:12<1193::AID-SMJ5>3.0.CO;2-F

Grant, R.M., 1996. Toward a knowledge-based theory of the firm. Strateg. Manag. J. 17, 109–122. https://doi.org/10.1002/smj.4250171110

Hamilton, C., Song, J., Cui, R., Olson, C., Cui, D., 2022. Evaluating provincial-level employment challenge during the coal transition in China. Adv. Clim. Change Res. 13, 729–737. https://doi.org/10.1016/j.accre.2022.08.006

Hossain, M.B., Nassar, S., Rahman, M.U., Dunay, A., Illés, C.B., 2022. Exploring the mediating role of knowledge management practices to corporate sustainability. J. Clean. Prod. 374, 133869. https://doi.org/10.1016/j.jclepro.2022.133869

Hosseini, M.R., Tahsildari, H., Hashim, M.T., Tareq, M.A., 2014. The Impact of People, Process and Technology on Knowledge Management. Eur. J. Bus. Manag.

Hsieh, P.J., Lin, B., Lin, C., 2009. The construction and application of knowledge navigator model (KNM^{TM}): An evaluation of knowledge management maturity. Expert Syst. Appl. 36, 4087–4100. https://doi.org/10.1016/j.eswa.2008.03.005

Hsieh, P.J., Lin, C., Chang, S., 2020. The evolution of knowledge navigator model: The construction and application of KNM 2.0. Expert Syst. Appl. 148, 113209. https://doi.org/10.1016/j.eswa.2020.113209

Jaya, A., Lakawa, I., Hawa, S., Bona, M.S., 2022. Analisis Kinerja Alat Berat Pada Proyek Normalisasi dan Perkuatan Tebing Sungai. Sultra Civ. Eng. J. 3, 1–8. https://doi.org/10.54297/sciej.v3i1.239

Kogut, B., Zander, U., 1996. What Firms Do? Coordination, Identity, and Learning. Organ. Sci. 7, 502–518. https://doi.org/10.1287/orsc.7.5.502

Leidner, D., Alavi, M., Kayworth, T., 2006. The Role of Culture in Knowledge Management:

Lyu, G., Bertolini, L., Pfeffer, K., 2016. Developing a TOD typology for Beijing metro station areas. J. Transp. Geogr. 55, 40–50. https://doi.org/10.1016/j.jtrangeo.2016.07.002

Mahmoudsalehi, M., Moradkhannejad, R., Safari, K., 2012. How knowledge management is affected by organizational structure. Learn. Organ. 19, 518–528. https://doi.org/10.1108/09696471211266974

Majchrzak, A., Cooper, L.P., Neece, O.E., 2004. Knowledge Reuse for Innovation. Manag. Sci. 50, 174–188. https://doi.org/10.1287/mnsc.1030.0116

Mandira, I.M.C., Damayanti, G.A.A.P.C., 2023. Analysis of SWOT, IFAS, EFAS, and BLC in the Heavy Equipment Industry in Bali. JRMSI - J. Ris. Manaj. Sains Indones. 14, 21–32. https://doi.org/10.21009/JRMSI.014.2.03

Mardani, A., Nikoosokhan, S., Moradi, M., Doustar, M., 2018. The Relationship Between Knowledge Management and Innovation Performance. J. High Technol. Manag. Res. 29, 12–26. https://doi.org/10.1016/j.hitech.2018.04.002

Masa'deh, R., Abdelkarim Almajali, D., Alrowwad, A., Obeidat, B., 2019. The Role of Knowledge Management Infrastructure in Enhancing Job Satisfaction: A Developing Country Perspective. Interdiscip. J. Inf. Knowl. Manag. 14, 001–025. https://doi.org/10.28945/4169

Nahapiet, J., Ghoshal, S., n.d. Social Capital, Intellectual Capital, and the Organizational Advantage. Knowl. Soc. Cap.

Nguyen, D.D., Nguyen, L., Sila, V., 2019. Does Corporate Culture Affect Bank Risk-Taking? Evidence from Loan-Level Data. Br. J. Manag. 30, 106–133. https://doi.org/10.1111/1467-8551.12300

Samuel, E.I., Justina, O.C., 2023. Implementation of Effective Knowledge Management Practices for Improving Productivity of Nigerian Construction SMEs 23.

Saputra, R.A., Yudoko, G., Firman, A.F., 2023. Proposed Strategy of Heavy Equipment Overhaul: Case Study of a Coal Mining Contractor in Indonesia. Eur. J. Bus. Manag. Res. 8, 140–145. https://doi.org/10.24018/ejbmr.2023.8.4.2014

Simeoni, F., Brunetti, F., Mion, G., Baratta, R., 2020. Ambidextrous organizations for sustainable development: The case of fair-trade systems. J. Bus. Res. 112, 549–560. https://doi.org/10.1016/j.jbusres.2019.11.020

Spender, J. -C., Grant, R.M., 1996. Knowledge and the firm: Overview. Strateg. Manag. J. 17, 5–9. https://doi.org/10.1002/smj.4250171103

Torabi, F., El-Den, J., 2017. The impact of Knowledge Management on Organizational Productivity: A Case Study on Koosar Bank of Iran. Procedia Comput. Sci. 124, 300–310. https://doi.org/10.1016/j.procs.2017.12.159

Wiig, K.M., 1997. Knowledge Management: An Introduction and Perspective. J. Knowl. Manag. 1, 6–14. https://doi.org/10.1108/13673279710800682

Yu, C.-P., Zhang, Z.-G., Shen, H., 2017. The effect of organizational learning and knowledge management innovation on SMEs' technological capability. EURASIA J. Math. Sci. Technol. Educ. 13. https://doi.org/10.12973/eurasia.2017.00842a

The Effect of Knowledge Sharing on Innovative Behavior in the Moroccan Pharmaceutical Industry

Houssam Baakir and Hanane Ellioua
LAMSAD research laboratory, Systems Analysis and Modeling Laboratory and Decision Support
National school of applied sciences BERRECHID, Hassan 1st University, Morocco

h.baakir@uhp.ac.ma
Hanane.ellioua@gmail.com

Abstract: In the dynamic landscape of contemporary global industries, the imperative to foster innovation has been recognized as an indispensable key to corporate growth. Nowhere is this more pronounced than in the pharmaceutical sector, where the pursuit of groundbreaking advancements in research and development is deemed indispensable. Understanding the factors that influence innovative behavior (IB) among employees is of utmost importance, and this paper seeks to study the influence of knowledge sharing (KS) within the pharmaceutical sector in Morocco, specifically focusing on two essential dimensions: knowledge donating (KD) and knowledge collecting (KC). The study aims to collect and analyze data from a diverse sample of 100 engineers in the Moroccan pharmaceutical industry. We used quantitative methodology by employing correlation and multiple regression methodologies, the research endeavors to unravel the intricate association linking knowledge sharing and pharmaceutical engineers' Innovative behavior. Preliminary findings reveal a positive influence of the dimensions of knowledge sharing on workers' innovative behavior. This suggests that a climate of knowledge exchange and actively seeking knowledge plays a crucial role in driving innovation within the pharmaceutical workplace. Notably, the study places a nuanced emphasis on the efficacy of knowledge donating, underscoring its pivotal role in fostering a dynamic and innovative environment. These findings contribute valuable insights to the broader discourse on organizational innovation. By highlighting the positive correlation between KS and IB, the investigation provides actionable information for practitioners in the pharmaceutical firms. Grasping the effect of KD and KC can empower firms to sustain a culture that encourages collaboration, continuous learning, and ultimately, groundbreaking innovations. As industries continue to evolve, this exploration serves as a timely contribution to the ongoing dialogue on organizational innovation, offering practical implications for both industry professionals and scholars alike.

Keywords: Knowledge Sharing, Moroccan Context, Pharmaceutical Industry, Quantitative Study, Innovative Behavior.

1. Introduction

The pharmaceutical sector in Morocco is experiencing rapid and dynamic growth, representing a strategic field focused on the research, development, and distribution of sophisticated medical products Berrado, A. (2018). At the heart of this transformation process, knowledge sharing has become a crucial aspect, playing a vital role in shaping the innovative behavior (IB) of workers in this evolving environment Chatterjee, D. (2020). This investigation aims to examine in detail the underlying mechanisms, obstacles, and advantages that define the dynamic connection between knowledge sharing (KS) and the development of innovation in the Moroccan pharmaceutical sector.

The current environment necessitates an extensive analysis of the factors that boost innovation, not only to maintain a competitive position in the global marketplace but also to satisfy the rising requirements of the healthcare sector (Liu, 2021). Innovation in the pharmaceutical sector is a major factor in developing more efficacious, secure, and accessible medicines, thereby boosting public health globally. It encourages individualized approaches to therapy, tailored to the specific circumstances of each patient. Additionally, it plays a vital role in improving healthcare accessibility by offering more affordable medicines and innovative retail techniques (van Muijlwijk-Koezen, 2020).

Innovation supports regulatory alignment and strengthens drug quality and safety (PAHI, 2020). The sharing of knowledge among staff makes a tremendous difference in the performance of pharmaceutical firms (Christofi, 2021). By supporting innovation and R&D, it accelerates the drug development cycle. Knowledge sharing further encourages ongoing training, allowing staff to maintain up-to-date awareness of new developments in the field (Sajjad, 2021). In summary, knowledge sharing is a vital foundation for the development of competitiveness and sustainable growth of pharmaceutical corporations.

Thus, the aim of our examination is to explore the association between knowledge sharing (KS) processes and innovative behavior (IB) in pharmaceutical corporations. Consequently, the purpose of this investigation is to examine how knowledge donating (KD) and knowledge collecting (KC) impact innovative behavior in the pharmaceutical industry in Morocco. To address this issue and achieve our objectives, we have chosen to conduct a quantitative study using a questionnaire. In this section, we will provide a literature synthesis of the

main constructs and the theoretical framework used to evaluate the effect of KD and KC on IB. The outcome of this section will be the research model.

2. Conceptual Framework: Innovative Behavior and Knowledge Sharing

2.1 Innovative Work Behavior

Organizational innovation results from individual innovativeness (Kalisz, D. E. 2021). Hence, there is considerable interest in IWB as a key to organizational efficiency (Janssen, 2000). Van Gyes (2012) describes innovative behavior (IB) as «The planned implementation, adoption, and application of new thoughts, procedures, policies, and products by individuals in their work role, group, or organization». Innovation is indeed a dynamic and complex social process (Avellar, 2013), comprising an interactional framework driven by a collection of interconnected human interactions (Purwanto, 2022). The human dimension occupies a central position in this process, as it is at the heart of generating, promoting, and implementing creative thoughts (Ali, 2019). The understanding of the role of IWB is reinforced by De Jong and Hartog (2010), who emphasize that individuals extend beyond the formal routine duties of a group or company to explore actual innovations, suggest alternative approaches to meeting targets, engage with existing methods of operation, and secure the necessary resources to implement their creative ideas. Innovative work behavior entails a model of high-level thinking, the identification of current and future challenges, the pursuit of opportunities, and the evaluation of performance gaps, as well as the exploration of contemporary approaches to addressing these gaps and challenges (Afsar, 2016).

Innovative behavior (IB) is a richer concept than creativity; it encompasses various stages with significant theoretical and practical implications (Ali, 2019). The innovation process consists of a specific set of steps (Ali, 2019): (1) Discovery of new ideas leading to opportunities for innovation or identification of weaknesses; (2) Idea generation involves exploring alternative approaches to solving problems and improving the current situation; (3) Idea promotion is defined as actively disseminating new ideas, building alliances to garner support and acceptance from stakeholders; (4) Implementation involves turning the idea into reality, experimenting with the innovation, adapting it, and integrating it into work practices. Employees who embrace innovative work behavior can readily and effectively identify new work circumstances and generate novel approaches to enhancing services and products (Prikshat, V. 2023). The prevalence of effective knowledge sharing serves as one of the drivers of IWB in companies (Prikshat, V. 2023). Therefore, it is crucial to investigate the type of knowledge sharing that stimulates IWB.

2.2 Knowledge Sharing Behaviors

The construct of knowledge sharing is largely debated in the management studies literature. It constitutes one of the important elements of KM, leading up to knowledge utilization. Knowledge sharing is a behavior whereby people reciprocally exchange their knowledge (Islam, T., & Asad, M. (2024). In the corporate context, knowledge sharing among workers fosters the creation of valuable tacit knowledge, contributes to the generation of new knowledge, enhances organizational knowledge, and provides advantages for the business. It is crucial to differentiate between behaviors and attitudes regarding knowledge sharing. Behaviors can be conceived as tangible actions that stem from attitudes. As observed by de Smékalová, L. (2023), KS behavior is influenced by an employee's attitude, namely their desire to exchange knowledge. Understanding the drivers, processes, and barriers related to knowledge sharing is crucial for developing appropriate approaches to foster a knowledge-sharing mindset and optimize the asset value of an enterprise's intellectual wealth. Knowledge sharing is an indispensable activity in corporations aimed at promoting the circulation and reciprocal transfer of know-how, competencies, and qualifications among employees (Anugrah, 2017). This practice supports innovation, organizational learning, and successful decision-making (Vanhaverbeke, 2019). Knowledge sharing involves two distinct active processes: knowledge collecting and knowledge donating. KC entails soliciting intellectual capital from others to discover what they know, while knowledge donating (also referred to as diffusion or contribution) involves sharing one's personal intellectual capital with colleagues (Nguyen, M. 2023).

The first process, knowledge donating, encompasses effectively sharing information, qualifications, or know-how with other workers. This can be achieved through various means such as teaching, training, mentoring, participating in conferences, and more. Knowledge donating is rooted in the principle of making a valuable contribution to the progress and advancement of others by offering what we have learned (Guo, 2021). On the other hand, knowledge collecting involves the process of investigating, gathering, and acquiring knowledge from

diverse sources. It entails collecting relevant and valuable knowledge and then applying it to solve problems, generate new insights, and foster innovation. Knowledge collecting methods can include documentary research, data analysis, observation, and investigation (Fatimah, 2024). Both processes enrich knowledge and promote advancement across various spheres of life, regardless of the professional or academic context (Wibowo, 2020).

3. Theoretical Framework and Hypothesis Development:

Many investigations on knowledge management have reinforced the notion that knowledge sharing results in better business outcome, including innovation (Du Plessis, 2007). Innovation is defined as "a process by which economic or social utility is derived from knowledge through the generation, dissemination, and conversion of knowledge to create novel or materially advanced products or services that benefit the community" (Kahn, 2018).

Today's corporations are striving to maintain their dominant market positions by enhancing their competent and creative workforce. Numerous investigations have underscored the importance of human capital and skilled human resources in addressing corporate sustainability and innovation issues (Rasli, 2014). Several investigations have highlighted the critical effect of KM in enhancing corporate effectiveness (Kim, 2012). As knowledge represents the greatest corporate asset, it enables the acquisition of new business outputs, including innovation (Shaalan, 2020). Knowledge sharing not only fosters problem-solving potential but also enhances workplace productivity (Mehrbani, 2021). Knowledge serves as the foundational element of the innovation cycle. Despite the limited investigations on knowledge sharing and innovative behavior, earlier studies have been constrained in exploring the drivers that encourage workers to embrace innovative behavior (Hussain, 2020).

According to Tran (2021), a corporation that encourages its staff to share their knowledge is expected to generate novel thoughts and foster new opportunities for the enterprise, thereby facilitating better innovation initiatives. Many researchers have observed that knowledge sharing has a positive impact on IWB; it enables staff to transfer their know-how to other team members and provides others with the opportunity to acquire valuable knowledge.

Sajjad (2021) examined the role of knowledge sharing (KS) on innovation and identified a favorable effect on innovation. Additionally, the research community has emphasized the necessity for more detailed studies on innovation and expertise (Rasli, 2014). This investigation analyses the significant aspects of knowledge sharing in conjunction with innovative behavior (IB), which have traditionally received less attention in the academic world. Innovation is the outcome of knowledge exchange among workers. Knowledge sharing generates valuable insights that subsequently facilitate and anticipate organizational innovation (Cuellar, 2020). Therefore, it can be hypothesized that the sharing and gathering of knowledge have a positive effect on the IB of workers within the company. Consequently, our research proposes the hypothesis that knowledge is crucial for innovation, and therefore, knowledge sharing exerts a beneficial influence on the development of IB among staff within the company.

Building on the preceding discussions and the analysis of earlier papers, the following hypotheses are proposed.

H1: knowledge donating influences pharmaceutical engineers' IB positively and significantly.

H2: Knowledge collecting influences pharmaceutical engineers' IB positively and significantly.

4. Field of Investigation

The pharmaceutical industry in Morocco is a rapidly evolving and expanding sector, making significant contributions to public healthcare and the economy. The industry is experiencing robust growth, fueled by increasing domestic demand for medications and high levels of exports. Morocco boasts a strong legal framework for the pharmaceutical business, with internationally recognized standards for quality and safety. While the country manufactures a portion of its drugs domestically, it also relies on imports to meet local needs. The government actively promotes domestic manufacturing through various measures and programs aimed at strengthening the country's pharmaceutical sector.

The Moroccan pharmaceutical industry is dedicated to investing in the research and development (R&D) of new products, although this investment is still relatively limited compared to other regions worldwide. However, there is a growing interest in producing generic drugs. The Moroccan government is committed to ensuring affordable access to medication for all Moroccans by implementing public health programs aimed at enhancing the availability and quality of essential medications. Despite its rapid growth, the Moroccan pharmaceutical industry

faces several challenges, including competition from international rivals and the proliferation of counterfeit medications. Nonetheless, there are numerous opportunities for expansion, particularly through increased exports to other African countries and by fostering innovation and R&D activities.

5. Sampling Technique, Sampler Size and Questionnaire

The selected respondents were primarily sourced from LinkedIn, utilizing a convenience sampling approach. This method was chosen as accessing workers directly was not a straightforward option for the investigators. Data content analysis yielded the following results: 50 respondents were women, compared to 170 men. The participants' ages ranged between 26 and 45.

Pharmaceutical engineers were contacted via direct email and invited to participate in a self-administered study. Initially, 500 surveys were distributed, but only 230 were returned fully completed and deemed suitable for analysis.

To quantify the underlying sub-dimensions of knowledge sharing, our research adopted the scale utilized by Lin (2007). For assessing innovative behavior, we utilized the 9-item scale developed by Janssen (2000), which comprises three components: generation, championing, and implementation of innovative ideas. Pharmaceutical engineers were asked to provide their responses using a Likert scale with four points: 1= strongly disagree, 2= disagree, 3= agree, and 4= strongly agree.

6. Results and Analyses

6.1 Overview of Descriptive Statistics

Table 1 shows that the variables "Knowledge Donating", "Knowledge Collecting" and "Innovative Behavior" are measured on a scale of 1 to 4. The mean of "Knowledge Donating" is 3.78 with a standard deviation of 0.713, showing a particularly high degree of knowledge sharing. For “Knowledge Collecting”, the mean is 3.69 with a standard deviation of 0.828, also showing a high degree of knowledge collecting. As for "Innovative Behavior", the average is 3.67 with a standard deviation of 0.551, also demonstrating a strong degree of "Innovative Behavior".

Table 1: Descriptive statistics

Variables	Minimum	Maximum	Mean	Std. Deviation
KD	1	5	3.78	.713
KC	1	5	3.69	.828
IB	1	5	3.67	.551

6.2 Exploratory Factor Analysis

To investigate the convergent and discriminant validity of the measurement scales for "Knowledge Donating," "Knowledge Collecting," and "Innovative Work Behavior," we conducted a factorial analysis using principal component analysis (PCA) (Table 2). To determine the appropriateness of our data for PCA (Hair et al., 2014), we performed the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity (Hair et al., 2014). The results of the KMO test and Bartlett's test indicate that the data meet the fundamental requirements for factor analysis and exhibit sufficient correlations.

The KMO coefficient is 0.83, and Bartlett's test is significant ($p < 0.001$). We then applied principal component analysis (PCA) with Varimax rotation to group all variables into principal components. The number of factors extracted was determined using the Kaiser criterion, which retains only principal components with eigenvalues greater than 1. Factors with eigenvalues less than 1 were considered non-significant and excluded. The factor analysis yielded a three-factor solution with a satisfactory total cumulative variance percentage of 77.11%.

Principal component analysis also revealed that items intended to measure the same construct loaded strongly on the same principal component, with a minimum loading of 0.61, indicating shared common variance and thus demonstrating convergent validity. Additionally, items measuring different constructs primarily loaded on distinct components, indicating good discriminant validity.

Table 2: Component matrix

Items	F1	F2	F3
Kd1	0.67		
Kd2	0.87		
Kd3	0.61		
Kc1		0.63	
Kc2		0.90	
Kc3		0.71	
Iwb1			0.63
Iwb2			0.73
Iwb3			0.81
Iwb4			0.97
Iwb5			0.75
Iwb6			0.69
Iwb7			0.79
Iwb8			0.68
Iwb9			0.71

F1 : Knowledge donating (Kd) ; F2: Knowledge Collecting (Kc); F3: Innovative Work Behavior (Iwb)

6.3 Reliability Assessment through Cronbach's Alpha:

Before beginning the correlation analyzes and testing our hypotheses, we will study the reliability of the measurement scales studied with the help of Cronbach's Alpha. The findings of the reliability analyze of the constructs demonstrate that "Knowledge donating" with three items obtained a Cronbach's alpha coefficient of .781, denoting excellent reliability. Similarly, the "Knowledge Collecting" variable showed an alpha coefficient of .832 with four items, suggesting satisfactory reliability. The "Knowledge Sharing" variable combining the two previous variables presented satisfactory reliability with an alpha of around .804. Finally, the variable "Innovative Behavior" presented the highest alpha coefficient, at .898, with nine items. These results support the reliability of the variables studied in this research.

6.4 Analysis of Correlations

The correlation matrix (Table 3) presents the relationships between the variables of "Knowledge donating", "Knowledge Collecting" and "Innovative Work Behavior". The correlation coefficients are significant at the 0.05 level. We observe a significant positive correlation between "Knowledge donating" and "Knowledge Collecting" ($r = .24$, $p < 0.05$) as well as between "Knowledge donating" and "Innovative Work Behavior" ($r = .40$, $p < 0.05$). In addition, a significant positive correlation is also observed between "Knowledge Collecting" and "Innovative Work Behavior" ($r = .44$, $p < 0.05$).

Table 3 : Matrice de corrélation de Pearson

Variables	Knowledge donating	Knowledge Collecting	Innovative Work Behavior
Knowledge donating	1	.24*	.40*
Knowledge Collecting		1	.44*
Innovative Work Behavior			1

**. Correlation is significant at the 0.05 level (2 tailed).

6.5 Hypotheses Testing by Multiple Regression Analysis

The findings of the regression analysis are illustrated in Table below indicate a significant influence of the variables "Knowledge donating" and "Knowledge collecting" on "innovative behavior", with respective

standardized coefficients of 0.220 and 0.127. This means that each one-unit increase in "Knowledge donating" is associated is to an augmentation of 0.220 in "innovative behavior", while each one-unit increase in "Knowledge collecting" is associated with an increase of 0.127 in “innovative behavior”. These coefficients are statistically significant, with t-Student values of 2.708 and 2.910 accordingly, and p-values of 0.008 and 0.004, both below the significance level of 0.05.

Furthermore, the regression model appears to be overall significant, with a coefficient of determination R2 of 0.71, which means that 71% of the variance in "Innovative Behavior" is explained by the variables included in the model. The Fisher test also shows a significant F statistic, with a value of 30.351 for a degree of freedom of 2 and 228, confirming the overall relevance of the model.

Regarding collinearity, the values of VIF (Variance Inflation Factor) are both less than 10, with values of 2.903 for "Knowledge donating" and 1.760 for "Knowledge collecting", which demonstrates the absence of major problems of multicollinearity between the predictors and reinforces the validity of our model.

Table 4: Results of multiple linear regression

	B	B	t	p	S.E	Collinearity Statistics	
Constant		.084	.617	.538	.135	Tolerance	VIF
KD	.220	.245	2.708	.008	.091	.344	2.903
KC	.127	.117	2.910	.004	.040	.568	1.760

R^2=.71

Fisher (2,228) = 30.351

7. Discussion and Interpretation of Results

The purpose of our investigation is to study the effect of KS on the innovative behavior of pharmaceutical engineers in Morocco. The research findings corroborate the formulated hypotheses. Following a comprehensive review of existing academic literature, two hypotheses are proposed.

Hypothesis H1 posits that KD has a positive and significant impact on the IB of pharmaceutical engineers. The findings of this investigation strongly support this hypothesis, indicating that KD indeed exerts a significant and positive effect on the IB of pharmaceutical engineers. This outcome suggests that pharmaceutical engineers who engage in knowledge donating within the workplace demonstrate a greater sense of commitment to the company's success. This aligns with Roman Kmieciak's research (2020), which finds a strong correlation between the KD and innovative work behavior within a major Polish capital group.

Furthermore, the second hypothesis posits that KC exerts a significant and positive impact on the IB of pharmaceutical engineers. The findings presented in the table substantiate this claim, thus providing support for the second hypothesis. This suggests that employees who demonstrate a greater inclination towards acquiring new knowledge within the organization are also more likely to exhibit a heightened commitment to the company's success. This underscores the relevance of fostering an organizational culture that promotes continuous learning.

This corresponds with Guo's (2021) findings, which indicate a positive correlation between knowledge collecting and IWB in Chinese software companies. Knowledge collecting enables workers to increase their personal knowledge reserves, enrich the knowledge necessary for innovation, and improve their capabilities, which significantly impacts innovative work behavior (Smith, 2006).

The result of our study aligns with previous research conducted by Du Plessis, M. (2007), who identified that employee knowledge sharing (KS) enhances a company's innovativeness. However, the specific impact of knowledge donating (KD) and collecting (KC) on innovative behavior (IB) has not been thoroughly investigated until now. Additionally, Carneiro, A. (2000), in their research note, proposed that KS contributes positively to employees' innovative behavior, a notion supported by the findings of this current study. Similarly, Migdadi, M. M. (2020), among the latest researchers, have also identified the beneficial impact of KS on IB.

Furthermore, the findings of this study reveal insightful aspects: both KD and KC significantly influence

employees' IB. Specifically, employees demonstrate higher levels of IB when they engage in knowledge collecting rather than knowledge donating. To put it differently, employees exhibit greater IB when they have the opportunity to gather information rather than simply disseminating it. As noted by Newell, S. (2000), during knowledge exchange, employees not only share information but also coordinate, develop, and transform it into meaningful and useful forms. Moreover, when employees acquire knowledge from their colleagues, they enhance their capacity to innovate (Tarhini, A., 2016). The underlying rationale behind employees' willingness to donate and collect knowledge is quite apparent. In essence, sharing knowledge represents a powerful expression of an employee's personal character, enabling them to recognize their own intrinsic value.

Moreover, it allows them to satisfy their urge for self-expression (Tarhini, A., 2016). However, this study suggests that individuals exhibit greater IB when they are empowered to expand their knowledge. Our findings reinforce the positive and significant impact of both KD and KC on the IB of pharmaceutical engineers. These findings underscore the importance of promoting knowledge-sharing and knowledge-donating practices within organizations, not only to foster the professional development of employees but also to enhance their commitment to the overall well-being and performance of the enterprise.

8. Conclusion

The conclusion of this examination underscores the critical value of knowledge sharing (KS) in the Moroccan pharmaceutical industry, both from a managerial and theoretical perspective. By investing in policies, technologies, and management practices that facilitate knowledge sharing, companies can not only foster innovation and enhance performance but also bolster their competitive position in the global marketplace. The positive and significant results obtained for hypotheses H1 and H2 underscore the critical value of fostering an organizational culture that promotes KS among pharmaceutical engineers. Managers and senior executives should take proactive measures to cultivate this culture by implementing incentives, sharing platforms, and policies that incentivize and recognize knowledge donating and collecting. Additionally, pharmaceutical companies should invest in knowledge management systems and technological platforms that streamline and facilitate knowledge sharing and collection processes. These tools can not only enhance operational efficiency but also stimulate innovation by enabling employees to readily access pertinent knowledge and share it with their colleagues. Executives have to grasp the significance of knowledge sharing (KS) for innovation and should receive training to promote and facilitate this practice within their teams. Training and awareness programs can be instituted to acquaint employees with the advantages of knowledge sharing and to enhance their communication and collaboration abilities. Companies can promote the establishment of informal collaboration networks where employees can exchange ideas, collaborate on problem-solving, and share experiences. These networks cultivate an environment conducive to innovation by enabling individuals from various functional backgrounds and different levels of expertise to collaborate and learn from one another.

Although our findings offer some precious indications on the influence of knowledge sharing (KS) on IWB within the Moroccan pharmaceutical industry, several research avenues are emerging to further enrich our understanding of this pivotal domain. Conducting an in-depth analysis of the cultural and organizational factors that shape individuals' willingness to share knowledge would be beneficial. This could encompass examining cultural values, organizational norms, leadership styles, reward systems, and trust climates, and how these components interplay to shape knowledge sharing behaviors. Gaining a deeper understanding of the underlying mechanisms by which knowledge sharing (KS) influences innovative behaviors in the workplace would be invaluable. This may entail identifying intermediary variables that elucidate the connection between KS and innovation, as well as moderating variables that influence the strength of this relationship in various contexts. Comparing knowledge sharing (KS) and innovative behavior (IWB) between the Moroccan pharmaceutical industry and other industries or countries would illuminate local specificities as well as international best practices. Such comparisons could facilitate the identification of learning opportunities and areas requiring strategic interventions to enhance competitiveness.

By addressing these research questions and fostering interdisciplinary collaboration across the domains of knowledge management, innovation, organizational psychology, and sociology, we can further enhance our comprehension of the underlying mechanisms that facilitate knowledge sharing (KS) and innovative behavior (IWB) within pharmaceutical firms. This, in turn, will enable us to develop managerial practices and policies that foster progress and sustainability in this critical sector.

References:

Akram, T., Lei, S., Haider, M. J., & Hussain, S. T. (2020). The impact of organizational justice on employee innovative work behavior: Mediating role of knowledge sharing. Journal of Innovation & Knowledge, 5(2), 117-129.

Al-Omari, M. A., Choo, L. S., & Ali, M. A. M. (2019). Innovative work behavior: A review of literature. International Journal of Psychosocial Rehabilitation, 23(2), 39-47.

Areed, S., Salloum, S. A., & Shaalan, K. (2020). The role of knowledge management processes for enhancing and supporting innovative organizations: a systematic review. Recent advances in intelligent systems and smart applications, 143-161.

Azeem, M., Ahmed, M., Haider, S., & Sajjad, M. (2021). Expanding competitive advantage through organizational culture, knowledge sharing and organizational innovation. Technology in Society, 66, 101635.

Azeem, M., Ahmed, M., Haider, S., & Sajjad, M. (2021). Expanding competitive advantage through organizational culture, knowledge sharing and organizational innovation. Technology in Society, 66, 101635.

Bagherzadeh, M., Markovic, S., Cheng, J., & Vanhaverbeke, W. (2019). How does outside-in open innovation influence innovation performance? Analyzing the mediating roles of knowledge sharing and innovation strategy. IEEE Transactions on Engineering Management, 67(3), 740-753.

Bednář, P., Danko, L., & Smékalová, L. (2023). Coworking spaces and creative communities: making resilient coworking spaces through knowledge sharing and collective learning. European Planning Studies, 31(3), 490-507.

Bhatti, S. H., Vorobyev, D., Zakariya, R., & Christofi, M. (2021). Social capital, knowledge sharing, work meaningfulness and creativity: evidence from the Pakistani pharmaceutical industry. Journal of Intellectual Capital, 22(2), 243-259.

Carneiro, A. (2000). How does knowledge management influence innovation and competitiveness?. Journal of knowledge management, 4(2), 87-98.

Castaneda, D. I., & Cuellar, S. (2020). Knowledge sharing and innovation: A systematic review. Knowledge and Process Management, 27(3), 159-173.

Chen, W., Zhu, X., Sun, S., Liao, S., & Guo, Z. (2021). The impact of employees' psychological capital on innovative work behavior: the chain mediating effect of knowledge donating and knowledge collecting. Frontiers in Psychology, 12, 761399.

Darwish, S. A. A. D., Ahmed, U. M. A. I. R., & PAHI, M. H. (2020). Innovative Work Behavior during COVID-19 for Medical Representatives in the Pharmaceutical Industry: Test of a Moderation Model in Bahrain. International Journal of Pharmaceutical Research (09752366), 12(4).

De Spiegelaere, S., & Van Gyes, G. (2012). Innovative work behavior: Concept & measurement. In ISPIM Conference Proceedings (p. 1). The International Society for Professional Innovation Management (ISPIM).

Di Vaio, A., Palladino, R., Pezzi, A., & Kalisz, D. E. (2021). The role of digital innovation in knowledge management systems: A systematic literature review. Journal of business research, 123, 220-231.

Du Plessis, M. (2007). The role of knowledge management in innovation. Journal of knowledge management, 11(4), 20-29.

El Mokrini, A., Benabbou, L., & Berrado, A. (2018, January). Multi-criteria distribution network redesign-case of the public sector pharmaceutical supply chain in Morocco. In Supply Chain Forum: An International Journal (Vol. 19, No. 1, pp. 42-54). Taylor & Francis.

Ganguly, A., Talukdar, A., & Chatterjee, D. (2020). Social capital, knowledge quality, knowledge sharing, and innovation capability: An empirical study of the Indian pharmaceutical sector. Knowledge and process management, 27(1), 25-42.

Herjanto, H., Amin, M., & Fatimah, C. E. (2024). Does knowledge collecting and donating enhance a bank's salesperson performance?. Business Process Management Journal, 30(1), 183-198.

Islamy, F. J., Yuniarsih, T., & Wibowo, L. A. (2020). The power of knowledge donating and knowledge collecting for academic performance: developing Indonesian students' knowledge sharing models. In Advances in Business, Management and Entrepreneurship (pp. 504-507). CRC Press.

Islam, T., & Asad, M. (2024). Enhancing employees' creativity through entrepreneurial leadership: can knowledge sharing and creative self-efficacy matter?. VINE Journal of Information and Knowledge Management Systems, 54(1), 59-73.

Janssen, O. (2000). Job demands, perceptions of effort-reward fairness and innovative work behaviour.Journal of Occupational and organisational psychology, 73(3), 287-302.

Kahn, K. B. (2018). Understanding innovation. Business Horizons, 61(3), 453-460.

Kmieciak, R. (2021). Trust, knowledge sharing, and innovative work behavior: empirical evidence from Poland. European Journal of Innovation Management, 24(5), 1832-1859.

Lam, L., Nguyen, P., Le, N., & Tran, K. (2021). The relation among organizational culture, knowledge management, and innovation capability: Its implication for open innovation. Journal of Open Innovation: Technology, Market, and Complexity, 7(1), 66.

Lee, S., Kim, B. G., & Kim, H. (2012). An integrated view of knowledge management for performance. Journal of Knowledge management, 16(2), 183-203.

Leong, C. T., & Rasli, A. (2014). The Relationship between innovative work behavior on work role performance: An empirical study. Procedia-Social and Behavioral Sciences, 129, 592-600.

Lin, H. F. (2007). Knowledge sharing and firm innovation capability: An empirical study. International journal of manpower, 28(3),315-332.

Migdadi, M. M. (2020). Knowledge management, customer relationship management and innovation capabilities. Journal of Business & Industrial Marketing, 36(1), 111-124.

Nguyen, M. (2023). Stay together to be strong: How online knowledge sharing matters. Australasian Marketing Journal, 31(4), 338-349.

Novitasari, D., Asbari, M., & Purwanto, A. (2022). Tourist satisfaction and performance of tourism industries: how the role of innovative work behaviour, organizational citizenship behaviour?. Journal of Industrial Engineering & Management Research, 3(1).

Obeidat, B. Y., Al-Suradi, M. M., Masa'deh, R. E., & Tarhini, A. (2016). The impact of knowledge management on innovation: An empirical study on Jordanian consultancy firms. Management Research Review, 39(10), 1214-1238.

Rajabi Farjad, H., Mirsepasi, N., & Naderi Mehrbani, K. (2021). The impact of knowledge management processes on organizational innovation with the mediating role of human resource productivity. Journal of New Approaches in Educational Administration, 12(1), 14-1.

Romasanta, A. K. S., van der Sijde, P., & van Muijlwijk-Koezen, J. (2020). Innovation in pharmaceutical R&D: mapping the research landscape. Scientometrics, 125, 1801-1832.

Sengupta, S., Bajaj, B., Singh, A., Sharma, S., Patel, P., & Prikshat, V. (2023). Innovative work behavior driving Indian startups go global–the role of authentic leadership and readiness for change. Journal of Organizational Change Management, 36(1), 162-179.

Smith, J. E. P. (2006). Social yet creative: the role of social relationships in facilitating individual creativity. Acad. Manag. J. 49, 85–101. doi: 10.5465/amj.2006.20785503

Swan, J., & Newell, S. (2000). Linking knowledge management and innovation.

Tornatzky, L. G., Fergus, E. O., & Avellar, J. W. (2013). Innovation and social process: A national experiment in implementing social technology. Elsevier.

Trialih, R., Wei, H. L., & Anugrah, W. (2017). Knowledge sharing behavior and quality among workers of academic institutions in Indonesia. International Journal of Business and Society, 18(S2), 353-368.

Xu, J., Wang, X., & Liu, F. (2021). Government subsidies, R&D investment and innovation performance: analysis from pharmaceutical sector in China. Technology Analysis & Strategic Management, 33(5), 535-553.

Beyond Rational: Understanding of Fake News in the Post-Truth Era

Anastasiia Iufereva and Elisabetta Risi
IULM University, Milan, Italy

anastasiia.iufereva@studenti.iulm.it
elisabetta.risi@iulm.it

Abstract: The paper focuses on fake news as one of the most serious threats and distinguishing features of the post-truth period, which is defined by the following aspects: the rise of diverse sources of information on the Internet, the devaluation of facts, and the proliferation of fake news. These conditions necessitate a revision of the algorithm, the verification and presentation of information, as well as tactics and techniques for dealing with fake news. The purpose of this research is to describe the distinct characteristics of fake news. The authors have specifically extracted research from the Web of Science, Scopus, and Google Scholar search databases; the sample includes 120 scientific articles with titles related to fake news that were published after 2016 when the term "fake news" gained legitimacy after being named word of the year by Collins (usage of the term increased by 365% since 2016). The analysis focused on key definitions of fake news suggested in each selected research and its permanent and non-permanent characteristics.

Keywords: Fake News, Misinformation, Disinformation, Journalism, Social Media, Post-Truth Era.

1. Introduction

The proliferation of the Internet and popular social practices online have resulted in significant shifts in the mass media sector during the last decade. Post-truth era has emerged, characterized by the intersection of sometimes opposing ideas, perceptions, and techniques. Under these conditions the fake news is spreading, which destroy public discourse in the media environment and exacerbate political and social differences. As a result, the primary goal of this research is to describe characteristics of fake news and determine which parts comprise the nature of this phenomena.

2. Sample Description

For this research scientific papers have been extracted from the database Web of Science, Scopus, and Google Scholar search. The sample consists of 120 scientific publications with titles that mention "fake news". The selected papers were published after 2016, when a term “fake news” was acquired a certain legitimacy after being named word of the year by Collins (since 2016 usage of the term had increased by 365%). The analysis focused on two crucial issues: (1) how each of the studies defined and operationalized the term of “fake news” and (2) what are the permanent and non-permanent characteristics of this phenomenon.

3. Results of Analysis

3.1 Fake News: Approaches to the Definition

Fake news is crucial phenomenon since it contributes to the formation of our "real" world through the constant consumption of media products that present their interpretation of reality. Even though fake news is widespread, it is defined differently. As a result, the definition of fake news remains ambiguous, causing semantic uncertainty.

Fake news is "a catch-all term with multiple definitions" (Lilleker, 2017, p. 1), resulting in various approaches to identifying fake news. In the academic literature, research focuses on two critical components in defining fake news: how fake news is communicated and circulated in today's information ecosystem, and the kind of fake news content that is created and shared. According to the first approach, scholars define communication technologies (e.g., websites, social media, etc.) as tools utilized solely for the creation and dissemination of fake news in today's information environment. This perspective is consistent with the technological determinism approach since it asserts that the emergence and subsequent development of social media platforms has exacerbated the problem of widespread fake news. The media is viewed as an essential component of fake news, and the role of the internet environment in the propagation of such messages is underlined. As for the second approach, the study focuses on the content of fake news, namely the format of such messages and degree of inaccuracy. Scholars describe the format in which fake news is provided, the features of it, and the degree to which they may be real or false. Therefore, the following part of the current research will outline in more detail two approaches frequently found in definitions of fake news: (1) the role of the medium as an

integral component of fake news and as the basis for the circulation of fake news; (2) the news format (false information masquerading as news), and the degree of falsity.

(1) According to the first approach which is in line with the technological determinism approach, fake news is "produced and published by mass communication vehicles such as social media, dominating traditional and social platforms, becoming increasingly part of many people's daily lives" (Rocha et al., 2021). Sutu (2019), for instance, states that "fake news is authentic material used in the wrong context, news products disseminated on websites that specialize in fake news and use layouts similar to those of real media sites <…>" (p. 83). According to Bakir & McStay (2017), a key element of contemporary fake news is that "it is widely circulated online" (p. 1). Thus, it leads to information overload and the dissemination of fake news. Fake news multiply rapidly and act as narratives that omit or add information to facts. Other studies highlighted the methods by which fake news spreads, emphasizing the crucial role that technology plays in communication (Aldwairi & Alwahedi, 2018). One such example of a technological communication tool is social media. Fake news can also be propagated through email chains, posters on streetlights, and other means (Rini, 2017). However, there is a substantial correlation—especially during the 2016 election—between social media and fake news (Rini, 2017, p. 45). Social media has completely changed the composition, scope, and intricacy of news in the last few years (Berkowitz & Schwartz, 2016; Copeland, 2007). Social media is widely regarded as an essential channel for disseminating news and user-generated material, among other types of information. According to Nielsen (2016) and Vosoughi et al. (2018), Facebook, Instagram, and Twitter are the main platforms used for information dissemination. These platforms publish a large number of postings each day. Social media serves as a platform for social engagement, communication, and entertainment in addition to information sharing (Hwang et al., 2011; Kuem et al., 2017). People can share diverse opinions and values if they have unrestricted access to a wealth of knowledge (George et al., 2018; Kim et al., 2019; Rubin, 2019). It is simple to become disoriented in this information flow and stop telling authentic news from fake news on social media (Stein-Smith, 2017, Kumar et al., 2018). According to Machete & Turpin (2020), "search engines and social media platforms contribute to people's tendency to believe the information they come across on these platforms without verifying its veracity, even though they do not encourage people to believe the information being circulated." Hence, fake news has become a major part of social media, raising doubts about information credibility, quality, and verification (Olan et al., 2022).

(2) A further area of investigation is the idea that fake news is an intrinsic feature of the Internet's information space. Proposed definitions ignore the media as a tool for the production and dissemination of fake news in favor of focusing on the characteristics of fake news, methods of content presentation, and the effects of dissemination on the general population. Definitions of "fake news" will be determined by interpreting two factors: (a) the way fake news is presented; and (b) the way facts and the degree of trustworthiness of the information are presented.

(a) The existing definitions are preoccupied with the format of fake news. There are numerous ways to propagate inaccurate or misleading information online, and this news format is just one of them. However, the definitions of recent research have consistently included the news format, as seen here: messages disguising themselves as news and disseminated via the Internet or other media are known as fake news. They are typically produced as jokes or to sway political opinions (Cambridge Dictionary, 2018). False information about the world is presented in fake news in a style and with material that mimics that of reliable news sources (Levy, 2017). "Fake news is made-up news, manipulated to look like credible journalistic reports that are designed to deceive us," according to Brennen (2017, p. 180). One of the goals of fake news is to mimic real-world events and situations. It often mimics the conventions of traditional media news and its key characteristics, which are verifiability, accuracy, balance, and truthfulness (Kim & Dennis, 2019; Jaster & Lanius, 2018, Lazer et al., 2018). For this reason, fake news may seem to be true news. According to these definitions, fake news frequently appears in the news format, which is a respectable method of reporting on current affairs in the real world. Furthermore, it should be mentioned that "this conceptualization of fake news emphasizes, on the one hand, that this information formally imitates media content and, on the other hand, that it has not been produced following the same processes or with the same intention as news produced by the media" (Miró-Llinares & Aguerri, 2021, p. 5).

The next definition of fake news is defined as news items that are purposefully and demonstrably incorrect and have the potential to mislead readers (Allcott & Gentzkow, 2017). According to Klein & Wueller (2017), "the online publication" of incorrect statements of truth might be interpreted as "fake news" (p. 6). "Altered truths" are the definition of fake news, demonstrating the validity of the media's agenda (Shrivastava et al., 2020). False information bundled to trick the public into believing it was created by experts who respect the truth, according to Fiedler (Rimer 2017). "Information that is knowingly false, erroneous, or deceptive and that is intended to

hurt the public or be profitable" (HLEG, 2018). These definitions have two essential components: intent and authenticity. Firstly, information that can be independently verified as false is included in fake news. This time, the notion of falsity is included in the definition and the attribution of falsehood is made at the narrative level. Second, the purposeful fabrication of fake news is to deceive readers. Numerous recent studies have embraced this definition (Mustafaraj & Metaxas, 2017; Conroy et al. (2015), Allcott & Gentzkow, 2017). The motivation behind fake news writers is described in certain scholarly studies, and it may be boiled down to two things: subverting social norms and shifting power dynamics. Therefore, we contend that a more comprehensive definition of fake news should be adopted, one that encompasses the phenomena of information flow between an actor and an action that primarily aims to refute widely held beliefs about reality to challenge established power structures (Weiss et al., 2021).

(b) Some research indicates that fake news has a certain degree of credibility. Manipulation of facts results in two sorts of fake news, each with varying dependability. It is worth noting that the fluidity and ambiguity of truth are also important characteristics of post-truth, which is distinguished by the absence of rigid structures, elasticity and plasticity, idea substitution, and the presence of multiple points of view, each of which can claim the truth. Under these conditions, a fact in fake news may be made up and have nothing to do with reality. According to Gelfert (2018), "fake news has little to do with real-world events." Fake news is defined as articles "invented entirely from thin air," completely contrived, transmitting "new content [that] is 100% false," and having "no factual basis" (p. 96). Other studies have defined fake news in similar ways, with a focus on facticity. For example, Pennycook et al. (2018) define fake news as "entirely fabricated and often partisan content that is presented as factual" (p. 1865). Another type of fake news is when a factual truth is altered or presented wrongly. In this scenario, we're dealing with partially produced fake news: "fake news" is defined as "complete or partly false information, (often) appearing as news, and typically expressed as textual, visual, or graphical content with the intention to mislead or confuse users."

Therefore, according to our view, fake news is a piece of information that might be completely or partially fictitious and deal with real events and situations. Fake news is purposely generated to mislead and/or manipulate a certain audience. To establish credibility, the news format is used to simulate a popular journalistic genre (actual news) with a structure (title, image, content) designed to capture readers' attention, inspire confidence, and, as a result, mislead them. "Once the reader suspends credulity and accepts the legitimacy of the source, they are more likely to trust the item and not seek verification" (Kalsnes, 2018). To identify the distinct characteristics of fake news, it is vital to highlight both continuous and non-constant traits.

3.2 Characteristics of Fake News

This section of this research deals with a discussion of the key characteristics of fake news. To determine the features of this type of disinformation, it is necessary to distinguish between constant and non-constant characteristics. Thus, the author suggests a certain type of typology that encompasses features of fake news. It can not only organize and systematize the existing knowledge regarding fake news, but also it can facilitate the recognition of this type of information.

3.2.1 Constant Characteristics of Fake News

A lack of evidence base. Fake news lacks a systematic, cohesive, and well-structured evidentiary base for the claimed issue. The evidence base is a collection of reputable sources of information that includes references to official documents, critical data, statistics, scientific papers, and so on. The news story, which includes recent events or words made by an actor (for example, a politician), is frequently at the heart of fake news. The news story is developed and condensed around this information occasion, and appealing to an evidence foundation is beyond the producers' attention span.

Suspicious and unverified primary sources. The source of fake news is difficult to detect. It can take the shape of a post on a news feed (on Facebook) or a tweet (on Twitter), just as true news is posted on these social media platforms (headline). Title, image, and signature/source. However, not all sources are equal in authority. "From this perspective, those who distribute fake news are completely identifiable: some pages take the names of famous newspapers by changing one or two letters to deceive; others create real websites, blogs, pages, Facebook or Telegram groups that often evoke conspiracy theories; sometimes, they are personal accounts of natural persons - often fake - who gain users' trust by touting important knowledge or by declaring their freedom from "the system" (Guerra e fake news, 2022). There is also the news without a link to the source: users spread this message making it popularized without knowing of origin of this news.

Imitation of news format. Many studies argue that fake news follows the format of a news narrative, resulting in increased attention and trustworthiness (Baptista & Gradim, 2020; Allcott and Gentzkow, 2017; Lazer, 2018; Rochlin, 2017; Kalsnes, 2018). Fake news is usually associated with freshly emerging, time-critical events, or hot topics in order to attract the attention of internet users, and this content may not have been thoroughly vetted by existing knowledge bases due to a lack of confirming evidence or assertions (Shu et al., 2017, Zhang & Ghorbani, 2020).

The importance of the topic for a certain segment of the society. The prevalence of fake news may be substantially determined by the publication's relevance/importance to the public (Salgado and Bobba, 2019; Galeotti 2019; Trilling et al. 2016). This importance is subjective, as this disinformation may appeal to certain readers but not others. Rini (2017) included this component in the definition of fake news, claiming that bogus information is produced to confuse a section of the audience, despite the fact that one of the primary purposes of fake news is to achieve popularity. To the degree that fake news is relevant, its popularity can be linked to the coverage features of a certain event or the topic covered or studied (Vosoughi et al. 2018; Bright 2016).

The velocity of fake news. Fake news and its creators are typically short-lived (Allcott & Gentzkow, 2017). Fake news, viral or not, has a limited duration. If the news spreads and sparks a public debate, competent journalists and fact-checkers may be able to quickly expose it. For example, several active fake news websites during the US presidential election of 2016 no longer exist following the campaign (Zhang & Ghorbani, 2020).

Intense emotional connotation of the message. Newsmakers frequently communicate their thoughts, emotions, attitudes, and sentiments through fake news. Zhang & Ghorbani (2020) present the concept of "non-physical content" as the core kernel of fake news, stating that it encompasses all of the significant ideas, sentiments, and perspectives that the authors wish to convey to the readers. Sentiment polarity is another significant aspect of non-physical material in fake news. To make their news more persuasive, authors frequently express strong positive or negative emotions in the text body (Devitt & Ahmad, 2007). In particular, stories that elicit powerful emotions become more appealing and widely disseminated. Aside from multiple categories and sentiment polarity, fake news can target certain domains and subjects. Some research (e.g., Galil & Soffer 2011) have found that fake news about crises, conflicts, catastrophes, money laundering, crimes, sexual offenses, or fraud, etc.) receives more public attention. Furthermore, the appealing theme is a political one. Vosoughi et al. (2018) reveal that incorrect content concerning politics was not only widely circulated, but also reached a larger number of people than other subjects.

Simplified language and style of the fake news. It has been recorded that the vocabulary employed by fake news is more formal and simpler in terms of details and production techniques, not just in article headlines but also throughout the content (Horne & Adali 2017). Fake news producers regard certain aspects, such as straightforward and stunning messages, appealing headlines that appeal to the audience's emotions, and clickbait, as important for multiple disclosures. In contrast to traditional media, the most commonly used words in discovered fake news, such as "sex", "death", "corruption", "illegal", "alien", or "lies", refer to dramatic or scandalous content (Budak 2019). Another feature of fake news is message repetition, which enhances its credibility: "Just one prior exposure to fake news headlines is enough to significantly increase subsequent awareness about their accuracy" (Pennycook et al., 2018, p. 1876). This repeating effect is exploited by web bots who are involved in fake news. Flooding the internet with social media bots and fake news sites that post and share the same fake news can make a bogus article appear credible (Tandoc, 2019). For example, a user may stumble across a bogus news report online and decide to search Google to confirm it. If that person sees similar fake news posted elsewhere, they may be misled into believing the post is genuine (Tandoc et al. 2018). As a result, repetition effects imply that repeated exposure to the same information—even if the repeat message comes from the same source and is thus rationally redundant—makes that information more convincing (Gelfert, 2019).

Conscious intent to deceive or mislead. The intentions of content creators are malicious. These intentions amount to the conscious intention of the authors to deceive or mislead the audience. For this reason, fake news is different from journalistic errors (a type of misinformation) and other types of journalistic genres (e.g., satire and parody). For instance, journalistic errors occur inevitably in the process of reporting on often intricate matters (Jaster & Lanius, 2018), and the main aim of satire and parody is to entertain the public, there is an implicit understanding between the author and the reader that the item is false (Tandoc, 2017).

Variability of the authenticity of the news. One distinguishing element of fake news is the manipulation of content validity. However, the credibility of such information varies. Most authors argue that fake news does not need to be completely false or fabricated. Fake news is completely or partially untrue (Tandoc et al. 2018;

Gelfert 2018; Rini 2017; Allcott & Gentzkow 2017; Jaster & Lanius, 2018), adheres to the media agenda, and attempts to describe actual occurrences while distorting and twisting the truth (Rini, 2017). Regarding the identification of sources of information, this can be indicated as a link to primary sources (e.g., reports, statistics, video, images, etc.). However, even if there is a factual basis, the data presented may be erroneous. "Many fake news stories are not completely false, but rather combine purposeful falsehoods with well-known realities to obfuscate. Almost all fake news claims to be about genuine people and entities, which contributes to its initial legitimacy. After all, bogus news claims to be news, not fiction" (Gelfert, 2018, p. 100). Many fake news stories are not entirely fictitious, but rather combine purposeful falsehoods with well-known facts to obfuscate the truth. The latter, purposely misleading one's audience, might be accomplished simply by selectively presenting partial truths. This implies that there is no value "to overstate the degree of disconnect that exists between fake news and reality, or, in any case, that it should not be built into the definition" (Gelfert, 2018).

3.2.2 Non-Mandatory Characteristics of Fake News

Fake news tends to be viral. The fundamental purpose of fake news is to become viral (Rini 2017) and generate a large number of reactions, including views, likes, reposts, and debates. However, this feature is not always present in fake news, as not all items may become popular and gain widespread attention. In the age of digital cacophony, most news, including fake news, goes ignored by users. The following factors can influence virality: topic relevance, high value of the news (for example, content with photos and video material makes the news more appealing), correctly selected format for presenting the news, and platform (fake media website, social networks, instant messengers, etc.). It is crucial to note that the success of falsified things is dependent on pre-existing social conflict (Tandoc, 2017). An equally significant component is the competent selection of the target audience, because, as previously stated, fake news is directed at a specific part of society, thus the content must relate to the values and attitudes of that target group in order to be noticed.

Mobilizing cognitive bias. Since fake news is directed at a specific demographic, it may involve manipulation of our bias. Gelfert (2018) even used the term "confirmation bias" to stress that the goal of fake news is to exploit consumers' pre-existing cognitive biases. "The most striking example is confirmation bias, the universal tendency to want new evidence that confirms our beliefs and theories" (Gelfert, 2018, p. 1). Far from being a side consequence of fake news, the systemic ways in which it mobilizes our cognitive biases and alters our thinking processes, are integral to its purpose. Confirmation bias contributes to many informal fallacies that stifle critical thinking, as well as systematic issues in the architecture of the sources and channels via which fake news travels, creating barriers to critical thinking and active investigation. Much fake news employs representational strategies that actively alter customers' cognitive biases, to deceive consumers into propagating (e.g., through online "sharing") the very statements that misled them in the first place (Gelfert, 2018).

Presence of photos, videos, and other multimedia materials in fake news. Fake news has also been defined as the alteration of real photographs or videos to create a misleading narrative. Visual clues are a significant but optional feature of fake news because not every fake news contains visual or graphical content (Kalsnes, 2018). As previously demonstrated, fake news exploits individual vulnerabilities, frequently relying on exaggerated or inaccurate visuals to elicit wrath or other emotional responses in customers (Shu et al., 2017). Visual characteristics are collected from visual materials (such as photographs and videos) to capture the many aspects of fake news. Image modification has grown in popularity as a result of digital photography, strong image alteration software, and expertise (Tandoc 2017). Effects might range from simple to complex. Simple modifications can include expanding the space. Effects might range from simple to complex. Simple modifications can include adding more space and deleting little items. More extreme modifications could include removing or putting people into the photograph. Another type of manipulation is when fake news appears in photo manipulations and uses images from one context in another (for example, fake news uses photographs that depict a completely different event and are unrelated to the situation being described, which is especially common for natural disasters, military operations, and so on) (Kalsnes, 2018).

Presence of sensational headline of fake news. Typically, fake news headlines are false and outrageous, having exaggeration, sensationalism, and even violence in common. However, this characteristic is not mandatory. Given the tendency of fake news to imitate real news, headlines can be neutral in tone, avoiding exaggeration and attempts to immediately shock readers.

Table 1: Characteristics of fake news

Constant characteristics of the content of fake news	
The lack of evidence base	Fake news lacks a systematic, cohesive, and well-structured evidentiary base for the claimed issue. The evidence base is a collection of reputable sources of information that includes references to official documents, critical data, statistics, scientific papers, and so on.
Suspicious and unverified primary sources	The origin of fake news is difficult to determine since it can spread on the Internet, particularly on social media, without attribution to the source. Internet users can propagate bogus news. Fake news can also surface on questionable news websites or on sites that resemble legitimate, authoritative media but are not.
Imitation of news format	Fake news takes the form of true news and refers to freshly developing, time-critical events or hot topics in order to attract the audience's attention.
The importance of the topic for a certain segment of the society	The chosen topic addresses the interests and values of a specific segment of the audience to produce a viral impact on the message.
The velocity of fake news	Fake news, viral or not, has a short lifespan.
Intense emotional connotation of the message and emotional response of the audience	News makers often communicate their thoughts, emotions, attitudes, and sentiments through fake news, making it more shareable and popular.
Simplified language and style of the fake news	The material is written in easy language. The presenting manner for the event is informal. The story's title is engaging and appropriately describes its content. Persuasion strategies may include several repetitions.
Conscious intent to deceive or mislead the audience	Fake news is manufactured and circulated for selfish reasons, since the author seeks to fool the audience.
Variability of the authenticity of the news	All fake news has one thing in common: the content is false, which varies depending on the author's aims. They typically showcase wholly or partially created content based on true facts (there is a reference to an event or famous persons).
Non-mandatory characteristics of the content of fake news	
Fake news tends to be viral	The primary purpose of any fake news is to become viral and generate a lot of reactions (views, likes, reposts, etc.). However, this feature is not always present in fake news, as not all items may become popular and gain widespread attention.
Mobilizing cognitive bias	Fake news may exploit customers' innate cognitive biases. It leads to several informal beliefs that stymie critical thinking, as well as systematic aspects in the architecture of the sources and channels via which fake news travels, creating hurdles to critical thinking and active inquiry.
Presence of photos, videos, and other multimedia materials in fake news	Fake news has also been defined as the alteration of real photographs or videos to create a misleading narrative.
Presence of sensational headline of fake news	Fake news headlines are typically inaccurate and outrageous, with exaggeration, sensationalism, and even violence as prevalent themes. However, this feature is not required because headlines can have a neutral tone.

4. Conclusions

The problem of fake news remains relevant and continues to spark discussions about its definition, features, and characteristics. The authors of this research have attempted to contribute to the analysis of fake news. We have identified the crucial characteristics of fake news, which might be beneficial for media experts and professional journalists. It is vital for them to be capable of identifying fake news, as legacy media still act as gatekeepers in the current media space by making decisions about which stories are featured or published. Moreover, understanding fake news in a more profound way is important for comprehending the consequences and effects of the post-truth era. In this context, the position of fact is changing, as subjective information that aligns with personal beliefs plays a more critical role. This shift leads to increased polarization of opinions and fragmentation of the mass media landscape, which, in turn, facilitates the spread of fake news.

References

Aldwairi, M., & Alwahedi, A. (2018) "Detecting Fake News in Social Media Networks", *Procedia Computer Science*, Volume 141, 2018, pp. 215-222.

Allcott H., & M. Gentzkow, M. (2017) "Social media and fake news in the 2016 election", *Journal of Economic Perspectives*, 31(2), pp. 211–236.

Bakir, V., & McStay A. (2017) "Fake news and the economy of emotions: problems, causes, solutions", *Digital Journalism*, N 6(2), pp. 1–22.

Baptista J.P., & Gradim A.A. (2022) "Working Definition of Fake News", *Encyclopedia*, *2*, pp. 632-645.

Berkowitz, D., Schwartz, D. (2016) "When fake news becomes realer than real", *Journalism Practice*, 10 (1), pp. 1–17.

Brennen B. (2017) "Making Sense of Lies, Deceptive Propaganda, and Fake News", *College of Communication Faculty Research and Publications*, 485, https://epublications.marquette.edu/cgi/viewcontent.cgi?article=1491&context=comm_fac

Bright, J. (2016) "The Social News Gap: How News Reading and News Sharing Diverge", *Journal of Communication*, 66, pp. 343–65.

Budak, C. (2019) "What Happened? The Spread of Fake News Publisher Content during the 2016 US Presidential Election", In The World Wide Web Conference. New York: ACM, pp. 139–50.

Cambridge Dictionary, [online], https://dictionary.cambridge.org/

Conroy N., Rubin V., & Chen Y. (2015) "Automatic deception detection: Methods for finding fake news", Proceedings of the Association for Infor-mation Science and Technology, 52(1), pp. 1–4.

Copeland, D.A. (2007) "A series of fortunate events: why people believed Richard Adams Locke's "Moon Hoax." *Journalism History*, 33(3), pp. 140–150.

Devitt, A. & Khurshid A. (2007) "Sentiment Polarity Identification in Financial News: A Cohesion-based Approach", Proceedings of the Association for Computational Linguistics (ACL), [online], https://www.researchgate.net/publication/220873208_Sentiment_Polarity_Identification_in_Financial_News_A_Cohesion-based_Approach

Galeotti, A. (2019) "Believing Fake News", In *Post-Truth, Philosophy and Law*, p. 58.

Gelfert A. (2018) "Fake News: A Definition", *Informal Logic*, 38 (1), pp. 84-117.

George, J. F., Gupta, M., Giordano, G., Mills, A. M., Tennant, V. M., & Lewis, C. C. (2018) "The effects of communication media and culture on deception detection accuracy", *MIS Quarterly: Management Information Systems*, 42(2), pp. 551–575.

Guerra e fake news, come riconoscere ed evitare le notizie false, [online], Report, https://www.altalex.com/documents/news/2022/03/14/guerra-e-fake-news-come-riconoscere-ed-evitare-le-notizie-false

High Level Expert Group (2018), Fake News and Online Disinformation. A multi-dimensional approach to disinformation. Brussels: European Commission.

Horne, B.D. & Adali S. (2017) "This Just in: Fake News Packs a Lot in Title, Uses Simpler, Repetitive Content in Text Body, More Similar to Satire than Real News", Paper presented at the Eleventh International AAAI Conference on Web and Social Media, Montreal, QC, Canada, May 15–18.

Hwang, Y.C., Yuan, S.T., & Weng, J.H. (2011) "A study of the impacts of positive/negative feedback on collective wisdom—case study on social bookmarking sites", *Information Systems Frontiers*, 13(2), pp. 265–279.

Jaster R., & Lanius D. (2018) "What Is Fake News?", *Versus*, 2(127), pp. 207-227.

Kalsnes B. (2018) "Fake news", [online], https://doi.org/10.1093/acrefore/9780190228613.013.809

Kim, A., & Dennis, A. R. (2019) "Says who? The effects of presentation format and source rating on fake news in social media", *MIS Quarterly: Management Information Systems*, 43(3), pp. 1025–1039.

Kim, A., Moravec, P. L., & Dennis, A. R. (2019) "Combating fake news on social media with source ratings: the effects of user and expert reputation ratings", *Journal of Management Information Systems*, 36(3), pp. 931–968.

Klein, D. O., & Wueller, J. R. (2017) "Fake news: A legal perspective", *Journal of Internet Law*, 20(10), pp. 5–13.

Koresh G. & Gil S.. (2011) Good news, bad news and rating announcements: An empirical investigation. Journal of Banking & Finance. In Press, Corrected Proof. 10.1016/j.jbankfin.2011.04.010.

Kuem, J., Ray, S., Siponen, M., & Kim, S. S. (2017) "What leads to prosocial behaviors on social networking services: a tripartite model", *Journal of Management Information Systems*, 34(1), pp. 40–70.

Kumar, N., Venugopal, D., Qiu, L., & Kumar, S. (2018) "Detecting review manipulation on online platforms with hierarchical supervised learning", *Journal of Management Information Systems*, 35(1), pp. 350–380.

Lazer, D.M, Baum M.A., & Benkler Y. (2018) "The science of fake news", *Science*, 359(6380), pp. 1094–1096.

Levy, N. (2017), "The Bad News About Fake News", *Social Epistemology Review and Reply Collective,* 6, no. 8, pp. 20-36.

Lilleker, G. (2017) "Evidence to the Culture, Media and Sport Committee 'Fake news' inquiry presented by the Faculty for Media & Communication, Bournemouth University. Documentation. Bournemouth University [online], http://eprints.bournemouth.ac.uk/28610/

Machete, P., & Turpin, M. (2020) "The Use of Critical Thinking to Identify Fake News: A Systematic Literature Review", *Responsible Design, Implementation and Use of Information and Communication Technology*, Mar 10; 12067, pp. 235–246.

Miró-Llinares, F., & Aguerri, J. C. (2023) "Misinformation about fake news: A systematic critical review of empirical studies on the phenomenon and its status as a 'threat'", *European Journal of Criminology*, 20(1), 356-374. https://doi.org/10.1177/1477370821994059

Mustafaraj E., & Metaxas P. (2017) "The Fake News Spreading Plague: Was it Preventable?", [online], https://www.researchgate.net/publication/315489413_The_Fake_News_Spreading_Plague_Was_it_Preventable

Nielsen, R.K. (2016), "Folk Theories of Journalism: The Many Faces of a Local Newspaper." *Journalism Studies,* 17 (7): 840–848.

Olan, F., Jayawickrama, U., & Arakpogun, E.O. (2022) "Fake news on Social Media: the Impact on Society", *Inf Syst Front,* https://doi.org/10.1007/s10796-022-10242-z

Pennycook, G., Cannon T.D., & Rand D.G. (2018) "Prior exposure increases perceived accuracy of fake news", Journal of Experimental Psychology, 147(12), pp. 1865-1880.

Rimer, S. (2017) "Fact-Checking "Fake News" Stories is a Waste of Time", World Economic Forum, [online], https://www.weforum.org/agenda/2017/07/why-fact-checking-fakenews-stories-is-a-waste-of-time.

Rini, R. (2017) «Fake News and Partisan Epistemology», *Kennedy Institute of Ethics Journal*, 27 (2), E43-E64.

Rocha, Y.M, de Moura, G.A., Desidério, G.A., de Oliveira, C.H., Lourenço, F.D., & de Figueiredo Nicolete, L.D. (2021) The impact of fake news on social media and its influence on health during the COVID-19 pandemic: a systematic review, *Z Gesundh Wiss*, Oct. 9, pp.1–10.

Rochlin, N. (2017) "Fake news: Belief in post-truth", *Library Hi Tech*, 35(3), pp. 386–392.

Rubin, V.L. (2019) "Disinformation and misinformation triangle", *Journal of Documentation*, 75(5), pp. 1013–1034.

Sales, L. (2017) "New ACTU boss says it's OK for workers to break "unjust laws" [online], Report, Sydney, http://www.abc.net.au/7.30/content/2017/s4636757.htm

Salgado, S., & Bobba G. (2019) "News on Events and Social Media: A Comparative Analysis of Facebook Users' Reactions", *Journalism Studies*, 20, pp. 2258–76.

Shrivastava G., Kumar P., Ojha R.P., Srivastava P.K., Mohan S., & Srivastava G. (2020) "Defensive modeling of fake news through online social networks", *IEEE Trans. Comput. Social Syst*., 7, pp. 1159-1167.

Shu, K., Sliva, A., Wang, S., Tang, J., & Liu, H. (2017) "Fake News Detection on Social Media", *ACM SIGKDD Explorations Newsletter*, 19(1), pp. 22–36.

Stein-Smith, K. (2017) "Librarians, information literacy, and fake news". *Strateg. Libr*. 37, pp. 1–4.

Sutu, R. (2019) "Fake News, from Social Media to Television Case Study of the Romanian Presidential Elections 2019", *Styles of Communication*, Vol 11, N0 2, pp. 81–92.

Tandoc, E.C. (2019) "The facts of fake news: A research review", *Sociology Compass*, pp.1-9.

Tandoc, E.C., Lim, Z.W. & Ling R. (2017) "Defining 'fake news': A typology of scholarly definitions", *Digital Journalism*, 6(2), pp. 137–153.

Trilling, D., Tolochko P., & Burscher B. (2016) "From Newsworthiness to Shareworthiness: How to Predict News Sharing Based on Article Characteristics", *Journalism & Mass Communication Quarterly*, 94, pp. 38–60.

Vosoughi, S., Roy D., & Aral S. (2018) "The Spread of True and Fake news Online", *Science*, 359, pp. 1146–51.

Vosoughi, S., Roy, D., & Aral, S. (2018) "The spread of true and fake news online". *Science*, 359 (6380), pp. 1146–1151.

Wardle, C. (2017) "Fake news. It's complicated" [online], Report, https://firstdraftnews.org/articles/fake-news-complicated/

Weiss, A.P., Alwan, A., Garcia, E.P., & Kirakosian, A.T. (2021) "Toward a Comprehensive Model of Fake News: A New Approach to Examine the Creation and Sharing of False Information", *Societies*, 11, 82.

Zhang X., & Ghorbani A. (2020) An overview of online fake news: Characterization, detection, and discussion, *Information Processing & Management*, Volume 57, Issue 2, https://doi.org/10.1016/j.ipm.2019.03.004.

Mapping University Knowledge Management: A Bibliometric Analysis

Kitti Lekszikov
University of Pannonia, Faculty of Business and Economics, Department Management, Veszprem, Hungary

lekszikov.kitti@gtk.uni-pannon.hu

Abstract: Knowledge management is becoming an increasingly important and popular research topic. Overall, higher education institutions do not have a dedicated knowledge management system, but in recent years there has been an increasing focus on knowledge management in higher education, as higher education institutions need to manage knowledge effectively to meet current educational challenges and needs. Knowledge management in higher education is a set of processes and tools that collect, structure, capture, store and share knowledge in higher education institutions so that it can be used by learners, teachers and managers. The research aims to undertake a comprehensive survey and review of the literature in the field of knowledge management in higher education. It also aims to map and analyse in detail the thematic scope of related research. In doing so, the research will provide an extensive insight into the context of knowledge management in higher education and current research directions. In my analysis, I chose the framework provided by the PRISMA method, as it guides the process from the first step of data collection to the last step of data processing. Using the PRISMA method, a systematic literature review is conducted, the relevant literature on the topic is listed, summarised and analysed. The analysis is based on the search rules predefined by the author, and the Web of Science database was used as a bibliometric data source for sampling the research, to examine publication trends in higher education knowledge management research. The research sample (N = 967) consisted of publications with the terms 'university' and 'knowledge management' in their titles, and after selection, analyses were performed on a sample of 100 items. VOSviewer software was used to support the analysis process and visualize the results. The literature review results in a comprehensive information table summarising and grouping knowledge management research in higher education according to a rule defined by the author. The results of this research provide a starting point for researchers interested in the field, identify research gaps and identify possible further research directions.

Keywords: Higher Education, Knowledge Management, Bibliometric Analysis

1. Introduction

Knowledge management is the process of managing and using knowledge effectively. The management and sharing of knowledge is increasingly seen as a key factor in higher education as it has become essential for its growth (Areekkuzhiyil, 2016). Knowledge management is particularly important in higher education institutions, as research and education are core activities. Knowledge is created through a variety of human activities (Dhamdhere, 2015; Ranjan and Khalil, 2007), which can take different forms (facts, opinions, experiences, models, etc.) (Adhikari, 2010).

Given the knowledge-intensive nature of higher education institutions, the development, existence and proper functioning of a higher education knowledge management system is essential.

During her research, the author surveyed the literature on knowledge management in higher education, aiming to analyse the publications in a quantitative way.

This article sought to shed light on the field of knowledge management in higher education by answering three research questions:

1. What are the prominent research themes in the field of higher education knowledge management?
2. Which countries are at the forefront of publishing articles on higher education knowledge management?
3. Which aspects of the knowledge management process are prominent in terms of publications in higher education?

The author considers this research to be incomplete, as none of the articles we have examined have addressed these three research questions together.

2. Literature Review

In practice, the implementation of knowledge management cannot be successful unless it has the support of all relevant stakeholders in higher education institutions, as well as government regulators. The stakeholders in

higher education institutions - faculty, administrative staff and students - are a community and must play a joint role in the implementation of knowledge management (Kanwal et al, 2019; Hawkins, 2000)

From the perspective of higher education institutions, knowledge management can be explained as a set of practices that help an institution to improve its teaching, research and administrative roles and encourage stakeholders to use and share data and information in decision making (Petrides & Nodine, 2003).

Rivera et al. (2016) proposed a six-factor process that facilitates knowledge creation, storage, transfer and application. Their model consists of: leadership, culture, structure, human resources, information technology and measurement. Furthermore, their study showed that cultural, human and structural aspects play an important role in university knowledge management models.

One of the most important facilitating factors for knowledge management in higher education is leadership behaviour, as leaders have a significant influence on the direction and effectiveness of knowledge management in their organisations (Nam Nguyen & Mohamed, 2011). Leaders can provide conditions that enable participants to implement and develop their transformational skills in order to enrich their own knowledge and access relevant knowledge shared by others (Crawford, Gould & Scott, 2003); and leadership behaviour can nurture knowledge production and validation (Von Krogh, Nonaka & Rechsteiner, 2012).

Fullwood and Rowley (2017) found in their study that knowledge management policies implemented by higher education institutions are either inadequate or unpredictable. However, there has been a recognition of the importance of knowledge management in higher education institutions (Veer-Ramjeawon & Rowley 2020), followed by initiatives to promote and opt for knowledge management in most cases (Iqbal et al. 2018).

3. Methodology of the Literature Research Process

The author has carried out a systematic literature review to explore the literature, which reduces the risk of relevant publications being omitted from the literature analysed.

Petticrew and Roberts (2008) argue that a systematic literature review is a way of generating meaning from significant amounts of information, and a tool that helps to clarify questions about what is and is not being obtained.

Arksey and O'Malley (2005) state that the rapid growth in the field of literature reviews has resulted in a diversity of terminology that shares characteristic bases across different denominations. The authors stress that these approaches, although given different names, agree on certain basic characteristics. These include the collection, evaluation and presentation of research evidence. According to Arksey and O'Malley, despite the diversity of names in the rapidly evolving field of literature reviews, the basic principles of methodology are similar and are linked to the systematic collection and evaluation of available research data.

Based on the structure used by Massaro et al. (2015), Dumay et al. (2015), Ayodele et al. (2018), who have already published a systematic literature review on knowledge management, the author has created his own rules. The approach they use comprises five interrelated stages, these are:

1. Formulation Of The Research Questions
2. Writing The Research Protocol
3. Identifying The Articles To Be Included In The Literature Search
4. Grouping And Coding The Articles
5. Analysis And Discussion Of The Results

The author used a hybrid approach in the literature search, combining the structure used by Massaro et al. (2015), Dumay et al. (2015), Ayodele et al. (2018) with the PRISMA method.

3.1 Formulating the Research Questions

For the purposes of this article, the research questions I formulated in the introduction will guide me. This article is not intended to answer the research questions that follow, but merely to provide a basis for collecting literature and writing the forthcoming publication. These questions are intended to ensure that this literary analysis is accurate and relevant to all aspects of the subject.

The following research questions were formulated for a comprehensive literature review:

Q1: Does a complex knowledge management system tailored to higher education institutions exist today?

Q1a: If so, what are the factors that influence the process of knowledge management in higher education?

Q2: Do higher education institutions have a knowledge management system in place and, if so, what is the nature of the system? If not, what are the reasons for this?

Q3: What are the factors that influence the process of knowledge management in higher education and the construction of the system?

Q4: What factors help and what obstacles hinder the effectiveness of knowledge management in higher education institutions?

3.2 Writing the Research Protocol

Systematic review of the procedure and methods used in a pre-defined, well-defined protocol is essential (Petticrew and Roberts, 2008; Dumay et al., 2015; Ayodele et al., 2018).

For the analysis, the framework provided by the PRISMA method proposed by Moher et al. (2010) was chosen as it guides the process from the first step of data collection to the last step of data processing. PRISMA provides a comprehensive and transparent process, can be applied to any research field and strongly supports the reproducibility of the review (Vu-Ngoc et al., 2018). The methodology used for systematic literature review consists of four basic steps, these are: identification, screening, eligibility and inclusion.

3.3 Identifying the Articles to be Included in the Literature Search

In the previous section, the method I use in my analysis was presented, thus completing the structure (Petticrew and Roberts, 2008; Dumay et al., 2015; Ayodele et al., 2018). This third stage, defined by them, is fully mapped to the PRISMA method process. The figure below shows the data collection and pre-processing steps used. The number of excluded articles is also highlighted at each step.

Figure 1: PRISMA flowchart

Source: own edit

The first step in the PRISMA analysis method is identification. The analysis was based on a database provided by Web of Science, where a keyword search was used to identify all relevant literature on the topic. The author searched several databases of scientific articles in order to find a platform for data collection, the Web of Science database was chosen because it is a comprehensive database containing hundreds of thousands of records. The

database was downloaded without any time-frame restriction, so it contains articles from 1995 to the date of download (3 April 2023), which represents a total of 967 scientific publications with content related to knowledge management in higher education. This article does not aim to compare periods and, as it does not include a longitudinal study, it does not have the problem of analysing all the articles published up to the date of download. In order to preserve more information, the database contains data up to the date of extraction, which is why the 2023 truncation year publications are also analysed. With the filters and search rule specified, nearly 1,000 hits were obtained: university* AND "knowledge management".

The next step in the analysis is screening. The analysis was based on a single database, so there was no need to remove duplicate records. The present step of the method can be divided into three stages. In the first stage, the hits were narrowed down to the subject area, discipline classification, selecting those that belonged to the discipline. Thus the following topics were selected: Management; Education & Educational Research; Knowledge Engineering & Representation; Economics; Operations Research & Management Science. This section excluded 377 hits from the analysis. In the second stage, the type of document was identified, and the choice was made for the articles, as the later part of the analysis will require the processing of the relevant literature that follows from the reading of the abstract. With this narrowing down, a further 26 articles were excluded. Finally, in the third stage, the refinement ended on the language aspect of the publications. Only the articles published in English were retained in order to avoid problems in the later stages of the analysis when comparing the results. At this stage, a few articles in French, Russian and German were excluded from the screening and later from the analysis. At the end of the second phase of the PRISMA method, 494 articles remained.

In the next, third stage, a manual reading was carried out to determine eligibility, during which all articles (494) in the downloaded database were read and literature relevant to the research was isolated. In this step, a further 394 studies were excluded because they were not relevant for the following reasons: (1) they mentioned knowledge management but did not examine it from the perspective of higher education institutions, (2) they mentioned knowledge management but the content was not knowledge management specific.

The manual reading is followed by the inclusion step, which consists of keeping the scientific publications that remain in the database after the above steps have been carried out and identifying different sets. The database consists of 100 relevant scientific publications.

After establishing relevance, a fourth stage of the structure (Petticrew-Roberts, 2008; Dumay et al., 2015; Ayodele et al., 2018) follows.

3.4 Grouping and Coding the Articles

The fourth step is to group the different articles received for the structured review. The main purpose of the grouping of articles is to facilitate the effective application of the systematic methodology, thus helping to produce a structured review. This grouping will make it easier to extract relevant information from the literature reviewed. The structured grouping allows a systematic overview and comparison of the literature, allowing it to be analysed from different perspectives. All this will help to define the research framework for future research and to formulate research questions and hypotheses.

Dumay et al. (2015) and Ayodele et al. (2018) use the same grouping and coding principles, however the groupings are developed according to the author's own preferences in order to best serve the structured processing of the literature. The relevant literature has been organised according to the grouping principle presented in the figure below.

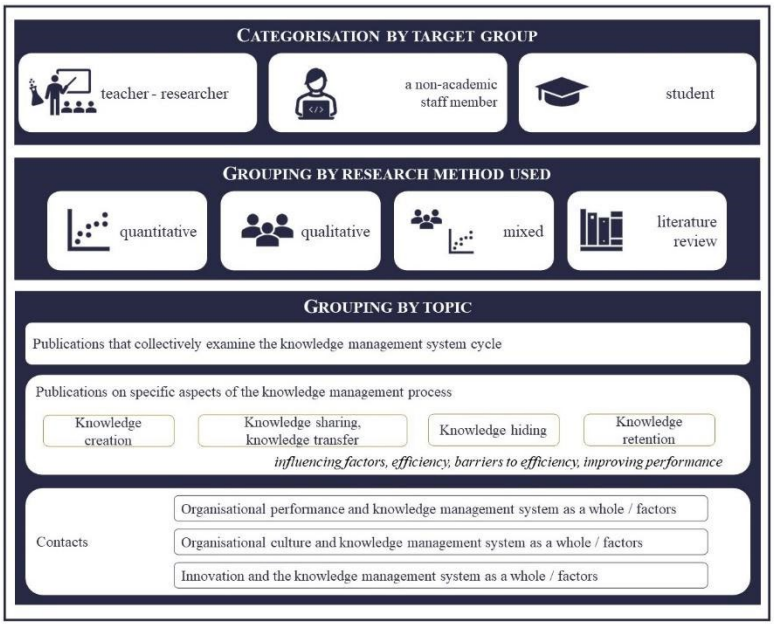


Figure 2: Grouping of reviewed articles

Source: own edit

In the literature review, the articles can be divided into teaching/research, non-academic staff and students according to the target group of the research. I choose this grouping for my research. The group of academics/researchers includes all employees who are closely involved in the teaching of students or who are involved in research activities that contribute to the development and innovation of their field. The next unit in the grouping I have defined is the non-academic staff, who do not carry out teaching and research activities but who provide and promote the University's activities. Finally, the third group is made up of full-time, part-time, undergraduate, masters and doctoral students.

In terms of the methodology used by the authors in their scientific publications, a distinction can be made between literature review, qualitative, quantitative, qualitative and quantitative research and data analysis methods. When grouped by topic, a distinction can be made between research that examines the entire knowledge management cycle as a whole, research that examines individual aspects of the cycle separately, and research that relates individual elements of the knowledge management system to other research areas.

4. Literature Research Results

During the literature search described above - prior to the manual reading - and after the final selection, I also carried out a quantitative analysis of the available data set. VOSviewer software supported the analysis process and visualization of the results. The analysis focused on 494 scientific publications before the manual reading and 100 scientific publications afterwards.

First, I examined the keywords indicated by the abstract of the publications. For a total of 494 items, the top 10 most frequently indicated keywords are "knowledge management" (n=286), followed by "innovation" (n=99), "performance" (n=92), "impact" (n=73), "universities" (n=57), "knowledge sharing" (n=52), "management" (n=55), "model" (n=47), "university" (n=42), "systems" (n=38). The figure below illustrates the keywords by network visualization with the exception of the keyword "knowlegde management" (its appearance distorted the network, suppressing the other keywords due to the size of the element count).

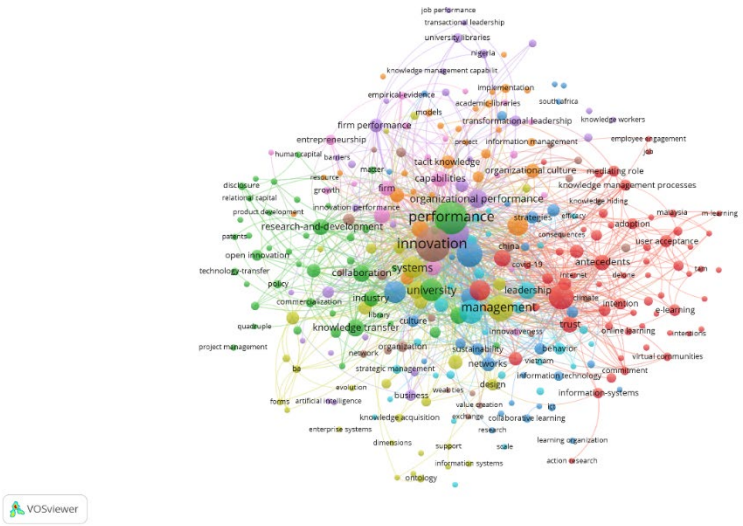


Figure 3: Cooccurrence of keywords in publications on knowledge management in higher education

Source: based on downloaded database, own editing

The keywords that were most frequently mentioned after manual reading were "knowledge management" (n=52), "knowledge sharing" (n=22), "innovation" (n=22), "performance" (n=21), "model" (n=15), "impact" (n=18), "management" (n=15), "antecedents" (n=12), "trust" (n=10), "universities" (n=18). The figure below illustrates the occurrence of keywords in the database filtered by network visualisation after manual reading. The keyword "knowlegde management" was excluded from the visualisation to avoid bias.

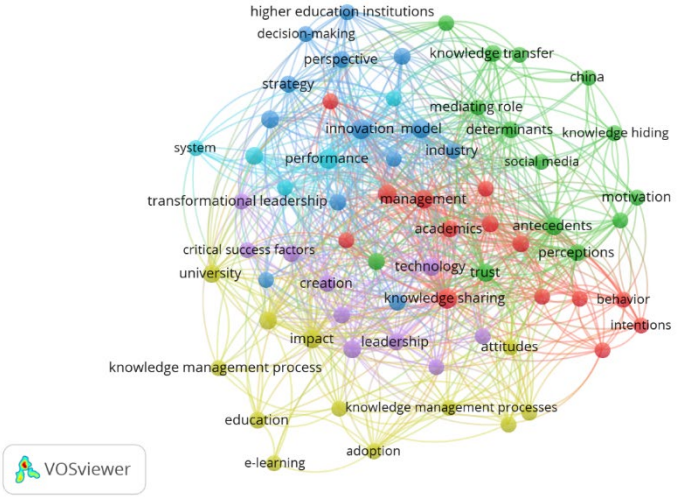


Figure 4: Cooccurrence of keywords in selected publications on knowledge management in higher education

Source: based on downloaded database, own editing

The network shows peaks in different colours. The colours represent the cluster classifications, so that vertices with the same colour belong to a cluster, connected by edges with the same colour. There is a high co-occurrence rate between keywords belonging to the same cluster. The size of the vertices represents the number of co-occurrences, while the thickness of the edges connecting the two vertices represents the frequency of co-occurrences.

From the two visualisations, it can be seen that the number of keywords has been reduced after the manual reading, with "innovation" and "performance" retaining their magnitude, but "knowledge sharing" being promoted. Knowledge hiding" (n=3), "knowledge transfer" (n=5), "knowledge creation" (n=8) and "trust" (n=10) were added to the map.

Quantitative literature analysis shows that knowledge creation, knowledge sharing, knowledge transfer and knowledge hiding are areas that have been researched in academic publications on knowledge management in higher education, but which have further research potential.

Quantitative approaches are also interesting for countries researching this topic. In the visualisation, countries where at least 3 publications have been published are indicated.

The following figures, first before and then after the manual reading, show a grid of countries contributing to knowledge management in higher education (peaks represent countries, edges represent the number of citations), with a reference focus. The figures below follow a gravity arrangement, i.e. whichever country has the most referral links is central in the middle, while those with few (or no) links are on the periphery. The following graph does not show isolated peaks, i.e. countries that are not connected to other countries.

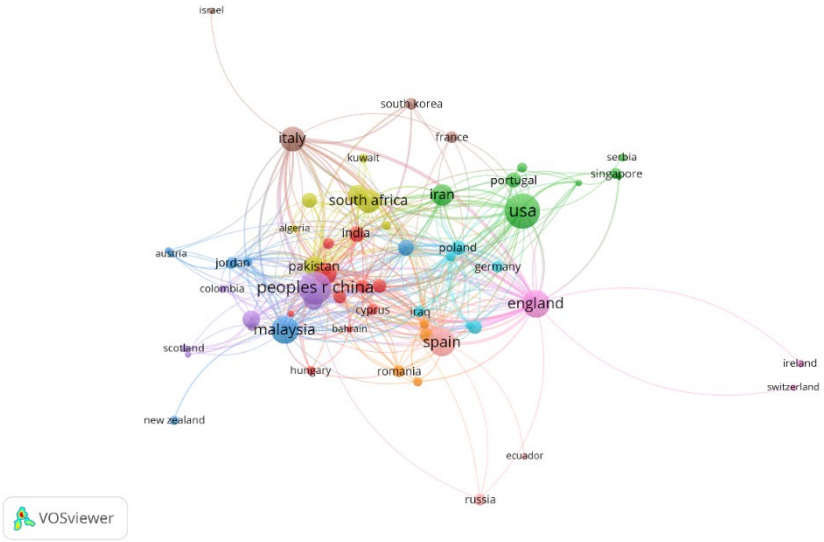


Figure 5: Network of countries publishing on knowledge management in higher education

Source: based on downloaded database, own editing

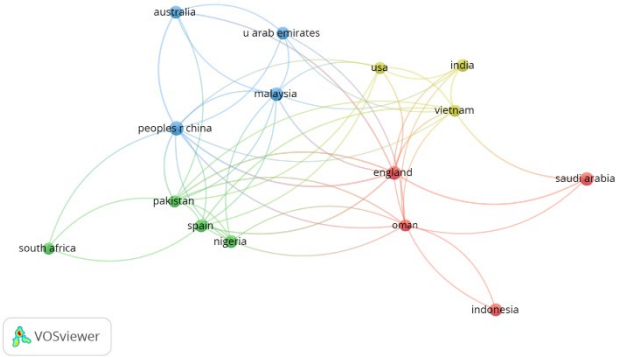


Figure 6: Network of countries publishing on knowledge management in higher education - after selection

Source: based on downloaded database, own editing

After manual reading, it can be said that, apart from China and England, knowledge management in higher education is the most researched area among researchers from Asian and African countries. It is important to note that among the European countries, only Spain is on the map. From the above, it can be concluded that, apart from Spain, there is no international literature on European institutions. It is important to note, however, that this indicates the country under which the researcher is publishing and not the country of higher education system studied.

Based on international publications, it can be concluded that, as a less researched area in our region, there is a great research potential for research on knowledge management systems in Hungarian higher education institutions.

5. Discussion

Knowledge management in higher education is increasingly coming under the spotlight as universities and research institutions recognise the importance of managing and sharing knowledge effectively. The results of

my research have led to several interesting and relevant conclusions that contribute to the academic discourse in this area.

5.1 Prominent Research Topics

Based on the analysis, the most prominent research topics in the field of knowledge management in higher education include general knowledge management, innovation, performance, knowledge sharing, and trust and knowledge hiding. The dominance of the keyword "knowledge management" in the publications is understandable, as it is the most general term, encompassing the whole cycle. At the same time, the prominence of innovation and performance suggests that researchers have a strong interest in investigating the effectiveness and efficiency of knowledge management systems.

Particularly noteworthy is the role of knowledge sharing and knowledge capture, which directly influence knowledge flows in institutions. And trust, as an increasingly prominent factor, also plays a key role in effective knowledge management processes. These findings suggest that future research should explore these factors in more depth, with a particular focus on their interactions and effects.

5.2 Leading Countries in Knowledge Management Research

The spatial distribution of publications also yielded interesting observations. The dominance of China and the UK alongside Asian and African countries suggests that there is a strong research activity in these regions in the field of higher education knowledge management. The presence of Spain as the only European country among the publications examined indicates that the European research community is less active in this field or less present in the international publication space.

This observation may have important implications for higher education institutions in Hungary. The data show that there is significant research potential in the study of knowledge management systems in Hungarian universities, which could contribute to the international academic discourse and increase the academic visibility of the region.

5.3 Outstanding Factors in the Knowledge Management System Process

Knowledge sharing, knowledge creation, knowledge hiding and trust play a key role in the study of knowledge management system processes. These factors have a significant impact on the effective flow and use of knowledge in educational institutions. The research results clearly show that these processes are closely interrelated and that the effectiveness of knowledge sharing is highly dependent on the level of trust within the organisation.

These factors may be of particular relevance for higher education institutions in Hungary, where the development of knowledge management systems can contribute to improving the effectiveness of teaching and research. The frequent occurrence of the keywords innovation and performance suggests that the development of knowledge management systems can directly contribute to the competitiveness and innovative capacity of institutions.

6. Conclusion

In conclusion, the results of the research highlight that knowledge management in higher education is a dynamically developing field of research, which offers many opportunities for future research. Innovation, performance, knowledge sharing and trust are key elements to be further explored in order to improve knowledge management systems. In particular in Hungary and the region, there is great research potential in this area, which can contribute to the development and international visibility of universities and research institutions.

7. Further Research Opportunities

The findings of this research have identified a number of further research directions and opportunities in the field of knowledge management in higher education. In what follows, I highlight two potential research topics that I believe hold great potential for future research. Firstly, I will highlight the motivations and consequences of knowledge hiding as a further research direction, which aims to assess why knowledge is hidden by lecturers, researchers and students and what impact this has on organisational performance. A further research option is

to investigate the effectiveness of knowledge sharing strategies, with the aim of examining the effectiveness of different knowledge sharing strategies in higher education institutions.

8. Research Limits

The present research has fundamental limitations, as only article-type documents were included in the database. Conference papers excluded by the rule would be relevant and relevant because their results appear faster than the publication process of journal articles. However, this study focused only on high-ranking scientific publications.

Acknowledgements

Supported by the únkp-23-3new national excellence program of the ministry for culture and innovation from the source of the national research, development and innovation fund.

References

Arksey, H., and O'Malley, L. (2005) Scoping studies: towards a methodological framework. *International journal of social research methodology*, *8*(1), pp 19-32.

Areekkuzhiyil, S. (2016) Impact of Organisational Factors on the Knowledge Sharing Practice of Teachers Working in Higher Education Sector. Online Submission, 4(8), pp 23-33.

Ayodele, F. O., Yao, L., and Haron, H. B. (2018) University Knowledge Management: Proposal for Broaden Integrative Perspective. Journal of Information & Knowledge Management, 1850032. doi:10.1142/s0219649218500326

Crawford, C. B., Gould, L. V., and Scott, R. F. (2003) Transformational leader as champion and techie: Implications for leadership educators. Journal of Leadership Education, 2(1), pp 1-12.

Dhamdhere, S. N. (2015) Importance of knowledge management in the higher educational institutes. Turkish Online Journal of Distance Education, 16(1), pp 162-183.

Dumay, J., Guthrie, J., and Puntillo, P. (2015) IC and public sector: a structured literature review. Journal of Intellectual Capital, 16(2), pp 267–284. doi:10.1108/jic-02-2015-0014

Fullwood, R., and Rowley, J. (2017) An investigation of factors affecting knowledge sharing amongst UK academics. Journal of Knowledge Management.

Hawkins, B. (2000) Libraries, knowledge management, and higher education in an electronic environment. In: ALA conference capitalizing on knowledge: The information profession in the 21st century, Canberra, Australia, pp 1–8.

Iqbal, A., Latif, F., Marimon, F., Sahibzada, U. F., and Hussain, S. (2018) From knowledge management to organizational performance: Modelling the mediating role of innovation and intellectual capital in higher education. Journal of Enterprise Information Management.

Kanwal, S., Nunes, M. B., and Arif, M. (2019) Knowledge management practice in South Asian higher education institutions. IFLA journal, 45(4), pp 309-321.

Massaro, M., Dumay, J., and Garlatti, A. (2015) Public sector knowledge management: a structured literature review. Journal of knowledge management, 19(3), pp 530-558.

Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., et al. (2010) Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. The International Journal of Surgery, 8, pp 336–341. https://doi.org/10.1016/j.ijsu.2010.02.007

Nam Nguyen, H., and Mohamed, S. (2011) Leadership behaviors, organizational culture and knowledge management practices: An empirical investigation. Journal of management development, 30(2), pp 206-221.

Petrides, L. A., and Nodine, T. R. (2003) Knowledge management in education: defining the landscape.

Petticrew, M., and Roberts, H. (2008) Systematic reviews in the social sciences: A practical guide. John Wiley & Sons.

Raj Adhikari, D. (2010) Knowledge management in academic institutions. International Journal of Educational Management, 24(2),pp 94-104.

Ranjan, J., and Khalil, S. (2007) APPLICATION OF KNOWLEDGE MANAGEMENT IN MANAGEMENT EDUCATION: A CONCEPTUAL FRAMEWORK. Journal of theoretical & applied information technology, 3(3).

Rivera, G., and Rivera, I. (2016) Design, measurement and analysis of a Knowledge Management model in the context of a Mexican University. Innovar, 26(59), pp 21-34.

Veer-Ramjeawon, P., and & Rowley, J. (2020) Embedding knowledge management in higher education institutions (HEIs): a comparison between two countries. Studies in Higher Education, 45(11), pp 2324-2340.

Von Krogh, G., Nonaka, I., and Rechsteiner, L. (2012) Leadership in organizational knowledge creation: A review and framework. Journal of management studies, 49(1), pp 240-277.

Vu-Ngoc, H., Elawady, S. S., Mehyar, G. M., Abdelhamid, A. H., Mattar, O. M., Halhouli, O., ... and Huy, N. T. (2018) Quality of flow diagram in systematic review and/or meta-analysis. PloS one, 13(6), e0195955.

Enhancing Knowledge Legacy: Strategies for Employees with Long Scientific Seniority in Construction Academia

Katarzyna H. Tomiczak
Faculty of Management, Warsaw University of Technology, Warsaw, Poland

katarzyna.tomiczak.dokt@pw.edu.pl

Abstract: This paper presents the results of a pilot survey conducted as part of a doctoral research project on the management of tacit knowledge of employees with long scientific seniority (LSS), defined as 25+ years post-doctorate, focusing on knowledge transfer in the academic environment related to construction. This planned research aims to identify the best methods to support the dissemination of tacit knowledge of LSS employees among employees of other generations. The primary goal was to create a model that supports the transfer of LSS tacit knowledge to other employees. The research question is: How should the tacit knowledge of LSSs be managed to preserve and pass their legacy on to younger generations? A pilot online survey was conducted with three groups of respondents: LSSs, their leaders (L-LSS), and co-workers(C-LSS). The anonymous survey included 72 statements in five areas: 1. awareness of tacit knowledge, 2. personal motivation to share tacit knowledge; 3. the traditional approach versus the innovative approach; and 4. organisational support for knowledge sharing; 5. management of generational diversity. The first two areas contained different questions for each of the three groups, whereas areas 3–5 contained identical survey questions. Responses were recorded on a five-point Likert scale. The pilot study involved research institute employees who volunteered to participate. The study sample consisted of 22 participants. The group of respondents comprised four generations. The lowest mean (below 3.0) concerned statements in Areas 2 and 4. Similarly, a median (equal to 3) was obtained for these areas. The remaining areas had a mean of 3.1 or above, with a median of 4. The standard deviation ranged from 0.93 (Area 3) to 1.25 (Area 2), which indicates that Area 2 (personal motivation to share tacit knowledge) and Area 4 (organisational support in sharing knowledge) are important areas for further analysis. The next step (February 2024) will be to conduct an online survey of two technical universities and two research institutes in Poland, followed by in-depth interviews (spring/summer 2024). The same procedure will be used for all the four European institutions (2024). The value of this study lies in determining the best practices for generational tacit knowledge sharing.

Keywords: Tacit Knowledge Management; Long Scientific Seniority (LSS); Knowledge Transfer; Generational Diversity; Construction Academia; Tacit Knowledge Dissemination.

1. Introduction

1.1 Background

Knowledge management and tacit knowledge are well-known among researchers. From works of Polanyi (1958) and Drucker (1959), Nonaka et al. (1994), and Prusak et al. (1998) to more recent works like Dalkir (2017), to name a few. There are also articles discussing possible futures in this field, including collaboration with artificial intelligence, presented by Bencsik (2021). It is also a topic presented on ECKM by Zabeda et al. (2023) and Kucharska et al. (2022). With technological progress reshaping industries, effectively managing tacit knowledge has become essential for organisational competitiveness, especially in heavy research sectors. The challenge intensifies in academic construction environments where experienced researchers possess significant yet often unarticulated knowledge. Recognising and utilising this expertise is crucial for sustaining innovation and guiding the sector's evolution. This paper investigates approaches to managing the tacit knowledge of long-term scientific seniority personnel, aiming to encourage practical discussions and collaborative research efforts within this specific context.

The subject was derived from the author's professional trajectory, stemming from her involvement at the Building Research Institute (ITB) since 2016. Two opposing mechanisms of tacit knowledge management have recently been identified within the ITB. The first pertains to the challenges of transferring knowledge from senior researchers, as impending retirement could precipitate a significant loss of experiential knowledge. The second, in contrast, illustrates the successful acquisition of tacit knowledge through interactive observation, a process the author has experienced first-hand during her collaboration with ITB's scientific secretary, Professor Lech Czarnecki, an outstanding specialist in the field of building materials engineering who has accumulated unique experience and skills during his over forty-year scientific career.

1.2 Key Definitions

The definitions of the key terms used in this study are described in detail. The management method "is a proven, recognised, logically structured way of solving specific organisational problems" (Morawski and Prudzienica, 2011). Tacit knowledge "is inextricably linked with a person, not easy to transfer and codify, it is a unique compilation of know-how, professional qualifications based on knowledge obtained in the process of formal education, skills (...), experiences, substantive observations, developed methods of conduct (...)." (Morawski 2017). An employee with long scientific seniority (LSS) obtained a PhD degree at least 25 years ago (approximately 1999 and earlier). Construction is characterised by a rather conservative and formal approach, which results from the obligations involved in designing and erecting buildings. This attitude can hinder knowledge diffusion. In addition, tacit knowledge can be an essential resource for further development of construction science..

1.3 Literature Review

1.3.1 Knowledge Management, Generations and Academia

A preliminary literature review was conducted to establish this research context. Sanei et al. (2013) delineated the process of knowledge transfer between generations T, BB, X, and Y in construction and engineering organisations headquartered in the United States. Brčić and Mihelič (2015) reported the results of research conducted in Slovakia on employees from the BB, X, and Y generations. This study examined how selected individual factors, including willingness, motivation, communication, and cooperation, influence the sharing of knowledge with colleagues. Virta's (2011) doctoral thesis analysed the transfer of knowledge between retiring employees and their successors in a medium-sized Finnish company that designs and produces electrical devices and systems for the global market.

In Poland, an article published in 2018 (Chomątowska, Żarczyńska-Dobiesz, 2018) explored the characteristics of the BB generation and presented the results of a study on the barriers to knowledge sharing among BB generation representatives. Responses were provided by representatives of both the organisation and the BB generation. Sidor-Rządkowska (2018) discussed the challenges of managing generational diversity in contemporary organisations and the benefits of implementing mentoring programs.

Dziadek (2019) presented a different perspective, which examined the problems and challenges associated with intergenerational knowledge transfer in modern enterprises across four generations: BB, X, Y, and Z. This study focused primarily on determining whether knowledge transfer systems were implemented in selected organisations and the ways in which these systems function, as well as understanding the intergenerational knowledge transfer model in businesses. Research conducted by Morawski (2017) appears to be closest to the doctoral student's area of interest, as it relates to the ability of key employees of the company to share knowledge (diffusion) and how employees with long scientific experience can be defined.

In recent publications, a study conducted by Chinese researchers (Rui and Ju, 2022) examined the application of relationship management theory in the transfer of knowledge between generations among younger employees aged 40 or less from various industries in China. Another article (Wang et al., 2023) discussed the relationship between workplace ostracism and knowledge-sharing behaviour in academia in China.

From the literature, four main research interests related to LSS have emerged:

- the diffusion/transfer of tacit knowledge of LSS employees,
- the way of managing this tacit knowledge,
- the management of generational diversity,
- identifying and overcoming barriers to knowledge sharing.

Together, these areas shape the research context on the tacit knowledge of LSS employees (Fig. 1).

Figure 1: Four main areas of the research context, [own elaboration]

1.3.2 Tacit Knowledge in Construction

Publications related to the construction field primarily focus on enhancing the productivity of organisations in the construction industry. It is essential to acknowledge that tacit knowledge plays a crucial role in the construction industry, as highlighted by Pathirage et al. (2007). In a subsequent article by the same authors (Pathirage et al., 2008), tacit knowledge in construction was defined as "understanding, abilities, skills, and experience of the person concerned, often expressed in action as thoughts, viewpoints, evaluations, and advice; produced and acquired by past experiences [...]". Research conducted on construction contractors in Hong Kong confirmed the more significant strategic role of tacit knowledge, as described by Chen and Sherif (2009). Khuzaimah and Hassan (2012) addressed the role of CoPs in knowledge management related to construction projects. Among more recent publications, Zhou et al. (2022) emphasised the process of externalisation of tacit knowledge in construction projects.

2. The Phd Thesis Framework

2.1 Scientific Gap

The noticed scientific gap refers to the primary process of sharing tacit knowledge (and more broadly, other processes) by LSS employees, that is, employees with long scientific seniority (min). 25 years after their doctorate, thanks to their unique life, professional, and scientific experience, they probably have unique tacit knowledge, which translates into their high scientific and research potential. The determinant here is not the employee's age, but his or her scientific experience counted from the year of obtaining a doctoral degree. Construction is a field that requires strict compliance with standards and rules and careful introduction of innovations and is characterised by formality and conservativeness. This is because the constructed structures must ensure the safety and durability of use. In this context, the tacit knowledge of construction scientists–a combination of experience, skills, and engineering intuition–is an important resource that can influence further development of scientific knowledge in the field of construction. The aforementioned formalism and caution may pose additional challenges to the diffusion of such important tacit knowledge.

2.2 Research Problem Definition

The primary aim of this study was to verify and develop methods to support the management of tacit knowledge of LSSs in construction institutions. Unlike tacit knowledge, explicit knowledge can be easily shared through scientific publications, databases, manuals, training materials, policies, and procedures, or the Internet and social media. Tacit knowledge, in the form of intuition, experience, skills, or reasoning, is not easy to capture, but is essential for retaining knowledge (in the context of staff turnover), strengthening cooperation between employees, improving efficiency and productivity, and fostering innovation. The main research question of this study is: “How should the tacit knowledge of LSSs be managed to preserve and pass their legacy onto younger generations?”

2.3 Research Methodology:

2.3.1 Research Methods

The doctoral project will utilise the following methods.

- Review and critiquing the literature
- Analysing documents (if applicable)
- Diagnostic surveys: Online questionnaires and in-depth interviews
- Expert Panel Discussion
- Heuristic techniques, such as brainstorming (if applicable, based on research outcomes and changes in the situation).

The expert panel offers valuable insights that are not accessible using other methods. Combining all these methods aims to provide a thorough, multi-sided view of the research topic, which will help develop a more customised method to encourage the spread of tacit knowledge among LSS employees.

2.3.2 Sample Selection

This research will be conducted across eight scientific institutions, split evenly between Poland and Europe. In Poland, the investigation will involve two research institutes and two construction faculties of polytechnics/universities. The same arrangement will apply to Europe-based institutions as well.

A purposive non-random sampling strategy ensures the most representative research results. The sample will include three study groups.

- LSS employees,
- Leaders of LSS employees,
- Individuals working with LSS employees (both academic and administrative staff).

Preliminary studies will be carried out at one Polish research institute, while other studies will be conducted across all eight institutions. The choice to concentrate on European countries rather than on Asian or American ones stems from their common cultural and historical contexts, which could affect tacit knowledge transfer methods.

2.3.3 Research Plan

In the first year, preparations for the research were conducted, including a literature review. Research assumptions in the academic environment of management sciences and construction were presented (participation in national and international conferences). The second year focuses on research, conducting a pilot and main survey as well as in-depth interviews, analysing all collected data, and developing a method to promote the spread of LSS employees' tacit knowledge. The third year is set aside for implementation, testing, and validation of the method. In the fourth year, the last year, it is planned to prepare conclusions and recommendations for academic institutions in the field of construction that employ LSS workers.

2.4 Expected New Contribution of the PhD Study

2.4.1 Theoretical Contribution

It is assumed that as a result of doctoral research, the following contributions will be made to the existing theoretical knowledge:

- Development of tacit knowledge management methods for different generations,
- Defining a group of LSS people, i.e. with long scientific experience, whose tacit knowledge is important for the development of construction,
- Identifying key challenges and barriers in managing tacit knowledge in construction due to significant generational differences,
- Identifying potential benefits from consciously managing the tacit knowledge of LSS employees.

2.4.2 Practical Contribution

The expected practical contributions to the research include the following:

- Developing a set of best practices and strategies for managing tacit knowledge, encouraging cooperation and knowledge sharing among different generations of researchers,
- Developing recommendations for changes in organisational structures, processes, and internal policies to better manage tacit knowledge in construction.

Subsequently, the insights obtained from this study could be applied and investigated further in diverse geographical contexts, including Asian, African, and American countries. Similarly, the methods and tools developed in this study could extend beyond construction to other disciplines and industries. Future research could explore how tacit knowledge is managed in various fields, such as the sciences, humanities, and social sciences, and how companies across different sectors manage and promote the diffusion of tacit knowledge across generations.

3. Methods

3.1 Methodology

3.1.1 Basic Information

This pilot study was the first element of a doctoral research programme. It was an online survey (three different forms) whose purpose was, among other things, to verify research tools and data collection methods. The main goals were to check how research workers in the field of construction would cope with a survey related to the tacit knowledge of employees with long scientific seniority (whether the questions are understandable and the scale of answers is appropriate, plus feedback and comments on the study), testing the research tool (MS Forms) in terms of providing answers, as well as their analysis and preliminary identification of survey areas requiring changes. MS Forms was used to conduct the survey was MS Forms and Microsoft Excel was used for the analysis. The choice of these tools is dictated by their availability and ease of use.

3.1.2 Sample

The pilot study was conducted at a Polish research institute specialising in construction; 22 individuals from all three groups took part. Participants were selected based on voluntary registration, meaning that those who met the conditions and expressed their willingness to participate after being informed about the purpose and scope of the study were invited.

3.1.3 Questionnaire

The study included 72 statements in five areas, with a space for comments after each area, and at the end, the so-called metrics for each group. These areas are:

I. Statements regarding awareness of tacit knowledge (15 statements);
II. Statements regarding personal motivation to share (or not) tacit knowledge (28 statements);
III. Statements regarding traditional vs. approach innovative (12 statements);
IV. Statements regarding organizational support for knowledge sharing (11 statements);
V. Statements on managing generational diversity (six statements).

A separate MS form was prepared for each treatment group. The respondents were asked to rate the statements on a Likert scale (1-5), where 1 means "I strongly disagree" and 5 means "I strongly agree ".

3.1.4 Data Analysis

Statistical analysis was conducted using MS Excel, which is the most easily available software. Mean values, medians, and standard deviations were calculated for each statement area across the entire sample group. Subsequently, the mean values for each area were computed for the three specific participant groups and compared to the overall results. This approach helped identify areas that required more attention in the main study. Additionally, technical changes were introduced into the structure of the main survey, and it was decided to change the tool for the main survey.

3.1.5 Influence on the Main Survey

As a result of the pilot survey, the following changes were made to the survey questionnaire:

- Context and more detailed descriptions of the statements were added to make it easier for respondents to answer.
- The number of statements increased to 94, especially in Areas II (+9), IV (+5), and I (+4).
- In the description of the rating scale, the value "3", previously described as "I have no opinion", was defined as "I have no opinion/both yes and no/I don't know", which gave greater freedom to express uncertainty.
- The part regarding the so-called “metrics” has been rearranged and unified to make it identical for all three survey forms.

In the main survey, to allow more time for responses and to allow them to be carefully considered, the questionnaires were sent as PDF files via e-mail before sending the survey link.

The response collection tool was changed to allow participants to save the survey while completing it, and to facilitate data analysis. The change was also dictated by an increase in the total number of questions in the questionnaire to over 100 (including the “metrics”), which exceeded the limit available for free in the MS Forms.

3.1.6 Limitations

Because the survey was conducted in one research institution, attention should be paid to the limitations of this study.

- limited representativeness of the research sample,
- the influence of the institutional context,
- limited objectivity of respondents.

The actual research group includes eight institutions, four from Poland and four from Europe, which will translate into a greater diversity of respondents and more reliable results.

3.2 Study Description

The preparations were performed prior to the pilot survey. On 23 November 2023, a meeting with the institute's employees was held, during which the concept of the doctoral dissertation was presented, key definitions and expected results were explained, and further steps regarding the research were taken. The assumptions of the survey, its objectives, and a discussion of the questionnaires, divided into areas, were presented and discussed. After the meeting, questions were sent to the participants who provided feedback. On this basis, some changes were made to the questionnaire.

The pilot study allowed for testing the survey questionnaire under practical conditions, with the participation of individuals representing the studied population. This enabled the collection of valuable feedback on the clarity and comprehensibility of the questions, as well as the overall structure of the research tool, contributing to the optimisation of the methodology before proceeding to the main stage of the study.

Links to the surveys were sent by e-mail and posted on the intranet, along with a cover letter and a short introduction to the topic. The survey form was active from 8 December 2023 to 3 January 2024. There were no restrictions on the time required to complete the survey, and anonymity was ensured using the appropriate MS Forms function. A total of 22 complete surveys were conducted. The groups were broken down as follows.

- Three LSS individuals
- Four individuals serving as LSS leaders, L-LSS
- 15 individuals cooperating with LSS, C-LSS

The main research will cover eight research institutions and will include:

- at least eight LSS individuals
- at least eight individuals serving as LSS leaders
- at least 16 individuals cooperating with LSS.

This means that the pilot sample constituted of (assuming minimums):

- LSS individuals: 37.5%
- LSS leaders: 50%
- Individuals cooperating: 94%

for the group planned for the main research.

4. Results

4.1 Research Sample Characteristics

The following is a summary of the data characterising the research sample. Given that respondents volunteered to participate, the distribution was

Table 1: Division by gender

Gender	Number	Share
Women	11	50%
Men	11	50%

Table 2: Division by generation, according to Sidor-Rządkowska, 2018

Generation	Number	Share
Generation T	2	9%
Generation BB	2	9%
Generation X	11	50%
Generation Y	7	32%

Table 3: Division according to the type of work performed

Type of work	Number	Share
Academic Staff	11	50%
Administrative Staff	11	50%

Table 4: Degree/title of academic staff

Degree/Title of Academic Staff	Number	Share
Professor	2	18%
Doctor with habilitation	2	18%
PhD	7	64%

Table 5: Education level of administrative staff

Level of Education	Number	Share
PhD	2	18%
Eng/Bachelors	2	18%
Masters	7	64%

Using a 5-point Likert scale in the study enabled the determination of the respondent's level of agreement with the presented statements. A low level occurs when the average value (the arithmetic mean calculated from all responses) is equal to or less than 2.99, moderate when the average falls in the range of 3–3.99, and high when the average is equal to 4 or greater than 4 (Sekaran & Bougie, 2016, as cited in Piwowar-Sulej, 2022).

Upon examining the average values for the five statement areas presented in Table 6, it is noted that only two statements registered averages below 2.99, signifying a low level of concordance among respondents. The remaining three statement areas exhibited average values that fell within the range of 3 to 3.99, reflecting a moderate degree of agreement. Table 7 shows the average response scores for each group relative to the overall mean. This delineation distinctly reveals a high level of agreement in the first area between LSS individuals and their coworkers. Conversely, the second and fourth areas showed low agreement between the LSS and C-LSS groups. The third area maintains a moderate level of statement agreement, whereas the fifth area shows high concordance among leaders and moderate agreement within the cohorts of the LSS and their co-workers.

Table 6: Statistical data for five survey areas, results for the entire research sample

Area	Average	Median	Standard Deviation
I. Statements regarding the awareness of tacit knowledge	3.9	4	1.04
II. Statements regarding personal motivation to share (or not) tacit knowledge	2.96	3	1.25
III. Statements regarding traditional vs. innovative approach	3.67	4	0.93
IV. Statements regarding organizational support for knowledge sharing	2.94	3	1.12
V. Statements regarding the management of generational diversity	3.6	4	1.08

Table 7: Statistical data – average – for five survey areas, results for each group

Area	Average LSS	Average L-LSS	Average C-LSS	Average
I. Statements regarding the awareness of tacit knowledge	4.16	3.35	4.0	3.9
II. Statements regarding personal motivation to share (or not) tacit knowledge	2.87	3.14	2.93	2.96
III. Statements regarding traditional vs. innovative approach	3.78	3.31	3.74	3.67
IV. Statements regarding organizational support for knowledge sharing	2.91	3.05	2.92	2.94
V. Statements regarding the management of generational diversity	3.50	4.04	3.50	3.6

To further explore the statements showing the most significant discrepancy, the following is an analysis of all five areas, detailing the responses from each group. In the first area, respondents agreed that the experience of LSS is valuable and unique. There is some disagreement between the L-LSS and other groups regarding the support offered by the LSS. However, the most significant discrepancy occurs in the statement regarding statement 9: "The knowledge of an LSS person is too specific to be transferred in a simple way, so the ability to observe and imitate his actions is important." People with LSS disagree with this opinion, while the other two groups agree.

Within the second statement area, consensus was evident across all groups for the nine statements. Notable divergence was observed between the L-LSS and the other two groups on the nine statements. A similar pattern of low agreement was noted between C-LSS and the other groups for two statements and across all groups for five statements.

In the third area, relating to the application of innovations and traditions in construction, respondents also agreed highly with seven statements. Some discrepancies appeared in tradition-related statements (three). However, the most significant disagreement concerns two statements. Both LSS and C-LSS agree that new trends in science are often overrated (L-LSS disagrees on this matter). Regarding the statement about "sticking to traditional approaches in construction because they have been tested by time", this area has the most significant disagreement. LSS individuals agree on this matter, L-LSSs disagree, and C-LSSs do not have clear opinions.

In the fourth area, all groups consistently agreed on three statements. Lower levels of agreement were found between the L-LSS and the others on two statements and between the C-LSS and the others on two statements. Finally, four statements demonstrated low agreement among all the groups.

In the fifth area (Fig. 5), there is general agreement on the three statements. In the case of the two statements, LSS and L-LSS agree, and C-LSSs do not have a common opinion. As for one statement, only the L-LSSs agree; the remaining groups do not have a clear opinion.

5. Discussion

5.1 Summary of Main Findings

This pilot survey yielded several important conclusions regarding the management of tacit knowledge among employees with long scientific seniority (LSS) at a construction institution. This study identified key areas in which tacit knowledge sharing is both robust and insufficient. In particular, the areas of personal motivation to share tacit knowledge and organisational support for knowledge sharing showed the lowest means and medians, indicating the need for further study. The results of the pilot survey suggest significant divergence in perceptions and motivations among LSS employees, their leaders, and co-workers. Notably, LSS employees appear to

undervalue the specificity and importance of their tacit knowledge, which may hinder effective knowledge transfer. This will be further examined in the main study.

5.2 Addressing Goals of the Pilot Study

The pilot study aimed to verify the research tools and data collection methods with specific goals:

- Assess understandability and appropriateness of questions: The pilot study successfully identified areas where the questions were unclear, or the scale of answers was inappropriate. This feedback led to adjustments in the survey design, improved clarity and ensured that the questions accurately captured the intended information.
- Test the research tool (MS Forms): The use of MS Forms was evaluated for its effectiveness in collecting and analysing data. While the tool was generally user-friendly, the pilot study revealed the need for a more sophisticated platform for the main survey, prompting a switch to a tool that allows saving progress and facilitates easier data analysis.
- Identify survey areas requiring changes: Preliminary analysis of the pilot data highlights specific areas requiring modification. For instance, an additional context was added to statements, the number of questions was increased to cover gaps identified during the pilot, and the rating scale was refined to better capture respondents' opinions.

By addressing these goals, the pilot study provided valuable insights that informed the refinement of the research methodology, ensuring that the main survey was more robust and capable of capturing comprehensive data on the management of tacit knowledge among LSS employees.

6. Conclusions

Here, represents the sum of the main conclusions.

- LSS employees do not realise that their knowledge and experience are unique and sufficiently specific to require appropriate diffusion methods.
- There is a need for greater support for organisations to share knowledge in material and organizational areas (including organizational culture).
- The role of a mentor should be formally embedded in the organisation, especially in the case of LSS people with high authority.
- Supporting interdepartmental and team initiatives with a diverse generational profile may result in greater efficiency in such teams' work and strengthen relationships and understanding between different groups of employees.

The pilot survey results shed light on LSS people's motivations for sharing tacit knowledge. In several cases, there were apparent differences between the perceptions of LSS individuals and the reception of these people by their leaders and colleagues. There are differences in the perception of the role and value of tacit knowledge among LSS, L-LSS, and C-LSS, especially in terms of effectiveness, motivation, and organizational support. All groups agreed on the need to balance tradition and innovation and the importance of mentoring and collaboration for scientific development. The development of organizational tools and strategies to support the diffusion of tacit knowledge is necessary. This indicates the need to better understand and implement modern communication tools and knowledge management methods to respond to different generational needs. Increasing awareness and appreciation of tacit knowledge at all organizational levels is necessary to maximise its potential for innovation and institutional development.

These results will be verified by an actual survey in which representatives of 16 scientific units from Poland and Europe will participate.

Acknowledgments

The work was financed by the Building Research Institute's (ITB) own research fund, SN-001.

References

Bencsik, A. (2021) “The sixth generation of knowledge management – the headway of artificial intelligence”, *Journal of International Studies*, 14(2), pp. 84-101. doi:10.14254/2071-8330.2021/14-2/6.

Chen, L. and Mohamed, S. (2010), "The strategic importance of tacit knowledge management activities in construction", Construction Innovation, Vol. 10 No. 2, pp. 138-163. doi.org/10.1108/14714171011037165

Chomątowska, B., & Żarczyńska-Dobiesz, A. (2018). Bariery dzielenia się wiedzą przez przedstawicieli pokolenia „Baby Boomers”. Przedsiębiorstwo we współczesnej gospodarce-teoria i praktyka. doi.org/10.19253/reme.2018.01.003

Davenport, T.H. and Prusak, L. (1998) Working Knowledge: How Organizations Manage What They Know. Harvard Business School Press, Boston.

Dalkir, K. (2017) *Knowledge Management in Theory and Practice*, Third Edition. The MIT Press.

Drucker, P.F. (1969) *The Age of Discontinuity*. Butterworth-Heinemann. Available at: doi.org/10.1016/B978-0-434-90395-5.50003-1.

Dziadek, K. (2019). Problemy i wyzwania międzypokoleniowego transferu wiedzy we współczesnych przedsiębiorstwach. Wyniki badań. ZN WSH Zarządzanie (2), 73-91. doi.org/10.5604/01.3001.0013.5210.

Juriševič Brčić, Ž., & Mihelič, K. K. (2015). Knowledge sharing between different generations of employees: an example from Slovenia. Economic Research-Ekonomska Istraživanja, 28(1), 853-867. doi.org/10.1080/1331677X.2015.1092308.

Kucharska, W. and Erickson, G.S. (2022) “Social Capital, Human Capital, Tacit Knowledge, and Innovations: A Polish-US Cross-Country Study”, in: *Proceedings of the 23rd European Conference on Knowledge Management, ECKM 2022*, pp. 687-695, Naples, 1-2 September 2022.

Khuzaimah, K. H. M., & Hassan, F. (2012). Uncovering Tacit Knowledge in Construction Industry: Communities of Practice Approach. Procedia - Social and Behavioral Sciences, 50, 343-349. doi.org/10.1016/j.sbspro.2012.08.039.

Morawski, M. and Prudzienica, M. (2011) *Zarządzanie wiedzą w kreowaniu innowacji zarządczych*. Wydawnictwo Uniwersytetu Ekonomicznego we Wrocławiu, Wrocław. [in Polish]

Morawski, M. (2017) *Pracownik kluczowy w procesie dzielenia się wiedzą. Motywy, warunki, metody*. Wydawnictwo Uniwersytetu Ekonomicznego we Wrocławiu, Wrocław. [in Polish]

Nonaka, I. and Takeuchi, H. (1995) *The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation*. Oxford University Press.

Polanyi, M. (1962) *Personal Knowledge: Towards a Post-Critical Philosophy* (2nd ed.). Routledge & Kegan Paul Ltd.

Pathirage, C.P., Amaratunga, D.G. and Haigh, R.P. (2007), "Tacit knowledge and organisational performance: construction industry perspective", Journal of Knowledge Management, Vol. 11 No. 1, pp. 115-126. doi.org/10.1108/13673270710728277

Pathirage, C., Amaratunga, R., & Haigh, R. The role of tacit knowledge in the construction industry: towards a definition. Presented at CIB W89 International Conference on Building Education and research (BEAR), Sri Lanka, 2008 https://salford-repository.worktribe.com/output/1460937/the-role-of-tacit-knowledge-in-the-construction-industry-towards-a-definition (access on 08.11.2023)

Rui, H., & Ju, H. (2022). How Does Rapport Impact Knowledge Transfer from Older to Younger Employees? The Moderating Role of Supportive Climate. Frontiers in Psychology, 13. doi.org/10.3389/fpsyg.2022.1032143

Sanaei, M., Javernick-Will, A. N., & Chinowsky, P. (2013). The influence of generation on knowledge sharing connections and methods in construction and engineering organizations headquartered in the US. Construction Management and Economics, 31(9), 991-1004. doi.org/10.1080/01446193.2013.835490

Sekaran, U. and Bougie, R. (2016) Research Methods for Business: A Skill Building Approach. West Sussex: John Wiley & Sons. (Cited in Piwowar-Sulej, K. (2022) Zrównoważony rozwój personelu poprzez szkolenia. University of Economics in Wrocław Publishing, Wrocław. [in Polish])

Sidor-Rządkowska, M. (2018) “Zarządzanie różnorodnością pokoleniową we współczesnych organizacjach”, *Studia i Prace WNEiZ*, 51, pp. 87–96. [in Polish]

Virta, M. (2011). Knowledge sharing between generations in an organisation - retention of the old or building the new? (Doctoral dissertation, Lappeenranta University of Technology, Lappeenranta, Finland). https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.912.3975&rep=rep1&type=pdf

Wang, G-H., Li, J-H., Liu, H., & Zaggia, C. (2023). The association between workplace ostracism and knowledge-sharing behaviors among Chinese university teachers: The chain mediating model of job burnout and job satisfaction. Frontiers in Psychology, 14, 1030043. doi.org/10.3389/fpsyg.2023.1030043

Zabeda, A.H., Chandiram, S.G., and Fountaine, R.A.H. (2023) “Knowledge Creation Among Managers and Supervisors in Palm Oil Estates in Malaysia”, in: *Proceedings of the 24th European Conference on Knowledge Management*, Vol. 24, No. 1, pp. 1-9, Lisbon, 7th & 8th Sept.

Zhou, Q., Deng, X., Hwang, B.G., et al. (2022). Developing the Framework of Tacit Knowledge Externalization in International Construction Projects. KSCE Journal of Civil Engineering, 26, 3691–3706. doi.org/10.1007/s12205-022-2164-0

Integration of Conversational AI Capabilities in Knowledge Management Processes for Higher Education

Joanne Chi-hang Tsoi and Fred Strønen
Oslo Business School, Oslo Metropolitan University, Oslo, Norway

joanne.ch.tsoi@oslomet.no
fredst@oslomet.no

Abstract: This paper explores the application of knowledge management (KM) in higher education institutions (HEIs), focusing on the potential of artificial intelligence (AI) technologies, especially Conversational AI to transform knowledge processes. By examining conversational AI systems, this paper investigates how such technology can enhance knowledge creation, sharing, and application within educational contexts. The illustrative example of Georgia State University's "Pounce" chatbot show practical benefits of AI in administrative and educational support. The paper suggests that integrating AI into KM practices can address the evolving needs of HEIs, supporting their mission to provide high-quality education to society. The paper underscores the importance of adopting advanced technologies to augment institution's competitive advantage. Through a real-life example of Con-AI application in KM, this paper contributes to the understanding of how HEIs can leverage technology to enhance their core functions and sustain their competitive edge.

Keywords: Artificial Intelligence, Knowledge Management, Alavi's Typology, Conversational Agent, Chatbots

1. Introduction

Higher education institutions (HEIs) offer different knowledge to individuals through mental, physical, and ideological training so that they can contribute to society (Deem, Mok and Lucas, 2008). Phusavat et al. (2011) also believes these types of well-educated individuals can increase the overall performance of organizations, regions or even countries. There seems to be a linkage between "knowledge" and "competitive advantage" in organizations and a significant body of research also shows that knowledge management (KM) factors contribute (Cepeda-Carrión and Vera, 2007; Haas and Hansen, 2004; Hart and Rodgers, 2023). HEIs play a vital role in society (Blass and Hayward, 2014) by providing opportunities for advanced learning, carrying out research, and advancing the development of knowledge and skills. They have the mission of providing high-quality instruction, encouraging creativity, and preparing students for professions in a variety of fields (Blass and Hayward, 2014). To survive and be competitive is also crucial for any HEI. In terms of competitiveness there is a need to fight for better reputation and international and local rankings for the institutions (Edwards, 2007). Like other businesses, HEIs also face a multitude of changes and challenges, such as the disruption of innovation and new technology (Blass and Hayward, 2014) in terms of artificial intelligence (AI)

There has been a noticeable increase in scholarly papers about AI since 2019, with a growth rate that is higher than 50% when compared to 2018 as noted by Lee et al. (2023). This trend indicates a visible increase in scholarly attention to AI, resulting in a significant rise in similar publications by the year 2023. Despite the substantial volume of research on AI-related topics, Duan, Edwards, and Dwivedi (2019) identified a significant gap in existing literature. They noted a lack of a comprehensive theoretical framework aimed at systematically understanding the utilization of AI-based tools and their impact on organizations, especially for HEIs.

There are only a few Conversational artificial intelligence (Con-AI) review studies in the context of HEIs. Dempere et al. (2023) did a literature review to explore the usages and effects of ChatGPT within HEIs and concluded that there are notable benefits in research support, automated grading, and enhanced human-computer interaction. They also highlight the potential advantages of the usage of ChatGPT, such as streamlined enrollment, improved student services, teaching enhancements, research aid, and increased student retention. However, this study focused more on the predictive and generative nature instead of the benefits of being conversational and interactive of ChatGPT. Pereira et al. (2023) did a scoping review of chatbots in HEIs to investigate the purpose of chatbots usage, the feasibility of chatbots and to figure out the quality of different chatbots within HEIs. In the context of HEIs, there seems to be very limited research on Con-AI, competitive advantage and KM. Thus, this paper will try to build up the relationship between the three mentioned components based on the study of Alavi and Leidner (2001) about how technology and system can enhance KM processes (including knowledge creation, knowledge sharing, and knowledge application).

2. Literature Review

2.1 The Knowledge-Based View and Knowledge Management Processes

The "knowledge-based view" (KBV) emphasizes the value of knowledge as a strategic asset for organizations. It proposes that knowledge, in its various forms, such as explicit and tacit knowledge, plays an important role in creating competitive advantage and driving organizational performance (Grant, 1996). Some other studies of KBV also considers a firm as a system that creates, integrates, and disseminates knowledge through the activities of its workforce, generating value for the firm (Kianto, Sáenz and Aramburu, 2017; Felin and Hesterly, 2007). In essence, the KBV emphasizes the importance of effectively managing and utilizing knowledge to achieve long-term success in today's dynamic environment. In the past, there were different studies about how KM should be considered as processes (Davenport, Järvenpää and Beers, 1996; Teece, 1998; Alavi and Leidner, 2001). While all these studies had the perspective of confirming KM as processes, Alavi and Leidner (2001) concluded that there are four major KM processes which can be enhanced by technology and systems. The study defines KM as a systematic and organizationally specified process for acquiring, organizing, and communicating both tacit and explicit knowledge. It also suggested that technology can be used to manage organizational knowledge by supporting the creation, sharing, and application of knowledge in organizations.

2.1.1 Knowledge Creation

Knowledge creation is often the reconfiguration and recombination of pre-existing background knowledge, but also includes building up concepts and creating solutions from scratch. As a result, organizations can adjust to changing circumstances and environments (Bhatt, 2001). Furthermore, knowledge acquisition from outside sources is also a way in creating one's own knowledge (Alavi and Leidner, 2001). Consequently, obtaining knowledge through information sourcing or search may be a form of knowledge creation (Alavi and Leidner, 2001; Jarrahi et al., 2023). Besides, Nonaka (1994) identifies four modes of knowledge creation: socialization, externalization, internalization, and combination. Socialization is the process of converting tacit knowledge into new tacit knowledge via social interactions and shared experiences among organizational members, such as engaging in discussion and team projects. Combination is the process of creating new explicit knowledge by merging, categorizing, reclassifying, and synthesizing current explicit knowledge, such as through literature surveys. Externalization is the transformation of tacit knowledge into new explicit knowledge, such as articulating best practices or lessons learned. Internalization is the process of developing new tacit knowledge from explicit knowledge, such as through reading or discussion. Knowledge creation within academic settings is crucial for preserving valuable insights, documenting local knowledge, and fostering academic excellence.

2.1.2 Knowledge Sharing

Knowledge sharing is the intentional exchange, dissemination, and transfer of knowledge among individuals, groups, or organizations to promote learning, innovation, and problem solving. It is the process of identifying valuable knowledge assets, capturing them in usable formats, and disseminating them to others via various communication channels. Knowledge sharing promotes collaboration, improves organizational performance, and helps with collective learning and decision-making (Bock et al., 2005; Alavi and Leidner, 2001; Van Den Hooff et al., 2003). Within HEIs, knowledge sharing is essential for promoting teamwork, creativity, and academic success.

2.1.3 Knowledge Application

After sharing of knowledge, the next step will be to put knowledge into practice, and this is termed as “knowledge application”. It can involve the repackaging of best practices or other available knowledge resources into useful and suitable solutions within an organization (Bhatt, 2001). To apply knowledge, it also requires careful and skillful selection, analysis, and assimilation of the relevant external knowledge in order to satisfy the needs of the organization at a suitable timing (Jarrahi et al., 2023). In the context of HEIs, knowledge application can refer to academic teaching, research and expertise in practical ways that benefit society.

2.2 Competitive Advantages and Knowledge Management Processes of HEIs

As per Hart and Rodgers (2023), the concepts of “competitiveness” and “competitive advantages” are distinct. In their study, it stated that “competitiveness” of a HEIs is “the ability to engage in educational exports, withstand competition, attract resources, provide employment, and foster a knowledge-based culture” and “the

institution's capacity to combine resources and competencies in unique ways" (Hart and Rodgers, 2023). It focused more on the external environment. While for "competitive advantages" of a HEI, it is the major abilities of an institution to have better performance over industry's competitors by using its valuable, scarce, inimitable and irreplaceable resources (Lo and Tian, 2019).

Previous research found that KM processes and systems, that support the working of employees can enable the operation of institution to function efficiently and effectively, thus increasing the competitive advantage of HEIs Alavi and Leidner (2001). Istikhoroh and Ardhiani (2022) did a correlational study to examine the relationship between KM processes and competitive advantage in the context of HEIs by using a quantitative approach, and they found the competitive advantage of an institution can be better through KM processes. Mohammed, Abdul and Gururajan (2018) investigates knowledge management processes in Australian higher education, highlighting its role in competitive advantage, university rankings, and profits. Using brainstorming with six ICT managers at a Queensland Regional University, the study figured out that the KM processes of knowledge creation, knowledge sharing, and knowledge transfer are some of the key themes.

2.3 AI and Technologies

According to Alavi and Leidner (2001), KM processes can be augmented by technology which enhance communication, facilitate collaboration, improve access to information, and enable routine tasks automation. Thus, technology is a critical enabler for successful KM in an organization, leading to improved decision-making and competitive advantage. In the past decades, AI has been one of the groundbreaking technologies. AI is still evolving speedily and thus its definition is also changing with new extensions. For instance, Russell and Norvig (1995) believe AI can be defined as machines or systems that mimic human's cognitive function to learn, to solve problems and to interpreting and generating languages. In addition, the Institute of Electrical and Electronics Engineers (IEEE) Corporate Advisory Group refers to AI as "the combination of cognitive automation, machine learning (ML), reasoning, hypothesis generation and analysis, natural language processing (NLP) and intentional algorithm mutation producing insights and analytics at or above human capability". In the past decade, due to the advancement in technologies (such as deep learning and NLP), augmentation of computer power, as well as the explosion of available data for algorithms training, AI has accelerated its momentum with new application possibilities (Bornet, Barkin and Wirtz, 2021). For instance, some online interactive platforms or tools might extend the definition of AI which can interpret and give replies to users' queries or prompts and create an interactive communication experience that mimics humans in the form of text, voice, or both in a way (Dwivedi et al., 2023).

2.4 The Relationship Between AI and KM Processes

In the past two decades, with the advancement of technology and the launches of different systems, the interaction between technology and KM processes is essential (Alavi and Leidner, 2001). By heavily facilitating the generation, sharing/transfer, and using of knowledge inside organizations, technology is bettering competitive advantage of an organization through these KM processes (Singh and Singh, 2019). Almeshref and Khwanda's (2022) study emphasizes the role of information systems in enabling KM processes, indicating that technology can have a significant impact on knowledge sharing, acquisition, and application. In terms of KM in HEIs, universities use a multifaceted approach that includes structured processes as well as digital tools (Al-Kurdi, El-Haddadeh and Eldabi, 2018). It includes creating and maintaining document databases, using platforms for collaborations, and integrating learning management systems to efficiently organize and disseminate knowledge resources. Furthermore, since promoting a culture of knowledge sharing among faculty and students, facilitating work collaboration, and encouraging the creation and dissemination of scholarly work are often regarded as important for HEIs (Brewer and Brewer, 2010), thus any technologies or systems which can help with these aspects will be very useful. Those KM-relevant technologies, which can encourage experience sharing to help transform tacit knowledge into explicit knowledge, contribute to achieving KM success (Nonaka and Von Krogh, 2009).

This synergy between AI and KM can lead to more efficient knowledge sharing, learning, and innovation within the organization (Sundaresan and Zhang, 2021; Jarrahi et al., 2022). Therefore, AI serves as a catalyst that contributes to the development of competitive advantage through the enhancement of KM processes within organizations. Hence, the interplay between AI and KM processes is symbiotic, with each element reinforcing and complementing the others to propel competitive advantage of an organization in the face of rapid technological advancements and market changes.

2.5 Conversational AI in HEIs

Amongst different kinds of AI, Con-AI has aroused the interest of academic research in recent years, due to the advancement in NLP since 2010, with the launch of Siri by Apple which is the first and most widely accepted virtual assistant (Campbell, 2020). Con-AI is a type of communicative AI, and it can perform designated tasks as a communicator which mimics humans (Guzman and Lewis, 2020). Through computational algorithms of NLP, Con-AI learns to automatize communicative functions and thus can "talk" to humans in natural language (Ng, 2022). Some well-known examples are Google Assistant, Apple Siri and Amazon Alexa which can respond to human requests by text or by voice. People can communicate with these unsupervised human-like "virtual assistants" and this is trending because of the navigation of Con-AI in daily life (Guzman, 2019). Some of the Con-AI will even make use of "large language models'' (LLM), such as ChatGPT, and it can help its users in a broad range of tasks thus offering convenience and personalization to the users (Gieselmann and Sassenberg, 2022). While other Con-AI systems can also discuss different topics and reply to a large number of questions from users (Smutny and Schrei-berova, 2020). Moreover, study from Sahab, Haqbeen and Ito (2024) also found that Con-AI, usually incorporates with ML and deep learning, can take the role as a facilitator during online communication and discussions. The study concluded that with the help of Con-AI, participants' engagement and collaborative problem-solving can be enhanced.

Con-AI tools are becoming more common in HEIs, benefiting teaching and administration. With these online chatbots, students can have 24/7 access to information and knowledge and can get immediate feedback from a human-like mean. By storing all the previous conversations of students, chatbots can give personalized assistance. KM processes can then be facilitated by using these Con-AI tools while students are interacting with them (Al-Sharafi et al. (2022). In the literature review of Chen, Chen and Lin (2020), they stated that the web-based and online intelligent education systems working together with humanoid robots and online chatbots can improve the efficiency of the educator's works, e.g. reviewing and assessing assignments from students. This can free up their time for improving teaching quality. In addition, curriculum can also be personalized according to students' progress due to ML capabilities of the AI-supported interactive educational system, which would in turn improving drop-out rate by improving overall learning experience of the students (Chen, Chen and Lin, 2020). Hannan and Liu (2021) also gave examples of how AI applications help HEIs to improve their competitive advantage. For instance, the paper figured out that online chatbots, such as IBM's Jill Watson, can be used as teaching assistants to avoid disconnection between students and their study. Besides, Microsoft's Azure can support students in their native languages when they interact with this on-campus chatbot which consists of ML algorithms to assist in speech transcription and text translation. The AI-chatbot "Pounce" for the Georgia State University also help to increase the enrollment rates of students into courses (Hannan and Liu, 2021).

As mentioned previously, technology like Con-AI which can help with KM processes will be valuable to the HEIs and their competitive advantage., Most of the literature about Con-AI are from the commercial sector with limited of them within the context of HEIs (Al-Sharafi et al., 2022). For research relevant to KM processes and Con-AI, Al-Sharafi et al. (2022) makes use of a hybrid SEM-artificial neural network (SEM-ANN) approach and develops a theoretical model based on extracting constructs from the expectation confirmation model, combined with the KM processes (knowledge sharing, knowledge acquisition, and knowledge application) to understand the sustainable use of chatbots (as a kind of Con-AI) for educational purposes. This study has found that if a Con-AI system can facilitate the processes of knowledge creation, knowledge sharing and knowledge application, it will benefit students to learn and acquire new knowledge. In addition, Sumbal and Amber (2024) did qualitative research by interviewing researchers and faculty members who have teaching and researching responsibilities from a university in Hong Kong, and they figured out that Chatbot powered by LLM and with a large knowledge base can facilitate Nonaka's 4 modes of knowledge creation.

3. Illustrative Example: "Pounce" AI Chatbot at Georgia State University

Background: At the beginning, "Pounce" AI chatbot acted as an institutional tool to help new students to get familiar with knowledge and information about registration, finances etc., to get around the new campus life. Later, the chatbot started to integrate into course content in 2021. Since then, besides daily interactions with students, Pounce will also push direct reminder about assignments and exams to students, giving them a chance to text them questions through "PolsPounce" to their instructors. These reminders are personalized according to the study progress of students and Pounce will also give students short quizzes before exam. Students can also have interactive practices with Pounce and can get immediate feedback. Pounce will also direct students to

internal discussion forums or study groups where they can collaborate and share their understanding about course content (Mdavis, 2022).

Knowledge Creation: When students ask Pounce questions, it is just like sharing their difficulties and challenges with the chatbot. This can create a vast amount of data and the Con-AI system can later analyze them and sort out common issues amongst students. For instance, tactic knowledge, such as areas which students may need more support or gaps in curriculum, can be transformed to read-to-use explicit knowledge after analysis of student's conversations with the chatbot. In addition, the ability for Pounce to collect real time feedback from students after each class can better curriculum development, thus more targeted and effective learning materials can be formed earlier. These will further encourage ongoing learning and participation in inventions within HEIs, and ultimately contribute to sustained organizational competitive advantage (Yang, 2007).

Knowledge Sharing: Pounce can provide quick and real-time answers to students' questions, e.g. information about course content, assignments deadlines and university services. This makes it possible for the sharing of knowledge efficiently 24/7 from Pounce's knowledge base to students. Pounce can facilitate peer-to-peer knowledge sharing by diverting students to different online forums or study groups for collaboration and sharing their understanding about course content. This will can foster a learners' community that actively share knowledge thus enhancing the overall learning environment

Knowledge Application: Based on individual profiles and past conversations with students, Pounce can provide personalized questions, prompts, advice and reminders to help students in applying knowledge they have gained in a practical way. Besides, with a knowledge base being built up from different systems and resources, Pounce can also suggest study materials and tutoring services in a timely and accurate manner. Students can then have better informed decisions about their academic activities which also benefits the effectiveness of application of knowledge and skills.

Results of using Pounce: Pounce AI chatbot at Georgia State University is a powerful tool that enhances KM processes by providing efficient, personalized, and continuous support to students. Its ability to facilitate knowledge creation, sharing, and application. By engaging students proactively, there was an obvious jump in students' performance in the institution. Besides, for the benefit of the educators, Pounce also freed up their time and resources in assisting their students as the Con-AI learned about from students' questions and experiences and augmented their knowledge base for frequently asked questions. Pounce also facilitated communication between students and educators by directing students who needed help from a human on a timely basis. This could help to detect in-risk students and prevent drop-out from course (Mdavis, 2022).

4. Concluding Discussion

This paper aimed at figuring out how Con-AI tools can improve the major KM processes as proposed by Alavi and Leidner (2001) in HEIs and thus augmenting the competitive advantage. The KM processes of knowledge creation, knowledge sharing, and knowledge application as facilitated by AI-supported chatbots can increase efficiency for teaching and administrative tasks within HEIs. This will in turn reduce certain costs and improve the work quality of students, faculty members and staff in the institution. By using an illustrative example, KM processes of a particular HEI has been improved after deploying Pounce AI chatbot and thus the competitive advantage of the institution. As a result, a theoretical framework has been developed as per below:

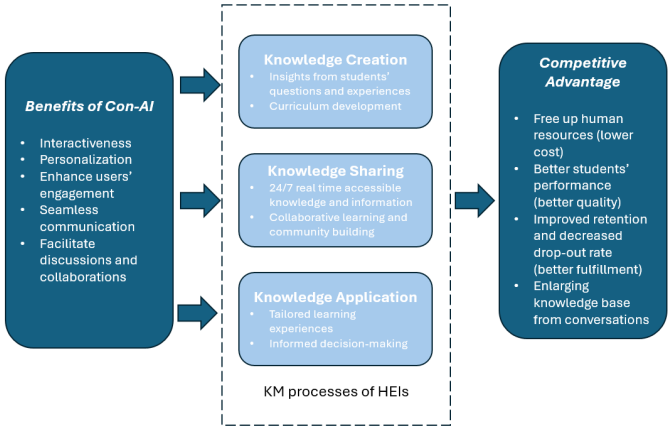


Figure 1: Con-AI enhanced KM processes and thus competitive advantage and competitiveness of HEIs

The KBV highlights knowledge, which is a strategic asset, is critical for organizational competitive advantage. By creating, integrating and disseminating knowledge, value can be generated by firms or organizations as a system. Besides, knowledge creation, sharing and application are effective KM processes which can be supported and enhanced by technology like AI. On the one hand, knowledge creation reconfigures existing knowledge, while knowledge sharing is more for collaboration and information dissemination. On the other hand, knowledge application means using knowledge to create practical solutions. All these 3 KM processes drive academic success and societal benefits.

Competitive advantage is about how an institution can have better performance over competitors by using its internal resources which are valuable, scare, inimitable and irreplaceable. In the context of HEIs, KM processes as supported by chatbots, such as Pounce, can be one of those unique resources. For Con-AI chatbots which are having advantages of allowing immediate access of knowledge for the users, as well as being communicative, conversational, and interactive, they can support students and enhance the operations and knowledge / information flow within different internal stakeholders of the institution. Communication and collaboration within the institution can also be better thus ultimately leading to better decision-making and augmented efficiency. For instance, studies confirmed Con-AI can enlarge the knowledge base and benefit the knowledge creation process. Both Nonaka and Krogh (2009) and Chen, Le and Florence (2021) stated that the ability for Con-AI to learn from past interactions from users and be equipped with relevant knowledge to answer different questions automatically, will enhance knowledge's connection and acquisition. Pounce functions similarly by acquiring tactic knowledge from different students when they interact with the chatbot. It can get insights to enrich the knowledge base for future enquiries and better curriculum development by transforming tactic to explicit knowledge. For knowledge sharing, Pounce can provide immediate access to information, answer enquiries from students and thus facilitating seamless communication across internal stakeholders of HEIs. Pounce can also help supporting individuals to apply and utilize knowledge possessed by others without learning or acquiring such knowledge, due to the knowledge base of Con-AI system is usually improved continuously with data from users' conversations. In addition, for knowledge application, Pounce can base on the students' profile and the past conversations and interactions to tailor-made quizzes to students. This can help students to apply their knowledge by facilitating brainstorming with also real-time feedback. Overall, AI chatbot Pounce have demonstrated tangible improvements in educational engagement and administrative efficiency for Georgia State University, providing the augmentation of the institution's competitive advantage.

In conclusion, HEI can largely improve their operational efficiency, educational outcomes and overall institutional performance with the support of Con-AI to optimize KM processes. The role of Con-AI and other AI technologies will continue to evolve and expand in KM processes which will probably transform the landscape of higher education.

5. Contribution and Future Research Opportunities

As AI tools are increasingly adopted in every industry in the past few decades, this paper contributes by bringing light to an under researched aspect of KM in the context of HEIs. It enriches the existing knowledge on the role Con-AI can play in HEIs in different means. First, this paper focuses on the communicative, interactive and conversational aspects of AI chatbot and discusses its role to strengthen the three major KM processes in HEIs. As an evolving technology, research on Con-AI by using the lenses of KM is not abundant, especially within the context of HEIs (Jarrahi et al., 2023). Second, by using an illustrative real-life example of Pounce at the Georgia State University, this paper explores the potential of how Con-AI can enhance the competitive advantage of HEIs through making sense of KM processes. It can help researchers to start diving deeper into the phenomenon of how Con-AI can help institutions in the future. This paper also gives valuable insight into how management of HEIs can make use of AI chatbot to better KM processes especially in teaching and administration thus augmenting institutional performance over industry's competitors. The benefits associated with Con-AI should encourage adoption by more HEIs and thus the need for resources allocation. This paper calls for future research to study the relationships between Con-AI, KM processes and competitive advantage of an institution within HEIs by using empirical research to have a more thoughtful understanding about the current happenings and future challenges. A suggestion for future research could be to conduct a multiple case study with data from stakeholders in different levels within different HEIs, such as private and public universities, HEIs in different regions, to understanding how Con-AI facilitate KM processes and the respective impact on the institution's performance. This can provide evidence-based practical insights which validate previous theories and contribute to a comprehensive understanding of such complex phenomena as Con-AI.

References

Alavi, M. and Leidner, D.E. (2001) 'Review: Knowledge Management and Knowledge Management Systems: Conceptual Foundations and research issues,' Management Information Systems Quarterly, 25(1), p. 107. https://doi.org/10.2307/3250961.

Al-Kurdi, O.F., El-Haddadeh, R. and Eldabi, T. (2018) 'Knowledge sharing in higher education institutions: a systematic review,' Journal of Enterprise Information Management, 31(2), pp. 226–246. https://doi.org/10.1108/jeim-09-2017-0129.

Almeshref, Y. and Khwanda, H. (2022) 'Information systems effect on enabling knowledge management,' International Journal of Professional Business Review, 7(5), p. e0834. https://doi.org/10.26668/businessreview/2022.v7i5.e834.

Al-Sharafi, M.A., Al-Emran, M., Iranmanesh, M., Al-Qaysi, N., Iahad, N.A. and Arpacı, İ. (2022) 'Understanding the impact of knowledge management factors on the sustainable use of AI-based chatbots for educational purposes using a hybrid SEM-ANN approach,' Interactive Learning Environments, 31(10), pp. 7491–7510. https://doi.org/10.1080/10494820.2022.2075014.

Bhatt, G.D. (2001) 'Knowledge management in organizations: examining the interaction between technologies, techniques, and people,' Journal of Knowledge Management, 5(1), pp. 68–75. https://doi.org/10.1108/13673270110384419.

Blass, E. and Hayward, P. (2014) 'Innovation in higher education; will there be a role for "the academe/university" in 2025?,' European Journal of Futures Research, 2(1). https://doi.org/10.1007/s40309-014-0041-x.

Bock, G.-W. et al. (2005) 'Behavioral intention formation in knowledge sharing: examining the roles of extrinsic motivators, Social-Psychological Forces, and organizational climate,' Management Information Systems Quarterly, 29(1), p. 87. https://doi.org/10.2307/25148669.

Bornet, P., Barkin, I. and Wirtz, J. (2021) Intelligent Automation: Welcome to the world of hyperautomation. https://doi.org/10.1142/12239.

Brewer, P.D. and Brewer, K.L. (2010) 'Knowledge Management, Human resource Management, and Higher Education: a Theoretical model,' Journal of Education for Business, 85(6), pp. 330–335. https://doi.org/10.1080/08832321003604938.

Campbell, M. (2020) 'Beyond conversational artificial intelligence,' IEEE Computer, 53(12), pp. 121–125. https://doi.org/10.1109/mc.2020.3024401.

Cepeda-Carrión, G. and Vera, D. (2007) 'Dynamic capabilities and operational capabilities: A knowledge management perspective,' Journal of Business Research, 60(5), pp. 426–437. https://doi.org/10.1016/j.jbusres.2007.01.013.

Chen, J.-S., Le, T.-T.-Y. and Florence, D. (2021) 'Usability and responsiveness of artificial intelligence chatbot on online customer experience in e-retailing,' International Journal of Retail & Distribution Management, 49(11), pp. 1512–1531. https://doi.org/10.1108/ijrdm-08-2020-0312.

Chen, L., Chen, P. and Lin, Z. (2020) 'Artificial Intelligence in Education: a review,' IEEE Access, 8, pp. 75264–75278. https://doi.org/10.1109/access.2020.2988510.

Davenport, T.H., Järvenpää, S.L. and Beers, M.C. (1996) 'Improving knowledge work processes,' Sloan Management Review, 37(4), pp. 53–65. http://www.providersedge.com/docs/km_articles/Improving_Knowledge_Work_Processes.pdf.

Deem, R., Mok, K.H. and Lucas, L. (2008) 'Transforming higher education in whose image? Exploring the concept of the 'World-Class' university in Europe and Asia,' Higher Education Policy, 21(1), pp. 83–97. https://doi.org/10.1057/palgrave.hep.8300179.

Dempere, J.M. et al. (2023) 'The impact of ChatGPT on higher education,' Frontiers in Education, 8. https://doi.org/10.3389/feduc.2023.1206936.

Duan, Y., Edwards, J.S. and Dwivedi, Y.K. (2019) 'Artificial intelligence for decision making in the era of Big Data – evolution, challenges and research agenda,' International Journal of Information Management, 48, pp. 63–71. https://doi.org/10.1016/j.ijinfomgt.2019.01.021.

Dwivedi, Y.K. et al. (2023) 'Opinion Paper: "So what if ChatGPT wrote it?" Multidisciplinary perspectives on opportunities, challenges and implications of generative conversational AI for research, practice and policy,' International Journal of Information Management, 71, p. 102642. https://doi.org/10.1016/j.ijinfomgt.2023.102642.

Edwards, J. (2007) 'Challenges and Opportunities for the internationalization of Higher education in the coming decade: Planned and Opportunistic initiatives in American institutions,' Journal of Studies in International Education, 11(3–4), pp. 373–381. https://doi.org/10.1177/1028315307303920.

Felin, T. and Hesterly, W.S. (2007) 'The Knowledge-Based View, Nested Heterogeneity, and new value Creation: Philosophical considerations on the locus of knowledge,' Academy of Management Review, 32(1), pp. 195–218. https://doi.org/10.5465/amr.2007.23464020.

Gieselmann, M. and Sassenberg, K. (2022) 'The more competent, the better? The effects of perceived competencies on disclosure towards conversational artificial intelligence,' Social Science Computer Review, 41(6), pp. 2342–2363. https://doi.org/10.1177/08944393221142787.

Grant, R.M. (1996) 'Toward a knowledge-based theory of the firm,' Strategic Management Journal, 17(S2), pp. 109–122. https://doi.org/10.1002/smj.4250171110.

Guzman, A.L. (2019) 'Voices in and of the machine: Source orientation toward mobile virtual assistants,' Computers in Human Behavior, 90, pp. 343–350. https://doi.org/10.1016/j.chb.2018.08.009.

Guzman, A.L. and Lewis, S.C. (2019) 'Artificial intelligence and communication: A Human–Machine Communication research agenda,' New Media & Society, 22(1), pp. 70–86. https://doi.org/10.1177/1461444819858691.

Haas, M.R. and Hansen, M.T. (2004) 'When using knowledge can hurt performance: the value of organizational capabilities in a management consulting company,' Strategic Management Journal, 26(1), pp. 1–24. https://doi.org/10.1002/smj.429.

Hannan, E. and Liu, S. (2021) 'AI: new source of competitiveness in higher education,' Competitiveness Review, 33(2), pp. 265–279. https://doi.org/10.1108/cr-03-2021-0045.

Hart, P.F. and Rodgers, W. (2023) 'Competition, competitiveness, and competitive advantage in higher education institutions: a systematic literature review,' Studies in Higher Education, pp. 1–25. https://doi.org/10.1080/03075079.2023.2293926.

Istikhoroh, S. and Ardhiani, M.R. (2022) 'Creating a competitive advantage for universities through Knowledge-Based Strategic Assets Management,' KnE Social Sciences [Preprint]. https://doi.org/10.18502/kss.v7i19.12443.

Jarrahi, M.H. et al. (2022) 'Artificial intelligence: a strategy to harness its power through organizational learning,' Journal of Business Strategy, 44(3), pp. 126–135. https://doi.org/10.1108/jbs-11-2021-0182.

Jarrahi, M.H. et al. (2023) 'Artificial intelligence and knowledge management: A partnership between human and AI,' Business Horizons, 66(1), pp. 87–99. https://doi.org/10.1016/j.bushor.2022.03.002.

Kianto, A., Sáenz, J. and Aramburu, N. (2017) 'Knowledge-based human resource management practices, intellectual capital and innovation,' Journal of Business Research, 81, pp. 11–20. https://doi.org/10.1016/j.jbusres.2017.07.018.

Lee, M.C.M. et al. (2023) 'The implementation of artificial intelligence in organizations: A systematic literature review,' Information & Management, 60(5), p. 103816. https://doi.org/10.1016/j.im.2023.103816.

Lo, M.F. and Tian, F. (2019) 'Enhancing competitive advantage in Hong Kong higher education: Linking knowledge sharing, absorptive capacity and innovation capability,' Higher Education Quarterly, 74(4), pp. 426–441. https://doi.org/10.1111/hequ.12244.

Mdavis (2022) 'Classroom chatbot improves student performance, study says,' Georgia State News Hub, 20 April. https://news.gsu.edu/2022/03/21/classroom-chatbot-improves-student-performance-study-says/.

Mohammed, A., Abdul, Hafeez-Baig and Gururajan, R. (2018) 'Exploring Processes that are Used for Managing Knowledge in the Higher Education Environment: A Case Study in a Queensland Regional University,' International Journal of Business and Economic Affairs, 3(2). https://doi.org/10.24088/ijbea-2018-32004.

Nonaka, I. (1994) 'A dynamic theory of organizational knowledge creation,' Organization Science, 5(1), pp. 14–37. https://doi.org/10.1287/orsc.5.1.14.

Nonaka, I. and Von Krogh, G. (2009) 'Perspective—Tacit Knowledge and Knowledge Conversion: Controversy and advancement in Organizational Knowledge Creation Theory,' Organization Science, 20(3), pp. 635–652. https://doi.org/10.1287/orsc.1080.0412.

Pereira, D.G. et al. (2023) 'Here's to the future: Conversational agents in higher education- a scoping review,' International Journal of Educational Research, 122, p. 102233. https://doi.org/10.1016/j.ijer.2023.102233.

Phusavat, K. et al. (2011) 'Interrelationships between intellectual capital and performance,' Industrial Management and Data Systems, 111(6), pp. 810–829. https://doi.org/10.1108/02635571111144928.

Russell, S. and Norvig, P. (1995) 'Artificial intelligence: a modern approach,' Choice Reviews Online, 33(03), pp. 33–1577. https://doi.org/10.5860/choice.33-1577.

Sahab, S., Haqbeen, J. and Ito, T. (2024) 'Conversational AI as a Facilitator Improves Participant Engagement and Problem-Solving in Online Discussion: Sharing Evidence from Five Cities in Afghanistan,' IEICE Transactions on Information and Systems, E107.D(4), pp. 434–442. https://doi.org/10.1587/transinf.2023ihp0014.

Singh, S.K. and Singh, K. (2019) 'Critical success factors and knowledge management process in Indian Nationalised Bank,' International Journal of Innovative Technology and Exploring Engineering, 8(12), pp. 4642–4649. https://doi.org/10.35940/ijitee.l3853.1081219.

Smutny, P. and Schreiberova, P. (2020) 'Chatbots for learning: A review of educational chatbots for the Facebook Messenger,' Computers and Education/Computers & Education, 151, p. 103862. https://doi.org/10.1016/j.compedu.2020.103862.

Sumbal, M.S. and Amber, Q. (2024) 'ChatGPT: a game changer for knowledge management in organizations,' Kybernetes [Preprint]. https://doi.org/10.1108/k-06-2023-1126.

Sundaresan, S. and Zhang, Z. (2021) 'AI-enabled knowledge sharing and learning: redesigning roles and processes,' The International Journal of Organizational Analysis, 30(4), pp. 983–999. https://doi.org/10.1108/ijoa-12-2020-2558.

Teece, D.J. (1998) 'Capturing Value from Knowledge Assets: The New Economy, Markets for Know-How, and Intangible Assets,' California Management Review, 40(3), pp. 55–79. https://doi.org/10.2307/41165943.

Van Den Hooff, B. et al. (2003) 'Knowledge sharing in knowledge communities,' in Springer eBooks, pp. 119–141. https://doi.org/10.1007/978-94-017-0115-0_7.

Yang, J.B. (2007) 'Knowledge sharing: Investigating appropriate leadership roles and collaborative culture,' Tourism Management, 28(2), pp. 530–543. https://doi.org/10.1016/j.tourman.2006.08.006.

Exploring Knowledge Management Dynamics in International Film Productions: Insights from the Maltese Film Industry

Tomasz Zontek
Warsaw University of Life Sciences, Faculty of Economics, Department of Management, Warsaw, Poland

tomasz.zontek@sggw.edu.pl

Abstract: This paper discusses an empirical analysis of the knowledge management in international film productions. It presents the findings of exploratory data research taking place during the research trip to Malta. The research took place between 2023 and 2024 during two film productions undertaken in this country. The main study aim is to indicate which forms of tacit and explicit knowledge management are used in international film productions. To achieve the aim of this study, several research questions were formulated: What is the nature of knowledge sharing in the Maltese Film Industry? Is it tacit or explicit knowledge that is shared? What is the difference between collaboration and knowledge sharing? What factors influence effective knowledge management within an international film crew, particularly in the context of the Maltese film industry? The study established a research hypothesis: The management skills of the film producer and the heads of departments, as well as efficient management of explicit and tacit knowledge, are essential factors in the success of film production. The multicultural differences of the film crew members are noticeable, but they are not considered as a disadvantage or a barrier. The methodology of this paper is based on qualitative research. A survey was used as the research method and the interview questionnaire was chosen as the research instrument. Interviews were carried out between 2023 and 2024. The study identified best practices for knowledge management during international film productions. Preliminary research results have identified factors influencing the effectiveness of knowledge management, as well as barriers related to the initiatives undertaken. Finally, the results obtained highlight the importance of compromise, mentoring and trust. Film production processes require effective knowledge management and efficient, talented film production managers. These individuals should be familiar with the principles of knowledge management and also be open to the cultural diversity of their employees.

Keywords: Knowledge Sharing, Film Production, Collaboration, Trust

1. Introduction

In contemporary academic discourse, knowledge management has emerged as a prominent area of scholarly inquiry. Scholars have noted a heightened appreciation for knowledge in present times, as evidenced by the proliferation of literature dedicated to this subject. This corpus encompasses theoretical treatises elucidating the phenomenon's intricacies, alongside empirical investigations shedding light on its practical manifestations. Hence, a consensus may be reached that, at a broad level, knowledge management has been sufficiently comprehended and explicated within academic circles (Miroński, 2010).

The intricacies of data, information, and knowledge are subjects of perpetual exploration and debate, especially within the contexts of knowledge management and information theory (Lei & Yucong, 2021). Despite their ubiquity in everyday language, the precise distinctions among these terms remain elusive, often used interchangeably rather than with precise delineation. Within scholarly discourse, various conceptual frameworks, such as the “pyramid of knowledge” or “knowledge hierarchy”, and the “pyramid of information” or “information hierarchy”, are employed to structure these cognitive entities, with the DIKW (Data, Information, Knowledge, Wisdom) framework standing as a notable exemplar. The article describes differences between those elements. Furthermore it explores the differences between knowledge sharing and collaboration. The article discusses knowledge management in the multicultural film context. It gives a brief description of Maltese film Industry and focuses on what type of knowledge is shared amongst the film crews participating in multicultural film projects. It provides the evidence that both tacit and explicit knowledge is shared during the film production. The conducted interviews allow to analyse the shared knowledge based on the industry professionals’ experience. The methodology based on the literature review provides tools to investigate how to share knowledge amongst film projects multicultural film projects’ participants. The article elaborates on the factors influencing effective knowledge management within an international film crew.

2. Difference Between Data, Information and Knowledge

The terms 'data', 'information' and 'knowledge' are among those that are difficult to define because of their original nature. These terms are often used interchangeably in everyday discourse, reflecting prevailing trends rather than precise distinctions. Their elucidation finds particular significance within the realms of knowledge

management and information theory (Lei & Yucong, 2021; Wolski & Gomolińska, 2020). Consequently, within scholarly discourse, the hierarchical structuring of cognitive entities is alternatively referred to as either the "pyramid of knowledge" or "knowledge hierarchy" or as the "pyramid of information" or "information hierarchy", contingent upon disciplinary orientation. Furthermore, the acronym DIKW, derived from the sequential arrangement of data, information, knowledge, and wisdom, serves as a notable framework within these domains for conceptual organization and analysis. As the final element within the DIKW framework, wisdom pertains predominantly to the philosophical domain, thus its detailed discussion falls beyond the scope of this analysis (Grabowski & Zając, 2009).

A prevailing perspective, echoed with minor deviations, posits that data is raw numerical values and facts, information denotes processed data, and knowledge emerges as authenticated information (Dreske, 1981; Machlup, 1983; Vance, 1997). However, the proposition of a hierarchical progression from data to information to knowledge, with each tier distinguished by various dimensions such as context, utility, or interpretability, seldom withstands rigorous evaluation. If we assume that information is a stream of data to which we assign a certain meaning (relevant to the goals we are achieving), then knowledge is an information resource. However, it is a resource organized in a special way - it corresponds to the intentions of its creators and users. In the case of companies competing for rare resources (e.g., orders, grants, popularity support), these intentions can be reduced to gaining a sustainable advantage on competitive market (Jemielniak & Koźmiński, 2021).

3. Intercultural Knowledge Management

Knowledge management, as a young field of management, encompasses the latest methods and techniques to ensure the most effective use of knowledge resources (Kłak, 2020). The basic dimensions of knowledge management are: acquisition, storage, transfer, development, use and creation (Desmarais et al. 2009, p. 219). In this paper the primary focus is on multi-cultural knowledge management. The primary objective of cross-cultural knowledge management is to facilitate the management of knowledge in other areas (e.g. functional areas: marketing, human resources management, production) in an international setting, and ultimately the management of the entire company (Grosskopf & Barmeyer, 2021; Schewe et al., 2022). Properly applied, intercultural knowledge should allow other knowledge to be used more fully in situations of contact with other cultures. For this to happen, it is necessary to go beyond recognising, understanding and accepting cultural differences. People and organisations should strive to treat cultural differences as sources of inspiration, new knowledge and experience. Previous studies suggest that managers should consider cultural differences in management (Luthans & Doh, 2012) and link intercultural management issues to business needs (Chmielnicki & Sulkowski, 2017, p. 51).

4. Maltese Film Industry

The assertion that "Malta has built a reputation as the mini-Hollywood of the Mediterranean" as articulated by journalist Daniel Rosenthal (Rosenthal, 2002) reflects the pre-existing prominence that the archipelago had attained within the realm of the film industry. It was during the early twentieth century that Malta commenced its role as a host to foreign productions, owing to the proficiency of its craftsmen, adept set builders, and model makers. By the late 1960s, this relatively small and newly independent island emerged as a cost-effective alternative to more established production hubs such as Italy, Spain, and France (Guest, 1968), capitalizing on its remarkable landscape versatility capable of simulating diverse geographical terrains. Nevertheless, for a duration spanning approximately four decades, international production activities remained sporadic, primarily due to the absence of adequate infrastructure and service networks required to attract foreign filmmakers (Xuereb, 2023). It was not until the early 2000s that the archipelago solidified its status as a competitive entity within the global film production domain (Graziano, 2015).

5. Methodology

Based on the literature review three research questions were stated: 1) What is the nature of knowledge sharing in the Maltese Film Industry? Is it tacit or explicit knowledge that is shared? 2) What is the difference between collaboration and knowledge sharing? 3) What factors influence effective knowledge management within an international film crew, particularly in the context of the Maltese film industry?

The methodology of this paper is based on qualitative research. A survey was used as the research method and the interview questionnaire was chosen as the research instrument (table 1). In this study, the perception of the respondents serves as the primary unit of analysis. Moreover, the respondents are not directly prompted to

discuss knowledge management and knowledge sharing; instead, they are guided to elaborate on the mechanisms of collaboration and skill-sharing within the Maltese film industry.

The study established a research hypothesis: The management skills of the film producer and the heads of departments, as well as efficient management of explicit and tacit knowledge, are essential factors in the success of film production. The multicultural differences of the film crew members are noticeable, but they are not considered as a disadvantage or a barrier.

Table 1: Interview protocol

No.	Survey question
1	What qualities should a professional director/production manager/production coordinator have?
2	Did you have a mentor, who would guide you through the intricacies of your film career?
3	What is important during the a) pre-production b) production c) post-production d) distribution (only for the film director) stage of the film?
4	How do you manage an intercultural film crew?
5	What are the differences between the international and national film production?
6	What was the most difficult film that you had to manage?

Source: Research methodology, own research

The present report scrutinizes the data to discern evidence of knowledge sharing and delineate the facilitating and impeding factors as elucidated through the depiction of knowledge sharing occurrences provided by the participants during interviews. Two research interviews were conducted with film industry professionals from November 2023 to February 2024. The list of these interviews is provided in table 2. The selection process for the initial two participants was predicated on recommendations from Maltese film producers. Subsequently, the results of the interviews were enriched by adding and analysing data compiled by Alony, I., Whymark, G., & Jones, M. L. in their work titled "Sharing tacit knowledge: A case study in the Australian film industry" (Alony et al., 2007). The interviews collected by mentioned authors are listed in table 3. It is noteworthy that the interview protocol didn't include specific questions about knowledge management. Due to the fact that the film professionals were confused when asked the question about knowledge management it was decided that other questions leading to this topic will be used.

Table 2: Completed interviews used in this study

Interviewee	Profession	Type	Date of record	Place of record	Pseudonym/ Citation
1	Director	Interview	19.01.2023	Malta	(Alex-Director, 2023)
2	Production Manager	Interview	26.01.2024	Malta	(Karl-Production-Manager, 2024)
3	First Assistant Director	Interview	29.04.2024	Malta (online)	(Ioan-First-Assistant-Director, 2024)
4	Camera Operator	Interview	06.05.2024	Malta (online)	(Michael-Camera-Operator, 2024)

Source: Own source

Table 3: Interviews used in previous study completed by other authors

Interviewee	Profession	Type	Date of record	Place of record	Pseudonym/ Citation
1	Producer	Interview	14.10.2004	Australia	(Alice-Producer,2004)
2	Production Manager	Interview	04.03.2004	Australia	(Lyn-Production-Manager, 2005)

Source: Alony, I., Whymark, G., & Jones, M. L. (2007) "Sharing tacit knowledge: A case study in the Australian film industry", *Informing Science Journal*, vol. 10, pp 41-59.

Individuals within specific professions are typically well-positioned to offer comprehensive insights into film management, encompassing associated challenges and procedures, particularly concerning knowledge sharing and collaborative endeavours. The interviews conducted were structured around open-ended questions, facilitating extensive probing and contextualization. A selection of these questions is presented in Table 2, although variations were introduced across interviews based on the trajectory of discussion, information provided, and the interviewee's role. Furthermore, it was envisaged that the questionnaire would evolve over time to align with emerging data categories (Alony et al., 2007).

6. Results

The research results allowed to describe the nature of intercultural knowledge management in film productions based in Malta. It also allowed to describe the explicit and tacit knowledge shared amongst the film crews. Furthermore it shows the difference between knowledge sharing and collaboration. Lastly, it points out the three factors that influence effective knowledge management within an international film crew, particularly in the context of the Maltese film industry.

6.1 Intercultural Knowledge Management

The film director when asked whether he changes the style of management when talking to people from different cultures, replied: “I don't know if I would be aware of it if I am. I think just what typically happens is, you know, a film, you're so pressed for, for time and resources. A lot of these things tend to fall away and just become more instinctive. And it's probably a little bit more about the individual” (Alex-Director, 2023).

The film director, in response to a question regarding potential alterations in management style when interacting with individuals from diverse cultural backgrounds, expressed uncertainty. He suggested that the demands of filmmaking, characterized by time and resource constraints, often lead to such considerations becoming instinctual rather than deliberate. Additionally, he implied that individual differences play a significant role in shaping his approach.

The production manager asked the same question replied: “I don't think the problems come with cultures because we in the industry are totally used to be around people from all over the world” (Karl-Production-Manager, 2024). Karl indicates positive outcomes of intercultural collaboration: “You find that most people from most countries are great people with extensive experience that you can learn from” (Karl-Production-Manager, 2024). Karl highlights the favorable results stemming from intercultural collaboration by emphasizing the inherent value of individuals from various backgrounds. He expresses that individuals from diverse countries typically possess considerable expertise, presenting opportunities for mutual learning and growth.

Alex as a film director tells his experience with directing cast in an intercultural film project: “Because I'm not fluent in Maltese, I had an enormous benefit that I never really had opinions about how my actors are saying their lines exactly. But what I'm more attentive to is what is being communicated non verbally in their performance. What are their eyes doing? What's their body language doing? How are they breathing? Those are the things I'm looking at when I'm watching my monitor. And I think that those things say a lot more about a character's emotional state in a scene than just how they read a line” (Alex-Director, 2023).

The multicultural dimension significantly influences intercultural communication dynamics. As the author underscores, non-verbal communication emerges as a pivotal component within this context. Non-verbal cues, encompassing gestures, facial expressions, body language, and vocal tone, often convey nuances of meaning that transcend linguistic barriers. In intercultural interactions, where verbal language may pose challenges due to differences in language proficiency or cultural nuances, reliance on non-verbal communication becomes particularly important. These non-verbal signals serve as a universal language that bridges cultural divides, facilitating understanding among individuals from diverse cultural backgrounds. Therefore, recognizing and interpreting non-verbal cues accurately is essential for effective intercultural communication, enabling individuals to navigate cultural differences and establish meaningful connections across multicultural contexts.

6.2 Explicit Knowledge

“I like to think that a lot of times the script is going to direct the film. That applies a lot to the actors, but it even applies to the department heads. If you've written something, that has a kind of a gravity, if it has a momentum, if it has a clarity, those are marks of a good writing. But I think it also, It generally kind of leads people along the same thought process” (Alex-Director, 2023).

The director refers to the film script as the most important document during film production. It contains vital information for all film departments. Throughout the film the director can go back to the script and refer his and his colleagues' ideas to the script. In this sense script can be considered as the main database of the film production. Script changes affect most of the film departments, and has to be debated with the heads of departments. Major script changes have impact on film budget, scheduling, casting, location choice etc.

6.3 Tacit Knowledge

The subsequent quotation distinctly delineates the characteristics of tacit knowledge exchange and its magnitude within the MFI. The collaborative dynamics on a film set entail a substantial dependency on the sharing of knowledge among individuals.

"Now with that said there are things you need to be dead clear on. And that's just for every director to decide about what those things are. It's just impossible to say in the abstract what they are on a given film or in a particular scene. Like I said, what I'm hoping is that the script is directing people. I'm hoping it's really dead clear in the script. And sometimes you find that it's not. And you have to take a moment and to say, I know you had a different idea about this, but here's what I need. And to express yourself very clearly, and when you're in production, which is different than when you're in pre-production. On pre-production, you can have a five or ten minute conversation about it" (Alex-Director, 2023).

The aforementioned quotation can be interpreted as either information sharing or knowledge sharing. Nonaka posits that while the message may initially convey factual data or information, its significance extends beyond mere content. When interpreted or internalized within a broader context, this information transcends into knowledge (Nonaka, 1994).

From the quote above it can be concluded that tacit knowledge complements explicit knowledge. People on the film set rely on the script as the most important database of the filmmaking. Unfortunately this database misses some of the details or contains some mistakes, which are critical to the film production process. Exchanging tacit knowledge allows to eliminate those mistakes and make correct decisions.

Another quote from the Alony et al. (2007) studies provides an understanding about the nature of communication on the film set: "a perfect example is probably ah, a costume designer going to a designer, and saying "what colour are you going to paint that wall in the set, because I really want her to wear this dress…" and he'll say "Oh I'm going to paint it orange" and she'll say "this dress is perfect for the sequence, absolute perfect for the sequence, and it won't look good against that orange wall." And that is the sort of collaboration you have to have, I mean these are all incredibly talented, highly volatile, very creative people and um, they've all got a vision but as long as they've all got the same vision then it works" (Alice-Producer, 2004).

The constant changes in film production process and the dynamic film environment require crew members to be open-minded, flexible and communicative. Film is a gathering of multitalented artists, who need to collaborate on many different levels in order to finish the product which is the distributed film. The quote above shows that knowledge sharing and collaboration are the key factors of any film production process.

6.4 Knowledge Sharing

"My friends told me about an amazing fund out of Germany through the public television broadcasters at "xxx"[1]. They have a program, whose name in German, I can't recall now how it's pronounced, but essentially it's a television program that gets some kind of financing under the prerogative to essentially program films from the European community that demonstrate a unique aspect of a European culture" (Alex-Director, 2023).

The film director gives an example of knowledge sharing without collaboration. In this example the knowledge exchanged is information about a fund provided by a German television. During the information transfer the sender of the information is active and the receiver of the information remains passive. The receiver gets the information, and it is then at their discretion whether they choose to utilize it or not.

Another useful example of knowledge sharing is provided by the cinematographer Ioan. On one of the projects due to unforeseen circumstances he needed to change his role from the first assistant director to downloader

[1] The name of the broadcast company is hidden for research purposes

"My boss called me at night and says: you're gonna go download tomorrow. I said to him: I've never done this before. And he's like: you'll be fine. There's someone who's going to teach you everything over the phone" (Ioan-First-Assistant-Director, 2024). This example shows evidence of knowledge sharing in which the receiver is taught over the phone about his new responsibilities on the film set. Later he says: "I ended up showing up the set. I called Nicola, who's the downloader that just left that production and he told me everything, how to do this job. So I picked it up pretty quick. Yeah, I've been doing it since" (Ioan-First-Assistant-Director, 2024). Ioan after this experience became the professional downloader, it proves that a simple conversation in which knowledge sharing occurs can change the direction of someone's professional career.

6.5 Collaboration

"I had met a young producer, we were probably about the same age. When I was trying to sell my first film at co-production markets back in 2017. He just started out a company called "xxx"[2] out of Berlin. He just kind of tracked up, we had a great conversation back then in 2017. Obviously my first went on a big journey between 2017 and 2021 when it came out. But he remembered the project, he saw the film, he loved it, he kept in touch. His company had an amazing track record in those intervening years and they made great co-productions like the film "xxx"[3], which was a big hit at Cannes, a year or two ago. Our film fit with what they were looking for" (Alex-Director, 2023).

In this example it's clearly seen that sometimes the collaboration doesn't start from the beginning. At first the director and the film producer communicated on one of the film markets in 2017. They kept in touch between the four years and it resulted in collaboration. The newest film of the director was coproduced by the company of the mentioned producer, as the result of four years of exchanging information and knowledge.

"You get very close to people who you work with, you form very strong bonds, more than the average people who work in an office environment do because you spend so much time together" (Lyn – Production-Manager 2005). The close relationships built in-between the crew members and the time that they spend together is a great environment for collaboration. Often the strong bonds last after the project, which means that most probably the collaboration will also last longer.

6.6 Compromise

Regarding the information exchange, it's crucial to think about the two sides of collaboration and what is their aim in information sharing. The next example gives an overview on the reasons behind collaboration: "Then essentially the trade is that you're giving them the free to air broadcast rights in Germany for whatever one or two years, I forget what the term is. Essentially it was a pre-sale for public television in Germany, for a Maltese language film, which is amazing and very rare. The amount of money makes a huge difference for us. But in the bigger scope of filmmaking, that's probably a pretty small fund. So for them, I think it's, it's kind of a low risk proposition, but for us it's like game changing" (Alex-Director, 2023). In this example the director of the small-budget Maltese film gets part of the funding of his film from the German broadcaster while the other side of the collaboration gets an exclusive broadcast rights in Germany for two years. The provided example shows that both sides of collaboration need to benefit from it.

You don't need to take all of the notes, but it's a quite rigorous application process and it's competitive and in the particular year that we were applying was more competitive than at other times, so I would take their advice seriously. I mean, just like in anything, you never want to take one hundred percent of people's notes, and you never want to take zero. You see, you're kind of foolish to do either of those things, so, you know, it was that kind of process" (Alex-Director, 2023).

In this excerpt director indicates that acquiring knowledge is a long and complicated process. There is a long way for the receiver to understand the sender's message and then to transfer that into action. The sender needs to be patient and understanding of receiver's beliefs, knowledge and opinions. Especially in art, where the information sent is a lot of the times subjective it's easy for misunderstandings and arguments.

[2] The name of the company is hidden for research purposes
[3] The name of the film is hidden for research purposes

6.7 Mentoring

“Communication is paramount. So being patient and clear is very important. Being able to say what you want to say with a few words, especially if you're talking over radio, you have to be able to condense your idea or to get the message across. And yeah, I think that's important is to be patient with people and to understand that, especially if you're one of the more senior people in a department that you're constantly going to have newer people and you have to be aware that that knowledge trickles in gradually, so they're not going to know all the lingo immediately. You have to be patient to explain things clearly enough, but to also help them like understand what's the specific term that you're using mean and help them learn that so that next time you can just say that one word and they'll know” (Michael-Camera-Operator, 2024).

Michael in his interview underlines the importance of mentoring. Mentor has to be patient and excellent in communicating. It’s really important that he communicates his ideas thoroughly and briefly. Patience is the factor that helps older crew members with communicating with trainees, a lot of the times trainees need more time to process information and to learn the professional language specific for the film set.

6.8 Trust

When asked about what are the biggest limitations of intercultural film production, production manager replied: “Of course you have problems along the way, be it a language barrier, be it cultural differences. Speaking in the position I'm in, I think getting to know the people is extremely important. You have to know the people who built their trust. Once you build trust, no matter where you come from, there's an element of security” (Karl-Production-Manager, 2024).

Karl highlights the importance of trust as the key factor gluing together the intercultural film production. When asked about the primary challenges encountered in intercultural film production, the production manager candidly addressed key limitations. However, speaking from his vantage point within the production realm, he emphasized the paramount importance of establishing genuine connections with the individuals involved. According to him, investing time and effort in understanding the diverse backgrounds and perspectives of the team members is essential. Building trust emerges as a critical factor in fostering a collaborative environment wherein individuals feel valued and supported. Once trust is cultivated, irrespective of cultural origins, a sense of security permeates the production process, enabling smoother coordination and enhanced teamwork.

7. Conclusions

In conclusion, this study has provided valuable insights into the knowledge management practices within the international film productions, particularly focusing on the context of the Maltese film industry.

All the researched questions were answered in the “Results” section. The nature of knowledge sharing in the Maltese Film Industry is based both on tacit and explicit knowledge. The findings indicate that effective knowledge management in international film productions requires a combination of tacit and explicit knowledge sharing. While explicit knowledge, such as that contained in scripts and production documents, provides a framework for the production process, tacit knowledge plays a crucial role in adapting to dynamic situations and making informed decisions. The results from the interviews confirmed the moderate relevance of the factors assumed in the research hypothesis to the effective functioning of the film crew and the success of film projects.

Article answers the question about differences between collaboration and knowledge sharing. Furthermore, the study demonstrated the interconnectedness of collaboration and knowledge sharing in the film industry. Collaborative efforts among filmmakers, producers, and crew members facilitate the exchange of knowledge and expertise, leading to more innovative and successful productions. Through qualitative research methods including interviews, the study explored factors influencing effective knowledge management within an international film crew. The results obtained focus the importance of compromise, mentoring and trust. The multicultural dimension of film crews adds complexity to knowledge management, but it also presents opportunities for learning and collaboration. The study revealed that successful film productions rely on strong interpersonal relationships and effective communication methods to navigate cultural diversity and achieve common goals. This study offers valuable insights for filmmakers, production managers, and industry stakeholders, by identifying best practices and highlighting the importance of cultural competence and collaboration. Moving forward, continued research in this area can further enhance the understanding of effective knowledge management strategies in the evolving landscape of global film production.

References

Alavi, M., & Leidner, D. E. (2001) "Review: Knowledge Management and Knowledge Management Systems: Conceptual Foundations and Research Issues", *MIS Quarterly*, 25(1), pp 107–136.

Alony, I., Whymark, G., & Jones, M. L. (2007) "Sharing tacit knowledge: A case study in the Australian film industry", *Informing Science Journal*, vol. 10, pp 41-59.

Ardichvili, A., Page, V., & Wentling, T. (2003) "Motivation and barriers to participation in virtual knowledge-sharing communities of practice", *Journal of Knowledge Management*, 7(1), pp 64 - 77.

Chmielecki, M., & Sułkowski, Ł. (2017) "Metody Zarządzania Międzykulturowego", in: G. Ignatowski, Ł. Sułkowski (Ed.), *Komunikacja i zarządzanie międzykulturowe. Współczesne wyzwania prawno-organizacyjne*, Difin, Warszawa, pp 37-52.

Desmarais, L., Parent, R., Leclerc, L., Raymond, L., MacKinnon, S., & Vézina, N. (2009). Knowledge transfer between two geographically distant action research teams. Journal of Workplace Learning, 21(3), 219-239.

Grabowski, M., & Zając, A. (2009) "Dane, informacja, wiedza-próba definicji", *Zeszyty Naukowe/Uniwersytet Ekonomiczny w Krakowie*, no. 798. pp 99-116.

Graziano, T. (2015) "The Mini-Hollywood of the Mediterranean: Strategies and Potentialities of Film Industry in Malta", *Journal of tourism, culture and territorial development*, 6(4), pp 67-92.

Grosskopf, S., & Barmeyer, C. (2021) "Learning from multi-paradigmatic sensitivity in cross-cultural management? Empirical and theoretical considerations", *International Journal of Cross Cultural Management*, 21(2), pp. 181-202.

Guest V. (1968) "Sun Shines on Filmakers", *Times of Malta*, October 26.

Jemielniak, D., & Koźmiński, A. K. (Eds.). (2021). Zarządzanie wiedzą. Wolters Kluwer Polska.

Kłak, M. (2020). Zarządzanie wiedzą we współczesnym przedsiębiorstwie. Marcin Kłak.

Lei, Y., & Yucong, D. (2021) "Trusted service provider discovery based on data, information, knowledge, and wisdom", *International Journal of Software Engineering and Knowledge Engineering*, 31(01), pp 3-19.

Levin, D., & Cross, R. (2004). The strength of weak ties you can trust: The mediating role of trust in effective knowledge transfer. Management Science, 50(11), 1477-1490.

Luthans, F., & Doh, J. (2012) *International Management: Culture, Strategy and Behavior*, McGraw Hill Companies, Inc.

Martins, D., Silva, S., & Silva, C. (2018) "Intercultural knowledge management", in: *Proceedings of the 19th European Conference on Knowledge Management*, ECKM, Academic Conferences and Publishing International Limited, pp. 530-536.

Mayasari, Y., & Chandra, T. (2020) "Social capital for knowledge management system of the creative industry", *Journal of Enterprising Communities: People and Places in the Global Economy*, 14(4), pp. 481-494.

Miroński, J. (2010) "Zarządzanie wiedzą międzykulturową", *E mentor*, 35(3), pp 51-58.

Nonaka, I. (1994). A dynamic theory of organizational knowledge creation. Organization science (Provi-

Rosenthal, D. (2002) "The Island of Everywhere", *Times of London*, April 19. Available at: http://www.pcpmalta.com/malta-film-industry-article-the-island-of-everywhere.html (Accessed: 11 February 2024).

Schewe, R. L., Hoffman, D., Witt, J., Freeman, M., & Shoup, B. (2022) "Cross-cultural environmental research: Lessons from the field", *Environmental Management*, 70(2), pp. 241-253.

Wolski, M., & Gomolińska, A. (2020) "Data meaning and knowledge discovery: Semantical aspects of information systems", *International Journal of Approximate Reasoning*, 119, pp 40-57.

Xuereb, K. (2023) "Shot in Malta: The politics of the film industry since independence", in: *The Different Faces of Politics in the Visual and Performative Arts*, Routledge India, pp 188-200.

Masters Research Papers

The Role of a Facilitator in Multidisciplinary Collaboration and Student's Experienced-Based Learning

Mamoru Miyazawa
Toyo University, Japan

s3f102300089@iniad.org

Abstract: This paper focuses on the necessity of experiential learning models and the importance of facilitators in the implementation of collaborative learning for students who have had no prior experience to such collaboration. It proposes a new role for educators in this. Multidisciplinary collaboration is defined as the process where by individuals with different perspectives recognize each other's expertise. In today's world, a high-tech business cannot succeed with a team specializing in only one field; business experts are required to collaborate with engineering experts to launch new high-tech businesses. Thus, university students must learn how to collaborate with multiple experts. The research adopts a case study of a Japanese university workshop where engineering, business, and design students, jointly create a high-tech business idea, and test their hypothesis. This multi-disciplinary collaboration develops student's ability to work with other specialized students. Past literature emphasizes the importance of experience-based learning: a learner recognizes specialized forms of knowledge through team discussion. For students who don't receive such learning, it's hard to understand how they learn from their experiences. As most Japanese students don't practice collaborating with other specialized people, they don't understand how to learn from their experiences. They are beginners in learning multidisciplinary collaboration, revealed by the fact that university students couldn't hold effective discussions and explain their own learning experiences. Interviews were conducted with students participating in collaborative learning workshop at university. It was found that novices repeatedly engaged in trial and error without effectively learning from experience, and the presence or absence of a facilitator influenced how they thought and derived value from their experiences. This challenge cannot be adequately addressed by students who are complete beginners; thus, intervention by educators or students who are actively engaged in collaboration is crucial. It was concluded that, irrespective of the outcomes of the workshop, the presence of a facilitator is key in promoting collaborative learning. Using Kolb's (2017) learning model, the study clarifies the impediments to a beginner's experience-based learning and how to overcome them. It proposes the role of a facilitator who is expected to promote experience-based learning. This paper could resolve issues related to multidisciplinary collaboration by adding a new facilitator role to intervene in the learning process and the students' experience-based learning.

Keywords: Multidisciplinary Collaboration, Experience-Based Learning, University Education, Facilitator, Multiple Experts

1. Introduction

This study examines how educators should utilize existing experiential learning models and what points they should consider when aiming to improve university students' multidisciplinary collaboration abilities. Furthermore, it highlights the insufficiently discussed role of facilitators, who are essential for learners' experiential learning, proposing new roles for them. There are many existing models of experiential learning suited for adult education (Kolb & Kolb, 2018; Kolb, 1999; Miettinen, 2010; Jarvis, 2005; Fry, 1979). Experiential learning learners draw from past experiences to bridge theory and practice and encourages reflection. By anchoring learning in the learners' experiences, it facilitates effective knowledge acquisition and enhances educational outcomes (Lewis, 1994). Diverse approaches to experiential learning exist, including methods that focus on encouraging learners to reflect on their experiences (Dewey, 2017; Ord, 2012; Lewis, 1994) and those fostering self-awareness through the contemplation of past experiences (Mezirow, 2014; Lewis, 1994).

The skill set required for multidisciplinary collaboration is essential in fields such as healthcare and engineering, and it is being fostered through different learning in universities and corporations (Lary, 2008; Heikkinen, 2015).

The ability to manage conflict and foster mutual understanding among students is a critical aspect of the knowledge base needed to function effectively in an organization and to drive innovation (Remenyi, 2009; Brown, 2008; Sanders, 2008; Allison, 2011; Nonaka, 2015). Universities have established departments focused on multidisciplinary collaboration skills, and ongoing discussions concern the development of various learning methods and the most advantageous ways to introduce them to cultivate these skills (Laura, 2006; Estes, 2004; McKelvey, 2006; Koch, 2017).

Despite the literature introduced and expanded learning opportunities, there is a gap in the discussion concerning the effectiveness of experiential learning for learners (Serda & Alsina, 2018; Kirschner, 2006; Koch, 2017). Educators have concentrated on providing the most affective learning opportunities. Additionally, emphasis has been placed solely on learners' experiences in teams, and the notable absence of facilitator engagement in the experiential learning process is problematic (Lary, 2008; Heikkinen, 2015; Kirschner, 2006;

Cindy, 2015). The presence of a facilitator in experiential learning is pivotal because they facilitate reflection and support the process by which learners acquire necessary knowledge (Boud, 1990; Kolmos, 2008).

Furthermore, future discussions will be required involving many facilitators to propose methods for facilitator development, using examples in businesses and universities, regardless of the field (Ames, 2011; Jones, 2006; Cindy, 2006). Facilitations focusing on business projects and collaborations in enterprises (Beranek, 2014; Den Hengst, 2005; Den Hengst, 2007) and the promotion of learning within communities and individuals to foster innovation in universities have been particularly noted (Yang, 2008; Harvey, 2001). However, this paper focuses on students who are unfamiliar with facilitation and collaborative learning, examining the role of the facilitator in supporting Kolb's experiential learning model. (Kayes, 2005)

Therefore, the present paper discusses methods around multidisciplinary collaboration skills, critically examining and enhancing Kolb's experiential learning cycle. In particular, Kolb's cycle recognizes the role of a facilitator in the experiential learning process, allowing them to engage with learners' experiences and promote learning and knowledge acquisition (Kolb, 2014). This enables a discourse and proposal of facilitator roles that are absent from current methods and those focused on experiential learning in multidisciplinary collaboration skills. Nevertheless, there is a lack of in-depth discussion on adapting Kolb's experiential learning cycle to education centred around multidisciplinary collaboration skills (Sato, 2015; Masuo, 2015; Morris, 2018). This study seizes the opportunity to examine exercises at Japanese universities aimed at students with no prior experience in multidisciplinary collaboration skills, discussing the significance of experiential learning for learners who are new to these competencies, as well as the indispensable role of facilitators in the process.

2. Literature Review

2.1 Experiential Learning

Past literature on experiential learning capitalizes on learners' experiences, engaging them in reflection and introspection to facilitate learning processes. With the proliferation of collegiate learners, the leveraging of student experiences has enhanced diverse educational outcomes (Miettinen, 2010). Among the various approaches and models predicated on experiential learning, John Dewey's paradigm serves as a foundation, focusing on the learner's self-reflection to achieve conceptual understanding and further learning (Dewey, 2017; Miettinen, 2010; Lewis, 1994). Mezirow's transformative learning posits that learning from experiences not only fosters personal growth but also endows individuals with fresh perspectives (Mezirow, 2014; Lewis, 1994). In addition, Jarvis (2006), with his theory of human learning and association with lifelong educational support, has highlighted experiential learning in the context of education, suggesting that learning occurs through the confluence of the inner person with the outside world. Despite the availability of experiential learning models that aid in the acquisition of knowledge and perspectives, prior discussions – such as Kolb's experiential learning cycle (Kolb & Kolb, 2018) – have not explicitly delineated the facilitative roles or the learning processes involved.

2.2 Kolb's Experiential Learning and Facilitators

This paper discusses Kolb's experiential learning cycle, which is comprised of four processes: experiencing, reflecting, thinking, and acting. Learners pass through these stages with facilitator intervention, moving from experience to reflection. According to Kolb (2014), experiential educators in this learning cycle embody roles as facilitators, subject experts, standard setters and evaluators, and coaches. Kolb's model posits that learners, through experience, engage in reflection, which then informs their thinking and subsequent actions (Kolb, 2015). The facilitator's profile – defined as possessing a warm, affirming style and focusing on 'inside-out learning' to motivate and foster self-knowledge – is critical for transitioning through the learning stages and building personal relationships and dialogues (Kolb, 2014). Furthermore, educators must accommodate the nine learning styles and the four dialectics of the learning cycle, tailoring their facilitation to the learners' styles. This paper examines the role of facilitators as defined by Kolb's cycle, especially within the context of learning aimed at interdisciplinary collaboration capabilities. However, Kolb's experiential learning doesn't focus on students who are complete novices. Additionally, it doesn't provide facilitators with examples of how to best utilize collaborative learning. Therefore, this paper discusses which aspects of students' experiences should be intervened to promote collaborative learning among novices.

2.3 2-3 Multidisciplinary Collaboration Skills, Experiential Learning, and Facilitators

Learning that centres on multidisciplinary collaboration skills is becoming increasingly prominent in universities and businesses, with emphasis placed on methods of collaboration and instructional strategies. Project-based learning, as an example of such learning, has been critiqued for lacking facilitator intervention in the learners' experiences (Cindy, 2015). The complementarity of lecture-based knowledge transmission and self-directed learning (as in project-based learning and reflective learning) suggests that combining the knowledge from lectures with self-guided learning can yield the benefits of collaborative and project-based learning education. However, existing methods fall short in providing appropriate reflection and action strategies for student experiences (Bernat-Carles Serda & Ángel Alsina, 2018). According to Kirschner (2006), the education-psychological stance is that experiential-based learning and project-based learning are mostly learner-centred, with educators minimally involved in learners' experiential activities. He advocates for experts and educators to actively engage with learners' experiences. Heikkinen (2015) claims that educators in existing collaborative learning scenarios focus too much on the introduction of learning opportunities while being involved in learners' experiential learning. He argues for educators to facilitate the transition of learners' experiences into practical applications within the context of interdisciplinary team projects.

Laura (2006) suggests that educators' negligence in engaging with student experiences can hinder the acquisition of the desired interdisciplinary collaboration skills; intervention by educators is crucial to maximizing the educational potential of varied experiences within projects. Koch (2017) emphasizes the enhancement of experiential learning through facilitators who engage with learners' motivations at technical universities. The role of facilitators is under-defined despite their necessity for supporting learners and fostering broader perspectives to facilitate learning (Goodyear & Dudley, 2015). Boud (1990) deliberates on how educators can draw from learner's to affect learning experiences, underscoring the critical interaction between students' and facilitators' joint learning endeavours.

(Ames, 2011) states that in higher education programs for university students, the impact of facilitation programs varies depending on students' learning attitudes and participation motivation. Additionally, facilitation in project-based learning at universities involves posing questions, encouraging thinking, and defining problems for learners. This paper concludes that the success of such programs is determined by facilitation. Similarly, (Jones, 2006) discusses the necessity of promoting shared understanding among students when using facilitation in collaborative learning (Cindy, 2006).

However, these studies don't focus on students who have never experienced collaboration or facilitation. In practice, (Hengst, 2005; Hengst, 2007) highlight the challenges facilitators face. Furthermore, (Harvey, 2001) analyses the roles and functions of facilitation in practice and works on conceptualizing facilitation.

Past literature claims that multidisciplinary collaborative capability is recognized as a critical skill that facilitates mutual understanding and conflict acceptance among people within organizations and sparking innovation (Remenyi, 2009; Brown, 2008; Sanders, 2008; Allison, 2011; Nonaka, 2015). This capacity is referenced throughout concepts, models, and philosophies such as design thinking (Brown, 2008) and co-creation (Sanders, 2008), which emphasize the sharing of knowledge and perspectives across diverse fields to conduct business effectively. Allison (2011) has discussed sharing methodologies for the knowledge necessary to generate innovation and train proactive business leaders. Additionally, McKelvey (2006) has argued for the necessity of bridging what students learn in academic education and research with practical applications. Nonaka's 'A Dynamic Theory of Organizational Knowledge Creation' (2015) has been noted as prominent, representing a collaboration method that is different from the workshop collaboration discussed in this paper.

Therefore, while collaborative-themed learning opportunities are considered, the absence of facilitators renders experiential learning inadequate. The specificity of facilitator roles should be examined depending on the field and learning method. This paper discusses the significance of experiential learning and elaborates on the essential role of facilitators in supporting learners' acquisition of interdisciplinary collaboration skills.

3. Case Study

This study discusses the existence and functions of facilitators with an emphasis on multidisciplinary collaboration capabilities through the Kolb's experiential learning cycle. The workshop involves students from technical and business disciplines teaming up to address a given theme – from identifying the problem to proposing solutions – over a one-year period. These students begin with little to no training or perspective on multidisciplinary collaboration, and they are uncertain about how best to leverage their expertise. Especially in

Japan, learning centred on collaboration is developing, and the students exhibit characteristics different from those in other countries. For instance, their passive and reticent attitudes can impede the experiential learning that would enhance their interdisciplinary collaboration skills (Sato, 2015). Additionally, there is a limited presence of educators capable of intervening in student experiences. Japanese universities possess structured learning and education systems where students generally adopt a passive stance. The emphasis tends to lie on credentialism, such as whether an experience contributes to job hunting success, or on sensory experiences like the ability to converse with others rather than on experiential learning that could impart multidisciplinary collaborative abilities. Moreover, concern often centres on whether students can complete a given learning process rather than engaging in effective discussion (Sato, 2015).

In this study, we conducted interviews with five respondents who had experienced workshops at the undergraduate level, focusing on their remarks about collaboration, experiences, and leadership. Each respondent was interviewed individually for 30 minutes. Students A, B, and C participated in workshops as members of team's conscious of facilitators and collaboration. Regardless of their workshop grades, these students reflected on their roles and awareness of collaboration, finding their experiences beneficial for future opportunities such as internships. In contrast, students D and E reported that the workshops weren't useful for their learning and that they had limited experiences. Although their teams had leaders, these students expressed discomfort and frustration with the facilitators and the ultimate team activities, describing their experiences as negative.

It analyses the experiences of learners in an ongoing year-long workshop concerning what they have learned and how they perceive multidisciplinary collaboration. Table 1 summarizes the interview results with students who participated in multidisciplinary collaboration practice, showing how this study aggregates the experiences of participants who were in teams both with and without a student fulfilling the role of a facilitator. Consequently, facilitators are intentionally left undefined, requiring the participating students to undertake a process of self-guided exploration and experimentation to ascertain their roles. Starting with questions regarding the importance of discussion that embraces conflicting viewpoints to bolster collaboration capabilities, the study explores university students' understanding of multidisciplinary collaboration and the experiences throughout the workshop.

Table 1: Interview results with students who participated in multidisciplinary collaboration workshops

	Presence of a facilitator	**Experience-based learning**	**Recognition of multidisciplinary collaboration skills**	**Consciousness of the learning process**
Student A, B, C	Exists	Occurs Through experience, recognizing one's own lacking expertise or elements	Encouraging mutual understanding among students Complementing each other	By having experiences Applying it to one's own field of expertise or practices such as internships
Student D, E	Does not exist	Does not occur Failures and disagreements of opinion Only directional and idea discrepancies	Working independently as individuals Seeking direction from the team leader to avoid friction Conforming unduly to each other's ideas	Experiencing only dissatisfaction through the experience No experiencing of proactive collaboration or active discussions Learning differs in content

4. Findings

The case study examining multidisciplinary collaboration workshops for university students suggests that when they operated within teams with a facilitator, they were capable of converting their experience into learning, gained awareness of collaborative skills, and became cognizant of their learning processes.

From the interviews, it was revealed that the role of the facilitator, along with the experience of the collaborative learning process, is crucial in promoting multidisciplinary collaboration. Students who experienced collaboration had different impressions of the workshop compared to those who didn't. The presence of a facilitator enabled the students who were conscious of collaboration to act more proactively, and even those who were not initially

aware started to think about contributing to the team and making efforts to engage. Moreover, students attempted to bridge the gap between the technical and business domains, striving to excel from their respective perspectives through trial and error. As a result, they were able to apply the experience gained from the workshop to internships and other practical endeavours.

In contrast, without a role that facilitates collaboration, even if students were aware of the importance of collaboration, the workshop became a routine group activity rather than a truly collaborative effort. Particularly, students D and E felt that the absence of an effective leader resulted in a team structure that didn't foster multidisciplinary collaboration. For them, the workshop ended up being an opportunity to experience the failure of collaboration.

The workshop participants responded as follows in the interviews;

Student A, specializing in programming, expressed initial bewilderment concerning multidisciplinary collaborative skills but acknowledged that participation in the workshop provided an opportunity to recognize and experience these capacities. The experience led to active participation in discussions and subsequent actionable behaviours.

Student B, with a design specialization, demonstrated an understanding of multidisciplinary collaborative skills. Compared to learning opportunities with passive students and absent facilitators, the workshops served as first-time experiences and understandings of these skills.

Student C, through their experience, recognized a personal deficiency in perspective regarding multidisciplinary collaboration and has since learned and applied this understanding, utilizing their newfound knowledge for practical action.

Conversely, students who participated in teams without a facilitator lacked experiential learning, recognition of multidisciplinary collaboration skills, and awareness of their learning processes, significantly deviating from the cases and models discussed in this paper.

Student D struggled to understand multidisciplinary collaboration through the workshop and reported an inability to achieve teamwork among peers. Instead of embracing 'frictions and conflicts', a quality typically associated with multidisciplinary collaboration, avoidance was prevalent, resulting in a lack of assertive collaboration. Student misinterpreted multiple disciplines working separately as collaboration. Not knowing about the role of facilitators meant that there was no one to guide the experiential learning process.

Student E had a narrow interpretation of multidisciplinary collaboration, equating it solely with experiencing inconsistencies and misalignments without any mention of embracing conflicts. The awareness of a learning process was absent, with learning equated only to experience and personal sentiment. Individual work, being straightforward, was preferred, signifying a misunderstanding of collaboration.

The interviews revealed that for students being introduced to workshops and the concept of multidisciplinary collaboration for the first time, the presence of a facilitator is crucial. For those without experiential learning perspective, the workshops served as an opportunity for experience, not for learning transformation and action. Facilitators are necessary to guide learners through the experiential learning cycle. Rather than attributing significance to mere experiences, facilitators are required to direct learners towards experiences that can be utilized in experiential learning.

In particular, the interviews elucidated that within the context of Japanese education, where one-sided instruction traditionally prevails, students have mentioned a lack of knowledge about collaborative discussions, experiences, and facilitators when it comes to multidisciplinary collaboration. Thus, when implementing experiential learning for learners with no multidisciplinary collaborative capabilities, facilitators who can guide them through Kolb's experiential learning cycle are essential. Moreover, facilitators who can create experiences that lead to knowledge and skill enhancement are needed.

For instance, Kolmos (2008) defined the role of a facilitator as someone who assists in motivating students and determining their direction, which is crucial at the learning initiation stage. In collaborative education in Norway, the introduction of facilitators has been shown to promote students' experiential learning (Kolmos, 2008). Similarly, Matsuo (2015) critiqued Kolb's experiential learning model and proposed roles for facilitators, suggesting that factors such as seeking challenging tasks, critical reflection, enjoyment of work, learning goal orientation, and a developmental network can foster learning. Moreover, the literature on leadership skills

indicates that educators and learners should discuss and construct the learning process, competency development, and the role of the facilitator (Estes, 2004).

In the present paper, we focus our attention on Kolb's experiential learning cycle (Figure 1). In particular, our discourse revolves around the learning steps of Concrete Experience (CE) and Reflective Observation (RO), contemplating the necessity of facilitators (Figure 2). These facilitators are entrusted with pivotal roles to target completely novice students, make them aware of effective experiences, and provide opportunities. Without the presence of a facilitator, learners may find themselves merely repeating experiences without deriving learning from them.

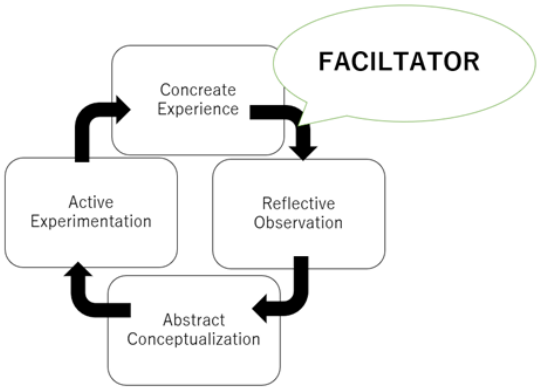


Figure 1: Kolb's experiential learning and the facilitator role

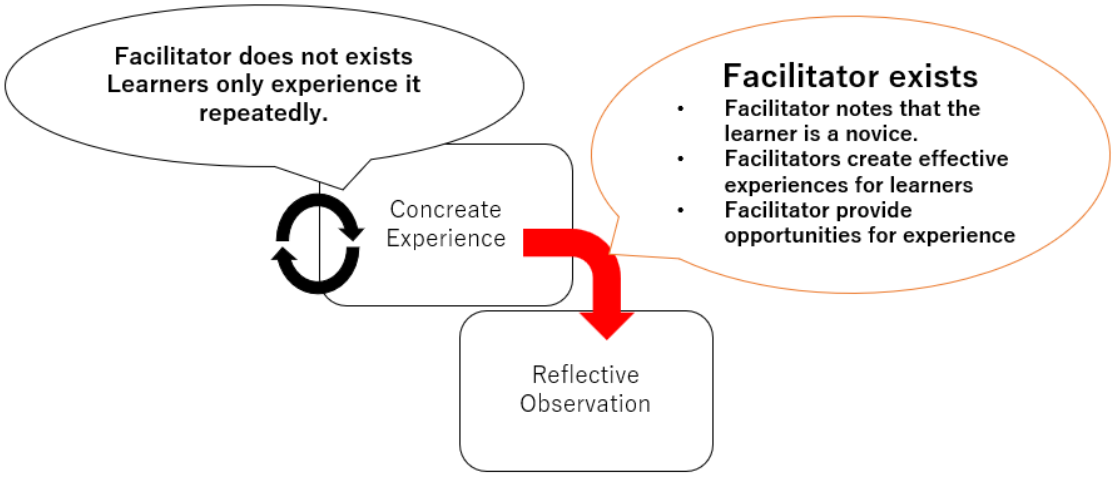


Figure 2: Learning processes and facilitators

5. Discussion, Conclusion, and Limitations

This paper has demonstrated the necessity of experiential learning models and the importance of facilitators when implementing collaborative learning for students who have had no prior experience to collaboration. Firstly, the presence of a facilitator enables the promotion of collaborative learning and the intervention in experiential learning, thus leading to transformative changes in students. Specifically, the role of the facilitator as utilized in Kolb's Experiential Learning Cycle is considered instrumental in providing experiential learning opportunities and advancing the learning process for students not accustomed to collaboration.

Past literature has focused on increasing the frequency of experiential learning and collaborative learning sessions, as well as reviewing methods of implementation and ensuring a student-centred learning approach. Therefore, this paper examined a workshop designed to impart multidisciplinary collaboration skills based on experiential learning as a case study, concluding that facilitator intervention is a critical element in the experiential learning of novices. Specifically, grounded in Kolb's learning model, this study proposed the elements of experiential learning that can be utilized for multidisciplinary collaboration learning and the role of facilitators

for novices. Kolb's learning model (2017) employs an experiential learning approach that uses nine cycles to transform learners' experiences into more reliable and effective encounters. The study identifies the obstacles beginners face in experiential learning and the methods to overcome them.

The case study and findings show that facilitators play a crucial role in experiential learning by encouraging learners' experiential learning and guiding them through Kolb's experiential learning cycle. It was especially noted that the Japanese students featured in the case study aren't accustomed to the premise of experiencing, reflecting, and engaging actively. Furthermore, Japan has a scarcity of educators trained to deliver experiential learning (Sato, 2015). Therefore, for learners who have never engaged in experiential learning, facilitators are necessary, and Kolb's experiential learning requires refinement. This paper highlights that the presence of a facilitator is an essential element when providing knowledge of multidisciplinary collaboration skills to novices who have no prior perspective on collaboration. Past arguments have emphasized the absence of facilitator intervention, valuing the mere experience of existing experiential learning. In this context, focusing on the role of facilitators as defined in Kolb's experiential learning, this paper found that the presence of a facilitator is instrumental in guiding novices through the learning cycle and in supporting their learning.

In terms of future directions, several aspects weren't addressed in the main text, such as methods for training facilitators necessary for collaborative learning and how to provide experiential learning tailored to the needs of organizations and communities. Specifically, this paper doesn't analyse how novices should create concrete experiences through Kolb's experiential learning cycle. Kolb's experiential learning doesn't define the specifics of what constitutes a concrete experience. Therefore, it is essential to discuss what types of experiences can accelerate learning for learners. Morris (2018) claims that Kolb's model has a lack of clarity regarding what constitutes a concrete experience, and past literature has debated about the elements a facilitator should have and who should do it. Matsuo (2015) developed a model in which five facilitators (seeking challenging tasks, critical reflection, enjoyment of work, learning goal orientation, and developmental network) directly and indirectly facilitate the performance of the four steps of Kolb's experiential learning process. In coaching, which resembles facilitation, peer coaching has developed among students and within businesses, enhancing mutual learning (Jones, 2019; Parker, 2008) Japan's deficiency in educators able to support learners as facilitators necessitates a discussion on how to cultivate such skills. Thus, future research is expected to clarify the role of facilitators in experiential learning for multidisciplinary collaboration.

References

Ames, M.E., Pratt, M.W., Pancer, S.M., Wintre, M.G., Polivy, J., Birnie-Lefcovitch, S. and Adams, G. (2011) The moderating effects of attachment style on students' experience of a transition to university group facilitation program. American Psychological Association (APA).

Beranek, P.M., Beise, C.M. and Niederman, F.A. (2014) Facilitation and group support systems IEEE.

Boud, D., & Walker, D. (1990). Making the most of experience. Studies in Continuing Education, Vol 12, No 2, pp 61-80.

Brown, T. (2008). Design thinking. Harvard Business Review, Vol 86, No 6, pp 84.

Dahl, A., Lawrence, J., & Pierce, J. (2011). Building an innovation community. Research Technology Management, Vol 54, No 5, pp 19-27.

Den Hengst, M. Collaborative Modeling of Processes: What facilitation support does a group need?.

Den Hengst, M. and Adkins, M. (2007) Which collaboration patterns are most challenging: A global survey of facilitators IEEE.

Dewey, J. (2017). Democracy and education & experience and education: How to encourage experiential education, problem-based learning & pragmatic philosophy of scholarship e-artnow.

Edwards, R., Hanson, A., & Raggatt, P. (2013). Boundaries of adult learning Routledge.

Estes, C. A. (2004). Promoting student-centered learning in experiential education. Journal of Experiential Education, Vol 27, No 2, pp 141-160.

Fry, R., & Kolb, D. (1979). Experiential learning theory and learning experiences in liberal arts education. New directions for experiential learning, Vol 6, No 79.

Goodyear, V., & Dudley, D. (2015). "I'm a facilitator of learning!" understanding what teachers and students do within student-centered physical education models. Quest, Vol 67, No 3, pp 274-289.

Gill, H., Bnurs, R.R., Dn, Loftus-Hills Ba, A., Bsw, M., Rycroft-Malone Bsc, J., Rgn, M., Titchen, A., Dphil, M., Kitson, A., Dphil, B., Frcn, R.N., Mccormack, B., Rmn, R., Seers, K., Phd, B. and Rycroft-Malone, J. Getting evidence into practice: the role and function of facilitation.

Heikkinen, J., & Isomöttönen, V. (2015). Learning mechanisms in multidisciplinary teamwork with real customers and open-ended problems. European Journal of Engineering Education, Vol 40, No 6, pp 653-670.

Helle, L., Tynjälä, P., & Olkinuora, E. (2006). Project-based learning in post-secondary education. Higher Education, Vol 51, No 2, pp 287-314.

Hmelo-Silver, C.E. and Barrows, H.S. (2006) Goals and Strategies of a Problem-based Learning Facilitator Purdue University (bepress).
Hmelo-Silver, C. E. (2004). Problem-based learning: What and how do students learn? , Educational psychology review, Vol 16, pp 235-266.
Jarvis, P. (2006). Towards a philosophy of human learning: An existentialist perspective. Human learning (pp. 1-15) Routledge.
Jarvis, P. (2012). Towards a comprehensive theory of human learning Routledge.
Jones, R. J., & Andrews, H. (2019). Understanding the rise of Faculty–Student coaching: An academic capitalism perspective. Academy of Management Learning & Education, Vol 18, No 4, pp 606-625.
Kayes, A.B., Kayes, D.C. and Kolb, D.A. (2005) Developing teams using the Kolb Team Learning Experience SAGE Publications, pp. 355.
Kirschner, P. A., Sweller, J., & Clark, R. E. (2006). Why minimal guidance during instruction does not work: An analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry-based teaching. Educational Psychologist, Vo 41, No 2, pp 75-86.
Koch, F. D., Dirsch-Weigand, A., Awolin, M., Pinkelman, R. J., & Hampe, M. J. (2017). Motivating first-year university students by interdisciplinary study projects. European Journal of Engineering Education, Vol 42, No 1, pp 17-31.
Kolb, A. Y., Kolb, D. A., Passarelli, A., & Sharma, G. (2014). On becoming an experiential educator SAGE Publications.
Kolb, A., & Kolb, D. (2018). Eight important things to know about the experiential learning cycle. Australian Educational Leader, Vol 40, No 3, pp 8-14.
Kolmos, A., Du, X., Holgaard, J. E., & Jensen, L. P. (2008). Facilitation in a PBL environment.
Lary, M. J., Lavigne, S. E., Muma, R. D., Jones, S. E., & Hoeft, H. J. Breaking down barriers: Multidisciplinary education Model
Lewis, L. H., & Williams, C. Experiential learning: Past and present
Matsuo, M. (2015). A framework for facilitating experiential learning SAGE Publications.
McKelvey, B. (2006). Van de ven and johnson's “engaged scholarship”: Nice try, but…. Academy of Management Review, Vol 31, No 4, pp 822-829.
Mezirow, J. (2014). A critical theory of adult learning and education. Education for adults (pp. 124-138) Routledge.
Miettinen, R. (2000). The concept of experiential learning and john dewey's theory of reflective thought and action Informa UK Limited.
Morris, T. H. (2020). Experiential learning–a systematic review and revision of kolb’s model. Interactive Learning Environments, Vol 28, No 8, pp 1064-1077.
Ord, J, John Dewey and experiential learning: Developing the theory of youth work
Parker, P., Hall, D. T., & Kram, K. E. (2008). Peer coaching. Academy of Management Learning & Education, Vol 7, No 4, pp 487-503.
Prichard, J.S., Stratford, R.J. and Bizo, L.A. (2006) Team-skills training enhances collaborative learning Elsevier BV, pp. 256.
Remenyi, D., & Griffiths, The Socratic dialogue in the work place: Theory and practice
Sanders, E. B. -., & Stappers, P. J. (2008). Co-creation and the new landscapes of design. CoDesign, Vol 4, No 1, pp 5-18.
Serdà, B., & Alsina, Á. (2018). Knowledge-transfer and self-directed methodologies in university students' learning. Reflective Practice, Vol 19, No 5, pp 573-585.
Sato Osam. (2011). Obstacles to introduction of Problem – Based Learning into Higher Education in Japan. Japan Society for Information and Management, Vol 32, No 1, pp 3-8.
Thomas, G. (2008). Preparing facilitators for experiential education: The role of intentionality and intuition. Journal of Adventure Education & Outdoor Learning, Vol 8, No 1, pp 3-20.
Yang, Y.C.C. and Yang, Y.-.C. (2007) A catalyst for teaching critical thinking in a large university class in Taiwan: asynchronous online discussions with the facilitation of teaching assistants Springer Science and Business Media LLC, pp. 241.

Exploring the Impact of Artificial Intelligence on Knowledge Management in Automotive Manufacturing within Different Cultures: China and Germany as Examples

Rui Wang and Yifen Yin*
Faculty of Humanities and Social Sciences, Macao Polytechnic University, Macao

p2313391@mpu.edu.mo
yfyin@mpu.edu.mo

Abstract: This study explores the impact of artificial intelligence (AI) on knowledge management (KM) in the automotive manufacturing industry with a focus on different cultural contexts in China and Germany. The role of cultural factors on the effectiveness of AI in KM practices is explored by comparing automobile manufacturers in China and Germany. This study uses case studies to compare, and contrast leading automotive manufacturers in both countries and combines industry reports, papers journals, and other digital resources on the Internet to explore how the manufacturing industry can use AI technology to improve efficiency in the KM process. In addition, the study explores the impact of culture on organizational structure, decision-making, and employee engagement with new technologies within a company. The preliminary findings suggest differences in the understanding and use of AI and KM between China and Germany due to their different history, culture, and level of economic development. In China, the integration of AI into KM is driven by rapid technological advances and strong government support, focusing on efficiency and scalability. In contrast, German companies show more caution, emphasizing accuracy, reliability, and augmentation of human expertise. These differences reflect broader cultural attitudes toward technology and innovation in both countries. The study contributes to the understanding of the interaction between AI and KM in the context of cultural differences. The findings will have important implications for subsequent AI research and policy development.

Keywords: Artificial Intelligence, Knowledge Management, Automotive Manufacturing Industry

1. Introduction

1.1 Importance of AI in the Automotive Manufacturing Industry

AI plays an increasingly important role in the automotive manufacturing industry, mainly in several key application areas to improve efficiency, increase safety, promote innovation, and enhance customer satisfaction. Different application scenarios and means reflect different importance.

For example, AI can improve automation in automotive production lines, reduce human error, and increase productivity. At the same time, AI can analyze production data, optimize workflow, reduce waste, and improve resource utilization efficiency (Kamran et al. 2022). By using AI vision systems for real-time inspection and quality control of automobiles in production, defects, and non-compliant products are identified and corrected. This ensures product quality and reduces the need for rework and after-sales service. It can also help automakers manage their supply chains more efficiently by optimizing inventory levels through predictive analytics, forecasting demand, reducing surpluses or shortages, lowering costs, and improving supply chain transparency and flexibility (Hofmann et al. 2023; Jarrahi et al. 2023).

In automotive design and engineering, AI can assist in design decisions through simulation and predictive analytics, optimize vehicle performance including fuel efficiency, safety, and durability, play a role in material selection and engineering testing, and increase the speed of innovation (Demlehner and Laumer, 2020). Help automakers offer more personalized vehicle configuration options that optimize vehicle performance based on customer preferences and driving habits. In after-sales service, predictive maintenance can be used to reduce vehicle breakdowns and improve customer satisfaction. Although not directly involved in the manufacturing process, AI plays a central role in the development of autonomous driving technology and has a significant impact on the development of the automotive manufacturing industry enabling vehicles to understand their surroundings and make safe and effective driving decisions (Uludağ et al. 2019).

1.2 The Critical Role of KM in the Automotive Manufacturing Industry

KM plays a critical role in the automotive manufacturing industry, which involves creating, sharing, using, and managing information and knowledge within an organization. In a highly complex and technology-driven industry such as automotive manufacturing, by effectively managing and sharing internal knowledge, automotive manufacturers can accelerate the process of new product development and enhance innovations

ranging from new technologies to new design concepts. This helps companies maintain a competitive edge and respond quickly to market changes and consumer demands. KM systems can help employees quickly access production processes, operating manuals, and best practice guidelines, which can reduce errors and improve efficiency and quality control on the production line (Hofmann et al. 2023; Jarrahi et al. 2023).

The automotive manufacturing industry has a complex supply chain involving numerous suppliers and partners. Effective KM helps to increase supply chain visibility, optimize inventory management, reduce delays, and ensure efficient coordination of all aspects of the supply chain.

KM can provide the necessary data and information to support fact-based decision-making. This includes market trend analysis, consumer behavior research, and evaluation of competitor strategies, thus helping management make more informed strategic decisions. KM systems enable new employees to assimilate more quickly into the company, and by accessing the company's knowledge base, they can learn the company's workflow, culture, and standard operating procedures more quickly (Demlehner et al. 2021). For existing employees, it's also a great resource for continuous learning and career development. Automotive manufacturing involves multiple departments such as design, engineering, production, and sales. KM helps break down barriers between departments and facilitates cross-departmental information sharing and collaboration, which improves the efficiency and effectiveness of the entire organization. KM can also support better customer service.

The relationship between intelligent vehicles and knowledge management can be effectively analyzed through the lens of the DIKW hierarchy theory, which stands for Data, Information, Knowledge, and Wisdom. This theory provides a framework for understanding how raw data is transformed into meaningful knowledge and ultimately wisdom. Data Collection and Management， Intelligent vehicles are equipped with a multitude of sensors that collect vast amounts of data. Effective knowledge management begins with the efficient collection, storage, and processing of this data. This involves Data Aggregation， Data Filtering， and Data Storage. Information Processing. Once data is collected, it needs to be processed to become useful information. For instance, image recognition algorithms can identify pedestrians, vehicles, and road signs from camera data. The next step is to transform information into knowledge. Identifying patterns in data that can inform decision-making. For example, recognizing that a certain intersection tends to have heavy traffic at specific times. Machine learning techniques allow intelligent vehicles to learn from past experiences and improve their decision-making over time. Finally, the application of knowledge to make wise decisions involves. Using knowledge to make real-time driving decisions. For instance, deciding when to change lanes or how to navigate around obstacles. This could involve updating algorithms and models to better handle new driving scenarios.

The integration of DIKW in intelligent vehicles has several practical implications. Improved data processing and knowledge management can lead to safer driving decisions, reducing the likelihood of accidents. Intelligent vehicles can optimize routes and driving behaviors to reduce fuel consumption and travel time. Providing drivers and passengers with relevant information, such as traffic updates and optimal routes, enhances the overall travel experience. The DIKW hierarchy theory provides a valuable framework for understanding the relationship between intelligent vehicles and knowledge management. By effectively managing data, transforming it into useful information, and applying knowledge wisely, intelligent vehicles can make better decisions, enhance safety, and improve efficiency. The ongoing advancement in AI and machine learning technologies will continue to enhance this relationship, leading to even smarter and more autonomous vehicles in the future.

1.3 Impact of Cultural Factors on KM

KM is not only about technology and processes, but is also closely related to people, organizational culture, and social interactions, so the influence of cultural factors in it should be explored in depth. Among them, organizational culture has a significant impact on the creation, sharing, and utilization of knowledge. Some key cultural factors have a critical impact on KM (Ammal et al. 2021).

An open culture encourages communication and collaboration among employees and facilitates the free flow of knowledge. Trust is the cornerstone of knowledge sharing; only when employees trust each other are they more willing to share their knowledge and experience. Fostering a culture of continuous learning and innovation is critical to KM. In such a culture, employees are encouraged to explore new ideas, learn new skills, and see mistakes as opportunities to learn and grow (Zhao et al. 2022; Yan et al. 2023; Kuang et al. 2018).

The culture should support knowledge sharing and creation through rewards and incentives. If the organization rewards employees who contribute knowledge and help others, then this will encourage more knowledge-sharing behaviors. In highly hierarchical organizational cultures, greater power distances may impede the flow

of knowledge. Lower-level employees may be reluctant to share knowledge with their superiors, fearing that their ideas and feedback will not be valued. Both direct and indirect communication styles can influence KM. In cultures that favor direct communication, knowledge sharing may be more direct and frequent. Whereas in cultures that favor indirect communication, people may be more cautious and need to build stronger trusting relationships to share knowledge (Manik et al. 2022).

A culture's tolerance for risk can influence an employee's willingness to try new approaches or come up with innovative ideas (Grum, 2020). In cultures that tolerate failure, employees may be more willing to share their knowledge and experiences, including those attempts that did not succeed. Organizations in collectivist cultures that place more emphasis on teamwork may be more likely to implement KM practices because knowledge is seen as a shared asset of the team. Whereas in an individualistic culture, knowledge may be viewed as an individual's property and employees may be more reluctant to share it (Tubaro and Casilli, 2019).

2. Theoretical Background and Research Methodologies

2.1 Overview of Automotive Manufacturing in China and Germany

Germany is one of the world's most famous automobile manufacturers, has a long history of automobile manufacturing, and is the founding place of many automobile brands, such as BMW, Mercedes-Benz, Audi and Volkswagen.

The German automotive manufacturing industry has long been a leader in automotive technology and innovation, especially in high-performance vehicles, luxury cars, and automotive engineering and design. In addition, influenced by Germany's Industry 4.0, German automotive companies have invested heavily in research and development (R&D), with the German automotive industry totaling €39 billion in R&D worldwide in 2017, twice as much as a decade ago, and averaging about 6 percent of overall sales (Uludağ et al. 2019; Manik et al. 2022).

The German automotive industry accounts for around 35% of the total R&D investment in the German economy. This puts it well ahead of other sectors. In 2018, the Volkswagen Group invested €13.9 billion in R&D for the year, ranking it number one in the global manufacturing industry. Through this fine and mature division of labor in R&D and its continuous optimization, the German automotive industry as a whole continues to show great potential for innovation and rapid efficiency improvements (Tubaro and Casilli, 2019).

China is the world's largest automotive market, ranking first in passenger car sales, and in recent years the demand in the field of electric and new energy vehicles has grown rapidly. It is worth noting that the government has played a driving role in the development of China's automotive industry.

As early as 2015, the Chinese government put forward the "Made in China 2025" strategy, the core of which is to realize the comprehensive intelligence of the manufacturing industry, more and more manufacturing industries have begun to transform in 2015, and started to integrate with AI in depth (Jarrahi et al. 2023).

Since 2015, more and more manufacturing industries have begun to transform and deeply integrate with AI. Especially in the new energy automobile industry, not only has it invested large capital, but the government has also played an active role in promoting the development and popularization of the new energy manufacturing industry through subsidies and special policies, which has led to the rapid modernization of China's automobile manufacturing industry, and the development of many Chinese automobile brands, such as BYD, Geely, the Great Wall, and Hongqi, in both domestic and international markets. Many Chinese car brands such as BYD, Geely, Great Wall, and Hongqi are becoming increasingly popular in both domestic and international markets (Teece, 2019). With increasing cooperation with international companies, including joint ventures and technology sharing, the competitiveness of Chinese automobiles in the global market is also gradually increasing (Zhao et al. 2022; Kuang et al. 2018).

As shown in Figure 1 below, in general, the German automotive industry is known for its innovation and high-quality products, while the Chinese automotive industry is known for its large market size and fast-growing new energy vehicle sector. The automotive industries of both countries are in a constant state of development and change, with far-reaching impacts on the global automotive market and technological development.

Figure 1: Timeline of the development of the automotive industry in China and Germany

2.2 Automotive Manufacturing and AI Applications Analytical Methods

This paper divides the degree of manufacturing AI into four aspects, as shown in Figure 2. That is intelligent manufacturing, automatic driving systems, AI virtual assistants, intelligent networks, and through these four aspects of Sino-German AI technology and automotive industry intelligence analysis. The parameter selection criteria are as follows:

1. Intelligent manufacturing: mainly refers to the automation, intelligence, and networking of the manufacturing process through the Internet of Things, cloud computing, big data, AI, and other intelligent technologies. Intelligent manufacturing indexing is quantitatively analyzed in terms of the amount of funds invested in the automotive manufacturing industry's preliminary R&D, the proportion occupied by the automation of the production process, and the utilization rate of production data (Taherdoost and Madanchian, 2023).
2. Autonomous driving: a rating of the level of automation of a vehicle, with specific classification criteria as shown in Figure 3 (Manik et al. 2022).
3. AI Assistant: It is a specific application of AI technology in the field of life assistance. It uses advanced technologies such as natural language processing, machine learning, and deep learning to provide users with personalized and intelligent services.

If we quantify the evaluation standard of AI, we can measure the professional degree and experience of AI assistants by the accuracy rate of navigation and road conditions, the accuracy rate of safety monitoring data, and the degree of entertainment information service.

4. intelligent network: also known as an Intelligent Transportation System (ITS), refers to the close integration of communication technology, information technology, and transportation technology, in the road traffic information system, life and social facilities system, and automobile system at three levels, to promote the transportation operation of the intelligent network application system. It aims to create an intelligent transportation network that can address social, economic, and environmental challenges, including construction, operation, and maintenance. The information interaction rate,

information transmission rate, and information carrying capacity per bit are analyzed as indicators for evaluating intelligent networking when measuring intelligent networking (Teece, 2019).

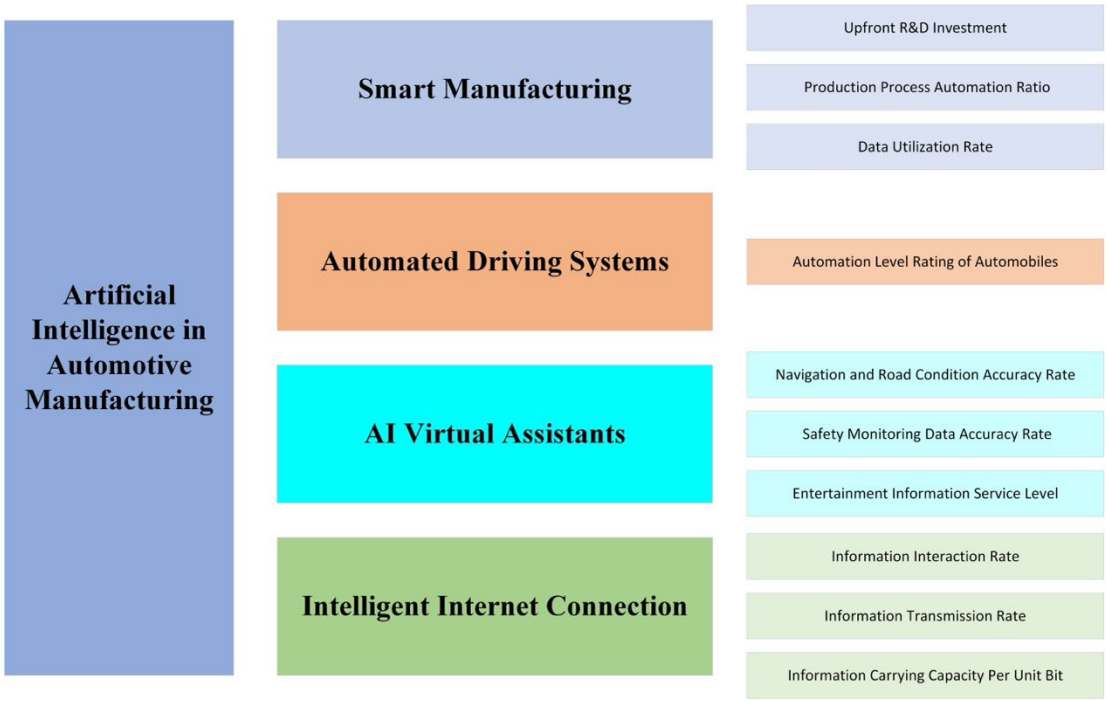


Figure 2: Quantitative criteria for the degree of intelligence in the automotive manufacturing industry

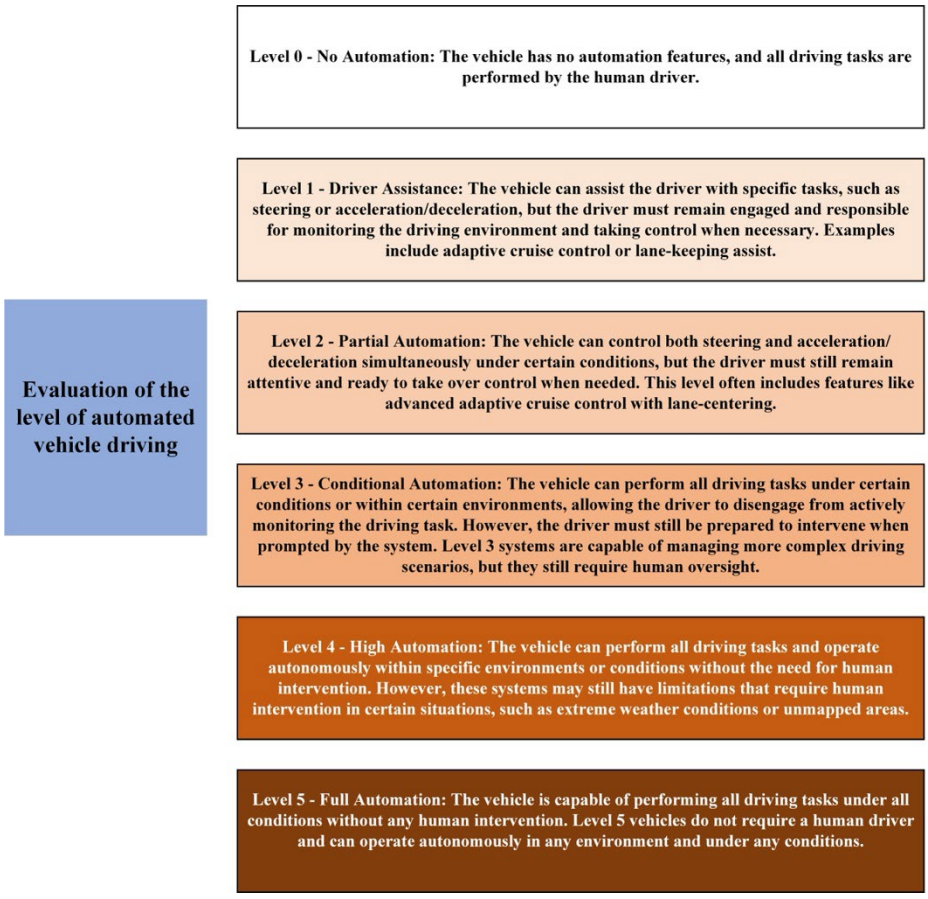


Figure 3: Rating criteria for automotive automation levels in this paper

2.3 Data Analysis

As seen in Figure 4 and Figure 5, the use of AI in China's automotive manufacturing industry is mainly focused on the pre-development of products, accounting for 51 percent of the total use of AI. The main use is reflected in the use of AI technology to automate the production process and improve production efficiency and quality control. By analyzing data from production equipment, AI can predict possible problems and maintenance needs of the equipment, reduce unplanned downtime, and improve productivity. This is the efficiency that China's manufacturing industry cares about the most. In addition to this, China's automotive manufacturing industry cares about user experience, such as the development and updating of AI virtual assistants, which account for 28% of China's manufacturing industry. Data from "China Intelligent Vehicle (Intelligent Connected Vehicle) and World Intelligent Vehicle Industry Speculation and Prospect Forecast Report, 2021-2024" published by China Automotive Industry Research Institute (CAIRI)

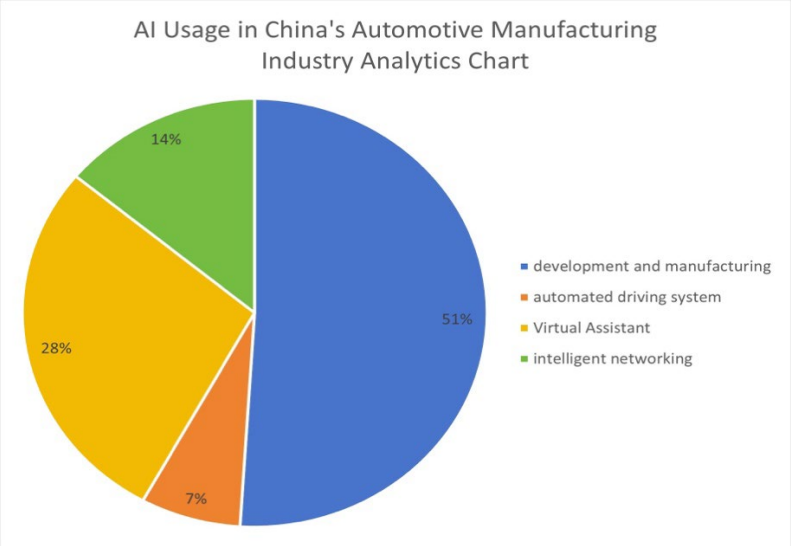


Figure 4: Percentage of intelligence degree of China's automobile manufacturing industry under this paper's standard

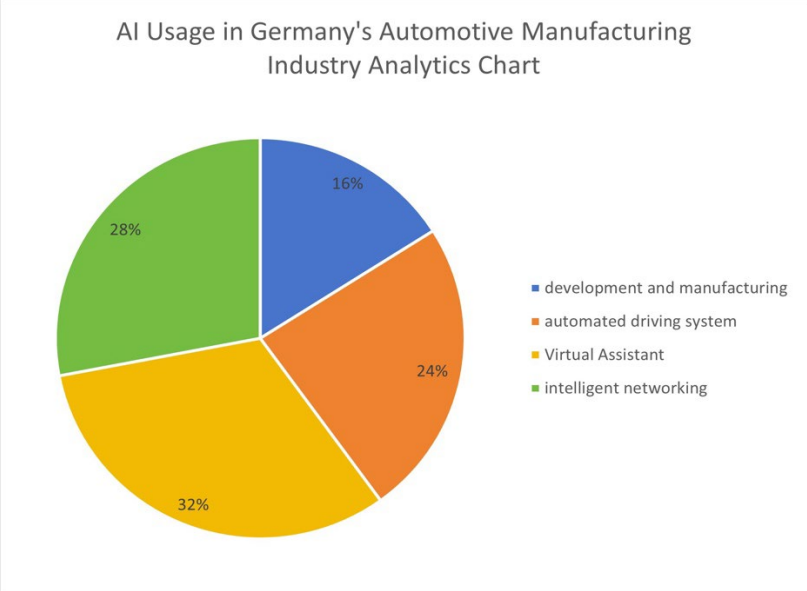


Figure 5: Percentage of intelligence degree of Germany's automobile manufacturing industry under this paper's standard

As seen in Table 1 below, the German automobile manufacturing industry in the use of AI, mainly concentrated on the late use of the product, and in the car's pre-development and design the use of AI accounted for only 16%, which has lot to do with Germany after the industrial revolution for the traditional fuel car obsession, from

the automation of the driving accounted for only 24% can be seen in Germany's new energy vehicle transition slower, in the international economic society Germany is lagging slightly behind in the international economic and social digitalization wave.

Table 1: AI in German Automotive Manufacturing

AI in German and China Automotive Manufacturing				
Areas of Application of AI	Development and manufacturing	Automated driving system	Virtual Assistant	Intelligent networking
AI in German Automotive Manufacturing Percentage	16%	24%	32%	28%
AI in China Automotive Manufacturing Percentage	51%	7%	28%	14%

The current background is that China is a global leader in key technologies and production levels such as batteries, motors, smart cockpits, etc., with an average range of over 460 kilometers for pure electric passenger vehicles, and many new technologies have emerged and taken hold in the country. China continues to make breakthroughs in the technological innovation of new energy vehicles. Battery technology is one of the keys to developing new energy vehicles. In recent years, Chinese enterprises have made remarkable progress in battery technology, such as China's latest generation of lithium iron phosphate batteries, which have an energy density of 180 watt-hours per kilogram and a range of more than 500 kilometers, which not only improves the energy density and range of batteries but also reduces the cost of batteries. AI is practically applied to the automobile manufacturing industry.

In recent years, Germany for using AI in the automotive industry, has also joined the R&D, Mercedes-Benz in the CES demonstrated the new MBUX virtual assistant. Based on large language modeling technology, its voice interaction is as natural as human communication; empowered by 3D graphic technology, its virtual image also has deep feelings and can express different emotions. It can integrate route guidance and driving assistance, presenting road environment information, navigation information, and dynamic information about the car in real-time and seamlessly on the screen. BMW Group also demonstrated a new voice assistant based on a large language model at CES 2024. The use of AI will be shown more fully. So what is the development of the German automotive industry for new energy vehicles? Official data shows that new car sales in Germany in February 2023 improved by 5.4% year-on-year to 217,388 units. However, Germany's progress on electric vehicles remains mixed, with sales of pure electric vehicles down 5% year-on-year, while plug-in hybrid electric vehicles (PHEVs) saw an increase in sales, with PHEV sales of 14,575 units, a 22% year-on-year boost (Uludağ et al. 2019).

With the use of AI, Germany as a result of the Industrial Revolution period ate the dividends of traditional fuel vehicles, coupled with the German automakers for traditional fuel vehicles manufacturing process has been skilled in the heart, want to break the routine there is a certain dilemma, which leads to Germany in the automobile manufacturing industry for the investment in new technology R&D, the transformation of the automated driving system there are ideological difficulties, and therefore companies want to develop new Energy is not enough power. In China, however, the government attaches great importance to environmental protection and has a strong interest in the development and use of new energy sources. In addition, China has maintained a high degree of enthusiasm for the digital economy in recent years. in 2023, China's new energy vehicle production and sales completed 9.587 million and 9.495 million units, respectively, an increase of 35.8% and 37.9% year-on-year, with a market share of 31.6%, and production and sales remained the world's first for nine consecutive years.

3. Comparative Analysis of KM in Chinese and German Automobile Manufacturing Industries

3.1 Differences and Similarities of KM in Chinese and German Automobile Manufacturing Industries

In recent years, Germany's federal education and research department set up a "future investment program" for the field of automotive machinery technology research and innovation to provide financial support. At the same time, Germany encourages German students to actively participate in automotive R&D and experiments for the internationalization of German brand vehicles and adopts various modes of KM to meet the needs and

challenges of the global market, such as centralized and unified intellectual property management, intellectual property management under the responsibility of R&D department, and joint management of intellectual property rights by the legal department and R&D department (Kamran et al. 2022).

China's automobile manufacturing industry has adopted various measures in KM, such as building a KM system, big data intelligence analysis, science and technology innovation knowledge service, and a new energy automobile national big data alliance to improve R&D efficiency, control costs and meet user needs.

Through the previous summary and analysis, we see that both Chinese and German automobile manufacturing industries attach importance to KM as a key factor to enhance competitiveness and innovation, but due to the differences in historical background, cultural characteristics, and market development stage, there are some significant similarities and differences between the two countries in the practice of KM. we will systematically compare and organize the two:

3.1.1 Similarities

Innovation emphasis: the automobile manufacturing industries of both countries attach great importance to innovation and regard KM as an important tool for promoting R&D and technological progress (Yan et al. 2023). This includes investment in new product development, and new technology applications (e.g. electric vehicles and autonomous driving technology).

Technology and digital applications: Both Chinese and German automakers are actively adopting advanced information technologies, such as AI, big data analytics, and cloud computing, to support KM and improve design, production, quality control, and customer service.

Global cooperation: Automakers in both countries recognize the importance of global knowledge sharing and international cooperation, and promote the exchange of knowledge and dissemination of best practices through cooperation with foreign partners, suppliers, and research institutions (Zhao et al. 2022).

3.1.2 Differences

Culture and organizational structure: German corporate culture is often more structured and hierarchical, emphasizing precision and quality control. KM systems tend to be more formal, emphasizing standardization and processes. In contrast, Chinese corporate cultures may be more flexible and dynamic, adaptable, and decision-making processes may rely more on relationships and networks. This may lead to KM practices that focus more on interpersonal communication and informal knowledge-sharing channels.

Knowledge sources and types: German KM tends to focus on internal R&D and the protection and utilization of long-term technology accumulation, valuing deep engineering knowledge and technological innovation.

China's automobile manufacturing industry, in its rapid development stage, is more likely to focus on integrating and absorbing international advanced technology and management knowledge, while at the same time rapidly enhancing its independent R&D capabilities (Demlehner et al. 2021).

Knowledge sharing and cooperation approach: German firms are likely to rely more on formal KM systems and procedures to facilitate knowledge sharing, such as through internal databases, standard operating procedures, and regular training. Chinese firms may rely more on informal networks and personal relationships for knowledge sharing, although formal KM practices are also being gradually established and improved.

Market orientation and customer needs: KM in German automobile manufacturing may focus more on product quality, innovation, and engineering excellence to meet the global market demand for high-end vehicles. China's automobile manufacturing industry may focus more on rapid market response and diversified needs in terms of KM, especially in the field of new energy vehicles and intelligent internet-connected vehicles, to adapt to the rapid changes in domestic and international markets. Based on these similarities and differences, the automotive manufacturing industries of the two countries show different effects on the application of AI.

3.2 Comparison of the Impact of Cultural Factors on KM in Chinese and German Automobile Manufacturing Industries

Through the above combined, it can be seen that the automobile manufacturing industries in China and Germany are affected by their unique cultural factors in KM, and these cultural differences have shaped the different practices of the two countries in knowledge creation, sharing, storage, and application, and we look at

the impacts of the different cultural factors on the automobile manufacturing industries in the two countries respectively:

3.2.1 Cultural Influences on China's Automobile Manufacturing Industry

Relationship orientation (relational): Chinese culture emphasizes interpersonal relationships and networks (i.e., "relationships"), which is reflected in KM by relying on strong personal relationships to facilitate knowledge sharing and transfer. Informal communication channels play an important role in knowledge flow (Demlehner et al. 2021).

Collectivism: Collectivist tendencies lead to a greater tendency for employees to work in teams and share knowledge, but at the same time may lead to individuals being less likely to initiate innovative ideas to avoid conflicting with the team's viewpoints.

Hierarchy: In a more hierarchical corporate culture, knowledge sharing may be hindered because subordinates may be reluctant to communicate information, especially critical or negative feedback, to their superiors.

Rapid Adaptation and Change: Flexibility and the ability to quickly adapt to changes in the market in Chinese corporate cultures help to quickly absorb and apply new knowledge, especially in areas of rapid technological advancement such as electric vehicles and smart internet vehicles (Taherdoost and Madanchian, 2023).

3.2.2 Cultural Influences in German Automotive Manufacturing

Structured and standardized: German corporate culture favors highly structured and standardized processes, which promotes the formalization and standardization of KM and helps to create, store, and share knowledge efficiently.

Quality and Precision: German engineering culture emphasizes quality, precision, and reliability, which is reflected in KM by high requirements for knowledge quality and strict control of knowledge creation and application processes (Ammal et al. 2021).

Risk aversion: The risk aversion tendency in the German culture may lead to more caution in knowledge innovation and trying out new methods, but it also implies more thorough evaluation before adopting and applying new knowledge.

Long-term planning and continuous improvement: The emphasis on long-term planning and continuous improvement in German corporate culture supports the emphasis on long-term knowledge accumulation and continuous learning in KM.

Based on this we integrate and compare the two and can find the different utility of cultural factors in the following three main aspects for KM in the automotive manufacturing industry in the two countries:

1. Knowledge sharing: In Germany, formal structures and processes promote systematic knowledge sharing, while in China, informal interpersonal relationships and networks play a more important role in knowledge sharing (Grum, 2020).
2. Knowledge innovation: The risk-averse tendency of German firms may lead to a cautious attitude towards knowledge innovation, whereas the rapid adaptability and ability to change of Chinese firms help to absorb and apply new knowledge quickly, especially in fast-changing markets and technologies (Uludağ et al. 2019).
3. Organizational structure: The hierarchical structure in the German automotive manufacturing industry may lead to vertical barriers in knowledge flow, while the hierarchical system in China may have an impact on knowledge flow both horizontally and vertically.

4. Conclusion

This study examines the impact of AI on KM in the automotive manufacturing industry in different cultural contexts in China and Germany. A comparative analysis of the Chinese and German automotive manufacturing industries provides new insights into understanding the impact of AI on KM in different cultural contexts and offers suggestions for KM practices in multinational enterprises in the context of globalization. The paper aims to emphasize the importance of adopting and promoting new technologies to understand and consider cultural factors. The study found that AI in both countries facilitated knowledge collection, analysis, and sharing, but the specific practices and ways of application differed. In China, automotive companies have shown a tendency to

adopt new technologies quickly and are very inclusive of new things, which is one of the reasons why Chinese-branded vehicles have gained international recognition in recent years. However, new technologies also bring new challenges, and the protection and management of digital knowledge is urgent. In Germany, automotive companies are adopting AI technologies with a greater focus on systematic and structured processes, reflecting their emphasis on quality and accuracy. This promotes the rigor and reliability of KM in Germany, in addition to the challenges it faces, such as increasingly stringent environmental regulations, the rise of electric vehicles, and global supply chain issues.

Based on the cultural specificities of China and Germany, then, we offer the following advice: For Chinese companies, it is important to focus on IP management and establish a sound legal and policy framework to support continuous innovation and technology development. German companies, on the other hand, can introduce more mechanisms to promote cross-functional cooperation and knowledge sharing to improve the organization's innovation capability and market responsiveness; on the other hand, they can encourage open innovation and external cooperation, pay attention to environmental regulations, and utilize external knowledge resources to strengthen the competitiveness of their enterprises. We believe that both Germany and China will have better development in the automotive industry. But while developing the automotive industry it is important to focus on understanding how different cultural backgrounds understand the use of AI.

Acknowledgments

This study was supported by a grant from the Macao Polytechnic University (Grant No. RP/CHS-01/2022). Also, thanks Prof. Yifen Yin and Qianxi Chen from Macao Polytechnic University, and Dr. Qixiang Niu from Northwestern Polytechnic University, for their guidance on the framework and content of the article. The authors sincerely thank the anonymous reviewers for their valuable and constructive comments.

References

Al Mansoori, S., Salloum, S. A., & Shaalan, K. (2020). The impact of artificial intelligence and information technologies on the efficiency of knowledge management at modern organizations: a systematic review. Recent advances in intelligent systems and smart applications, 163-182.

Ammal, S. M., Kathiresh, M., & Neelaveni, R. (2021). Artificial intelligence and sensor technology in the automotive industry: An overview. Automotive Embedded Systems: Key Technologies, Innovations, and Applications, 145-164.

Demlehner, Q., & Laumer, S. (2020). Shall we use it or not? Explaining the adoption of artificial intelligence for car manufacturing purposes.

Demlehner, Q., Schoemer, D., & Laumer, S. (2021). How can artificial intelligence enhance car manufacturing? A Delphi study-based identification and assessment of general use cases. International Journal of Information Management, 58, 102317.

Grum, M. (2020). Managing human and artificial knowledge bearers: the creation of a symbiotic knowledge management approach. In Business Modeling and Software Design: 10th International Symposium, BMSD 2020, Berlin, Germany, July 6-8, 2020, Proceedings 10 (pp. 182-201). Springer International Publishing.

Hofmann, M., Neukart, F., & Bäck, T. (2023). Artificial Intelligence and Data Science in the Automotive Industry, 2017. URL: https://arxiv. org/abs/1709.01989.

Jarrahi, M. H., Askay, D., Eshraghi, A., & Smith, P. (2023). Artificial intelligence and knowledge management: A partnership between human and AI. Business Horizons, 66(1), 87-99.

Kamran, S. S., Haleem, A., Bahl, S., Javaid, M., Prakash, C., & Budhhi, D. (2022). Artificial intelligence and advanced materials in automotive industry: Potential applications and perspectives, Materials Today: Proceedings, 62, 4207-4214.

Kuang, X., Zhao, F., Hao, H., & Liu, Z. (2018). Intelligent connected vehicles: the industrial practices and impacts on automotive value-chains in China. Asia Pacific Business Review, 24(1), 1-21.

Manik, H. F. G. G., Christanti, R., & Setiawan, W. (2022). Knowledge management and community-based enterprise: an initiative to preserve the shadow puppet traditional knowledge in Yogyakarta, Indonesia. VINE Journal of Information and Knowledge Management Systems.

Soegoto, E. S., Utami, R. D., & Hermawan, Y. A. (2019). Influence of artificial intelligence in automotive industry. In Journal of Physics: Conference Series (Vol. 1402, No. 6, p. 066081). IOP Publishing.

Taherdoost, H., & Madanchian, M. (2023). Artificial intelligence and knowledge management: Impacts, benefits, and implementation. Computers, 12(4), 72.

Teece, D. J. (2019). China and the reshaping of the auto industry: A dynamic capabilities perspective. Management and Organization Review, 15(1), 177-199.

Tubaro, P., & Casilli, A. A. (2019). Micro-work, artificial intelligence and the automotive industry. Journal of Industrial and Business Economics, 46, 333-345.

Uludağ, Ö., Kleehaus, M., Dreymann, N., Kabelin, C., & Matthes, F. (2019). Investigating the adoption and application of large-scale scrum at a German automobile manufacturer. In 2019 ACM/IEEE 14th International Conference on Global Software Engineering (ICGSE) (pp. 22-29). IEEE.

Yan, W., Xiong, Y., Gu, A., Lu, H., & Zhang, X. (2023). Digital technology and enterprise knowledge management: literature review and theoretical framework construction. Asia Pacific Business Review, 29(4), 931-949.

Zhao, Y., Wen, S., Zhou, T., Liu, W., Yu, H., & Xu, H. (2022). Development and innovation of enterprise knowledge management strategies using big data neural networks technology. Journal of Innovation & Knowledge, 7(4), 100273.

Non Academic Papers

Cost Learning as a Knowledge Management Tool in the Process Of Building the Competitiveness of Logistics Enterprises

Sylwia Łęgowik-Świącik and Joanna Kadłubska
Czestochowa University of Technology the Faculty of Management, Poland

s.legowik-swiacik@pcz.pl
joannakadlubska1@interia.pl

Abstract: This article contributes to research on the factors building the competitiveness of enterprises, taking into account knowledge management processes, by deepening the understanding of cost learning processes. The cost learning construct is a knowledge management tool that allows for searching for new areas for building the competitiveness of enterprises. Cost learning processes are particularly important in logistics companies due to the service-oriented nature of their operations. Cost learning in building the competitive advantage of logistics enterprises requires the identification of factors building their competitiveness. Therefore, considering the current state of research and experience in the field of cost learning in building the competitive advantage of enterprises, the objective of this publication has been to understand and explain the relationships between cost learning and the factors building the competitiveness of logistics enterprises. To achieve the assumed objective, the following research methods were used: critical literature analysis, survey questionnaire and Pearson correlation analysis. The empirical research was conducted on a sample of 100 enterprises. The research conclusions suggest that building competitiveness should take into account the selection of strategic factors building the competitiveness of enterprises, identified on the basis of knowledge management processes that take into account cost learning. The issue of cost learning in building the competitive advantage of logistics enterprises is important and up-to-date due to its impact on strategic decision-making in these enterprises.

Keywords: Cost Learning, Knowledge Management, Competitiveness of Enterprises

1. Introduction

The development of enterprises in a competitive environment depends on the selection of strategic goals, design, implementation, and execution of the strategy. Therefore, making the right decisions regarding building competitiveness requires the implementation of knowledge management tools that will allow for the correct diagnosis of the current state of the enterprise and the indication of directions for its further development. Cost learning processes are an important knowledge management tool since they allow for searching for new areas for building the competitiveness of enterprises. Cost learning processes are particularly significant in logistics companies due to the service-oriented nature of their operations. Logistics companies are organizational units specializing in the implementation of activities such as transport, logistics, forwarding, warehousing, as well as additional activities such as reloading, handling, packaging, and labeling (Brah, Ying Lim, 2006). This definition emphasizes the specificity of operations of logistics companies, which means that they must have specific elements of assets and liabilities necessary to conduct business activities by such entities. This means that logistics companies operating in a competitive market are focused on developing strategies to take advantage of market opportunities (Lin, Ho, 2011).

Cost learning is a knowledge management tool in the context of building the competitiveness of logistics companies, as it allows them to identify and analyze key areas in which they can reduce operating costs, without negatively affecting the quality of services. Through cost learning, logistics companies are able to better understand where and how they can introduce innovation to reduce costs and at the same time increase the value of the services they offer. Moreover, cost analysis and learning on its basis helps logistics companies identify potential operational and financial risks and develop strategies to minimize them. Cost knowledge allows logistics companies to make more informed strategic decisions. This means that logistics companies can use cost information to plan long-term development, invest in new markets or technologies, which directly affects their competitive position. However, the adaptability of logistics companies, especially in terms of the geopolitical situation in Eastern Europe, is limited and does not guarantee obtaining a sustainable competitive advantage. Therefore, cost learning processes are becoming more and more important, as they enable flexible adaptation to customer needs. Hence, when considering the current state of research and experience in the field of cost learning in building the competitive advantage of enterprises, the objective of this publication has been to understand and explain the relationships between cost learning and the factors building the competitiveness of logistics enterprises. To achieve the adopted objective, the structure of the article has been divided into two main parts. In the first part of the article, theoretical one, the competitive strategy based on cost leadership is discussed, pointing to cost learning processes in logistics companies in counterpoint. Then, the

factors building the competitive advantage of logistics enterprises in the context of cost learning are identified. The second part of the article is the presentation of the results of the empirical research, including the description of the research methodology applied. The discussion and summary present and discuss the results of the empirical research, including the conclusions with some practical implications.

2. Theoretical Foundations for Cost Management and the Implementation of the Cost Leadership Strategy

Searching for new areas of cost management and the implementation of the cost leadership strategy is the result of permanent changes occurring in the endogenous and exogenous environment of modern enterprises. In the literature on the subject, the cost management process includes making decisions related to planning, identification, analysis, evaluation and control of activities connected with the use of resources in the enterprise's operations (Kaplan, Cooper, 1998). However, the critical analysis of the presented approach to the definition of cost management raises the question whether it is really a process that allows for learning costsin the enterprise? The cost management process implemented in enterprises often results in cost reduction, which allows lower prices, which leads to an increase in sales and profitability of the business conducted (Zengin, Ada, 2010). This means that the driving factor of the cost management process is decisions that reflect the choice of one of the possible courses of action in the given situation (Coeurderoy, Durand, 2004). However, it should be noted that when new competitors appear on the market, companies should modify not only the cost management process. In order to acquire new knowledge about costs, operational activities should be reoriented, which will allow for generating new revenue streams as a result of cost learning (Banker, et al., 2018). Conducting the cost management process aimed at creating value may also prove problematic (Kulmala, et al., 2002). When implementing cost management processes, it should be remembered that customer needs and expectations are changing (McNair, et al., 2001). Therefore, the cost management process should strengthen the current value creation or enable the expansion of the current scope of activity through diversification. The idea of managing company costs is also criticized for the extermination of costs, the construction of a strategy based mainly on financial measures and the issue of detaching managers' remuneration from the increase in the value of the company (Henri, et al., 2016). This type of situation can be improved by striving to increase profitability while controlling costs and optimizing the capital structure in order to reduce the cost of capital.

In this context, the cost leadership strategy is important in the cost management process if it leads to learning how to achieve higher prices, lower costs, and greater sales (Valipour, et al., 2012). This means that the cost leadership strategy should take into account the correct relationships between strategic resources, customers and value creation (Hamel, 2001). The cost leadership strategy should be related to strategic resources through the configuration of unique activities, resources and competencies the task of which is to support the implementation of strategic goals (Baroto, et al., 2012). If the cost leadership strategy remains in compliance with the customer, it provides benefits, thus creating, on the one hand, a combination of customer relationships, and on the other hand, it is a point of connection between the company and the customer (Tanwar, 2013). It is worth noting that the cost leadership strategy, while being related to value creation, determines the efficiency of the business conducted (Nandakumar. et al., 2012), increasing the ability to create profit.

However, it should be emphasized that the literature on cost management and the implementation of the cost leadership strategy in logistics companies, especially in terms of the geopolitical situation in Eastern Europe, is fragmentary and dispersed. The current state of knowledge in the field is characterized by methodological diversity. The lack of in-depth theoretical research in this field results in few attempts to explain the relationships between cost learning and factors building the competitiveness of logistics enterprises. The above arguments led to an attempt at theoretical analysis and empirical research to fill the identified gap by deepening the understanding of the cost learning process and the mechanisms underlying it.

3. Competitive Strategy Based on Cost Leadership and the Process of Cost Learning in Logistics Enterprises

The competitiveness of enterprises is the basic concept characterizing modern economies, it is the sustainable ability to design, produce and sell products the prices of which, as well as quality and other values are more attractive than the corresponding products offered by the competitive environment. The competitiveness of enterprises combines not only specific product features but can also be perceived through the prism of competitiveness in terms of available resources (financial, human, material, intellectual) (Nikolova, et al., 2017). All the above features of competitiveness increase the company's potential and reduce its operating costs

(Stonehouse, Snowdon, 2007), which positively affects product prices and the level of profits achieved by the company. In all theories regarding the competitiveness of enterprises, strategy plays a key role. The most famous concept in the literature is the concept of competitive advantage by M.E. Porter (Porter, 2000). Its basis is the search for sources of competitive advantage in individual economic sectors in which enterprises operate.

The competitive advantage strategies formulated by ME Porter are universal and can also be used by logistics companies. M.E. Porter distinguishes three competitive advantage strategies (cost leadership, differentiation, and focus) (Porter, 2003) but the cost leadership strategy is essential in the context of learning costs by logistics companies. This is due to the fact that placing emphasis on competing based on a leading position in terms of total costs in this strategy allows logistics companies to obtain the status of a leader in the sector of logistics services in relation to the level of generated costs. The cost leadership strategy is a bit of a challenge for logistics companies (Chluska, 2023) since it allows for achieving a relatively high market share, provided that logistics companies are able to maintain a low level of operating costs, otherwise they will be forced to look for alternative types of a competitive advantage (Porter, Magretta, 2014). The benefit of implementing the cost leadership strategy for logistics companies is the ability to generate higher profits. Additionally, logistics companies can benefit from flexibility in terms of services provided and the ability to gain a favorable position in the market, which benefits may result from the implementation of the cost leadership strategy, as presented in Figure 1.

Figure 1: Benefits of the cost leadership strategy in logistics enterprises

Source: Porter, M., Magretta, J. (2014). Strategy and Competition: The Porter Collection (3 Items). Harvard Business Review Press.

The application of the cost leadership strategy must consider cost learning processes. Cost learning can take place by observing the experience curve (Yelle, 1979), which describes the phenomenon of the decrease in unit costs of manufacturing products as the total production volume increases (Li, et al., 2015). The idea of the cost learning process assumes that the more units of a product the enterprise manufactures, the more it learns about the production process, which allows for the optimization and improvement of operations, due to which it is possible to reduce the level of unit costs of products and thus improve performance. Cost learning within the experience curve may consist in cost reduction. In this case, with each doubling of cumulative production, a decline in unit costs can be observed (Gray, et al., 2009). This is the result of increased efficiency, better use of resources, innovation in processes, as well as employee skills and experience (Jaber, et al., 2008) . This means that the greater the cumulative production, the greater the possibility of cost reduction. This effect is noticeable since companies learn how to minimize waste, improve processes, and increase productivity (Yu, et al., 2020). Through cost learning, logistics companies can identify ways to improve processes such as inventory management, transportation, warehousing, and customer service (Zhu, et al., 2021). By using modern technologies and automating processes, logistics enterprises can help reduce operating costs and increase performance. Moreover, as the volume of freight and routes handled increases, logistics companies can reduce operating costs, which contributes to the implementation of the cost leadership strategy.

To sum up, it is worth emphasizing that cost learning is an important knowledge management tool in the implementation of the competitive strategy based on cost leadership. It allows for systematic cost reduction due to greater production and experience gained. Enterprises, especially those in the logistics industry, can use cost learning to optimize their operations and increase competitiveness through the cost strategy. However, it is important not to neglect other key aspects of the business such as quality, innovation, and customer service. This is possible to achieve when the functioning of logistics companies is based on a low-cost position implemented in a strategic segment, or on high differentiation of services, or by applying both solutions.

4. Identification of Factors Building the Competitive Advantage of Logistics Enterprises in the Context of Cost Learning

The understanding of cost learning processes in logistics companies should be determined by a selected set of factors (Figure 2), which should include areas such as (Jaber, Saadany, 2011):

- introducing changes in the company's competitive strategies regarding key resources,
- acquiring knowledge in the company by creating new organizational practices,
- learning in the enterprise by searching for and implementing good practices,
- taking advantage of opportunities and making innovative decisions,
- diversification of activities as a factor determining the market position of the enterprise,
- taking actions to implement positively assessed opportunities.

Figure 2: Factors building the competitive advantage of logistics enterprises in the context of cost learning.

Source: Jaber, M.Y., Saadany, A.M., (2011), An economic production and remanufacturing model with learning effects, Int. J. Prod. Econ. 131 (1).

Introducing changes in competitive strategies in terms of key resources of logistics companies should contribute to distinguishing a given company from competitors (Tomski 2014). Therefore, logistics companies ought to focus their activities, on the one hand, on cost learning by introducing changes in terms of cost rationalization, as well as the selection of key resources, and on the other hand, on searching for new sources of revenue (Ranjith, 2016). The changes should also consider relationships with key customers and the scope of services and products provided (Bumane, 2018).

Acquiring knowledge in the enterprise by creating new organizational practices and learning through searching for and implementing good practices is a manifestation of strategic innovation (Kramer, Porter, 2011). Therefore, strategic innovation is reflected in taking actions aimed at knowledge acquisition and organizational learning. It is worth noting that strategic innovation, through acquiring knowledge and cost learning, contributes to changing the business model and maintaining the adopted level of competitiveness of logistics enterprises (Dyduch, 2019).

Taking advantage of opportunities and making innovative decisions is a sign of strategic entrepreneurship, which, however, requires the implementation of the process of planning and learning costs by logistics companies for the idea to be implemented. Therefore, strategic entrepreneurship should not only enable taking advantage of opportunities and making innovative decisions (Kaplan, Norton, 2006), but also allow for planning new ventures and taking actions to implement positively assessed opportunities in the environment (Lepak, et al., 2007).

The diversification of activities as a factor determining the market position of the enterprise is the factor of the company's position in the market. The factors of positioning a logistics company on the market should consider professionalism and flexible behavior, as they determine the market position of the company (Mangan, 2004). Therefore, the diversification of activities of the logistics company (Skowron-Grabowska, 2023) ought to take into account cost learning processes, since they determine the company's ability to engage in new areas of operation, allowing for acquiring new markets and new skills, abilities and competences (Kim, Mauborgne, 2017).

Taking actions to implement positively assessed opportunities is an important factor determining the company's predispositions to compete in the market. The identification of the company's predispositions to compete on the market of logistics services should take into account: high quality of the services provided, good price-quality ratio of the services provided and low costs (Otola, Grabowska, 2020). This means that taking actions to implement positively assessed opportunities requires the implementation of cost learning processes, carried out by assessing the ability of logistics companies to conduct business and compete in the market, considering internal and external factors resulting from the market environment.

Summarizing the above considerations, it can be noted that the selected set of factors for implementing cost learning processes in logistics enterprises constitutes a conceptual instrument of strategic management, acting as a template for the cost learning process. Its advantage is the primacy of strategic choices, which causes that managers' attention is focused on strategic factors building the competitiveness of logistics enterprises, enabling, on the one hand, cost reduction and, on the other hand, achieving a competitive advantage (Stępień, 2022). The correctly selected set of factors needed to implement cost learning processes constitutes the basis for developing a detailed cost learning plan in logistics companies. This means that logistics companies should choose a set of selected factors to implement cost learning processes that will allow them to specify the most critical management areas while considering the company's strengths and weaknesses against the background of existing and identifiable opportunities and threats.

5. Research Methodology and the Structure of the Research Sample

The empirical research was quantitative in nature. The selection of the research sample was purposeful. The research was carried out using - CATI Computer Assisted Telephone Interview (Hair, et al., 2014). The applied research method has both limitations and advantages. The limitations include difficulties associated with examining areas that are complicated for the respondent and the complexity of the process of conducting research consisting of many questions (Vogel, Koutsombogera, Costello, 2020). The advantages of using the CATI method when achieving the research objective include: systematicity of stages occurring during the research, obtaining high-quality results in a short period, integrated data collection flow (Oláh, et al., 2019) . To accomplish the research objective, a survey questionnaire was used, which was verified in the presence of the interviewer. The questions used a five-point Likert rating scale. The respondents were asked to answer to what extent they agreed or disagreed with each statement. Answer 5 meant "I completely agree", 4 - "I agree", 3 - "I don't know", 2 - "I disagree", and 1 - "I completely disagree". The structure of the research sample is presented in Figure 3.

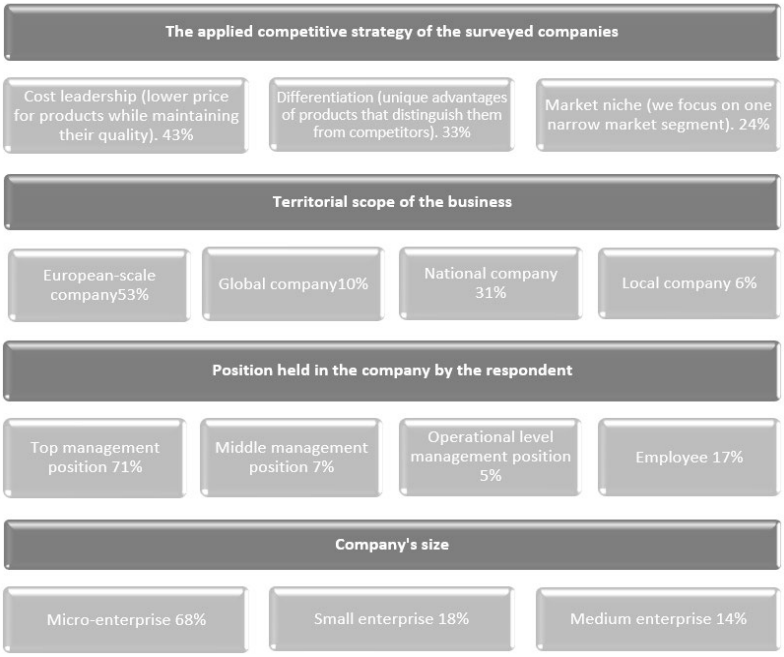


Figure 3: Structure of the research sample

Source: Own study based on the conducted research.

The population of the surveyed enterprises consisted of 100 micro, small and medium-sized logistics enterprises operating in Poland. When analyzing the structure of the research sample, it is noted that most of the research covered enterprises using the cost advantage strategy (43%). Considering the territorial scope of their activities, the vast majority of the surveyed entities were European-scale enterprises (53%). Most of the survey respondents held top management positions (71%). When considering the size of the business conducted and the size of the enterprise, it should be noted that the vast majority of the surveyed entities were micro logistics enterprises (68%).

6. Results of the Conducted Empirical Research

In order to understand and explain the relationships between cost learning and the factors building the competitiveness of logistics enterprises, the Pearson correlation coefficient was used, which takes the values in the range < -1.1 >. The tested relationships were additionally confirmed by a significance test (at the level of $\alpha = 0.05$). Table 1 presents the research results obtained using the Pearson correlation matrix for introducing changes in the company's competitive strategies and the factors determining the company's competitiveness, i.e. low costs.

Table 1: The relationship between introducing changes in the company's competitive strategies (changes in the set of key resources) and the factor determining the company's competitiveness (low costs).

Pearson correlation matrix	Low costs as a factor determining the company's competitiveness
Introducing changes in the company's competitive strategies in terms of key resources	0.75

Source: Own study.

When analyzing the data presented in Table 1, it is noted that there is a strong positive relationship between introducing changes in the company's competitive strategies regarding key resources and the factors determining the company's competitiveness, such as low costs (0.75). Logistics companies are aware that low costs have a positive impact on their competitive position in the market. Additionally, the surveyed companies are changing the set of key resources. As a result, competitors' strategies change, making them more attractive in the market. Table 2 shows the correlation between strategic innovation manifested in acquiring knowledge in the surveyed enterprises and low costs.

Table 2: The relationship between acquiring knowledge in the enterprise by creating new organizational practices and low costs.

Pearson correlation matrix	Low costs as a factor determining the company's competitiveness
Acquiring knowledge in the enterprise by creating new organizational practices	0.75

Source: Own study.

Based on the results presented in Table 2, it can be concluded that in the surveyed enterprises there is a strong positive relationship between strategic innovation in the process of acquiring knowledge by creating new organizational practices and low costs as a factor determining their competitiveness (0.75). Creating new organizational practices can increase the efficiency of enterprises and contribute to the reduction of waste, which may translate into lower operating costs. Table 3 shows the correlation between the input variables of strategic innovation and the factor determining the economic competitiveness of the surveyed enterprises, i.e. low costs.

Table 3: The relationship between learning in the company by searching for and introducing good practices and low costs.

Pearson correlation matrix	Low costs as a factor determining the company's competitiveness
Learning in the company by searching for and introducing good practices	0.71

Source: Own study.

When considering the results presented in Table 3, it can be concluded that there is a strong positive relationship between strategic innovation in the process of searching for and implementing good practices and low costs treated as a factor determining the competitiveness of micro, small and medium-sized logistics enterprises (0.71). The surveyed companies are searching for and implementing good practices and at the same time analyzing the level of decision-making costs. Table 4 shows the correlation between the factors determining the company's competitiveness, such as low costs, and taking advantage of opportunities and making innovative decisions.

Table 4: The relationship between taking advantage of opportunities and making innovative decisions and low costs.

Pearson correlation matrix	Low costs as a factor determining the company's competitiveness
Taking advantage of opportunities and making innovative decisions	0.67

Source: Own study.

When analyzing the research results presented in Table 4, it is noted that in the case of the logistics enterprises studied, there is a strong positive relationship between the factor determining the company's competitiveness, such as low costs, and the ability to seize opportunities and make innovative decisions, which are a manifestation of strategic entrepreneurship (0.67). These enterprises are aware that low costs are an important factor in building the competitiveness of enterprises, and taking advantage of opportunities and making innovative decisions increases the attractiveness of the sector. As a result, companies become much more competitive in the market. Table 5 presents the research results obtained using the Pearson correlation matrix of the input variables for business diversification and low costs.

Table 5: The relationship between the diversification of activities and low costs in the surveyed enterprises.

Pearson correlation matrix	Low costs as a factor determining the company's competitiveness
Diversification of activities as a factor determining the company's market position	0.67

Source: Own study.

The conducted research presented in Table 5 indicates that in the case of the logistics companies surveyed, there is a strong positive relationship between low costs as the competitiveness factor and the diversification of activities treated as a factor determining market position (0.67). Micro, small and medium-sized logistics enterprises are becoming more competitive by maintaining low operating costs, which allows them to offer their products or services to customers at lower prices. However, the diversification of activities allows them to offer a wider catalog of services, which makes them more attractive to their clients. Table 6 shows the correlation between the factors determining the company's competitiveness, manifested in low costs, and strategic entrepreneurship, consisting in positively assessed opportunities resulting in taking actions aimed at their implementation.

Table 6: The relationship between taking actions to implement positively assessed opportunities and low costs.

Pearson correlation matrix	Low costs as a factor determining the company's competitiveness
Taking actions to implement positively assessed opportunities	0.60

Source: Own study.

Based on the correlation research, a strong positive relationship (0.60) is noted between the factor determining the company's competitiveness in the form of low costs and strategic entrepreneurship implemented through positively assessed opportunities resulting in taking actions aimed at their implementation (Table 6). This may indicate that the surveyed enterprises, while implementing a strategy focused on low costs, also take actions aimed at implementing positively assessed opportunities. Each positively assessed opportunity is a motivating factor to act, and aiming at low costs in relation to positively assessed opportunities increases the competitiveness of the surveyed enterprises.

7. Discussion

When considering the results of the obtained research aimed at understanding and explaining the relationships between cost learning and the factors building the competitiveness of logistics enterprises, it is noted that there are strong positive relationships. When analyzing strong positive relationships in relation to cost learning processes through the implementation of the factors such as: introducing changes in competitors' strategies in terms of key resources, or taking advantage of opportunities and making innovative decisions, it can be concluded that the surveyed logistics companies are aware of the potential of their knowledge and use opportunities to build their competitiveness. A similarly strong positive relationship exists between low costs and acquiring knowledge by creating new organizational practices, as well as learning through searching for and implementing good practices, which may translate into a long-term process requiring the management staff to have knowledge about the customer to provide them with services of high quality and acceptable prices. Based on the results obtained, it can be concluded that there is a strong positive relationship between low costs and the diversification of activities, which is a factor determining the market position of the company, as well as taking actions to implement positively assessed opportunities. This may mean that the surveyed logistics companies rationalize their cost structure based on positively assessed opportunities, which will allow these entities to become more competitive by maintaining low operating costs to offer their products or services to customers at lower prices.

Summarizing the results of the research procedure in the field of examining the relationship between the factors building the competitiveness of the surveyed logistics enterprises, it should be noted that the low-cost strategy is characteristic of logistics enterprises which, while conducting their operations, on the one hand, take actions aimed at learning the company's costs, and on the other hand, identify factors building competitiveness, striving to increase sales revenues, which has a positive impact on the economic results of the surveyed enterprises.

8. Conclusions

To sum up the presented considerations, it should be stated that they allow for the following conclusion that, in a situation of environmental variability, the factors that highlight the consistency between the ability to identify factors of competitive advantage and the ability to initiate changes undertaken in the area of conducted business activities are of great importance. The following conclusions emerge from the conducted research:

- the surveyed logistics companies build competitive advantage based on cost learning processes, which constitute a knowledge management tool, understood as a long-term process, requiring the management staff to have knowledge about the product and the customer,
- when assessing the conditions for building the competitiveness of logistics companies, it can be noted that the processes of learning the costs of strategic innovation of the surveyed enterprises are positively influenced by factors building their competitiveness, which may indicate an increase in the awareness of the management staff of logistics industry enterprises regarding the potential associated with having knowledge.

The business environment of logistics companies is dynamic and requires constant adaptation to new conditions. Therefore, cost learning becomes an element of building the competitiveness of logistics companies that allows them to quickly respond to market changes and meet competitive challenges. Moreover, cost learning, which is a knowledge management tool in logistics companies, enables not only cost optimization, but also innovation, strategic decision-making, and flexible response to changes, which is the basis for building competitiveness in the logistics services market. In conclusion, the considerations presented in this study allowed for achieving the intended objective. The issue of understanding and explaining the relationship between cost learning and the factors building the competitiveness of logistics enterprises is important and up-to-date due to its impact on strategic decision-making in these enterprises.

The recommendation for the surveyed logistics companies is to implement cost learning processes to build competitive advantage and improve competitiveness. The accurate identification of factors building competitiveness allows for changes in competitive strategies and should lead to distinguishing the company from its competitors.

References

Banker, R. D., Byzalov, D., Fang, S., Liang, Y. (2018). „Cost management research". *Journal of Management Accounting Research*, *30*(3), 187-209.

Baroto, M. B., Abdullah, M. M. B., Wan, H. L. (2012). „Hybrid strategy: A new strategy for competitive advantage". *International Journal of Business and Management*, *7*(20), 120.

Brah, S. A., Ying, L. H. (2006). „The effects of technology and TQM on the performance of logistics companies". *International Journal of Physical Distribution and Logistics Management*, 36(3), 192-209.

Bumane, I., (2018), „The methodology of the statement of comprehensive income and its impast on profitability: the case of Latvia", *Entrepreneurship and Sustainability* Issues, nr 6 (1), 77-86.

Chluska, J., (2023), „The Role of the Intellectual Potential of Employees in Creating the Goodwill of a Teaching Hospital", Proceedings of the 24th European Conference on Knowledge Management. Vol. 24 nr 1 (red.) Matos Florinda, Rosa Alvaro.

Coeurderoy, R., Durand, R. (2004). „Leveraging the advantage of early entry: proprietary technologies versus cost leadership". *Journal of Business Research*, *57*(6), 583-590.

Dyduch, W. (2019), „Entrepreneurial strategy stimulating value creation: Conceptual findings and some empirical tests", *Entrepreneurial Business and Economics Review*, Vol. 7, No. 3, 65-81.

Gray, J.V., Tomlin, B., Roth, A.V., (2009) *Outsourcing to a powerful contract manufacturer: the effect of learning-by-doing*, Prod. Oper. Manag. 18 (5), 487–505.

Hair, J.F. et al., (2014), *Multivariate Data Analysis*. 7th Ed., Pearson Education, Upper Saddle, 129, pp. 282-288.

Hamel, G. (2001). Leading the revolution: an interview with Gary Hamel. *Strategy & Leadership*, *29*(1), 4-10.

Henri, J. F., Boiral, O., Roy, M. J. (2016). „Strategic cost management and performance: The case of environmental costs". *The British Accounting Review*, *48*(2), 269-282.

Jaber, M.Y., Goyal, S.K., Imran, M., (2008) *Economic production quantity model for items with imperfect quality subject to learning effects*, Int. J. Prod. Econ. 115 (1), 143–150.

Jaber, M.Y., Saadany, A.M., (2011), *An economic production and remanufacturing model with learning effects*, Int. J. Prod. Econ. 131 (1), 115–127.

Kaplan, R. S., Cooper, R. (1998). *Cost and effect: using integrated cost systems to drive profitability and performance*. Harvard Business Press.

Kaplan, R. S., Norton, D. P. (2006). *How to implement a new strategy without disrupting your organization*. Harvard Business Review, 84(3), 100.

Kim, W. C., Mauborgne, R. A. (2017). *Blue ocean leadership*. Harvard Business Review Press.

Kramer, M., Porter, M.E., (2011) "Creating value for business and society", Harvard Business Review Poland, No 99.

Kulmala, H. I., Paranko, J., Uusi-Rauva, E. (2002). „The role of cost management in network relationships". *International Journal of Production Economics*, *79*(1), 33-43.

Lepak, D.P., Smith, K.G., Taylor, M.S., (2007), „Value Creation and Value Capture. A Multilevel perspective", Academy of Management Review 2007, Vol. 32, No. 1, 181-182.

Li, T., Sethi, S.P., He, X.,(2015), „Dynamic pricing, production, and channel coordination with stochastic learning", Prod. Oper. Manag. 24(6), 857–882.

Lin, C. Y., Ho, Y. H. (2011). „Determinants of green practice adoption for logistics companies in China". *Journal of business ethics*, 98, 67-83.

Mangan, J., (2004), „Combining Quantitative and Qualitative Methodologies in Logistics Research", *International Journal of Physical and Logistics Management*, 2004, Vol. 34, No. 7.

McNair, C. J., Polutnik, L., Silvi, R. (2001). „Cost management and value creation: the missing link". *European Accounting Review*, *10*(1), 33-50.

Nandakumar, M. K., Ghobadian, A., O'Regan, N. (2011). „Generic strategies and performance–evidence from manufacturing firms". *International Journal of productivity and performance management*, *60*(3), 222-251.

Nikolova, V. L. , Rodionov, G.D., Afanaseyeva, V.N., (2017), Impact of Globalization on Innovation Project Risks Estimation, European Research Studies Journal, nr 20(2B), 396-410.

Oláh, J. et al., (2019), *Analysis and comparison of economic and financial risk sources in SMEs of the Visegrad group and Serbia*. 515 Sustain., 11.7. 1853.

Otola, I., Grabowska M., (2020), *Business Models. Innovation, Digital Transformation, and Analytics*, Taylor and Francis Group, Boca Raton, 9-11.

Porter, M.E. (2000) "Location, competition and economic development: Local clusters in a global economy". *Economic Development Quarterly*, 14(1), 15–34.

Porter, M.E. (2003) "The economic performance of regions". *Regional Studies*, 37, 549–578.

Porter, M.E., Magretta J., (2014). *Strategy and Competition: The Porter Collection* (3 Items). Harvard Business Review Press.

Ranjith, V.K., (2016), „Business Models and Competitive Advantage", *Procedia Economics and Finance*, 37, 207.

Skowron-Grabowska, B., (2023), „Innovativeness in Enterprise Strategies Value Creation and Innovation Multidimensionality", *Management and Production Engineering Review*, Vol. 14, No. 3, 27-43.

Stępień, M. (2022) "The Dynamics of Knowledge in the Implementation of the Distribution Channels Changing Project under Conditions of the Covid-19 Pandemic: a Case Study", Academic Conferences and Publishing International Limited, Proceedings of the 23rd European Conference on Knowledge Management. Vol. 23 No 2 (ed.) Centobelli Piera, Cerchione Roberto, 1140-1148.

Stonehouse, G., Snowdon, B. (2007). „Competitive advantage revisited: Michael Porter on strategy and competitiveness". *Journal of Management Inquiry*, 16(3), 256-273.

Tanwar, R. (2013). „Porter's generic competitive strategies". *Journal of business and management*, *15*(1), 11-17.

Tomski, P., „Entrepreneurship as a career choice: the empirical perspective". *Polish Journal of Management Studies* 2014, 9, 244-253.

Valipour, H., Birjandi, H., Honarbakhsh, S. (2012). „The effects of cost leadership strategy and product differentiation strategy on the performance of firms". *Journal of Asian Business Strategy*, *2*(1), 14-23.

Vogel, C., Koutsombogera, M. Costello, R. (2020) *Analyzing Likert scale inter-annotator disagreement*, Neur. Approach. Dynam. Sig. 513 Exchang, Springer, Singapore, 383-393.

Yelle, L.E., (1979), The learning curve: historical review and comprehensive survey, Decis. Sci. 10 (2), 302–328.

Yu, B., J. Wang, X. Lu, H. Yang, (2020), *Collaboration in a low-carbon supply chain with reference emission and cost learning effects: cost sharing versus revenue sharing strategies*, J. Clean Prod. 250, 119460.

Zengin, Y., Ada, E. (2010). „Cost management through product design: target costing approach". *International Journal of production research*, *48*(19), 5593-5611.

Zhu, X., Chiong, R., Liu, K., Ren, M. (2021), „Dilemma of introducing a green product: Impacts of cost learning and environmental regulation", *Applied Mathematical Modelling* 92, 829–847.

Ba in Projects and Programs: Creating the Habitat That Nurtures Knowledge

Tiziano Villa
PMP®, PMI-ACP®, PMI®-DASSM®, The Project Management Lab®, Monza, Italy

tiziano.villa@pmlab.it

Abstract: By their nature, projects and programs are temporary and innovative initiatives, crowded by knowledge workers who are called to interact, discuss, collaborate, in an ad-hoc way of working due the uniqueness of the projectized environment. Because of this, one of the main challenges for project and program managers is "how to address the knowledge dimension". In other word "how to create the habitat that nurtures knowledge, mainly the tacit one". Creating the right *Ba* is the turning point. Of course, during the project/program life cycle, many and different *Ba* must be created and lived. This paper is aimed at discussing in a very practical way a collection of projectized *Ba*. They are: *Ba* for project risks identification according to a predictive approach; *Ba* for project sprint retrospective according to an agile approach; *Ba* for organizational change readiness in a large program; *Ba* for moving from project delivery to business value. Each *Ba* fosters the engagement of knowledge workers in sharing their tacit knowledge towards the common goal of the project/program. Is your project at risk of colliding with the iceberg of knowledge? Does the tacit knowledge remain in the deep layers of the iceberg? Doesn't the register of lessons learned tell the true life of the project? Aren't project key people engaged in sharing knowledge? This paper can help you.

Keywords: ADKAR®, Benefits Management, Knowledge Creation, Knowledge Workers, Organizational Change Management, Portfolio Management, Program Management, Risk Identification Techniques, Sprint Retrospective, Tacit Knowledge, Value Chain.

1. Sketching the Scene

In 1998 Nonaka and Konno published on California Management Review the paper "The concept of *Ba*". *Ba* is defined as "a shared space for emerging relationships" (Nonaka Konno, 1998). "*Ba* provides a platform for advancing individual and/or collective knowledge. Thus, we consider *Ba* to be a shared space that serves as a foundation for knowledge creation." (Ibidem). *Ba* has become a pillar of knowledge management. In September 2023 at the ECKM – European Conference on Knowledge Management in Lisbon, Prof Konno during his keynote speaker presentation (Konno, 2023) highlighted the still current centrality of *Ba* as "the realm of knowledge, a shared dynamic context in which knowledge creation occurred, a place where individuals share knowledge for a soft alliance focused on innovation" (Konno Schillaci, 2021). No doubt, *Ba* is still today and will remain tomorrow the North Star that guides organizations and individuals to navigate the complex and fascinating sea of knowledge, especially when the waves, the sea currents and the winds of projects and programs must be faced. *Ba* may be considered as a social habitat. Habitat is the natural environment of an organism, the type of place where it can best live and grow. Referring to human relationships, we can depict habitat with the term "Cynefin". *"Cynefin, pronounced ku-nev-in, is a Welsh word that signifies the multiple factors in our environment and our experience that influence us in ways we can never understand"* (Snowden Boone, 2007). The projectized habitat is crowded by knowledge workers that might share their tacit knowledge "on condition that…" but "not regardless". Changing the conditions, changing the results. Conditions refer to the organizational and social habitat within which knowledge workers (i.e. project team members) are asked to meet, clash, confront, perform. According to an organizational perspective, some habitat conditions that, for better or for worse, must be taken in consideration are: project vision and goal, team ground rules, project management plan, monitoring & controlling criteria, work-life integration. If these conditions are recognized, discussed, agreed spending the time and effort it takes, the exchange of knowledge flows naturally. If these conditions are ignored, passively accepted, imposed skimping on the time and effort it takes, the exchange of knowledge ends abruptly. Similarly for the social perspective: on the one hand, high levels of trust, respect, openness foster knowledge sharing; on the other hand, low levels of trust, respect, openness hinder knowledge sharing. Because of this, social habitat is *"the place of our multiple belongings"* (Snowden 2011) that should be well addressed. We can sum-up this scene with a simile: *"knowledge workers are like the cats: it depends which way you brush their fur"* (Villa, 2020). If you pet the cat in the right direction, the cat will purr at you. If you pet the cat in the wrong direction the cat will scratch you. The cat is still the same, but the result is quite different! Thus, let's enter in more details in order to understand how to create the right habitat, that's to say the *Ba* that can nurture knowledge. Particularly, the Originating *Ba* to be understood as *"the world where individuals share feelings, emotions, experiences, and mental models. Originating Ba is the primary Ba from which the knowledge-creation process begins and represents the socialization phase (tacit knowledge sharing). Physical, face-to-face experiences are*

the key to conversion and transfer of tacit knowledge" (Nonaka Konno 1998). Of course, different projectized *Ba* should be designed and implemented moving across management approaches (i.e. predictive/waterfall vs. adaptive/agile), ontological levels (i.e. project vs. program vs. portfolio), ways of working (physical proximity vs. remotely).

2. *Ba* n.1 – Project Risk Identification – Predictive Approach – Physical Proximity

PRM - Project Risk Management bases much of its effectiveness on the process. "Identify Risks". The key benefit of this process is *"the discovery and documentation of existing individual risks and the sources of overall process risk"* (PMI, 2021). This way the project team can use details and insights coming from identified risks for prioritizing them and developing appropriate risk responses. The challenge is "how to identify a huge, meaningful and disruptive amount of project risks?", going beyond a partial, trivial and generic list of risks. In other words, moving from the small visible top of the iceberg to the large submerged part of the iceberg. This challenge requires to share tacit knowledge that project team members own about project risks. Therefore, a *Ba* focused on risk identification should be carefully designed and implemented. A risk identification meeting entails a *Ba* with these ten characteristics: 1) Participants: a small group (a maximum of 10 people), project manager and all project team members in case of a small project, project manager and members of PMT – Project Management Team in case of a large project. 2) Duration: two hours. 3) Location: a large room for exclusive use where we can move freely and with a large wall on which we can stick post-it notes, one large table, no chairs, everyone standing and never sitting (of course, special accommodations as needed). 4) Materials: a set of 12 packets of post-it notes in 6 different colours (2 per colour), a set of 10 pencils, a set of 4 different colour markers, laptops and similar are forbidden, no risk checklists. 5) Comfort items: water, soft drinks, candies, snacks for free. 6) Input: poster with the description of the project charter hanging on the wall. 7) Agenda: Opening session (how will we work together in a safe, open, collaborative way?) 10'; Crawford Slip & Affinity Diagramming working session 20' with post-it of colour yellow; Assumption Analysis working session 20' with post-it of colour green; Stakeholder Analysis working session 20' with post-it of colour orange; RBS – Risk Breakdown Structure working session 20' with post-it of colour pink; Risk Syntax final working session 20' with post-it of colour azure; Closing session 10'. 8) Operating rules: during each working session participants discuss and write risks on post-it notes; at the end of the working session participants stick post-it notes on the wall clustering them by categories (each category is written on a post-it of colour red); during final working session participants rewrite risk descriptions according to a formalized risk syntax. 9) Final Result: the portfolio of project risks ordered by categories (i.e. Technology, Customer, Sellers, Organization, Policies, Skills, etc.), written on post-it notes, formalized with a formal syntax, codified by ID, hanging on the wall. A separated category list of risks that need to be better understood. 10) Takeaways and Next Steps: selfie of participants with the wall with risks in the background; let's congratulate ourselves on the quantity and originality of the risks we have identified; lessons learned from the meeting (pros and cons table); action plan for risk analysis (vital few vs. trivial many) and risk responses (focus on priority risks and risk ownership). This type of *Ba* exploits risk identification techniques like the episodes of a knowledge exploration game.

3. *Ba* n.2 – Project Sprint Retrospective – Adaptive Approach – Remotely

Sprint Retrospective is one of the four agile ceremonies formally established by Scrum and generally suggested by other agile methods. *"The purpose of the Sprint Retrospective is to plan ways to increase quality and effectiveness. The Scrum Team inspects how the last Sprint went with regards to individuals, interactions, processes, tools, and their Definition of Done. Assumptions that led them astray are identified and their origins explored. The Scrum Team discusses what went well during the Sprint, what problems it encountered, and how those problems were (or were not) solved. The Scrum Team identifies the most helpful changes to improve its effectiveness"* (Schwaber Sutherland, 2020). Sprint retrospective is based on the twelfth principle of the Agile Manifesto: *"at regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly"* (Authors of agile manifesto, 2001). Sprint retrospective can be performed physically in presence or remotely. In both cases, sprint retrospective requires a live synchronous interaction. Sprint retrospective is a powerful opportunity for sharing knowledge according to a continuous improvement perspective. However, sprint retrospective might prove to be completely unproductive with participants pretending to discuss but not going into things and simply exchanging obvious considerations. In short: "much ado about nothing!". Thus, sprint retrospective requires its own *Ba.* Nowadays, the most part of agile projects is based on virtual teams, geographically distributed. Because of this, the suggested *Ba* should be organized as follows: 1) Video Energy: open the meeting with a 3' music video that brings people into the right mood. 2) Initial

retrospective declaration: “regardless of what we discover in this retrospective, we know and firmly believe that each of us did the best job possible and made available everything we knew, our skills and abilities, the resources available at that moment for the specific project situations addressed"; show this declaration on the first page of the collaboration tool (i.e. Mentimeter). 3) Our ground rules: “Let's try not to interrupt each other; We accept other people's opinions, as they are neither right nor wrong, but they are opinions as such; Everyone speaks for themselves and not in the name and on behalf of others; We pledge to listen to whatever a person has to say, before responding; Let's decide in advance what is important to say to justify the time we will take; There are no set-ups behind and at the expense of someone present in the meeting; Let's feel free to intervene whenever we feel like it, we are not obliged to contribute in every step of the retrospective, to say something at all costs, to carry out all the assigned tasks”. Show these rules on a Mentimeter page. 4) Preliminary safety secret ballots: “In this session, how comfortable are you in being able to openly say what you think needs to be said?”; scale (from 5=safe to 1=unsafe): 5- No problem, I feel like saying everything openly, 4- I feel like saying most things but some things will be difficult to say, 3- I feel like sharing some things, but I will keep others to myself, 2- I intend not to say much. Mostly I'm going to leave room for others, 1- I will smile, I will say that everything is ok, I will agree with whatever comes out of the discussion, but I will in no way allow others to understand what I really think.; use a Mentimeter Scales Page to collect secret ballots. 5) Overall perception: “how do you think this sprint went?”, score from 5 = very well to 1 = very bad, scores do not need to be justified; use a Mentimeter Scales Page to collect scores. 6) Sprint strengths: “what worked or went well and why? do it again!”; everyone writes his/her considerations on a Mentimeter Open Ended Page, then general discussion and insights written on a similar Mentimeter page. 7) Sprint Weaknesses: “what caused problems, failed to work properly or did not go well and why? don’t do it again!”; everyone writes his/her considerations on a Mentimeter Open Ended Page, then general discussion and insights written on a similar Mentimeter page. 8) Sprint Improvements: “what can we done differently in the next sprint to improve our way of working (processes and/or behaviors) and overcome the problems incurring previously? do differently next time!”; everyone writes his/her considerations on a Mentimeter Open Ended Page, then general discussion and insights written on a similar Mentimeter page. 9) Improvement plan: for each improvement action a member of the agile team takes the ownership on voluntary basis; avoid to force ownership; appreciate taking ownership. 10) Warnings: last Mentimeter Open Ended Page collects alerts: “hey guys, let’s pay attention to this …, in order to gain the benefits of our sprint retrospective!”. This type of *Ba* takes the agile team by the hand and accompanies it along its learning adventure.

4. *Ba* n.3 – Organizational Change Readiness – Program Level - Physical Proximity and Remotely

“Benefits through change”. This is the essence of a program. A program consists of *“related projects, subsidiary programs, and program activities managed in a coordinated manner to obtain benefits not available from managing them individually”* (PMI, 2024). Programs must realize benefits. It can happen only implementing organizational change that supports the transition from deliverables to outcomes. For this reason, program management encompasses a specific performance domain called “Change”. The purpose of this domain is *“to manage program change to improve effectiveness and efficiency of benefits realization, delivery, and sustainment during the program life cycle and after its transition to an organization’s operations”* (Ibidem). This domain applies models, methods and techniques coming from the discipline of “Change Management” defined as *“a comprehensive, cyclic and structured approach for transitioning individuals, groups and organizations from a current state to a future state with intended business benefits”* (PMI, 2013). The conclusion is that program management and change management are strictly overlapped disciplines. The starting point of an effective program change is the change readiness assessment of recipients (one or more). This assessment *“measures of the reality of the current organization in relation to the future state from two perspectives: organizational systems and structures that need to be improved or will support the change; and the people and culture that are able to support or may resist the change”* (Ibidem). This assessment should be performed just at the outset of the program, in order to understand whether the desired change is viable and at which cost. Imagine a large, expensive and innovative program that must completely renew the company CRM system. The main recipient consists of a sales force of 500 people distributed in four European countries. The new CRM system will totally overturn the way of working and behaviors of the sales force, one year from now. Thus, the question to try to answer now, and not a year from now, is “which is the current level of change readiness of the sales force?”, and consequently “which are the cost of change management required for achieving the necessary level of readiness?”. Change readiness is not declared, it must be elicited. How? With a specific *Ba.* The purpose of this *Ba* is to explore the current level of change readiness of the recipients and not to sell the future outcome. For this reason, recipient should be actively engaged in exploring its level of change readiness and the underlying

reasons. Experiences, insights, perceptions, beliefs, attitudes of people involved in change should be revealed and shared. Therefore, this *Ba* should be designed around the profile of recipient (job description, organizational structures/legal entities to which people belong, geographical distribution, cultural diversities, number of people involved, etc.). These are some key features of this type of *Ba:* 1) Assessment Target: all people of the recipient if small (<30), a selected sample of the recipient if large; mixed sample with different change attitudes (Leading, Supportive, Neutral, Resistant, Hostile) and different legal entities, countries, languages, cultures, in case of a global recipient. 2) Assessment Plan: depending on the profile of the target, organize the assessment activities in person, remotely, or hybrid. 3) 5W1H Change Statement: a brief summary (big picture) highlighting Why the change? What is the change? Who is interested in the change? When the change is expected? Where the change will happen? How the change might be implemented? communicate the statement to recipient through media that fit best. 4) Change Metaphor: ask the target the question: "this change is as if it were..."; invite to answer using figurative language based on metaphors, similes, hyperboles, images, symbols, oxymorons, idioms, aphorisms, titles of movies/songs, etc.; collect and share the figurative answers without judging them. 5) You and the Change: ask the target the question: "how do you see yourself in this process of change?" according to the ESVP categories (Explorer, Shopper, Vacationer, Prisoner); collect, categorize and share the answers without judging them. 6) Resistance to change: starting from results of previous steps that depict the "as-is readiness" (low – high) explore the underlying causes of resistance; use the ADKAR® model for the diagnosis: Awareness of the need to change ("Have stakeholders really understood why they have to change?" An unaware stakeholder doesn't commit and promote change), Desire to participate and support the change ("Do stakeholders see gains for them deriving from the requested change?" A stakeholder without benefits and/or with disbenefits doesn't commit and promote change), Knowledge on how to change ("Do stakeholders know how to implement the required change?" A stakeholder that doesn't have previous experiences and/or is not organized to put in place the change, doesn't commit and promote change), Ability to implement the change, Reinforcement to keep the change in place ("Do stakeholders have the capacity and capability to implement the change?" A stakeholder without the necessary resources in terms of effort and/or skills, doesn't commit and promote change), Reinforcement to keep the change in place ("Are stakeholders able to maintain in place the implemented change?" A stakeholder that, after the extraordinary effort to implement the change, is unable to maintain the change in place, doesn't commit and promote the change). ADKAR® may be applied through different techniques such as brainstorming, focus groups, guided workshops. 8) Change Tales: ask the target to write 50-word tales about situations of change they have experienced in the past; collect and share the tales without judging them. 9) Everything like before! ask the target "what are the pros and cons of maintaining the status quo?"; collect, categorize and share the answers without judging them. 10) Final Thought: close the assessment asking the target to greet us with a final thought that enhances the work done together during the assessment; show the thoughts. This type of *Ba* enables sharing knowledge about change as a normal condition in organizations.

5. *Ba* n.4 – Value Chain – Portfolio level – Physical Proximity

"Do the project right" not necessarily means *"Do the right project".* A delivery compliant with requirements does not automatically generate business value. Because of this, the world of projects is full of "white elephants". Project managers are too often focused on a limited deliverable-oriented perspective. This is fine as all the project team's efforts are concentrated on carrying out the new solution while respecting time, cost and quality constraints. This can work in simple and stable business conditions but not in complex and dynamic business conditions. Sometimes, for program managers too. The concept of Value Chain can avoid this impasse. The Value Chain is circular. It starts from Strategy and ends into Strategy. For example, the strategy of a city may be "to become a best place to live". Strategy breaks down into high-level goals, called Strategic Objectives. For example, "to improve the local economy of the city". A strategic objective can be accomplished through the execution of a Portfolio of specific initiatives (Programs and Projects). For example, the program "Attraction of new businesses" and the project "Business of the year award". Deliverables are tangible artifacts created by an initiative such as a project. For example, "a new business platform for local job search and offer". Outcome is a new organizational state after the transition of deliverables to final users. For example, "80% of local companies and workers regularly use the new job search and offer platform". Benefit is a gain realized by the organization and beneficiaries through portfolio, program, or project deliverables and resulting outcomes. For example, "the city attracts more talents, companies have improved revenues, jobs increased 15% year over year". Finally, benefits create Value, that's to say the net result between achieved benefits and incurred costs. For example, "our city went from fortieth to twenty-fifth place in the Job opportunities National Ranking". Value is evaluated to understand if the strategy worked, should be refined, must be rethinked. Each link of the chain is knowledge-sensitive, in that to be effective, it requires the availability of a wide and multifaceted mix of skills, gained on

field by many roles at different organizational levels. We can focus on the Portfolio link, upward connected with Strategic Objectives and downward connected with Programs and Projects. A portfolio is *"a collection of projects, programs, subsidiary portfolios, and operations managed as a group to achieve strategic objectives"* (PMI, 2017). *"A portfolio exists to achieve organizational and business unit strategies and goals". (Ibidem).* In jargon they say that portfolio is "the bridge between strategy and execution". Therefore, *"a functioning portfolio should be a representation of an organization's intent, direction, and progress at any given moment"* (Ibidem). Building a portfolio entails its own *Ba.* This *Ba* should support portfolio management that must *"balance conflicting demands among portfolio components, allocates resources (e.g., human, financial, assets, and intellectual) based on organizational priorities and capacity, and integrates management principles and sound practices to deliver business value aligned with the strategic objectives"* (Ibidem). Which are the characteristics of a Portfolio *Ba*? Let's analyse them using an example. Imagine we are the BU – Business Unit Europe of a global engineering company. There are similar BUs for other geographic areas. The company provides ad-hoc projects to private and public organizations. The BU is focuses on the Europe portfolio, and the BU Manager (portfolio manager) is accountable for the business results of this portfolio. Portfolio is divided into two main types of components: customer projects and internal projects. The Europe business has grown strongly in the last year. This trend is good and bad at the same time. Good because the pipeline of customer projects is increasing with higher perspective revenue and profit. Bad in that the BU has a limited capacity of resources that can't be increased in the short term. Furthermore, there are some mandatory internal projects that cannot be deferred with heavy penalties from the regulatory bodies. The challenge is "how to balance customer and internal projects according to the limited capacity?". Roles involved are BU Manager (1), Specialist of PMO – Portfolio Management Office (1), projects manager (2) of internal projects, account managers (5) of customer projects The pipeline consists of 2 internal projects and 13 customer projects, for a total of 15 portfolio components. Portfolio *Ba* could work as follows: 1) Portfolio Statement: share a brief declaration of the profile of Europe portfolio. 2) Sell the portfolio component: each of the 7 component requestors (2 project manager and 5 account manager) runs a short presentation of each candidate component (why to invest on this component? what would happen if the component was not activated? Which are the constraints within which the component must be carried out?). 3) Top-down guidelines: recap the BU strategic objectives. 4) Strategic Objectives / Portfolio Components Matrix: use the matrix to discuss and assess whether and to what extent each component supports the achievement of strategic objectives. The matrix provides answers to these questions: A) Which is the component that provides the lowest contribution to objectives? What does this component have to do with the portfolio? B) Which is the component that provides the highest contribution to objectives. What can we do to find the funds for this component? C) Which is the strategic objective least supported by the portfolio components? What other components can we activate to better support this objective? D) Which is the strategic objective most supported by portfolio components? Are all these components necessary for this objective? 5) Components are not for free: each requestor provides and explains the investment required to complete the component; estimated are compared. 6) BU Capacity: assess the available resources (FTE and skills) of the BU, distributed along time periods, for example quarters. 7) Demand /Supply Matrix: provide a big picture, highlighting the gaps over time between demand and supply for each of portfolio resources (i.e. designer, engineer, technical leader, etc.). 8) Balance the portfolio: select a subset of portfolio components which can start in the next time window, for example in the first half of the year, balancing benefits, costs, resources, risks. 9) Component Ownership: agree the person accountable for each component execution. 10) Communicate the project selection: align interested people regarding the selection made and the expected value for the BU. This type of *Ba* unchains tacit knowledge moving from project delivery to business value.

6. Conclusion

Ba is a powerful concept for knowledge creation in projects, programs, portfolios. Many and different are the projectized situations where a well-designed *Ba* can make the difference. This paper has documented four types of *Ba*, moving across management approaches (i.e. predictive/waterfall vs. adaptive/agile), ontological levels (i.e. project vs. program vs. portfolio), ways of working (physical proximity vs. remotely). For each *Ba* specific criteria and steps have been provided for an effective design and implementation. Sponsors, project manager, program manager, technical leader, PMO specialists should become more familiar with *Ba*, in order to unleash the power of tacit knowledge owned by knowledge workers. Indeed, this is a big challenge to cope with, particularly for large, complex and innovative projectized initiatives. This challenge requires a strong commitment by top management, clear knowledge roles and responsibilities, experiments and feedbacks in order to improve incrementally the design and the implementation of *Ba* within the organization. Otherwise, *Ba* remains a remains a beautiful principle only on paper.

References

Authors of agile manifesto (2001) *Manifesto for Agile Software Development,* https://agilemanifesto.org/

Konno, N. (2023) *Society 5.0 Knowledge and Conceptual Capability,* Proceedings of the 24th ECKM - European Conference on Knowledge Management.

Konno, N. and Schillaci C. E. (2021) *Intellectual capital in Society 5.0 by the lens of the knowledge creation theory,* Journal of Intellectual Capital Vol. 22 No. 3, 2021.

Nonaka, I. and Konno, N (1998) *The Concept of "Ba": Building a Foundation for Knowledge Creation,* California Management Review, 40, 1-15.

PMI® - Project Management Institute (2021) *A guide to the project management body of knowledge (PMBOK® Guide) Seventh Edition*, PMI®.

PMI® - Project Management Institute (2013) *Managing Change in Organizations,* PMI®.

PMI® - Project Management Institute (2017) The Standard for Portfolio Management Fourth Edition, PMI®.

PMI® - Project Management Institute (2024) *The Standard for Program Management Fifth Edition,* PMI®.

Snowden, D. J. (2011) *The Cynefin Framework,* CognitiveEdge https://www.youtube.com/watch?v=N7oz366X0-8.

Snowden, D. J. and Boone M. E. (2007) *A Leader's Framework for Decision Making and Action,* HBR.

Schwaber, K and Sutherland, J. (2020) The Scrum Guide, https://scrumguides.org/.

Villa, T. (2020) *Knowledge workers as a key factor for project success,* PMI® - Northern Italy Chapter.

Work in Progress Papers

Identification of Benefits and Risks for Enterprises Arising from Consumer Engagement: A Preliminary Discussion

Monika Eisenbardt
University of Economics in Katowice, Poland

monika.eisenbardt@ue.katowice.pl

Abstract: The concept of collaboration between consumers and businesses is the main premise of the study. It is crucial in generating knowledge relevant for both business and consumers. This collaboration, characterized by continuous change, is based on the utilization of new technologies, devoid of formal contractual limitations, and stems from the active involvement of consumers in business activities oriented towards knowledge and consumer ideas. Although this collaboration brings numerous benefits, it also entails risks for businesses. Utilizing the results of previous research, this study employs a systematic literature review to identify the benefits and risks arising from consumer involvement in business activities. The study results are presented as variables and divided into four categories of benefits: product-related, reputational, economic and social, and informational and technological. Additionally, risks have been identified. These variables will be used in further research among businesses, providing valuable insights for companies seeking to effectively leverage consumer knowledge while simultaneously mitigating associated risks.

Keywords: Consumer Engagement, Enterprise Collaboration, Benefits, Risks, Knowledge Creation, Research-in Progress.

1. Introduction and the Research Gap

The primary focus of this ongoing research is the concept of collaboration between consumers and enterprises. This collaboration is fundamental for knowledge creation within enterprises, providing knowledge that is useful for business purposes as well as for consumers. It is characterized by continual variability and dynamism, built upon the utilization of specific knowledge sources and new technologies. This collaboration takes on an informal nature, meaning it is not regulated by any contracts or documents. It often stems from consumers' willingness to engage in knowledge sharing and their interest in utilizing new technologies in this regard.

The results of previous research on consumers and enterprises demonstrated that enterprises recognize the need to involve consumers in their operations (Eisenbardt, 2021; Eisenbardt, 2020; Mullins at al., 2020; Ziemba et al., 2022). However, consumer engagement alone may prove insufficient to effectively support business operations and acquire valuable knowledge. Therefore, it becomes imperative to discern the benefits associated with consumer engagement to develop a research tool for conducting studies within enterprises. However, enterprises also experience certain threats mainly due to the freedom with which consumers can share knowledge and experiences related to a given enterprise and its products or services.

Literature research indicates that researchers mainly focus on the perspectives and experiences of consumers (Eisenbardt et al., 2018; Hernández-Serrano et al., 2017; Potra et al., 2018; Rayna, Striukova, 2016; Wolny, 2019). As a result, there is a significant number of studies focusing on consumers, especially regarding their activities and the benefits they gain from accessing and sharing knowledge (Eisenbardt, 2020). However, it has been noted that there is a lack of scientific studies analyzing this issue from the perspective of enterprises, and to the best of our knowledge, there is no published preliminary discussion or systematic review of such research. This constitutes a research gap, particularly concerning the benefits that enterprises derive from consumer engagement and the associated risks.

To address this identified gap, the study seeks to answer the following research questions:

RQ1: What benefits do enterprises derive from consumer engagement?

RQ2: What risks are associated with consumer engagement for enterprises?

As researchers suggest, literature reviews are crucial for advancing research in a given field because they enable researchers to focus on areas that warrant further investigation and can prevent inadvertent duplication of certain ideas (Rowe, 2014; Roztocki, Strzelczyk, and Weistroffer, 2023). Therefore, this study primarily focuses on conceptualizing the benefits and risks arising from consumer engagement and translating them into variables that can be utilized in the research process. The goal is to develop a framework of the benefits and risks associated with consumer engagement and, consequently, offer valuable insights for enterprises seeking to effectively leverage consumer knowledge while mitigating associated risks.

2. Research Methodology

The study aimed to operationalize the benefits and risks arising from consumer engagement. To achieve this, a systematic literature review (SLR) was conducted. As emphasized by researchers, such a review must include explicit criteria for the inclusion and exclusion of studies, explicit strategies for searching research reports, systematic coding and analysis of the quality of included studies, and should provide a synthesis of quantitative and/or qualitative research findings (Orłowska, Mazur, Łaguna, 2017). Following Krywalski-Santiago (2023), a multi-stage process was employed to review the existing literature, including searching databases and identifying the most active contributors (publishers and authors) using the Web of Science (WoS); the PRISMA-S checklist was applied to ensure the rigor of the systematic literature review; finally, this study proposes a comprehensive framework of benefits and risks for enterprises.

The WoS database was utilized. Searches were conducted using the phrase: "*benefits AND ((consumers OR prosumers) AND (involvement OR engagement OR participation))".* As a result, a search on Web of Science (WoS) yielded 624 publications (for the years 2023-2015) within the categories of Business, Management, and Computer Science Information Systems. Focusing on scholarly works for the purposes of this study, the search primarily targeted journal articles, books, book chapters, and conference proceedings, among which journal articles comprised 90% of the analyzed sample. Professional reports, datasets, and dissertations were excluded.

3. The Literature Review Results

Figure 1 illustrates the number of publications in the WoS database for each year. As depicted, the issue of benefits and risks arising from consumer engagement is gaining popularity.

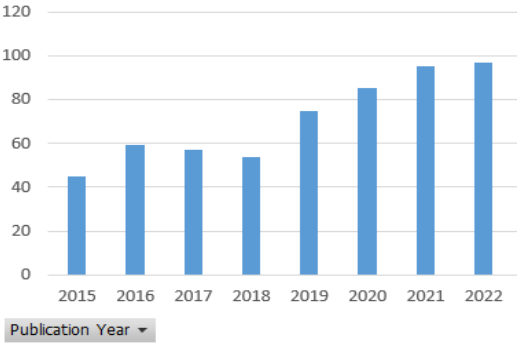


Figure 1: The WoS Database Publications over time

The WoS analysis generates a list of the most active publishers in the search area, with the first 10 presented in Table 1.

Table 1: The most active publishers

Journal title	Number of papers
JOURNAL OF BUSINESS RESEARCH	39
EUROPEAN JOURNAL OF MARKETING	23
JOURNAL OF RETAILING AND CONSUMER SERVICES	19
JOURNAL OF SERVICES MARKETING	17
JOURNAL OF PRODUCT AND BRAND MANAGEMENT	15
PSYCHOLOGY & MARKETING	13
JOURNAL OF CONSUMER BEHAVIOUR	11
INTERNET RESEARCH	10
INTERNATIONAL JOURNAL OF CONTEMPORARY HOSPITALITY MANAGEMENT	10
JOURNAL OF RESEARCH IN INTERACTIVE MARKETING	10

The keywords extracted from the publications are depicted in Figure 2. The word cloud was generated using PowerBI software.

Figure 2: Keywords listed in analysed publications

A detailed analysis of abstracts and article content (where available in open access) was conducted for 250 articles according to the WoS list, sorted by the Relevance criterion. The research scope for this study exclusively centers on the benefits and risks for enterprises arising from consumer engagement. Therefore, articles focused solely on consumer research without reference to the benefits and risks for enterprises were excluded.

The research approach for the current study is presented in Figure 3. The current study builds upon previous research on knowledge and ideas from consumers. Past research considered the demographic characteristics of consumers, the sources of knowledge they utilized, their willingness to share knowledge and ideas, and the ongoing development of ICT, which serve as primary knowledge sources for consumers and enterprises.

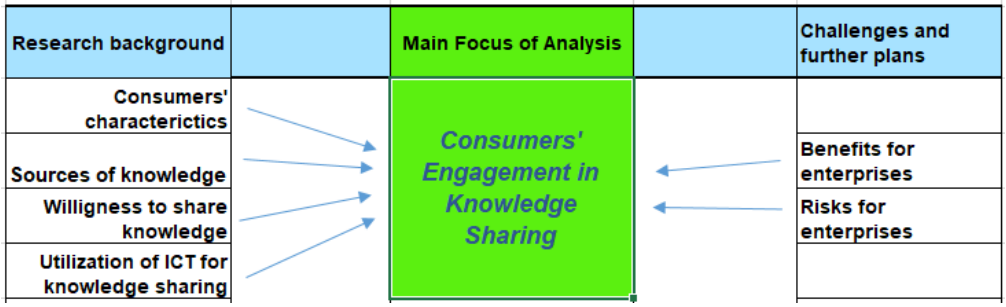


Figure 3: Research approach adopted for the study

As depicted in Figure 3, building upon foundational research, the current focus shifts towards exploring the benefits and risks for enterprises associated with consumers' knowledge. This involves understanding how enterprises can utilize consumer knowledge to enhance product development, refine marketing strategies, improve customer service, and enhance overall business performance. Concurrently, it entails examining potential risks. By delving into these aspects, the aim is to provide valuable insights for enterprises seeking to effectively leverage consumer knowledge while mitigating associated risks. In this endeavor, the study aims to address the following research questions: RQ1. What benefits do enterprises derive from consumer engagement? RQ2. What risks are associated with consumer engagement for enterprises?

To address these questions, Table 2 presents the literature review findings regarding the conceptualization of benefits and risks arising from consumer engagement, as well as their operationalization into variables. Upon analyzing the data, it was observed that variables could be grouped into categories, as also indicated in some of the publications. Thus, variables were categorized into four benefit categories: product-related, reputational, economic and social, informational and technological. Moreover, risks were also identified.

Table 2: Theoretical Framework for Further Research

Benefits and Risks	Category
• New ideas for products and services • Product life extension • Co-creation of products and their value • Enhanced level of product and service modernization • Tailoring offerings to customer needs • Customer testing of products and services • Minimizing last-minute product changes	***Product-related***
• More effective promotional and advertising activities • Better understanding of customer needs • Offering products and services that stand out from the competition • Building lasting relationships with customers • Improving customer retention rates • Loyalty towards the company and brand • Aligning customer interests with company interests • Improving customer service quality • Enhancing the company's image and reputation • Promoting innovative thinking within the company • Involvement of celebrities in promotional campaigns • Predicting trends	***Reputational***
• Financial benefits, e.g. increased financial profits for the company • Customer willingness to pay a higher price (premium price) • Risk minimization • New product distribution channels • Improving business processes within the company • Acquiring customers as business partners • Actions for sustainable development and corporate social responsibility • Increase in trust in knowledge from customers	***Economic and Social***
• Increase in the number of recipients • Direct posts and comments from customers • Diversity of information sources • Access to emerging market trends • Developing profiles on social media platforms (fan pages) • Developing company mobile applications • Developing a corporate blog • Continuous improvement in IT • Investing in modern information systems	***Informational and Technological***
• Excessive customer power • Threats to the security of company data • Too many changes in the company • Too fast pace of changes in the company • The need to share profits with consumers • Limited production flexibility linked to customer expectations • Customer takeover of product control • Customer-driven phenomena that operate independently of company-initiated actions • Excessive reliance on information and knowledge from customers • Excessive expectations towards company employees • Resistance from company employees	***Risks***

4. Concluding Remark

Building upon our previous research findings, engaging consumers in various aspects of business operations has been shown to yield numerous advantages for enterprises, albeit accompanied by certain risks. Through an extensive literature review, we were able to identify and categorize the benefits and risks associated with the current research into four distinct categories. In a broader sense, these benefits encompass areas such as product development, marketing, customer relationships, economic gains, and technological advancements. From generating innovative ideas to fostering customer loyalty and streamlining business processes, the potential benefits are considerable. However, it is essential to recognize the accompanying risks, including

challenges related to data security, employee resistance, and the need to maintain a balance of consumer power. Despite these risks, the rewards of consumer engagement outweigh the potential drawbacks. By strategically managing these risks and leveraging the benefits, enterprises can effectively harness the power of consumer knowledge to drive innovation and achieve success in the competitive marketplace.

This paper serves as a preliminary discussion laying the groundwork for further research, which will involve the development of a research tool and conducting studies within enterprises.

References

Eisenbardt, M. (2021). ICT as a tool for gaining and sharing knowledge. In J. Watrobski, W. Salabun, C. Toro, C. Zanni-Merk, R.J. Howlett, ans L.C. Jain (eds.) Procedia Computer Science 192, pp. 1839-1847. 25th International Conference on Knowledge-Based and Intelligent Information & Engineering Systems (KES 2021).

Eisenbardt, M. (2020). Incentives as a trigger for consumer knowledge sharing with enterprises and public sector organizations. In A. Garcia-Perez & L. Simkin (eds.), Proceedings of the 21st European Conference on Knowledge Management ECKM 2020, pp. 222-232. DOI: 10.34190/EKM.20.133

Eisenbardt, M., Ziemba, E., and Mullins, R. (2018). Comparative analysis of barriers to knowledge sharing for Polish and UK consumers. *Polish Journal of Management Studies, 18*(2), pp. 73–83. DOI: 10.17512/pjms.2018.18.2.06

Hernández-Serrano, M.-J., Renés-Arellano, P., Graham, G., and Greenhill, A. (2017). From prosumer to prodesigner: participatory news consumption. Comunicar 50(XXV), pp. 77–87. https://doi.org/10.3916/C50-2017-07

Krywalski Santiago, J. (2023). The progression in employer branding and employee-based brand equity: Scholar API-based systematic literature review. Journal of Economics & Management, 45, pp. 237-289. https://doi.org/10.22367/jem.2023.45.11

Mullins, R., Dettmer, S., Eisenbardt, M., and Ziemba, E. (2020). Comparing current and future knowledge sharing with enterprises by Poland- and UK-based prosumers. Journal of Economics and Management, 41(3), 47-68.

Orłowska, A., Mazur, Z., and Łaguna, M. (2017). Systematyczny przegląd literatury: Na czym polega i czym różni się od innych przeglądów? [Systematic literature review: What does it entail and how does it differ from other reviews?]. Ogrody Nauk i Sztuk, 7, pp. 350-363. DOI 10.15503/onis2017.350.363.

Potra, S., Pugna, A., Negrea, R., and Izvercian, M. (2018). Customer perspective of value for innovative products and services. Procedia - Social and Behavioral Sciences, 238, pp. 207-213. doi: 10.1016/j.sbspro.2018.03.025

Rayna, T. and Striukova, L. (2016). Involving consumers: The role of digital technologies in promoting 'prosumption' and user innovation. Journal of the Knowledge Economy [Open Access], pp. 1–20. DOI:10.1007/s13132-016-0390-8.

Rowe, F. (2014). What literature review is not: Diversity, boundaries and recommendations. European Journal of Information Systems, 23(3), pp. 241-255. https://doi.org/10.1057/ejis.2014.7

Roztocki, N., Strzelczyk, W., and Weistroffer, H. R. (2023). The role of e-government in disaster management: A review of the literature. Journal of Economics & Management, 45, pp. 1-25. https://doi.org/10.22367/jem.2023.45.01

Wolny, R. (2019). The development of prosumption on the Polish e-services market. Zeszyty Naukowe SGGW, Polityki Europejskie, Finanse i Marketing, 22(71), pp. 238-249. DOI 10.22630/PEFIM.2019.22.71.39

Ziemba, E., Eisenbardt, M., Mullins, R. and Dettmer, S. (2022). Consumer engagement in business process innovation–ICT companies cases from Poland and UK. Journal of Computer Information Systems, 62(2), pp.302-315. https://doi.org/10.1080/08874417.2020.1808865

Determinant of Knowledge Sharing among Lecturers in Higher Education Institutions in Nigeria

Okeoghene Mayowa-Adebara[1] and Rexwhite Tega Enakrire[2]
[1]Department of Library & Information Science, National Open University of Nigeria, Nigeria
[2]Department of Information & Knowledge Management, University of Johannesburg, South Africa;

okeoghenemayowa@gmail.com
rexwhite.enakrire80@gmail.com

Abstract: Lecturers in Higher Education Institutions (HEIs) are constantly burdened with numerous responsibilities, including meeting students' information needs and performing their duties optimally. Addressing students' information needs and maintaining effective teaching and learning processes requires adequate tacit knowledge application. Therefore, knowledge sharing among lecturers is crucial for fostering and transforming activities within HEIs. The knowledge that is created and stored must be shared to retain its value; otherwise, it becomes useless. Despite the opportunities and benefits associated with knowledge sharing (KS), some lecturers still find it difficult and are reluctant to share their knowledge, learning experiences, and skills due to a lack of trust. It is on this premise, that this study investigates the determinants of knowledge sharing among lecturers in HEIs. The research is guided by two objectives: to establish why knowledge sharing is essential in HEIs and to determine strategies that could promote trust among lecturers to facilitate knowledge sharing. The social exchange theory underpins this study, which employs a literature review of articles within a qualitative research approach. The findings reveal that knowledge sharing helps to highlight each lecturer's unique contributions, particularly in problem-solving initiatives. Trust is identified as a fundamental strategy for enhancing collaboration among lecturers. When trust is present, lecturers are more likely to be open and committed to their responsibilities and maintain integrity, reliability, and effective communication. The study fosters mutual understanding and teamwork among lecturers to enhance collaboration and social interaction. This collaborative environment can pave the way for the exchange of knowledge, information, and skills, ultimately benefiting the entire HEI community.

Keywords: Determinant, Trust, Knowledge, knowledge sharing, Lecturers, Higher Education Institutions (HEIs)

1. Introduction

This paper reports on the determinants of knowledge sharing among lecturers in Higher Education Institutions (HEIs) in Nigeria. Lecturers in HEIs are constantly burdened with numerous responsibilities, including meeting students' information needs and performing their duties optimally. Addressing students' information needs and maintaining effective teaching and learning processes requires adequate tacit knowledge. Therefore, knowledge sharing among lecturers is a crucial factor in fostering and transforming activities within HEIs. The knowledge that is created and stored must be shared to retain its value; otherwise, it becomes useless. Despite the opportunities and benefits associated with knowledge sharing (KS), some lecturers still find it difficult and are reluctant to share their knowledge, learning experiences, and acquired skills due to a lack of trust in one another. HEIs encompass post-secondary or tertiary educational institutions, such as colleges, polytechnics, vocational institutes, and universities. These institutions aim to foster learning and generate knowledge to accomplish educational objectives (Alemu, 2018). HEIs have played an indispensable role in society, including providing information and guidance to meet students' varied information needs (Bantanur, Mukherjee, & Shankar, 2015). Students' information needs range from coursework and scholarships for further education to examination preparation, assignment completion, job opportunities, career development, and acquiring competencies/skills to address real-life problems (Khan & Jan, 2022). In Nigeria, where this study is situated, the educational sector is managed by the Federal Ministry of Education (Oyebade & Dike, 2013). Nigerian HEIs were established to develop skilled manpower, which, in turn, enhances the intellectual competence of individuals. The acquisition of physical and intellectual skills, promotion of scholarship, and community service are critical issues in the Nigerian economy (Oyebade & Dike, 2013).

To enhance teaching, learning, research, and knowledge transfer, diverse training programs need to be promoted among lecturers in HEIs. The Ministry of Education should effectively manage all educational institutions, regardless of their type. The National Universities Commission (NUC), which serves as the supervisory body for all tertiary institutions in Nigeria, should ensure that universities meet the needs of students and society at large (NUC, 2012). For academics in HEIs to achieve this objective, lecturers need to trust one another. Knowledge sharing, a key component of knowledge management (KM), is crucial for the growth and success of any organization due to its ability to improve products and services. KM fosters creativity, innovation, cost reduction, sustainability of competitiveness, and the achievement of organizational objectives

by building trust among lecturers. KS also helps HEIs respond to changes, promotes collaboration, and ensures they remain current with up-to-date information and developments both within and outside the institutions.

HEIs have become knowledge-intensive organizations focused on the creation and dissemination of knowledge through teaching, learning, research, published articles, curriculum development, administration, and sharing of knowledge (Ramjeawon & Rowley, 2018; Fullwood & Rowley, 2017). They also aim to make knowledge available to information seekers (Ozmen, 2010). Since created knowledge supports learning, teaching, and research, lecturers need to harness this success by providing education and training programs to students (Fullwood & Rowley, 2017; Ozmen, 2010). The authors of this paper emphasize that to meet the diverse information needs of students (both undergraduate and postgraduate) and other staff members, lecturers require versatile knowledge and skills in their areas of expertise. This would enhance their ability to perform their duties optimally. However, many lecturers, especially in Nigerian HEIs, are still reluctant to share their knowledge, learned skills, and experiences due to a lack of trust. Based on the authors' personal experience of over ten years working in HEIs, it has been observed that many lecturers view knowledge as power. They believe that sharing their knowledge might allow others to surpass them in various aspects of life, gain more power, and uncover new knowledge and secrets in their teaching fields. As a result, they prefer to keep their knowledge for personal self-interest. This reluctance to share knowledge is detrimental because adequate knowledge that is not shared cannot contribute to organizational growth. Sharing knowledge allows lecturers to learn and unlearn, which is crucial for their career progression.

2. Purpose of the Study

The purpose of this study is to investigate the determinant of knowledge sharing among lecturers in HEIs in Nigeria. To guide this further the following research objectives of "to establish why knowledge sharing is essential in HEIs and to determine strategies that could promote trust as a factor among lecturers in knowledge sharing in HEIs" were broken into sub-themes, namely:

- The understanding of what knowledge entails
- Why knowledge is essential in HEIs
- The effect of trust on knowledge sharing among lecturers in HEIs.
- Strategies that could promote trust for knowledge sharing among lecturers in HEIs.

The next section describes the literature review, theory adopted, methodology and conclusion presented in the study.

3. Literature Review

The literature review of this paper was guided by the sub-themes earlier mentioned in this study.

3.1 Knowledge

Knowledge has become an indispensable component for institutions to gain a competitive advantage over their competitors (Wang, Wang & Liang, 2014). The knowledge utilized by an organization advances its operations through the tasks carried out by employees. This knowledge can be categorized into explicit and tacit knowledge. Explicit knowledge is written, documented, and made available to the public or individuals through various means. Examples include knowledge published in books, journal articles, and magazines, and shared through seminars, meetings, and conferences. In contrast, tacit knowledge encompasses individual intuition, values, experiences, and beliefs, which are not easily communicated or transmitted (Nonaka and Takeuchi, 1995). While tacit knowledge gives an organization a competitive advantage, it is difficult to acquire, diffuse, observe, and share within organizations (Savolainen, 2008). Knowledge is crucial in any organization because it aids in the development and improvement of products and services (Ceylan, 2013). Managing knowledge effectively is important as it leads to positive outcomes. Knowledge management (KM) is a strategy that includes managing intellectual capital, generating, and transferring knowledge, adopting best practices, and fostering innovation, all of which are centered on knowledge sharing (Kimile et al., 2020).

KM is believed to help collect information about various facts and gain the skills and experiences of faculty members in HEIs, thereby enhancing academic activities. For lecturers to sustain their teaching, learning, and research practices, they require deep knowledge that aligns with global standards in the lectureship profession. Extant literature and the experiences of authors who have worked in HEIs suggest that the most effective way for lecturers to sustain their teaching, learning, and research practices while adhering to global standards is by

cultivating a culture of KS (Ali, Gohneim, & Al Ronbaie, 2014; Jeyanthi & Shrivastava, 2019) across their various domains. The acquisition of adequate tacit knowledge among lecturers in HEIs not only fosters and transforms the organization but also helps lecturers excel in their profession. Therefore, it is essential to share created, stored, and managed knowledge to maintain its usefulness and value within the organization. KS has become an indispensable tool in HEIs, enabling lecturers to exchange ideas and insights. The act of sharing lecturers' know-how with colleagues takes various forms (Adamseged & Hong, 2018), including face-to-face communication, group discussions, online forums, conferences, written correspondence, research publications, technical reports, media advisories, and training programs.

The outcome of the KS process can lead to competitive advantages, improved services, enhanced productivity, and better job performance for lecturers (Chikezie, Dibua, & Ihim, 2016). Achieving the overall objectives of an institution is closely tied to the opportunities associated with KS. However, despite these benefits, many lecturers in Africa, specifically in Nigerian HEIs, still find it difficult and are reluctant to share their knowledge due to a lack of trust (Awodoyin, Osisanwo, Adetoro & Adeyemo, 2016; Eiriemokhale & Idiedo, 2020). They fear that sharing their knowledge will diminish their fame and allow their colleagues to gain more knowledge and skills (Muqadas, Rehman, Aslam & Ur-Rahman, 2017). If lecturers refuse to share what they know and learn, they miss out on understanding the best practices in teaching, learning, and research. Continuous openness and sharing are necessary to perform tasks effectively and to learn new strategies. The implication is that one's current knowledge might become outdated compared to others. Sharing knowledge allows for correction and support from those who are more knowledgeable, which can be crucial during interactions and discussions.

The success of lecturers' expertise depends largely on their exposure, experiences, and engagement in various projects within and outside the organization. Drawing from their experiences working at different HEIs, the authors of this paper have observed that many lecturers are reluctant to share their tacit knowledge. They fear that such knowledge might be used against them in the future for promotions, writing articles, career growth, or gaining a competitive advantage. This knowledge is precious to lecturers because it takes a long time to build. Tacit knowledge includes personal knowledge, understanding, know-how, experiences, beliefs, values, and intuitions gained through learning, education, and experience. It is embedded in individuals' minds and can only be shared through interaction and communication with others. Kamal, Manjit, and Gurvinder (2007) emphasize the importance of KS in knowledge-based organizations like universities, where many employees are knowledge workers. In an educational environment, effective KS ensures that academics can realize and develop their potential to the fullest. HEIs play a key role in knowledge creation, especially tacit knowledge, which is difficult to create and is often innovative. This explains the reluctance to share it. Academic staff who have developed this embedded knowledge believe it constitutes the intellectual capital of an educational institution, crucial for its overall functioning and success (Kacperska & Łukasiewicz, 2020). Therefore, the only way to share this knowledge among colleagues is through trust, as the knowledge owners do not want their contributions jeopardized when shared (Kacperska & Łukasiewicz, 2020).

3.2 Why Knowledge is Essential in HEIs

Knowledge has become a critical factor in all organizations, especially HEIs. Like other organizations, HEIs heavily rely on knowledge to carry out various tasks. The types of knowledge crucial to these institutions include explicit and tacit knowledge. Explicit knowledge is routinely consulted by lecturers and students in fulfilling their responsibilities, whether completing academic tasks, managing teaching and learning, conducting research, engaging in community development, or participating in academic citizenship. Lecturers rely extensively on applying knowledge to execute their teaching and learning duties, such as developing course materials/modules, writing research papers, and engaging in interactions and presentations during conferences, seminars, and workshops. From students registering for courses to attending classes and participating in extracurricular activities until graduation, the application of knowledge underpins their achievements and progress. It is crucial to emphasize that knowledge is akin to the water humans drink daily. Just as water sustains human life, knowledge serves as the fundamental resource for everything in HEIs and professional life. Without knowledge, human existence, including that of lecturers in HEIs, becomes uncertain because every aspect of academic work involves the application of knowledge. The consideration of knowledge lies in how data and information available to lecturers are transformed into knowledge. Lecturers engage in searching for data, which consists of raw figures or factual details about events, while information is the result of interpreted, processed, or explained data (Pangil & Nasurddin, 2013). Knowledge, in turn, comprises experiences and actionable information that reduce uncertainty and enhance decision-making (Afolayan, 2020). There are two types of knowledge: tacit and explicit. Tacit knowledge resides in individuals' minds, acquired through experience in an intangible form

(Gamble, 2020). It is challenging to articulate, interpret, and formalize (Polanyi, 1962), often shared through regular interactions, discussions, workshops, and seminars (Ehijiabone & Olatokun, 2020). Explicit knowledge, on the other hand, is easily communicated, encoded, understood, written, documented, explained, and shared (Jain & Moreno, 2015).

3.3 Effect of Trust in Knowledge Sharing among Lecturers in HEIs

The concept of trust is often interpreted differently across the world. It holds deep significance in various contexts and to different individuals. Trust lacks a singular, universal definition that fully encapsulates its essence. Dirks and de Jong (2022) define trust as "a generalized expectancy held by an individual or group that another will behave in ways desired, promised verbally, or written statement." Dirks and de Jong (2022) suggest that trust is a psychological state involving vulnerability based on positive expectations of another's intentions or behaviour. These scholarly definitions illustrate that trust is cultivated through interactions, whether among individuals or within organizational settings. Indeed, trust cannot develop without interpersonal communication and engagement. It evolves gradually; the more individuals interact, the stronger their bonds and willingness to rely on each other's promises. Trust encompasses elements such as benevolence, reliability, competence, honesty, and openness (Dirks, & de Jong, 2022; Enakrire & Smuts, 2024). It's no surprise that every organization seeks trustworthy, dependable, and amicable employees with low self-orientation. Trust is built on honesty, reliability, integrity, and confidence in an institution or individual (Annansingh, Howell, Liu & Baptista, 2018). In HEIs, trust plays a crucial role in enabling lecturers to fulfil their duties in teaching and research. A culture of trust fosters increased interaction, communication, and strong bonds among lecturers, facilitating learning, growth, and improvement in their respective fields (Brown, 2014). Research has linked trust among employees to organizational support, heightened commitment, reduced turnover intention, and a more open organizational climate (Ferres, Connell, & Travaglione, 2004; Thomas & Zolin, 2009).

Trust is essential for KS because it serves as a crucial facilitator of collaboration and effective exchange of information. Studies by Akanbi and Ondari (2017), Akosile and Olatokun (2019), and Mutahar et al. (2022) have identified trust as a key factor that supports collaboration and KS. In HEIs, fostering KS activities requires a foundation of trust (Ogunmokun et al., 2020). Within knowledge-intensive environments like HEIs, lecturers highly value their time, position, and expertise, which are safeguarded through their skills, know-how, and years of experience. They are mindful of protecting their reputation and integrity and choose carefully whom they share knowledge with due to potential risks such as sabotage. If lecturers lack confidence in their colleagues' intentions, particularly fearing misuse of shared knowledge, they may hesitate to collaborate. Instances of mistrust among lecturers, perhaps stemming from societal divisions, can negatively impact KS initiatives. However, the positive effects of KS can also be profound. When knowledge is shared among colleagues, HEIs can demonstrate excellence and gain global recognition through achievements such as high-ranking scholarly publications and academic awards. Such outcomes highlight the positive impact of trust in facilitating KS among lecturers, supported by active participation in workshops, seminars, and conferences. This collaborative environment not only enhances individual reputations but also contributes to institutional success and recognition.

Elaimi and Persaud (2014) argue that a major reason why lecturers may hesitate to share knowledge is the fear of diminishing its value. Knowledge, whether tacit or explicit, is inherently valuable. Sharing tacit knowledge particularly hinges on trust, as the possessor must feel confident in the recipient's integrity and intentions. Tacit and explicit knowledge are indispensable in HEIs, working together to enable lecturers to achieve their goals effectively. Establishing trust fosters an environment where lecturers feel comfortable sharing their expertise, experiences, and skills, thereby promoting KS among peers. Holste and Fields (2010), Savolainen (2019), and Aruoren, Odiri, and Igemoha (2021) highlight the significance of trust in KS among lecturers. Trust among employees not only enhances their willingness to share knowledge and expertise but also stimulates creativity and fosters an open environment for the free flow of ideas and information. Conversely, a lack of trust can lead lecturers to withhold valuable information, resulting in decreased productivity. The presence of trust can enhance lecturers' capabilities through shared knowledge, boost research productivity, improve student grades through well-invested teaching materials, and contribute to institutional sustainability.

3.4 Strategies for Promoting Trust Among Lecturers for Knowledge Sharing in HEIs

Various authors have proposed strategies to foster trust among lecturers in HEIs, tailored to different contexts. Brewster and Railsback (2003) advocate for enhancing faculty communication, promoting collaboration, cultivating relationships, and engaging in discussions aligned with institutional vision and mission. They also

highlight the importance of nonverbal communication and the application of soft skills, such as soliciting feedback and asking questions among colleagues. Wong (2020) suggests fostering a culture of coaching and mentoring younger colleagues to cultivate inclusivity, transparency, and honesty within HEIs. Other strategies to build trust among lecturers include effective communication, team participation, leveraging reliable technology for interaction, promoting cultural inclusiveness, and fostering mutual respect (Kwaye, 2018). These strategies, when implemented, significantly enhance KS among lecturers in HEIs by creating an environment conducive to freely sharing knowledge, expertise, and skills through platforms like seminars, social interactions, inter-departmental collaborations, and accessible knowledge repositories (Mpanya, 2005).

4. Social Exchange Theory

This study is underpinned by the Social Exchange Theory developed by Homans (1958) and Blau (1964). Homans (1958) explained that the theory explores exchanges between parties, which involve tangible or intangible, profitable, or unprofitable transactions. Blau (1964) expands on this, emphasizing that the theory hinges on trust, personal obligations, gratitude, and mutual expectations between parties. Individuals regulate their interactions based on the perceived costs and benefits, without any binding contractual agreements ensuring rewards for efforts or interactions. Thus, employees' trust in an organization correlates with their willingness to invest energy, time, and effort (Blau, 1964). The theory elucidates how trust could facilitate KS among lecturers in HEIs. Trust catalyzes social exchanges, fostering interactions, relationships, intimacy, and cooperation among employees and colleagues. Kurtulus, Kruse, and Blasi (2011) suggest that employees trust their colleagues, supervisors, and managers to treat them fairly. Through KS, this treatment relates to honesty in their engagement in positive behaviours that impact organizational outcomes. Trust is pivotal for sustaining relationships and interactions, with the expectation that positive actions of honesty, fairness, and generosity will be reciprocated, despite the absence of formal contractual obligations (Gambetta, 1988; Tariq et al., 2012). In HEIs, trust empowers lecturers to engage vulnerably, fostering interactions, collaboration, and strong bonds as they exchange ideas, experiences, skills, and expertise, anticipating reciprocal gestures from their peers. Conversely, a lack of trust in HEIs can lead to dysfunction, and reluctance to interact, communicate, cooperate, or collaborate, fostering cliques within the organization and resulting in frustration, decreased productivity, performance anxiety, and a reluctance to share knowledge (Brown et al., 2015; Fang, 2021; Patmore, 2020). The Social Exchange Theory is highly relevant to understanding why and how KS among lecturers is crucial in Nigerian HEIs, as well as how trust facilitates this process. As a lecturer, before sharing experiences, skills, and know-how with colleagues, it must ensure that the knowledge is used appropriately. With trust, colleagues will reciprocate by sharing their own experiences and skills in the future. The theory is essential in the workplace, demonstrating honesty, trustworthiness, and willingness to share knowledge, and expecting the same among colleagues.

5. Methodology

This study applied a literature review method where the researchers harvested different articles from the online database of Google Scholar. The researchers read through the articles and internalised the content based on the topic under investigation. Most of what the researchers focused on were key terms of “Trust” ‘‘Effect of trust”, “knowledge sharing among lecturers”. and ‘‘strategies that could promote trust for knowledge sharing” in the literature gathered for the study. While reading through the various literature gathered for the study, the researchers used their observation method in selecting the various literature that speaks directly to the discourse of KS among lecturers in HEIs. The findings obtained while reading and internalizing the research papers harvested for the study were later used to buttress the understanding of various scholars' research studies. Starting from when the literature for the study was harvested up until when the paper was developed and edited took the authors three months. Since the literature sourced for the study was in an open database, there was no ethical consideration because a human factor was not involved.

6. Conclusion

The study identifies trust as a critical determinant that can enhance KS among lecturers in HEIs. Many lecturers hesitate to share their tacit knowledge due to fears of diminishing their recognition and allowing colleagues to gain an advantage. However, withholding knowledge means missing out on understanding best practices in teaching, learning, and research. The study emphasizes that trust among lecturers stimulates creativity and creates an open environment for the free flow of ideas and information. According to the Social Exchange Theory applied in this study, when knowledge is shared voluntarily without immediate reward, there is an expectation of reciprocal assistance in the future. Lecturers play a pivotal role in HEIs, initiating knowledge-sharing activities

as they fulfil their duties in teaching, research, academic citizenship, and community development. The study underscores the importance of lecturers sharing their knowledge, experiences, skills, and expertise under the condition that they trust their colleagues to handle this knowledge responsibly. KS involves lecturers willingly exchanging their knowledge and skills, which is essential for advancing tasks and transforming HEIs. To establish concrete and sustainable knowledge sharing among lecturers in HEIs, the study advocates prioritizing mutual understanding, collegiality, and teamwork. This approach is crucial as trust and knowledge sharing operate within social exchange relationships. By fostering mutual understanding and teamwork, HEIs can create a collaborative environment conducive to exchanging knowledge, information, and skills, ultimately benefiting the entire academic community.

References

Afolayan, O.T. (2020). A framework for action to improve tacit knowledge sharing in Nigeria's Higher Education Institutions. *Journal of Information Science, Systems and Technology*, 4(1),68-79.

Akanbi, H.B., and Ondari, E.O. (2017). The effect of trust and concerned interest as factors affecting knowledge sharing practice among librarians. *Journal of Social Sciences & Humanities*, *12*(3).

Akosile, A., and Olatokun, W. (2019). Factors influencing knowledge sharing among academics in Bowen University, Nigeria. *Journal of Librarianship & Information Science*, *52*(2), 410-427

Alemu, S.K. (2018). The meaning, idea, and history of University/Higher education in Africa. A brief literature review. *Forum in International Research on Education*, 4(3),210-227.

Ali, O.F., Gohneim, A., and Al Ronbaie, A. (2014). Knowledge sharing culture in higher education institutions: Critical literature review. *European, Mediterranean & Middle Eastern Conference on Information Systems,*1-18.

Adamseged, H.Y., & Hong, J.J. (2018). Knowledge sharing among university faculty members. *Journal of Education and Practice, 9*(24), 1-10.

Annansingh, F., Howell, K.E., Liu, S., and Baptista Nunes, M. (2018). Academics' perception of knowledge sharing in higher education. *International Journal of Educational Management*, *32*(6), 1001–1015.

Aruoren, E.E., Odiri, V.I.O., and Igemohia, M. (2021). mediating effect of organizational trust on the nexus between organizational justice and knowledge sharing: An empirical investigation. Journal of Management Information and Decision Sciences, 24(6), 1-14.

Awodoyin A., Osisanwo T., Adetoro, N., and Adeyemo I. (2016) Knowledge sharing behaviour pattern analysis of academic librarians in Nigeria. *Journal of Balkan Libraries Union, 4*(1),12–19.

Bantanur, S., Mukherjee, M., and Shankar, R. (2015). Emerging dimensions of sustainability in institutes of higher education in India. *International Journal Sustainable Built Environment*, *4* (2), 323-329

Blau, P. (1964). *Exchange and power in social life*. New York: Wiley.

Brewster, C., and Railsback, J. (2003). Building trusting relationships for school improvement: Implications for principals and teachers. By Request Series. https://files.eric.ed.gov/fulltext/ED481987.pdf

Brown, S., Gray, D., McHardy, J., and Taylor, K. (2015). Employee trust and workplace performance. *Journal of Economic Behavior & Organization, 116*, 361-378.

Brown, L. (2014). The importance of trust. https://teachforall.org/news/importance-trust

Ceylan, C. (2013). Commitment-based HR practices, different types of innovation activities and firm innovation performance. *The International Journal of Human Resource Management*, *24*(1), 208-226.

Chikezie, O.M., Dibua, E. C., and Ihim, M.C. (2016). Knowledge sharing and competitiveness of selected pharmaceutical manufacturing companies in Anambra state, Nigeria. *European Journal of Business, Economics & Accountancy, 4*(7), 42-54.

Dirks, K. T., and de Jong, B. (2022). Trust within the workplace: A review of two waves of research and a glimpse of the third. *Annual Review of Organizational Psychology and Organizational Behavior*, *9*(1), 247-276.

Ehijiagbone, A.C. and Olatokun, W.M., (2020). Tacit knowledge sharing among lecturers: Observations from Nigeria's Premier University. *Library Philosophy and Practice (e-journal)*. 4502.

Elaimi, K., and Persaud, A. (2014). The impact of organizational factors and Web 2.0 technologies on knowledge sharing in Saudi Arabian firms. *The Journal of Human Resource and Adult* Learning, *10*(2), 30-40.

Eiriemokhale, K. O., and Idiedo, V. O. (2020) Knowledge Sharing Practices among Lecturers in Nigerian Universities: A Case Study. *Information and Knowledge Management, 10*(6), 35-44

Enakrire, R.T., and Smuts, H. (2024). Trust as a Determining Factor in Tacit Knowledge Sharing Among Academics in Higher Education Institutions. In *International Conference on Knowledge Management in Organizations* (pp. 51-60). Cham: Springer Nature Switzerland.

Fang, G. (2021). Rebuilding trust in a less trusting environment. https://pursuit.unimelb.edu.au/articles/rebuilding-trust-in-a-less-trusting-environment

Ferres, N., Connell, J., and Travaglione, A. (2004). Co-worker trusts as a social catalyst for constructive employee attitudes. *Journal of Managerial Psychology*, *19* (6), 608-622.

Fullwood, R., and Rowley, J. (2017). An investigation of factors affecting knowledge sharing amongst UK academics. *Journal of Knowledge Management, 21*(5), 1254–1271.

Gamble, J.R. (2020). Tacit vs explicit knowledge as antecedents for organizational change. *Journal of Organizational Change Management.*

Gambetta D. (1988). Trust: Making and breaking cooperative relations. New York: Basil Blackwell.

Holste, J.S., and Fields, D. (2010). Trust and tacit knowledge sharing and use. *Journal of Knowledge Management 14*(1),128-140

Homans, G.C. (1958). Social behaviors as exchange. *American Journal of Sociology, 63,*6, 597-606

Jain, A.K. and Moreno, A. (2015). Organizational learning, knowledge management practices, and firms's performance. *The Learning Organization, 22*(1), 14-39.

Jeyanthi, P. and Shrivastava, S. (2019). The determinant parameters of knowledge transfer among academicians in Colleges of Chennai Region. *Theoretical economics letters*, *9*, 752-760.

Kacperska, E., and Łukasiewicz, K. (2020). The importance of trust in knowledge sharing and the efficiency of doing business in the example of tourism. *Information, 11*(311), 1-18.

Kimile M.N., Bill, H., Kurgat, K., and Wasike J. (2020). Knowledge sharing among communities of practice in public Universities in Kenya. *Journal of Information & Technology*, *l4*(2),1-12.

Kwaye, A.S. (2018). *Effective strategies for building trust in virtual teams* (Doctoral dissertation, Walden University).

Kurtulus, F.A., Kruse, D., and Blasi, J. (2011). Worker attitudes towards employee ownership, profit sharing, and variable pay. Economics Department Working Paper Series. 123.

Maponya, P.M. (2005). Fostering the culture of knowledge sharing in higher. *SAJHE*, *19* (5), 900-911.

Muqadas, F., Rehman, M., Aslam, U., and Ur-Rahman, U. (2017). Exploring the challenges, trends, and issues for knowledge sharing. *VINE Journal of Information and Knowledge Management Systems, 47*(1), 2–15

Mutahar,Y., Farea, M.M., Abdulrab, m, Al-Mamary, y.A., Alfalah, A.A. and Grada, M. (2022) The contribution of trust to academic knowledge sharing among academics in the Malaysian research institutions. *Cogent Business & Management, 9*(1),1-16,

Nonaka, I., and Takeuchi, H. (1995). *The knowledge-creating company*. Oxford University Press, Oxford

NUC, (2012). National University Commission Manual of Accreditation Procedure for academic programmes in Nigerian universities. Abuja: National Universities Commission

Veer Ramjeawon, P., and Rowley, J. (2018). Knowledge management in higher education institutions in Mauritius. *International Journal of Educational Management*, *32*(7), 1319-1332.

Savolainen, T. (2008). Sharing tacit knowledge in a project-based organization: Perspective of Trust. *Research reports in Industrial Engineering and Management, Oulu*, *2*(2008), 676-688.

Tariq, A., Aslam, H., Habib, M., Siddique, A., and Khan, M. (2012). Enhancing employees' collaboration through trust in organizations: An emerging challenge in human resource management. *Mediterranean Journal of Social Sciences, 3,* 559-565.

Thomas and Zolin, 2009). Thomas, G.F., & Zolin, R. (2009). The central role of communication in developing trust and its effect on employee involvement. *Journal of Business Communication*, *46* (3), 287-310.

Ogunmokun, O.A., Eluwole, K.K., Avci, T., Lasisi T.T., and Ikhide, J.E. (2020). Propensity to trust and knowledge sharing behavior: An evaluation of importance-performance analysis among Nigerian restaurant employees. Tourism Management Perspective, 33, 1-11.

Oyebade, S.A., and Dike, C. (2013). Restructuring Nigerian Tertiary (University) Education for Better Performance. *Bulgarian Comparative Education Society*.

Ozmen, F. (2010). The capabilities of the educational organizations in making use of tacit knowledge. *Procedia - Social and Behavioral Sciences*, 9, 1860–1865.

Patmore, J.J. (2020). Trust in the Workplace 2020. DOI: 10.13140/RG.2.2.14535.93600

Polanyi, M. (1962). Tacit knowing: It's bearing on some problems of philosophy. *Reviews of Modern Physics*, *34*(4),601-616.

Pangil, F. and Nassurdin, A.M. (2013). Knowledge and the importance of knowledge sharing in organizations

Wang, Z., Wang, N., and Liang, H. (2014). Knowledge sharing, intellectual capital, and firm performance. *Management Decision*, *52*(2), 230-258.

Wong, Z. (2020). *Building trust and connection between leadership and employees at Briteweb*. Master, 's thesis, Royal Roads University, British Columbia, Canada

Generative AI Solutions for Enhancing Knowledge Management: A Literature Review and Roadmap

Marcelo Pimentel[1] and Jose Carlos Veliz Palomino[2]
[1]Universidad de Lima, Perú
[2]CENTRUM Católica Graduate Business School, Perú

ppimente@ulima.edu.pe
jcveliz@pucp.edu.pe

Abstract: This article explores the potential of Generative Artificial Intelligence (GenAI) to improve knowledge management in organizations. Despite growing interest in GenAI, a thorough review of its applications and effectiveness in knowledge management is still needed. GenAI has shown promise in automating content creation, synthesizing information, and improving decision-making processes. However, its integration into knowledge management systems remains fragmented. This study seeks to consolidate existing knowledge and chart a path for future research in this area. The research uses a systematic literature review (SLR) following PRISMA guidelines, complemented by a thematic analysis to ensure a comprehensive assessment of the existing literature. We reviewed articles published between 2020 and 2024, focusing on GenAI applications in knowledge management. A thematic analysis was conducted to identify key themes and trends. This paper contributes to the academic and professional environment by providing a detailed review of GenAI applications in knowledge management, identifying best practices, and offering strategic recommendations for leveraging GenAI to improve organizational processes. The review highlights key areas where GenAI can improve knowledge management: automating the generation of knowledge assets, enhancing knowledge discovery and retrieval, supporting collaboration, and improving decision making through advanced analytics. In addition, it addresses ethical considerations and potential challenges, such as data privacy and the need for human oversight.

Keywords: Generative AI, Knowledge Management, Decision-Making, Organizational Innovation.

1. Introduction

Since the 1990s, firms adopted a knowledge-based view, transforming into systems for producing and applying knowledge, with outcomes as products and services (Zhou et al., 2024; Wang et al., 2023; Ji et al., 2024). Knowledge solidified as a cornerstone of organizational strategy, essential for competition and innovation (Sumbal and Amber, 2024; Hu et al., 2024; Bilgram and Laarmann, 2023). Despite diluted terminology, the concept of organizations as creators and applicators of knowledge endures (Pan et al., 2024; Zheng et al., 2024).

On this basis, generative artificial intelligence (GenAI) has revolutionized organizational knowledge management, offering unprecedented opportunities. The emerging GenAI tools are versatile and can be employed in diverse fields (Eloundou et al., 2023). This research addresses: What is the current state of research on GenAI in Knowledge Management, and what challenges does it currently face?

2. Methodology

Systematic reviews need to be updated periodically to stay relevant and incorporate the latest evidence. This review examines literature from 2020 to 2024, concentrating on gaps in Knowledge Management using GenAI, starting with the identification of pertinent keywords. A search for peer-reviewed English articles was conducted in the Scopus database. Keywords used included: (Generative Artificial Intelligence, Generative AI; Knowledge Management, Organizational Knowledge; Innovation). Articles related to business and management were selected. Following this, study selection, data extraction, synthesis, and interpretation of results were performed (Machado et al., 2019). 42 studies were included. The complete methodological process is shown in Figure 1.

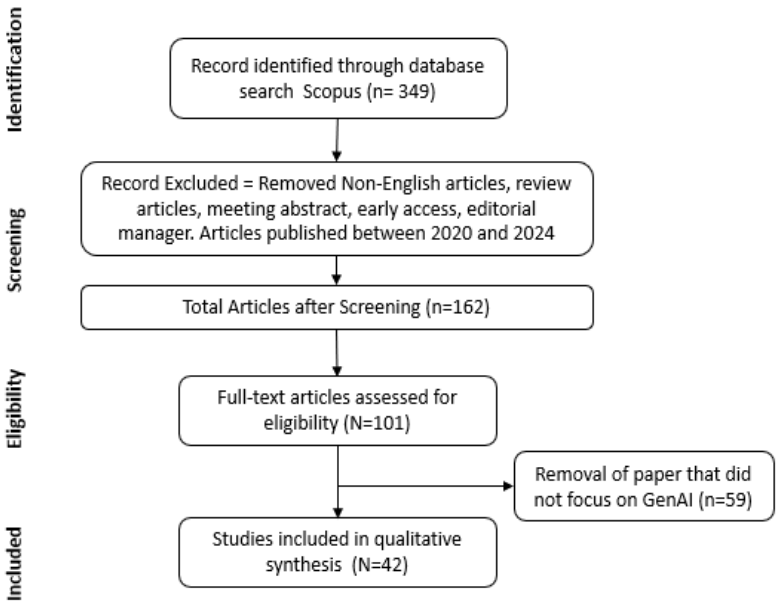


Figure 1: Flow Diagram Prisma

3. Findings

In organizations, knowledge is distributed among individuals' minds, social systems, procedures and computer files. Tacit knowledge resides in individuals and organizational culture, whereas explicit knowledge is documented in forms such as policies, procedures and information systems (Nazeer et al., 2023). Historically, the ability to store organizational knowledge was limited by the type and availability of data (Lee et al., 2024). GenAI is able to process huge amounts of data from reports, query responses and meeting notes (Kernan Freire et al., 2024) and manage it in different ways to create new and better content (Alavi et al. 2024), storing this information for future reference (Chen and Zhu, 2023; Vandelanotte et al., 2023) even GenAI excels at processing data, regardless of whether it is unstructured or well-structured (Xia et al., 2024). This advance facilitates knowledge access and management, but also presents new challenges, redefining the landscape of knowledge management in organizations (Yang et al., 2024; Ali et al., 2023).

The application of knowledge is a crucial aspect of knowledge management within organizations as it generates value (Jablonka et al., 2024). Simply storing and making knowledge accessible does not automatically improve productivity and performance (Benbya et al., 2024). Recent case studies and research indicate that GenAI systems are positively influencing knowledge work by boosting productivity and knowledge application. For example, GenAI can be used for the creation of interactive training material, thereby increasing the effectiveness of the process because the new employee can learn on his own and does not need another employee at his side, which consumes time and resources (Alavi et al. 2024). Furthermore Brynjolfsson et al. (2023) found that leveraging GenAI to capture, combine and apply customer service knowledge resulted in an overall productivity increase of 14% for customer service agents, with a 30% increase for novice agents. In addition, the quality of customer service improved, as seen in higher customer satisfaction scores. In addition, the quality of customer service improved, as seen in higher customer satisfaction scores. Initial use cases suggest that GenAI tools have the potential to improve knowledge application and performance. For example, Intercom, a company specializing in customer service solutions, has launched pilot programs using GenAI to improve customer engagement and drive corporate growth (Reid, 2023). Similarly, JP Morgan (2023) is employing GenAI to create synthetic data that trains machine learning models to detect new and emerging anomalies, which could be missed if trained on real data alone. The integration of GenAI into organizational knowledge management processes is expected to boost productivity and the quality of knowledge work in several industries.

Goldman Sachs (2023) predicts that widespread adoption of GenAI could increase annual labor productivity growth in the United States by almost 1.5 percentage points. Knowledge management of the future will depend more on the ability to efficiently search databases and obtain the desired results, rather than on the direct acquisition of knowledge (Jarrahi et al., 2023). This approach is driven by the ability of GenAI tools to interpret

natural language, thus enabling user needs to be met more accurately. Therefore, users will not need to internalize as much knowledge.

Successful adoption of GenAI in knowledge management requires staff buy-in, which can be difficult because some workers fear being replaced by software. The effectiveness of GenAI tools relies on their ability to be trained and to handle tacit and implicit knowledge, which makes employee buy-in crucial. If employees resist the use of new technologies, implementation will not be effective (Alavi, Leidner and Mousavi, 2024).

4. Expected Results and Future Plan

Integrating Generative AI (GenAI) into knowledge management systems is set to revolutionize how organizations manage and utilize their intellectual assets. By automating content creation, enhancing data analysis, and streamlining decision-making processes, GenAI enables organizations to transcend traditional knowledge management boundaries, leading to substantial improvements in operational efficiency, innovation, and competitive advantage. GenAI helps uncover hidden patterns and insights from large datasets, fostering more effective knowledge sharing and collaboration across teams. By automating repetitive tasks such as report generation and data entry, GenAI allows employees to focus on higher-value activities, thereby boosting productivity.

Organizations adopting GenAI can anticipate accelerated innovation cycles, enabling them to develop new products and services more quickly and efficiently. The flexibility of GenAI solutions ensures that organizations can scale their knowledge management practices and adapt swiftly to changing market conditions. To maximize these benefits, organizations should implement comprehensive training programs to equip employees with the necessary skills to utilize GenAI tools effectively and cultivate a culture of innovation.

Through this research, we aim to identify key trends in the impact of generative artificial intelligence on knowledge management. Our objective is to provide organizational leaders with critical insights that will help them address the ethical challenges associated with GenAI use, thereby facilitating the development of appropriate policies and guidelines.

References

Alavi, M., Leidner, D., & Mousavi, R. (2024). Knowledge Management Perspective of Generative Artificial Intelligence (GenAI). *Alavi, Maryam*, 1-12.

Ali, Omar, Murray, Peter., Momin, Mutjaba., & Al-Anzi, Fawaz. (2023). "The knowledge and innovation challenges of ChatGPT: A scoping review". *Technology in Society*, 102402.

Benbya, Hind; Strich, Franz; Tamm, Toomas. (2024). "Navigating generative artificial intelligence promises and perils for knowledge and creative work". *Journal of the Association for Information Systems*, vol.25, no1, p. 23-36.

Bilgram, Volker; Laarmann, Felix. (2023) "Accelerating innovation with generative AI: AI-augmented digital prototyping and innovation methods". *IEEE Engineering Management Review,* vol.51, no2, p.18-25.

Brynjolfsson, Erik, Li, Danielle, & Lindsay, Raymond (2023). "*Generative AI at work"* (National Bureau of Economic Research, working paper, No. 31161). http://www.nber.org/papers/w31161

Chen, Bodong and Zhu Xu (2023). "Integrating generative AI in knowledge building". *Computers and Education: Artificial Intelligence,* vol.5, p. 100184.

Daher, Wajeeh, Diab, Hussam, and Rayan, Anwar (2023). "Artificial intelligence generative tools and conceptual knowledge in problem solving in chemistry". *Information*, Vol *14, No* 7, p: 409.

Earley, Seth (2023). "What executives need to know about knowledge management, large language models and generative *AI"*. *Applied Marketing Analytics,* vol. 9, no 3, p. 215-229.

Eloundou T, Manning S, Mishkin P, Rock D. (2023). "GPTs are GPTs: An early look at the labor market impact potential of large language models". *ArXiv.* https://arxiv.org/abs/2303. 10130.

Goldman Sachs. (2023). Generative AI could raise global GDP by 7%. https://www.goldman sachs.com/intelligence/pages/generative-aicould-raise-global-gdp-by-7-percent.html

Hu, Xin; Liu, Ang; Dai, Yun. (2024) "Combining ChatGPT and knowledge graph for explainable machine learning-driven design: a case study". *Journal of Engineering Design*, p. 1-23.

Jablonka, Kevin Maik, Schwaller, Philippe, Ortega-Guerrero, Andres, and Smit, Berend (2024). "Leveraging large language models for predictive chemistry". *Nature Machine Intelligence*, vol. 6, no 2, p. 161-169.

Jarrahi, M. H., Möhlmann, M., & Lee, M. K. (2023). Algorithmic management: The role of AI in managing workforces. *MIT Sloan Management Review*.

Ji Hong; Gao Zhi; Ren Jinchang, Wang Xing-Ao, Gao Tianyi, Sun Wenbo, and Ma Ping (2024) "Prompting-to-Distill Semantic Knowledge for Few-shot Learning". *IEEE Geoscience and Remote Sensing Letters*.

Jo, Hyeon. (2024) "Uncovering the reasons behind willingness to pay for ChatGPT-4 premium". *International Journal of Human–Computer Interaction*, 2024, p. 1-16.

JP Morgan (2023). WIRED special feature: Smart Money https://www.jpmorgan.com/payments/ payments-unbound/volume-3/smart-money

Kernan Freire, Samuel, Wang, Chaofan, Foosherian, Mina., Wellsandt, Stephan, Ruiz-Arenas, Santiago and Niforatos, Evangelos. (2024). "Knowledge sharing in manufacturing using LLM-powered tools: user study and model benchmarking". *Frontiers in Artificial Intelligence*, vol.7, p.1293084.

Lee, Jooyeup; Jung, Wooyong; Baek, Seungwon (2024). In-House Knowledge Management Using a Large Language Model: Focusing on Technical Specification Documents Review. *Applied Sciences*, vol. 14, no 5, p. 2096.

Machado, Luisa, Rasekaba, Tom and Cardoso, Jhon (2019). "Protocol for a systematic review of the prevalence, risk factors and management of asthma exacerbations in pregnant women". BMJ open, Vol9, No4, pp. e026921.

Pan, Shirui, Luo, Linhao, Wang, Yufei, Chen, Chen, Wang, Jiapu and Wu Xindong (2024). "Unifying large language models and knowledge graphs: A roadmap". *IEEE Transactions on Knowledge and Data Engineering*.

Reid, Fergal (2023, June 15). Announcing Intercom's new AI features. The Intercom Blog. https://www.intercom.com/blog/announcingnew-intercom-ai-features/

Sumbal, Muhammad Saleem and Amber, Quratulain (2024) "ChatGPT: a game changer for knowledge management in organizations". *Kybernetes*.

Wang, Jiangnan, Li, Haisheng, Wang, Leiquan and Wu, Chunlei (2023). "A multimodal dialogue system for improving user satisfaction via knowledge-enriched response and image recommendation". *Neural Computing and Applications*, Vol*35, No*18, pp:13187-13206.

Xia, Liqiao, Li, Chengxi, Zhang, Canbin, Liu, Shimin and Zheng, Pai. (2024). "Leveraging error-assisted fine-tuning large language models for manufacturing excellence". *Robotics and Computer-Integrated Manufacturing*, vol.88, p. 102728.

Yang, Linyao, Chen, Hongyang, Li, Zhao, Ding, Xiao, & Wu, Xindong (2024). "Give us the facts: Enhancing large language models with knowledge graphs for fact-aware language modeling". *IEEE Transactions on Knowledge and Data Engineering*.

Zheng, Mingyoue, Zhang, Wei, Wang, Qinggong, Kongab Xiangtai, Xiong, Jiacheng, ... and Fu Zunyun (2024). "Fine-tuning Large Language Models for Chemical Text Mining". *Chemical Science*.

Zhou, Jingiao, Liang, Ziqi, Fang, Yuhua, & Zhou, Zhanxi, (2024). "Exploring Public Response to ChatGPT with Sentiment Analysis and Knowledge Mapping". *IEEE Access*.

Late Submissions

Conversational Artificial Intelligence: A Catalyst for Rethinking Assessment in Higher Education

Desireé J Cranfield[1], Isabella M Venter[2] and John Mulyata[1]
[1]Swansea University, Wales, UK
[2]University of the Western Cape, Cape Town, South Africa

d.j.cranfield@swansea.ac.uk
iventer@uwc.ac.za
john.mulyata@swansea.ac.uk

Abstract: Conversational Artificial Intelligence has disrupted higher education by fundamentally altering its landscape. Fuelled by natural language processing and machine learning this technology has gained widespread adoption particularly since the release of ChatGPT in November 2022. As universities embrace digital transformation, assessment practices must evolve to align with the capabilities of Artificial Intelligence-driven chatbots and virtual assistants. This paper explores how conversational artificial intelligence impacts higher education, in particular, student assessment. A fundamental shift in assessment and evaluation of student competencies is necessary to not only consider knowledge retention but also critical thinking, communication, and adaptability skills. A review of the literature was conducted to understand how assignments should change due to the emergence of this disruptive technology. Conversational Artificial Intelligence and its application within the higher education context is uncertain, with disparate practices—in terms of ethical consideration and understanding—across the sector. A case study was conducted in which MSc Management students undertaking a specific module were tasked to use three Artificial Intelligence tools in their report writing of a business, to verify the sources and content provided by the Artificial Intelligence tool, and to critically evaluate the process as well as the output received for each prompt. The paper proposes a collaborative approach to navigate the ethical implementation and utilization of conversational Artificial Intelligence in higher education, advocating for the co-creation of guidelines through forums like Knowledge Cafés, stressing the need to rethink student assignments and its assessment and the adoption of artificial intelligence technologies by students for assignments.

Keywords: conversational artificial intelligence, knowledge café, higher education, assessment, disruptive technology

1. Introduction

The launch of advanced models such as OpenAI's ChatGPT in November 2022 (OpenAI, 2023) has significantly accelerated the adoption of conversational Artificial Intelligence (AI) in higher educational settings. These models are capable of understanding and generating human-like text, making them useful for a range of applications from tutoring to administrative support. The introduction of these advanced models has become popular tools amongst both students and academic staff, who are using it to improve their academic practice, as Bahroun *et al*. (2023, p. 2) points out "In the domain of teaching, generative artificial intelligence showcases promising opportunities for lesson planning, personalized learning support, rapid assessment and evaluation, and addressing learners' queries".

Since traditional assessment methods—particularly in Business and Management courses—can easily be supported by AI, it presents higher education with a conundrum. Assessment serves multiple purposes beyond merely measuring what students have learned, however, it is becoming more difficult to measure what students have learnt or their ability to critically analyse texts, given the fact that AI can be employed to do so for them. In a study by Smolansky *et al.* (2023) it was found that educators favour assignments that are tailored to incorporate AI use and which promote critical thinking. However, students have mixed feelings about this approach, partly because they worry it might stifle their creativity. The results highlight the need to involve both educators and students in efforts to reform both assignments and its assessment, emphasizing the learning process rather than its outputs, fostering higher-order thinking, and encouraging real-world applications.

There is thus a need to rethink assessment in higher education to be agile in the current climate of AI as a disruptive technology, especially in subjects, where the essay and report are commonly used for student assignments. It is important that academic staff are given the autonomy to innovate and experiment with different forms of assignments and its assessment so that learning, creativity and development is measured. The main aim of the paper is to explore the impact of conversational AI on higher education, specifically focusing on how this technology influences student assessment practices. The paper seeks to understand the necessary shifts in evaluating student competencies to accommodate the capabilities of AI-driven chatbots and virtual assistants. Additionally, it aims to propose a collaborative approach for the ethical implementation and utilization of conversational AI within the higher education sector.

In this paper an example is provided where students were tasked with including conversational AI tools in their assignment. The usefulness of Knowledge Cafés to discuss and deliberate on assessment in higher education is proposed as a helpful platform to rethink assessment in general. An introductory review of the literature is presented next, with an example of how assessment was rethought by considering the reality of conversational AI.

2. Background

Recent research has underscored the significant influence of AI on teaching and learning within higher education, acknowledging both the favourable and unfavourable views of conversational AI. However, the consensus is increasingly recognizing the indispensability of AI tools. Crompton & Song (2023) highlight the considerable promise of AI to broaden and improve educational practices. Rudolph *et al.* argue that it presents substantial opportunities when both students and faculty are properly educated on using the technology ethically (Rudolph, Tan, & Tan, 2023).

2.1 Conversational artificial intelligence

Virtual assistants, conversational agents, and chatbots are all tools designed to facilitate interaction between humans and machines using natural language. However, the terminology used by different authors within the AI field can have varying meanings.

Gartner classifies conversational agents as Virtual Assistants (VAs) and notes that they are utilized for personal, educational, or business functions. According to Gartner, these VAs operate using semantic analysis and Natural Language Processing (NLP) and may also integrate chatbot technologies. By observing and interpreting human behaviours, conversational agents or VAs apply these models to predict outcomes and facilitate decision-making (Gartner, 2023). According to Basu conversational AI is a broad field that includes both open-domain and closed-domain chatbots designed for human-like interactions through conversation (Basu, 2019). Katsarou *et al.* (2023) refers to a specialized category of a virtual assistant called an embodied conversational agent (ECA) which is characterized by increased complexity, and which is primarily utilized for educational purposes. These agents are effective because they possess a deep knowledge base in specific fields and have the capability to assist learners by offering easy access to information and enhancing motivation. Amazon's Alexa, Apple's Siri, and Google Assistant are cloud-based, general-use Intelligent Virtual Assistants (IVAs) (Katsarou, Wild, Sougari, & Chatzipanagiotou, 2023). In this paper we refer to all the above as conversational AI agents.

2.2 Benefits of conversational artificial intelligence in education

According to Rudolph *et al.* artificial intelligence has the capacity to revolutionize teaching and learning methods, boosting student engagement by enabling experiential and experimental learning. For instance, by using AI tools such as ChatGPT, students can explore various strategies and methods for problem-solving and goal attainment (Rudolph, Tan, & Tan, 2023). The integration of conversational artificial intelligence, particularly chatbots, in education presents a wide array of benefits that can revolutionize the learning experience for students, enhance engagement, and provide personalized support. Thus, increased availability for students at any time, adaptability to cater to individual student needs, providing scripted education interactively, answering questions using natural language processing, chunking information into manageable segments, allowing for personalized learning experiences, enhancing student motivation, improving speech skills in foreign languages, reducing student anxiety, promoting self-paced learning, offering instantaneous feedback, and easing administrative procedures (Kaphings & Kohlmann, 2021; Sysoyev & Filatov, 2023; Gökçearslan, 2024; Lee, 2023; Ilieva, 2023; Babirye, 2024; Ghayoom, 2023).

2.3 Challenges of conversational artificial intelligence in education

Despite the advantages of conversational AI, it is important to acknowledge that chatbots, including advanced models like ChatGPT, may have limitations and can make mistakes, which could potentially lead to issues, especially in education. Therefore, careful consideration and analysis are necessary for the successful implementation of chatbots in educational settings. A further concern is that conversational AI can produce adequate text for students and that plagiarism checkers will not be able to detect it. However, these concerns might also stem from educators' reluctance to adjust to new methods for both student assignments and the assessment thereof. Traditional Business Management written assignments have often been criticized for being boring and unsuccessful at measuring student learning (McMurtrie, 2023). Ojha *et al*. (2023) suggest that the incorporation of artificial intelligence in education has prompted a reassessment of teaching methods and practices, which includes assessment strategies. The challenge is how does one design assignments to effectively measure student competency and not AI comptetency.

2.4 Impact of artificial intelligence on student assignments and its assessment

Assessments in educational and professional environments traditionally focus on measuring knowledge, skills, and abilities through tests, exams, interviews, and performance evaluations. With the more extensive use of AI tools currently, these practices will have to transform.

2.4.1 Traditional assessment practices

Paper-based exams, in-person interviews, and subjective evaluations: Human biases might influence traditional assessments which may not be uniformly administered as it relies on standardized formats and subjective grading criteria. Furthermore, these assessment methods may not always accurately reflect students' abilities since students could have used conversational AI to do assignments (Holzinger, Lettner, Steiner-Hofbauer, & Capan Melser, 2020). Scalability is another problem when assessing exams or tests since it requires significant resources, and it is very time-consuming for large classes. Feedback is thus often delayed, and sometimes not detailed or personalized (Hadibarata & Jusoh, 2023). Traditional methods of assessment may also not capture students' holistic development and individual learning needs, resulting in a one-size-fits-all approach that may not cater to diverse student populations (El Hashash, 2022).

2.4.2 Assessment using AI tools: online adaptive tests, AI-driven interviews, and simulations

The gap in traditional assessment practices could potentially be addressed by conversational AI, providing personalized learning experiences (Hadibarata & Jusoh, 2023). Although AI can reduce human bias, algorithmic bias can occur if not carefully managed. The consistency of AI tools is high, and it is standard since AI tools can apply the same criteria uniformly across all assessments. As far as scalability is concerned it is scalable to large numbers of users with automated processes for administering and scoring. Feedback is immediate and it can be detailed with AI identifying specific areas of strengths and weaknesses (Hadibarata & Jusoh, 2023). Furthermore, AI tools can analyse vast amounts of data to detect patterns, predict outcomes, and provide insights that are not readily apparent through traditional assessment methods.

2.4.3 Hybrid approaches

By using AI for initial screenings and practice, institutions can enhance efficiency and provide targeted educational support. Simultaneously, having human evaluators oversee more nuanced or critical decisions ensures that the grading and assessment of assignments maintain a necessary level of human insight and ethical consideration. This hybrid model not only optimizes resource use but also supports a more personalised learning experience. Students can receive immediate feedback from AI-driven tools, which helps them identify and focus on areas needing improvement. Meanwhile, educators can devote more time to complex evaluation tasks and personalised teaching, rather than routine grading/assessment (Ifelebuegu, 2023)

2.4.4 Group assignments

For collaborative or group assignments, it is possible to use AI to track and analyse individual contributions in group tasks, facilitating a more precise evaluation of each student's involvement in the collaborative task. Additionally, AI can oversee and guide online discussions, ensuring equitable participation from all students and fostering critical thinking and teamwork. However, AI deployment in such cases demands substantial investments in technology and training, which could worsen the digital divide and amplify inequalities in education (Ifelebuegu, 2023).

2.5 Ethical considerations

Some of the ethical issues with using AI for assessment in higher education concerns privacy, data security, bias in AI algorithms, transparency in decision-making processes, and the potential for AI to replace human judgment when providing feedback in the assessment of assignments (Holmes, et al., 2022; Franco D'Souza, Mathew, Mishra, & Surapaneni, 2024; Akgun & Greenhow, 2022). There are also ethical considerations related to intellectual property rights, ownership of AI-generated content, and the impact of AI on widening educational disparities (Akgun & Greenhow, 2022; Franco D'Souza, Mathew, Mishra, & Surapaneni, 2024; Ng, Wu, Leung, Chiu, & Chu, 2024). Issues such as accountability, fairness, and the ethical implications of using AI in educational settings need to be carefully addressed to ensure ethical AI use in higher education (Ng, Wu, Leung, Chiu, & Chu, 2024; Baker, Mills, McDonald, & Wang, 2023). These ethical considerations emphasize the importance of critically examining the implications of integrating conversational AI in higher education—particularly in the execution of assignments and assessment of assignments—to ensure that students are ethically supported and that their rights and well-being are safeguarded.

Teaching students to use conversational AI ethically poses a significant challenge, and leaving this to individual staff members may not yield the desired results. Integrating ethics education into business curricula can enhance

students' ethical decision-making skills and prepare them for future challenges (Eyal, Berkovich, & Schwartz, 2011), especially with the rise of conversational AI. This integration is important for fostering responsible business practices and corporate social responsibility (Olatoye, et al., 2024). Therefore, establishing frameworks for responsible AI use and embedding ethical considerations into business education would be essential for ethical business conduct (Olatoye, et al., 2024).

2.6 The concept of Knowledge Cafés

The Knowledge Café serves as a dynamic space where individuals can critically engage with ideas in a dialectical manner. It provides a unique opportunity for researchers to unobtrusively hear from numerous knowledgeable individuals about key topics, thus making it a valuable tool for both knowledge sharing and research (Singh, 2017). It convenes people to discuss topics of mutual interest, helping them to understand issues more profoundly and explore various possibilities with the objective to unearth collective knowledge, facilitate idea sharing, and deepen understanding of subjects. The Knowledge Café is a simple but flexible, conversational; compared to similar methodologies, it makes no definitive attempt at making decisions or trying to reach consensus as part of the Café itself. At its best, a Knowledge Café adheres to a set of principles that help create a relaxed, informal, conversational environment conducive to open dialogue and to learning (David Gurteen, n.d.). The attendees of such a café are empowered to express their genuine concerns without fear or judgment (Piskopani, Webb, & Caleb-Solly, 2023).

2.7 Current research on AI and assessment

The impact of conversational AI on student assessments is significant. Studies show that integrating AI in assignments leads to innovative and improved outcomes. For example, conversation-based assessments (CBA) use AI to evaluate students' comprehension (Yildirim-Erbasli, Bulut, Demmans Epp, & Cui, 2023) and tools like Artificial Intelligence–based student learning evaluation (AISLE) assess understanding through concept maps, revolutionizing assessment methods (Jain, Schroeder, & Faulkenberry, 2014).

AI in assignments enhances student engagement, motivation, and learning outcomes, with technologies like educational robots and conversational agents boosting interest and attitudes towards learning (Yang, Oh, & Wang, 2020). This integration also facilitates personalized learning, improves teaching efficiency, and provides valuable insights into student performance (Uluskan, 2023; Samuelsson, 2023).

AI has the potential to reshape traditional assessments, offering more interactive, personalized, and effective methods. By leveraging AI, educators can enhance the assessment process, provide customized feedback, and better align assessments with learning objectives, ensuring that student skills and learning are accurately measured.

2.8 Identified gaps in the literature

Gaps in the current literature around conversational AI in higher education and business management assessment methods include the need for 'authentic assessments' focusing on higher-order cognitive skills and problem-solving, rather than traditional methods (Ifelebuegu, 2023). There is a call for re-evaluation of the appropriateness of multiple-choice questions (MCQs) as an assessment tool in higher education due to the risks of academic dishonesty and dependence on AI models (Li & Chignell, 2022). Additionally, there is a gap in evaluating the environmental impact of AI applications in the chemical industry, given data gaps and challenges in choosing appropriate assessment methods (Odonkor, Kaggwa, Uwaoma, Hassan, & Farayola, 2024). Comprehensive qualitative assessments exploring the practical experiences, benefits, and challenges of academic professionals utilizing AI tools in engineering pedagogy remain limited (Hao, et al., 2024). There is a gap in assessing the readiness of conversational AI models for application in real-world clinical scenarios (Wang, et al., 2023)

These gaps highlight the need for further research to address the effectiveness, ethical considerations, and practical implications of integrating conversational AI in higher education and business management assignments and its assessment methods. This paper attempts to close this gap by undertaking research to understand how students would perform, and what their perceptions of the alternative assessment method was, which embedded the use of conversational AI platforms.

3. Methodology

Case study methodology allows for in-depth exploration of specific instances within real-life contexts, defined as intensive studies of single units (Gerring, 2004). Widely used in fields like nursing, marketing, and information systems (Crowe, et al., 2011; McCutcheon & Meredith, 1993), it enables investigation from multiple perspectives within a bounded context (Rashid, Rashid, Warraich, Sabir, & Waseem, 2019). This research utilised case study

methodology with participant observation, allowing for high-quality data collection through active engagement (Wilkinson, 2017). Following Fàbregues and Fetters' (2019) steps—literature review, research question formulation, case design selection, case boundary definition, data collection preparation, data analysis, report writing, and quality appraisal—the study aimed to understand how students would perform, and what their perceptions of the alternative assessment method was, which embedded the use of conversational AI platforms.

Objective 1: Analyse the impact of conversational artificial intelligence on student assessment practices in higher education**.**

Research Questions

1. How has conversational artificial intelligence disrupted higher education, particularly in terms of student assessment?
2. How should assignments and evaluations evolve to consider not just knowledge retention but also critical thinking, communication, and adaptability skills in the era of conversational AI?

Objective 2: Explore best practices for the ethical implementation and utilization of conversational AI in higher education assessments**.**

Research Questions:

1. What are the ethical considerations associated with the implementation and utilization of conversational AI in higher education?
2. How can AI technologies be incorporated into student assignments and integrated into assessment?

4. A Case: Rethinking student assignments and its assessment

4.1 Background

As part of the MSc Management programme at Swansea University, a module on Information Systems is taught. The module looks at ways in which information systems can be used effectively to achieve competitive advantage. The MSc Management cohort is usually a small cohort of not more than 45 students. In 2024 a cohort of initially 36 students enrolled for the module, with only 28 submitting to the final coursework. Most of the cohort are from the Indian and Nigerian descent—some of the students often have English as a third or fourth language and therefore find it difficult to use English both for communication and for writing reports. The assessment of this module has seen several changes over the years, in 2024, the module included two multiple choice/true and false online tests, as well as a business report that students needed to research and write up. Students ordinarily would be tasked in an assignment to research a company and provide a report on the various aspects of the information systems used within the company. With the popularisation of ChatGPT and other conversational AI tools, the module coordinator tried to incorporate AI tools in the assignment which required students to use AI tools for their report writing.

4.2 Integrating AI tools in assignments

Traditional report writing assignments face the problem of students using conversational AI tools to complete much of the work, making it hard for educators to assess learning. To address this, a module coordinator designed an assignment allowing AI tool use but requiring students to critically evaluate their prompts and AI responses, reducing the risk of plagiarism, and ensuring that critical skills were also being used.

Students were assigned to use three AI tools, verify sources, and critically evaluate the process and outputs. They also had to write a short report on the process and output validity and create a business report on a company and its information systems.

Students were advised how to undertake the coursework and what constituted the misuse of conversational AI tools. The importance of developing skills and critically analysing what they were doing and receiving as output of the tools was a required skill to develop. Students were advised of the structure of the coursework and how the process of using the AI platforms would be evaluated. A generic template for the process was provided.

Upon receiving the assignment, students found it interesting but challenging, requiring multiple briefing sessions for clarity. Both the process and the final report were part of the summative assessment.

At the International Congress & Exhibition on Current Trends on Science Technology Education SCITEED 2024 conference, similar assignments were discussed, emphasizing the evaluation of both the product and the process in assessments involving AI tools.

5. Data analysis and results

5.1 Objective 1 - Analyse the impact of conversational artificial intelligence on student assessment practices in higher education.

5.1.1 Fundamental shift required for student assessment in higher education

Given the ease of using conversational AI by students for their coursework, academic staff are uncertain who is writing the work, complicating the evaluation of student competencies. A fundamental shift in assessment practices is needed to address AI-driven technologies, but there is no program-level guidance, leaving academics to innovate at the module level.

Developing new assessment methods that evaluate student competencies rather than AI capabilities is challenging (Thurab-Nkhosi & Williams, 2018). This requires revisiting module objectives and transferable skills, focusing on practical demonstrations and interpersonal skills where AI falls short (Chen & Zhu, 2016). The syllabus and prompt-engineering techniques may also need revision.

Integrating AI in assignments necessitates rethinking evaluation criteria, faculty training, and resource allocation (Chow, 2024). Ensuring the validity and reliability of AI-driven assessments is crucial, as biases and inaccuracies in AI algorithms could affect fairness, effectiveness, and raise data privacy and security concerns (Sharma & Lin, 2022).

The Russell Group, in partnership with educational experts, developed principles to ensure students and staff are AI-literate, leveraging technological breakthroughs in teaching and learning. The five principles (Russel Group, 2023) are:

1. Support students and staff in becoming AI-literate.
2. Equip staff to help students use generative AI tools effectively.
3. Adapt teaching and assessment to include ethical AI use and support equal access.
4. Uphold academic rigour and integrity.
5. Collaborate to share best practices as AI evolves in education.

The fifth principle emphasizes collaboration, suggesting this approach should extend to program and module levels to share best practices. Knowledge Cafés, like those conducted by Swansea University academics at various international conferences, as well as at Swansea University, provide a platform for academics to share experiences with conversational AI in higher education.

5.1.2 Authentic assessment methods for appropriate skills development and effective assessment

In the era of conversational AI, leveraging conversational Artificial Intelligence in higher education institutions is essential for assessing knowledge retention, critical thinking, communication, and adaptability. Developing authentic assessment types requires innovation, creativity, and rethinking student skills and module intentions. Kasimatis & Papageorgiou (2021) describe authentic assessment as a dynamic evaluation focusing on skill development, suitable for evaluating critical thinking (Jingbo & Ying, 2023), while embedding it in curricula, can enhance employability by fostering reflection, communication, and collaboration (Manville, Donald, & Eves, 2022; Manville, Donald, & Eves, 2022). By incorporating real-life scenarios, universities can effectively measure critical thinking skills (Chusni & Suherman, 2021), engaging students in meaningful activities to improve learning outcomes (Vu & Dall'Alba, 2013).

5.2 Objective 2: Explore best practices for the ethical implementation and utilization of conversational AI in higher education assessments

5.2.1 Ethical considerations associated with the implementation and use of conversational AI in higher education?

Students included the output of their prompts in the coursework submission, ensuring transparency and a clear description of the process. Despite their interest, students expressed concerns about the difficulty and their lack of understanding, requiring multiple explanatory sessions. However, inconsistent attendance meant some students did not fully grasp the assignment.

Ethical considerations highlight the need for education to align with work life, ensuring students can apply their learning professionally. Neglecting this may hinder their real-world effectiveness. Integrating ethics education into business curricula enhances students' ethical decision-making skills and prepares them for future challenges (Eyal, Berkovich, & Schwartz, 2011; Lopez, Rechner, & Olson-Buchanan, 2005)

5.2.2 How can AI technologies be incorporated into student assignments and integrated into assessment?

For this case study, the coursework included assessing the process of developing the report. Students used three AI tools and traditional methods, with 30% of the assignment allocated to critically evaluating the AI output and creating the report. After setting the task, one author was invited to present at a conference on embedding AI in assignments, and it was at this conference that there were other instances of academics using a similar example of assessing process as well as the outcome. However, many students struggled to provide critical reflections, often just presenting alternative outputs with little analysis. This highlights the challenge of embedding AI in assignments. Academics are catapulted into radically changing and rethinking assessment due to the popularisation of AI. The importance of co-creating and sharing new assessment methods to evaluate different student competencies is key to academic prowess and success.

6. Discussion and conclusions

6.1 Major findings

While universities struggle to manage AI at the program level, academics are attempting to innovate assessment methods, there is a lack of consensus on the ethical use of AI, and there is a need for understanding the benefits of collaboration for co-creating authentic assessment methods. Developing new forms of authentic assessment methods to evaluate student competencies requires a collaborative approach, as suggested also by the Russel group guidelines.

Academics and universities must adapt to technological advances in the AI/digital age. This case study presents an example of integrating conversational AI into coursework and assessment, highlighting the necessary shift in higher education to assess student learning outcomes effectively. It emphasizes evaluating the process, not just the outcome, and the need for ethics teaching in business curricula for consistency across programs.

In this fast-paced digital era, rapid AI advancements make it essential for academics to share best practices and co-create ethical assessment methods. Knowledge cafés provide a collaborative framework for informal conversations and sharing best practices, including ideas for new forms of authentic assessment.

6.2 Limitations

The study may have research methodological limitations in that further focus groups and interviews would have provided a deeper understanding of the complexity of AI use within student assessment and authentic assessment development and perception.

6.3 Future research

Future research on conversational AI use in education could focus on two key areas: its adoption and effectiveness in higher education and developing guidelines for embedding conversational AI use for authentic assessment in an ethical way.

References

Akgun, S., & Greenhow, C. (2022). Artificial intelligence in education: Addressing ethical challenges in K-12 settings. *AI and Ethics, 2*(3), 431-440.

Babirye, L. N. (2024). Chatbots in Practical Science, Technology, Engineering, and Mathematics (STEM) Education. IGI Global. doi:10.4018/979-8-3693-0343-6.ch008

Bahroun, Z., Anane, C., Ahmed, V., & Zacca, A. (2023). Transforming Education: A Comprehensive Review of Generative Artificial Intelligence in Educational Settings through Bibliometric and Content Analysis . *Sustainability*(15), 1-40.

Baker, B., Mills, K., McDonald, P., & Wang, L. (2023). AI, concepts of intelligence, and chatbots: The “Figure of Man,” the rise of emotion, and future visions of education . *Teachers College Record, 125*(6), 60-84.

Basu, K. (.-4. (2019). Conversational ai : open domain question answering and commonsense reasoning. *Electronic Proceedings in Theoretical Computer Science,, 306*, 396-402. doi:https://doi.org/10.4204/eptcs.306.53

Chen, W., & Zhu, W. (2016). Effectiveness of quality physical education in improving students' manipulative skill competency. *Journal of Sport and Health Science*. doi:10.1016/j.jshs.2015.04.005

Chow, J. C. (2024). Generative Pre-Trained Transformer-Empowered Healthcare Conversations: Current Trends, Challenges, and Future Directions in Large Language Model-Enabled Medical Chatbots. *Biomedinformatics*. doi:10.3390/biomedinformatics4010047

Chusni, M., & Suherman, S. (2021). Developing authentic assessment instrument based on multiple representations to measure students' critical thinking skills. *Momentum Physics Education Journal*, 194-208. doi: https://doi.org/10.21067/mpej.v5i2.5790

Crompton, H., & Song, D. (2023, Jan). The Potential of Artificial Intelligence in Higher Education. *International Journal of Educational Technology in Higher Education, 20*(22), 1-22.

Crowe, S., Cresswell, K., Robertson, A., Huby, G., Avery, A., & Sheikh, A. (2011). The case study approach. *BMC Medical Research Methodology, 11*(1). doi:https://doi.org/10.1186/1471-2288-11-100

David Gurteen. (n.d.). *Knowledge-cafe-concept*. Retrieved 06 04, 2024, from Knowledge Cafe: https://knowledge.cafe/knowledge-cafe-concept/

El Hashash, A. (2022). Role of Digital Formative Assessment in Improving the Assessment and Monitoring of Students' Learning and Their Significance During the COVID-19 Pandemic. *Open Journal of Educational Research*, 9-12.

Eyal, O., Berkovich, I., & Schwartz, T. (2011). Making the right choices: ethical judgments among educational leaders. *Journal of Educational Administration, 49*(4), 396-413. doi:https://doi.org/10.1108/09578231111146470

Fàbregues, S., & Fetters, M. D. (2019). Fundamentals of case study research in family medicine and community health. *Family Medicine and Community Health, 7*(2), e000074. doi:https://doi.org/10.1136/fmch-2018-000074

Franco D'Souza, R., Mathew, M., Mishra, V., & Surapaneni, K. M. (2024). Twelve tips for addressing ethical concerns in the implementation of artificial intelligence in medical education. , 29(1), p.2330250. *Medical Education Online, 29*(1), 2330250.

Gartner. (2023). *Virtual Assistants*. Retrieved November 16, 2023, from Information technology: https://www.gartner.com/en/information-technology/glossary/virtual-assistant-va

Gerring, J. (2004). What Is a Case Study and What Is It Good for? *American Political Science Review, 98*(2), 341-354. doi:DOI: 10.1017/9781316848593

Ghayoom, M. (2023). Applications of Chatbots in Education. IGI Global. doi:10.4018/978-1-6684-6234-8.ch004

Gökçearslan, Å. (2024). Benefits, Challenges, and Methods of Artificial Intelligence (AI) Chatbots in Education: A Systematic Literature Review. *International Journal of Technology in Education, 7*(1), 19-39. doi:10.46328/ijte.600

Hadibarata, T., & Jusoh, M. (2023). Strategies for Online-education Model for Project and Laboratory-based Assessment in Environmental Monitoring and Analysis Course. *Acta Pedagogia Asiana, 2*(1), 14-25.

Hao, J., von Davier, A. A., Yaneva, V., Lottridge, S., von Davier, M., & Harris, D. J. (2024). Transforming assessment: The impacts and implications of large language models and generative AI . *Educational Measurement: Issues and Practice, 43*(2), 16-29.

Holmes, W. P.-P., Santos, O. C., Rodrigo, M. T., Cukurova, M., Bittencourt, I. I., & Koedinger, K. R. (2022). Ethics of AI in education: Towards a community-wide framework. *International Journal of Artificial Intelligence in Education, 32*(3), 504-506.

Holzinger, A., Lettner, S., Steiner-Hofbauer, V., & Capan Melser, M. (2020). How to assess? Perceptions and preferences of undergraduate medical students concerning traditional assessment methods. *BMC Medical Education, 20*, 1-7.

Ifelebuegu, A. O. (2023). Rethinking online assessment strategies: Authenticity versus AI chatbot intervention. *Journal of Applied Learning & Teaching, 6*(2), 1-8.

Ilieva, G. (2023). Effects of Generative Chatbots in Higher Education. *Information, 14*(9), 492. doi:10.3390/info14090492

Jain, G. G., Schroeder, J. L., & Faulkenberry, E. D. (2014). Artificial intelligence-based student learning evaluation: a concept map-based approach for analyzing a student's understanding of a topic. *IEEE Transactions on Learning Technologies, 7*(3), 267-279.

Jingbo, H., & Ying, L. (2023). Holistic Language Learning: Implementing Authentic Assessment to Cultivate 4C Skills in Chinese University English Course. *Advances in Educational Technology and Psychology, 7*, 126-130. doi:http://dx.doi.org/10.23977/aetp.

Kaphings, '. A., & Kohlmann, W. (2021). Comparing models of delivery for cancer genetics services among patients receiving primary care who meet criteria for genetic evaluation in two healthcare systems: BRIDGE randomized controlled trial. *BMC Health Services Research, 21*(1). doi:10.1186/s12913-021-06489-y

Kasimatis, K., & Papageorgiou, T. (2021). Education executives views about the development of authentic learning and assessment environments. *Advances in Education and Educational Trends Series*, 130-141. doi:https://doi.org/10.36315/2021ead11

Katsarou, E., Wild, F., Sougari, A.-M., & Chatzipanagiotou, P. (2023). A Systematic Review of Voice-based Intelligent Virtual Agents in EFL Education. *International Journal of Emerging Technologies in Learning (iJET) , 18*(10), 65-85.

Lee, J. C. (2023). Exploring the Role of Artificial Intelligence Chatbots in Preoperative Counseling for Head and Neck Cancer Surgery. *The Laryngoscope, 134*(6), 2757-2761.

Li, J., & Chignell, M. (2022). FMEA-AI: AI fairness impact assessment using failure mode and effects analysis. *AI and Ethics, 2*(4), 837-850.

Lopez, Y. P., Rechner, P. L., & Olson-Buchanan, J. B. (2005). Shaping ethical perceptions: an empirical assessment of the influence of business education, culture, and demographic factors. *Journal of Business Ethics, 60*(4), 341-358. doi:https://doi.org/10.100

Manville, G., Donald, W., & Eves, A. (2022). Can embedding authentic assessment into the curriculum enhance the employability of business school students?. *Gile Journal of Skills Development, 2*(2), 73-87. doi:https://doi.org/10.52398/gjsd.2022.v2.i2.pp73-87

Manville, G., Donald, W., & Eves, A. (2022). Embedding authentic assessment into the curriculum: enhancing the employability of business students. *Academy of Management, 2022*(1). doi:https://doi.org/10.5465/ambpp.2022.10012abstract

McCutcheon, D., & Meredith, J. (1993). Conducting case study research in operations management. *Journal of Operations Management, 11*(3), 239-256. doi:https://doi.org/10.1016/0272-6963(93)90002-7

McMurtrie, B. (2023). ChatGPT Is Everywhere: Love it or hate it, academics can't ignore the already pervasive technology. *69*(15), 32-38. Retrieved from The Chronicle of Higher Education.

Ng, D. T., Wu, W., Leung, J. K., Chiu, T. K., & Chu, S. K. (2024). Design and validation of the AI literacy questionnaire: The affective, behavioural, cognitive and ethical approach. *British Journal of Educational Technology, 55*(3), 1082-1104.

Odonkor, B., Kaggwa, S., Uwaoma, P. U., Hassan, A. O., & Farayola, O. A. (2024). The impact of AI on accounting practices: A review: Exploring how artificial intelligence is transforming traditional accounting methods and financial reporting . *World Journal of Advanced Research and Reviews,, 21*(1), 172-188.

Ojha, S., Narendra, A., Mohapatra, S., & Misra, I. (2023). From robots to books: An introduction to smart applications of AI in education (AIEd). arXiv preprint arXiv:2301.10026.

Olatoye, F. O., Awonuga, K. F., Mhlongo, N. Z., Ibeh, C. V., Elufioye, O. A., & Ndubuisi, N. L. (2024).). Ai and ethics in business: a comprehensive review of responsible ai practices and corporate responsibility. *International Journal of Science and Research Archive, 11*(1), 1433-1443. doi:https://doi.org/10.30574/ijsra.2024.11.1.0235

OpenAI. (2023, March 14). *Openai.com*. Retrieved from ChatGPT 3.5: https://Chat.openai.com

Piskopani, A.-M., Webb, H., & Caleb-Solly, P. (2023). Using a Knowledge Café approach as a public engagement activity for raising awareness of data protection issues in robotics for health and social care. *Proceedings of the First International Symposium on Trustworthy Autonomous Systems* (pp. 1-5). ACM.

Rashid, Y., Rashid, A., Warraich, M., Sabir, S., & Waseem, A. (2019). Case study method: a step-by-step guide for business researcher. *International Journal of Qualitative Methods, 18*. doi:https://doi.org/10.1177/1609406919862424

Rudolph, J., Tan, S., & Tan, S. (2023). ChatGPT: Bullshit spewer or the end of traditional assessments in higher education? *Journal of Applied Learning & Teaching, 6*(1), 1-22.

Russel Group. (2023, July 4). *New prinicples on the use of AI in education*. (R. Group, Editor) Retrieved 2024, from Russell Group : https://russellgroup.ac.uk/news/new-principles-on-use-of-ai-in-education/

Samuelsson, J. (2023). Arithmetic Fact Fluency Supported by Artificial Intelligence. *Frontiers in education technology, 6*(1), 13.

Sharma, A., & Lin, I. W. (2022). Human-AI Collaboration Enables More Empathic Conversations in Text-based Peer-to-Peer Mental Health Support. doi:10.48550/arxiv.2203.15144

Singh, S. (2017). The Knowledge Café as a Research Technique. *The Electronic Journal of Business Research Methods, 15*(1), 29-40.

Smolansky, A. C., Raduescu, C., Zeivots, S., Huber, E., & Kizilcec, R. (2023, July). Educator and student perspectives on the impact of generative AI on assessments in higher education Proceedings of the tenth ACM conference on Learning@ Scal. *Proceedings of the tenth ACM conference on Learning@ Scale*, (pp. 378-382).

Sysoyev, P. V., & Filatov, E. M. (2023). Chatbots in teaching a foreign language: advantages and controversial issues. *Tambov University Review Series Humanities*(1), 66-72. doi:10.20310/1810-0201-2023-28-1-66-72

Thurab-Nkhosi, D., & Williams, G. (2018). Achieving confidence in competencies through authentic assessment. *The Journal of Management Development*(8), 652-662. doi:10.1108/jmd-12-2017-0413

Uluskan, M. (2023). Structural equation modelling–artificial neural network based hybrid approach for assessing quality of university cafeteria services. *The TQM Journal, 35*(4), 1048-1071.

Vu, T., & Dall'Alba, G. (2013). Authentic assessment for student learning: an ontological conceptualisation. *Educational Philosophy and Theory, 46*(7), 778-791. doi:https://doi.org/10.1080/00131857.2013.795110

Wang, Z., Zhong, H., Zhang, J., Pan, P., Wang, D., Liu, H., . . . Kang, Y. (2023). Small-molecule conformer generators: evaluation of traditional methods and AI models on high-quality data sets . *Journal of Chemical Information and Modeling, 63*(21), 6525-6536.

Wilkinson, C. (2017). Going backstage: observant participation in research with young people. *Children S Geographies, 15*(5), 614-620. doi:https://doi.org/10.1080/14733285.2017.1290924

Yang, D., Oh, E. S., & Wang, Y. (2020). Hybrid physical education teaching and curriculum design based on a voice interactive artificial intelligence educational robot. *Sustainability, 12*(19), 1-14.

Yildirim-Erbasli, S. N., Bulut, O., Demmans Epp, C., & Cui, Y. (2023). Conversation-Based Assessments in Education: Design, Implementation, and Cognitive Walkthroughs for Usability Testing . *Journal of Educational Technology Systems, 52*(1), 27-51.

A Study on Usage of Formal Knowledge Sharing Systems in Project-Based Organizations

Anandasivakumar Ekambaram
SINTEF Community, Trondheim, Norway

siva@sintef.no

Abstract: Projects are one-time activities that have time and resource limitations. Projects are considered as arenas for learning. There are opportunities for creating new knowledge and utilizing existing knowledge in projects. Since projects are per definition unique, there is at least some degree of uniqueness associated with each project. This uniqueness provides opportunities to learn something new in each project. The known element in projects – such as existing solutions that have been proven to produce good results – can be shared and utilized to avoid using time and resources to create the same or similar solutions from scratch. Knowledge sharing and learning can play a notable role in improving the ability of project-based organizations to carry out their projects successfully and contributing to obtain higher productivity, profitability and sustainable competitive advantage. However, there are several challenges. This paper looks at one of the challenges, namely ineffective usage of formal knowledge sharing systems in project-based organizations. In this regard, the following two research questions are considered: (1) What are the challenges of using formal knowledge sharing systems? (2) How can the challenges be addressed? Formal knowledge sharing systems play an important role in supporting knowledge sharing and learning in organizations. Technological development has created many possibilities to enhance functions as well as benefits of such systems. However, there are several factors that are to be taken into consideration in order to make sure an effective usage of formal knowledge sharing systems in project-based organizations. This paper presents six factors in this regard and emphasizes the need to have a strategic view and a top management perspective of knowledge sharing and learning in project-based organizations. The study on which this paper is based, is of qualitative nature. In this regard, interviews have been conducted to gather information from five public project-based organizations in Norway.

Keywords: Knowledge Sharing, Learning, Project, Organizational Culture, Organizational Structure, Strategic Focus

1. Introduction

Projects are a popular form of work in organizations to achieve a clear goal within a certain time-period and cost. Projects are considered an arena for learning. Since projects are by definition unique, they have at least a certain degree of uniqueness that will lead to acquisition of new knowledge. At the same time, projects also include some known elements - for example known methods and solutions - which give the opportunity to utilize the existing knowledge. In other words, new knowledge can be developed (knowledge exploration) and existing knowledge can be shared (knowledge exploitation) in projects.

Exploring and exploiting knowledge can have positive effects on project-based organizations (PBOs) and the projects that they carry out. There are many benefits from sharing knowledge and focusing on learning in projects. Figure 1 shows some of the gains.

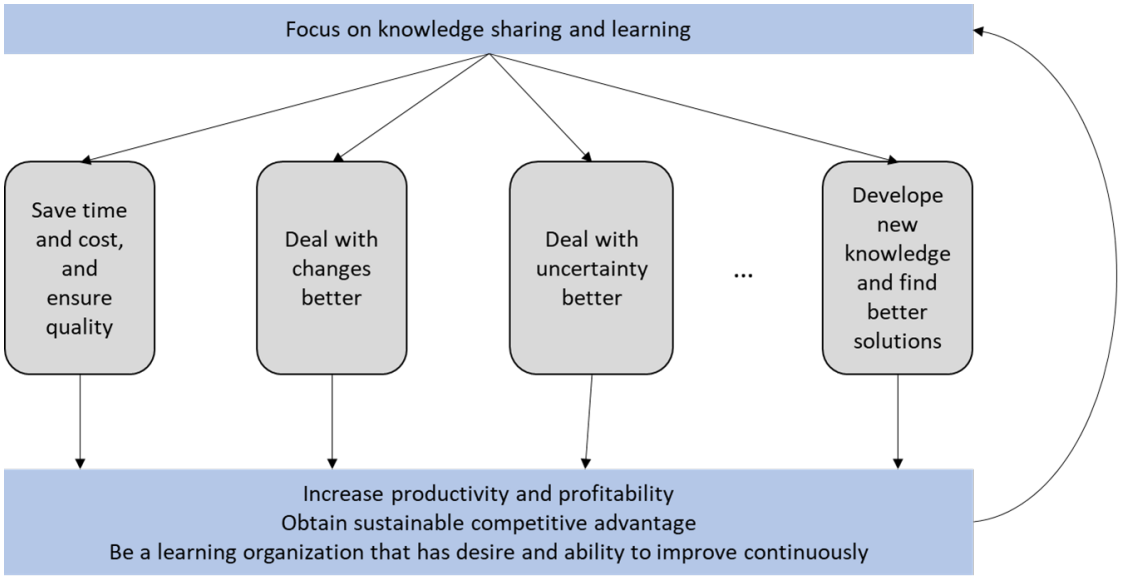


Figure 1: Positive effects knowledge sharing and learning

But the question is: Do project-based organizations get these benefits?

"If HP knew what HP knows, we would be three times as profitable." – A manager at Hewlett Packard (HP) mentioned this several years ago (Boshyk, 2000). Researchers also point out the importance of knowledge sharing and learning in project-based organizations and its positive effects. (Abdellatif et al., 2019; Mahura & Birollo, 2021; Kvålshaugen et al., 2021; Zhang et al., 2024). Although many measures have been implemented, PBOs still experience challenges related to knowledge sharing and learning. It is not always easy to share knowledge from projects to the base organization / the permanent organization (Williams, 2008; Duffield & Whitty, 2015; Evers & Chappin, 2020).

What prevents PBOs from achieving the benefits of knowledge sharing and learning? What are the barriers? How can the barriers be dealt with? A pre-project called *Experience sharing and learning in project-based organizations* (ELPO) – on which this paper is based – attempts to address this matter. This paper looks at one of the aspects of this research pre-project, namely usage of formal knowledge sharing systems in PBOs. The research questions hence are:

- What are the challenges of using formal knowledge sharing systems?
- How can the challenges be addressed?

The structure of the paper is as follows: After the introduction, background information including research method that is applied in this study is provided, followed by relevant concepts. And then, results, analysis and discussion are presented. Finally, concluding remarks wind up the whole discussion.

2. Background Information and Research Method

The pre-project ELPO is financed by Project Norway (https://prosjektnorge.no/). Project Norway is a national arena for the exchange of knowledge and experiences, where new knowledge about projects is developed through research-based collaboration with Norwegian business and industry.

This study applied qualitative research methods. Fourteen interviews were conducted in five public PBOs in Norway during 2023 to collect information. The interviews were semi-structured – having an overarching, flexible structure, and encouraging natural dialogue and discussion. The duration of the interviews varied between 1 and 1.5 hours. Those who were interviewed are anonymized and identified through a code (Respondent 1, 2, etc.). The respondents have experience of performing roles such as project member, project manager, project owner and department manager.

3. Relevant Concepts

3.1 Knowledge

Davenport & Prusak (1998, page 5) define knowledge as follows:

> "Knowledge is a fluid mix of framed experience, values, contextual information and expert insight that provides a framework for evaluating and incorporating new experiences and information. It originates and is applied in the minds of knowers. In organizations, it often becomes embedded not only in documents or repositories but also in organizational routines, processes, practices and norms."

This definition points out that knowledge provides a framework for evaluating, interpreting and gaining new experiences and information.

Another relevant term is experiential learning. Experience-based learning, introduced by Kolb, suggests that concrete experiences provide a basis for observation, reflection and abstract conceptualization. Kolb's experiential learning model is composed of four stages that go in a spiral (Kolb, 1984):

1. Concrete experience
2. Observation and reflection on that experience
3. Formation of abstract concepts after that reflection
4. Testing the new concepts

Figure 2 illustrates it.

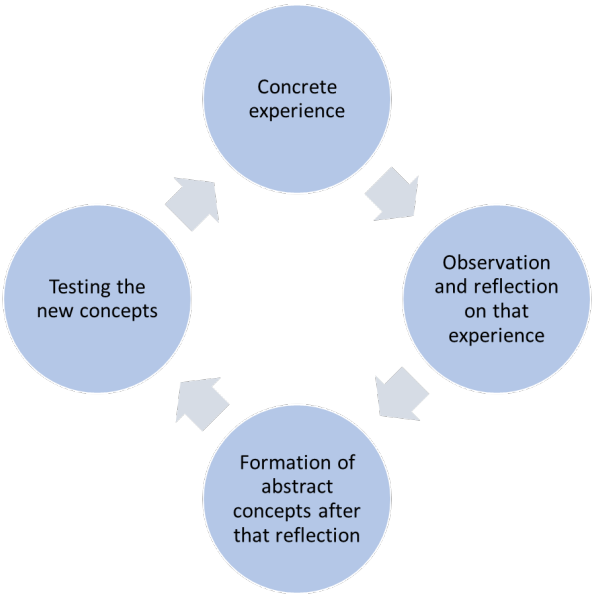


Figure 2: Experience-based learning (Kolb, 1984)

Knowledge sharing and learning can be addressed in organizations, not only at project level or operational level, but also at strategic level. In this connection, it is relevant to look at the term 'knowledge governance'.

Pemsel (2012) says that an organization can define means and support for knowledge-creating processes and activities. However, the creation of knowledge takes place through individual and collective interaction and reflection, which can be independent of such means and support. Organizations therefore need strategies for how to handle knowledge and learning effectively. Strategies are created through knowledge governance in an organization and are implemented through the management of knowledge.

According to Zhang et al. (2024), Knowledge governance can be defined as a governance mechanism to manage and influence knowledge management processes, for example knowledge acquisition, storage, transfer and creation.

Aslam et al. (2024) also point out that knowledge governance uses a broader perspective to address issues related to knowledge sharing and learning, and also has a strategic focus on managing knowledge sharing and learning in organizations – rather than finding simple solutions to individual problems.

3.2 The Iron Triangle

Projects are by definition unique. They are one-time activities that have time and resource constraints. Traditionally, project success was measured by taking into account how the project handled the use of time and costs, and quality (Navarre & Schaan, 1990; Ika & Pinto 2022; Karlsen, 2023). These 3 aspects form the so-called iron triangle of the project.

Citing Ika & Pinto (2022), Karlsen (2023, page 365) describes the components of the iron triangle:

- Cost: That the project is completed within the budget.
- Time: That the project is finished within the deadlines.
- Quality: That all deliveries meet the required quality standards.

Although other aspects that define project success have become prominent (such as stakeholder management and safety, health and environment), the iron triangle still influences the practical world of project management, at least to some extent.

3.3 Motivation

The degree of motivation, which individuals have, to carry out a task can be linked to their attitudes and behavior towards carrying out the task. Motivation plays an important role in knowledge sharing and learning. Motivation can be categorized as extrinsic motivation (for example praise, public recognition, money and promotion) and

intrinsic motivation, for example inner joy, interest and satisfaction in performing a task (Skyttermoen & Vaagaasar, 2015).

Incentive mechanisms can be used to motivate – to provide both extrinsic and intrinsic motivation to – organizational members to share knowledge. Karlsen (2023, page 175) presents some of the significant factors that can create job satisfaction and motivation for project team members:

- Meaningful work: When team members feel that their work is meaningful and contributes to a greater goal, they are more likely to be motivated and satisfied.
- Well-defined goal: When team members understand what they are working towards and what is expected of them, they are more likely to be motivated and have a sense of achievement when they achieve their milestones and goals.
- Autonomy: When team members are given autonomy and are trusted to make decisions, they are more likely to be motivated and have a sense of ownership over their work.
- Feedback: When team members receive positive feedback for their work, they are more likely to feel motivated and engaged.
- Recognition: When team members feel that their work is recognized and appreciated, they are more likely to be motivated and satisfied.
- Opportunities for learning and development: When team members have opportunities to learn new skills and take on new challenges, they are more likely to be motivated and feel meaningful about their work.
- Supportive team culture: When team members feel they are trusted and supported by their colleagues and have a positive team culture, they are more likely to be motivated and satisfied.

4. Results, Analysis and Discussion

Here, our primary focus is on formal systems that have been implemented in PBOs to support knowledge sharing; for example, knowledge databases, lessons learned reports, project evaluation reports and knowledge registers. Such systems are used to register and obtain knowledge and experiences. Results from the interviews show that there are challenges of using the systems effectively, and indicate how the challenges can be dealt with.

4.1 Challenges

First, we will look at six key challenges that hinder effective use of formal knowledge sharing systems in PBOs.

4.1.1 Attitudes and Culture

If one's personality and attitudes towards sharing knowledge and learning are negative, then this will become a barrier. Several of the respondents mention this as one of the central barriers. Respondent 4 mentions that there are different personalities and attitudes, and not all of them support knowledge sharing and learning. Respondent 2 gives an example of this:

> "[…] perhaps it is also because I have been project manager for 10, 15 projects. So I know this from A to Z, and I don't need someone to teach me my profession – When you have that attitude, it becomes a barrier to learning."

Respondent 8 says that it is difficult to motivate people who really do not want to use systems that were implemented to promote knowledge sharing and learning. Respondent 12 says:

> "Knowledge is not registered all the time. There can be several reasons for this. There is a structure to register knowledge, but not a sufficient culture or attitudes to do so."

Respondent 6 says that if a project manager prioritizes knowledge sharing and learning in his / her projects, then that project manager will facilitate it. This depends on the person, clarifies respondent 6. Based on own experiences, respondent 8 says:

> "Managers who focus on or prioritize knowledge sharing allocate time for knowledge sharing in project meetings. However, it depends much on individuals and their choice […]. There is a lack of culture for learning."

Kjeilen (2021), Mahura & Birollo (2021), Alves et al. (2022) also points out the importance of culture for learning.

Respondent 13 says that not everyone is curious about learning something new and sharing their knowledge. Respondent 2 says the following:

> "It's not everyone who really sees the importance. You either forget about sharing knowledge or don't prioritize it".

Here it is relevant to refer to one of the barriers to knowledge sharing and learning that Maryse & Chappin (2020) mention: Lack of interest in other projects and not understanding the necessity for sharing knowledge with other projects.

Lack of motivation can also be due to negative attitudes towards the use of formal knowledge sharing systems. In connection with this, respondent 8 says the following:

> "It's hard to motivate people who really don't want to. I don't think it's just a lack of knowledge that they can't do it here. But a lot depends on personality and will. You have people who want to learn new things, use new systems, see new opportunities and just jump at it. You also have some people who see problems (in knowledge sharing systems) and just focus on the problems and stop there. They don't want anything more to do with the systems."

This statement points out the importance of developing a positive organizational culture which helps to create positive attitudes towards knowledge sharing and the use of formal knowledge sharing systems.

Personality and attitudes can affect motivation. Several respondents say that a lack of motivation among people to work with or participate in activities related to knowledge sharing and learning in projects is one of the barriers. In this context, respondent 13 says that there is a lack of curiosity among project members.

4.1.2 Training

Respondent 12 says that although there are very good procedures, there is a lack of motivation to use knowledge sharing systems. There could be several reasons for that. One of them is attitudes and culture that we have seen earlier. Another is a lack of knowledge about how to use the systems. Respondent 8 mentions that a low level of knowledge on how to use the knowledge sharing systems effectively in projects is one of the barriers. In this context, it is relevant to look at another barrier that respondent 4 mentions: Lack of training related to the use of systems. Training programs can provide knowledge and guidance that are necessary for effective use of knowledge sharing systems.

4.1.3 Awareness of the Usefulness of the Systems

In addition to providing the necessary knowledge on using formal knowledge sharing systems, it is also important to raise awareness of the usefulness of the systems. Respondent 14 mentions a lack of this awareness as one of the barriers to knowledge sharing. Furthermore, respondent 14 mentions that creating commitment and motivation is extremely important in this context. One of the factors that can influence motivation to use knowledge sharing systems is the systems' user-friendliness.

4.1.4 User-Friendliness

Respondent 2 says that it is cumbersome to register 'lessons learned' in knowledge sharing systems. Respondent 13 points out a lack of structure that can guide what and how one should register in such systems. This respondent further says that one may not see the value of registering one's experiences / knowledge in such systems. We'll look at this matter more in Chapter 4.2.2.

Those who want to acquire knowledge may also experience certain challenges. Respondent 2 mentions that it is difficult to find topics / the needed solutions because of too much information (information overload). This type of challenges can lead to little use of lessons learned reports according to respondent 1. Respondent 4 says:

> "If you have a database or a system in which it is very difficult to find the needed knowledge, then I think that the system will be very poorly utilized. If you want to obtain knowledge from such difficult systems, then you try a little, and then you don't want to spend so much time on it before giving up."

4.1.5 Incentive Mechanisms

Motivation can be created in several ways. One possibility is to implement relevant reward systems. Respondent 11 mentions a lack of reward systems / incentive mechanisms as one of the barriers to knowledge sharing and

learning. Filstad's (2010) study also points this out. Incentive mechanisms can motivate project members to use formal knowledge sharing systems and participate in activities that promote knowledge sharing and learning in organizations. Some important factors that can create motivation are presented in chapter 3.3.

4.1.6 Adequate Time and Priority

One of the topics that is connected to motivation is performance measurement. This is about what a project member and manager are measured against. In this context, it is relevant to see a statement from respondent 7:

> "It's very nice to say that everyone should register their knowledge and experiences in the knowledge databases and everyone should talk to someone to gain or share knowledge. But, it's never followed up. No. It's clear that in a busy day-to-day work in projects, you prioritize (to do) what you're measured against."

This statement indicates that knowledge sharing and learning is not a usual criterium to measure performance of project managers and project members. Project managers (and project members) are normally measured in terms of their ability to deliver the project within the agreed deadline (time), cost and quality. Here, we look at projects from a project delivery perspective or a project manager perspective. The priority is project delivery, not knowledge sharing and learning in the project. In this regard, it is relevant to refer to the iron triangle that we have seen in Chapter 3.2.

The above statement from respondent 7 also shows that there is a need to use a higher perspective (for example top management perspective / senior management perspective) than a project manager perspective or a project delivery perspective to address knowledge sharing and learning in PBOs effectively. Several respondents mention involvement, commitment and support from top management / project owners / senior managers in this context. We will look more at this topic in chapter 4.2.

4.2 Improving the Usage of Formal Knowledge Sharing Systems

Many factors can be considered when one tries to find possibilities for improving the usage of formal knowledge sharing systems in PBOs. In this regard, we will look at one of the overarching factors: Involvement and support from the top management.

As we have seen in Chapter 4.1.6, there is a need for using a higher perspective (for example top management perspective / senior management perspective) than a project manager perspective or a project delivery perspective to address knowledge sharing and learning in PBOs effectively. Several respondents mention involvement, commitment and support from top management / project owners / senior managers in this context. The top management perspective provides a strategic view of knowledge sharing and learning in PBOs – that is, considering knowledge sharing and learning as a means to increase productivity, effectiveness, profit and competitive advantage (refer Figure 1 in Chapter 1). The concept called knowledge governance that we have seen in Chapter 3.1 can be considered here in this regard.

Top management's involvement and support can be seen in two dimensions: Organizational structure and culture.

4.2.1 The Structural Dimension

Top management can make sure – with the practical assistance from project managers – that project members (as well as project managers) get adequate time for knowledge sharing and learning in projects. It is important to note that project managers may not have the mandate / authority / priority to allocate time and resources for knowledge sharing and learning in their projects. Several respondents point out that the time aspect / time restriction is one of the barriers to knowledge sharing and learning in PBOs. More on this matter can be found in Ekambaram (2024). In addition, other recent scientific literature (scientific articles and reports) also mentions this barrier – for example, Kjeilen (2021), Sunnemark et al. (2024), Iftikhar & Lions (2022), Alves et al. (2022), and Pinkhasik & Herrmann (2021).

As respondent 5 indicates, obtaining knowledge from a source (for example, from a task, a colleague or a report) itself may not automatically lead to learning. There may probably be a need for reflection (refer Kolb's model on experience-based learning in Chapter 3.1). And reflection requires a certain amount of time. Therefore, there should be adequate time and priority for knowledge sharing and learning, and ensured by the top management.

Top management can also contribute to making sure effective use of knowledge sharing systems by investing in obtaining knowledge sharing systems that are not only relevant, but also user-friendly. Top management can ensure that the organization has user-friendly formal knowledge sharing systems that can help project managers and project members to find information about knowledge sources (where to find the needed knowledge) and obtain the knowledge that they need. Knowledge sharing systems can also provide clear instructions and guidance for registering and finding knowledge so that the knowledge can easily be found, understood and applied by future knowledge seekers in a proper way.

Another contribution from the top management can be establishing appropriate training programs that provide the needed knowledge and competence to the users, so that they can use the knowledge sharing system effectively. In connection with user-friendly systems, respondent 4 mentions an important point regarding the effective use of knowledge sharing systems: It is necessary to provide employees with sufficient training to ensure effective use of (recently introduced) knowledge sharing systems. A strategic focus on the implementation of training programs for employees can help to create a common understanding of how to use a knowledge sharing system and thus lead to common work practices, increase productivity and achieve competitive advantage. Here it is relevant to mention a statement from respondent 8:

> "There is an incredibly big difference in how people perceive working in such a system (a knowledge sharing system)."

This statement emphasizes the importance of creating a common understanding of the use of formal knowledge sharing systems.

When management implements measures to promote knowledge sharing and learning, it is important to ensure that project members actually use / practice the measures and follow up on the measures. Respondents 2 and 7 mention that the follow-up plays a significant role in the effective use of knowledge sharing systems. Kjeilen (2021) also says that work with knowledge sharing requires management to follow it up.

4.2.2 The Cultural Dimension

With the strategic focus on knowledge sharing and learning, the top management can greatly influence creating an organizational culture (that encompasses components such as attitudes, norms, values and behavior) that encourages and promotes knowledge sharing and learning in the organization. A clear communication of the strategy (that focuses on knowledge sharing and learning in and between projects in the organization) and why this strategy is important, action-plan for implementing the strategy as well as concrete measures, and the signals (emphasizing the importance of knowledge sharing and learning) that are sent by the top management regularly can play an important role in developing a positive culture for knowledge sharing and learning in PBOs.

Another measure that top management can take in connection with the use of knowledge sharing systems is to motivate organizational members to use knowledge sharing systems actively and effectively. There are several ways to motivate organizational members by providing extrinsic and intrinsic motivation (see Chapter 3.3). One way to create intrinsic motivation, according to some of the respondents, is to highlight the benefits of registering valuable knowledge in a formal knowledge sharing system. If a project member knows that his / her knowledge has helped someone else in the organization, it will bring some kind of recognition and joy to the project member. Sanboskani & Srour (2022) also mention this type of measure and positive effect of it in their study. Many of the motivating factors presented in chapter 3.3 – in particular, meaningful work, feedback, recognition, opportunities for learning and development, and supportive team culture – can contribute to creating a positive effect. This (that is, making visible the positive effect of using the knowledge sharing system) can encourage that project member (who has helped others), and possibly other organizational members to use the knowledge sharing system actively. They can then clearly know that the time they spend registering their knowledge is valuable, and that the registering activity actually helps their colleagues and the organization.

Pinkhasik & Hermann (2021) and Iftikhar & Lions (2022) mention the importance of motivation and incentive mechanisms to promote knowledge sharing and learning. Several respondents mention that it is important to motivate project members and managers to share knowledge. One of the reasons for this is that project members are not measured on knowledge sharing, says respondent 7. Respondent 9 points out that knowledge sharing is not seen as a key performance indicator. Project members do not naturally get motivated to spend time and energy on sharing knowledge due to busy everyday life in projects and the prioritization of completing project tasks. If the top management / project owners motivate project members and managers in the organization by using relevant incentive mechanisms (reward systems), then the situation can change.

Respondents 6, 11 and 13 mention that rewarding those who share knowledge with others can make a positive difference in knowledge sharing and learning in project-based organizations. Factors that provide motivation, which we have seen earlier in chapter 3.3, can be referred to here.

5. Concluding Remarks

This paper looks at one of the barriers to knowledge sharing and learning in PBOs, namely ineffective formal knowledge sharing systems. Six key challenges that hinder effective use of formal knowledge sharing systems in PBOs are described, and the importance of top management's involvement and support can address the challenges are discussed.

Top management's support and contribution to promote knowledge sharing and learning in PBOs should be operationalized at all professional levels in PBOs (for example, top management, project owners, project managers, project members, etc.). In order to do the operationalization effectively, both the structural and cultural aspects of organizations are to be taken into consideration.

Further study can include focusing on the research questions (presented in Chapter 1) in one or more case projects in order to get a detailed and context-specific understanding of the topic of consideration.

Reference

Abdellatif, T. M.; Capretz, L. F.; Ho, D. (2019): Automatic recall of software lessons learned for software project managers, *Information and Software Technology*, Vol. 115, Page 44-57.

Alves, J. L.; de Nadae, J.; de Carvalho, M. M. (2022): Knowledge management enablers and barriers: exploring the moderating effect of communication barriers, *International Journal of Managing Projects in Business*, October 2022.

Aslam, M. S.; Qammar, A.; Ali, I.; Yaqub, M. Z.; Ahmed, F.; Mohapatra, A. K. (2024): Fostering innovation speed and quality in ICT firms: The role of knowledge governance mechanisms, absorptive capacity and environmental dynamism, *Technological Forecasting & Social Change*, Volume 205.

Boshyk, Y. (2000): Beyond knowledge management: How companies mobilize experience, In Marchand, Donald A. & Davenport, T. H. (Eds.), *Financial Times: Mastering information management*, Prentice Hall.

Davenport, T. & Prusak, L. (1998): *Working knowledge – How organizations manage what they know*, Harvard Business School press.

Duffield, S. & Whitty, J. S. (2015): Developing a systemic lessons learned knowledge model for organizational learning through projects, *International Journal of Project Management*, Vol. 33, Page 311-324.

Ekambaram, A. (2024): Knowledge sharing and learning in projects – Focusing on time restriction, 12th Nordic conference on Construction Economics and Organisation, Trondheim, Norway, 30-31 May.

Evers, G. & Chappin, M. H. (2020): Knowledge sharing in smart grid pilot projects, *Energy Policy*, Vol. 143.

Filstad, C. (2010): *Organisasjonslæring – Fra kunnskap til kompetanse*, A book on organizational learning, Fagbokforlaget.

Iftikhar, R. & Lions, C. (2022): Interorganizational knowledge sharing barriers and enablers: the case of Peshawar Bus Rapid Transit project, *International Journal of Managing Projects in Business*, Volume 15, Number 5, Page 769-792.

Ika L. A. & Pinto, J. K. (2022): The "re-meaning" of project success: Updating and recalibrating for a modern project management, *International Journal of Project Management*, Vol. 40, Page 835-848.

Karlsen, J. T. (2023): *Project management – From startup to success*, Scandinavian University Press.

Kjeilen, H. N. (2021): Erfaringsoverføring i byggebransjen – Hindre og pådrivere for erfaringsoverføring og læring hos entreprenører, *Master thesis on experience transfer in the building construction sector*, Department of Civil and Environmental Engineering, Norwegian University of Science and Technology.

Kolb, D. A. (1984): *Experiential Learning: Experience as a Source of Learning and Development*, New Jersey, Prentice Hall.

Kvålshaugen, R.; Swärd, A.; Djupvik-Flaa, P.; Stenberg, S.; Virgenes, U. (2021): Gjentakende samarbeid i utbyggingsprosjekter: Skaper det verdi og i så fall hvilke verdier og hvordan?, A r*eport on recurring collaboration in development projects*, Prosjekt Norge & Handelshøyskolen BI, Senter for byggenæringen.

Mahura, A. & Birollo, G. (2021): Organizational practices that enable and disable knowledge transfer: The case of a public sector project-based organization, *International Journal of Project Management*, Vol. 39, Issue 3, Page 270-281.

Maryse, G. E. & Chappin, M. H. (2020): Knowledge sharing in smart grid pilot projects, *Energy Policy*, Volume 143.

Navarre, C. & Schaan, J. L. (1990): Design of Project Management Systems from Top Management's Perspective. *Project Management Journal*, 21 (2): 19-27.

Pemsel, S. (2012): Knowledge processes and capabilities in project-based organizations, *Doctoral thesis*, Construction Management, Lund University, Sweden.

Pinkhasik, P. & Herrmann, P. (2021): Learning from external stakeholders: Evidence from two railway projects in Germany, *Project Leadership and Society*, Volume 2.

Sanboskani, H. & Srour, I. (2022): Using advanced statistical methods to identify the drivers of knowledge sharing intention among construction workers, *Journal of Construction Engineering and Management*, Volume 148 (2).

Skyttermoen, T. & Vaagaasar, A. L. (2015): *Verdiskapende prosjektledelse*, Cappelen Damm Akademisk.

Sunnemark, F.; Westin, W. L.; Saad, T. A.; Assmo, P. (2024): Exploring barriers and facilitators to knowledge transfer and learning processes through a cross-departmental collaborative project in a municipal organization, *The Learning Organization*, Vol. 31, No. 3.

Williams, T. (2008): How do organizations learn lessons from projects – and do they?, *Transactions on Engineering Management*, Vol. 55, Page 248-266.

Zhang, X; Shen, W; Tang, W; Duffield, C, F.; Hui, F. K. P.; Zhang, L; Lou, C. (2024): How to improve the effects of knowledge governance on individual learning across projects: From the perspective of relational capital *International Journal of Project Management,* Vol. 42.

Impact of Chatbots on Satisfaction and Loyalty in Lima's Telecom Sector

Catherine Alexandra Herrera Fallaque
University of Lima, Peru

20190938@aloe.ulima.edu.pe

Abstract: The migration towards digital environments has transformed the expectations of consumers, who now not only look for quality products and services, but also convenience, personalization and efficiency in each interaction with the brand. This change presents significant challenges for companies, as they need to constantly adapt to meet their needs and thus maintain loyalty in a highly competitive market. The pressure to offer added value and maintain customer preference is intensified by the ease with which consumers switch to competitors. which drives companies to innovate and adapt AI such as chatbots, which could be the answer to this challenge. The objective of this research work is to know if the use of chatbots positively influences the satisfaction and perceived loyalty of consumers of telephone services, since in this case the speed, quality of the service and the customer's need for understanding. They are critical and represent a greater challenge to differentiate. The methodology used for this research maintains a quantitative, correlational, non-experimental approach. The type of sampling was non-probabilistic, and the strategy was snowball. The instrument used was a questionnaire with a sample of around 130 consumers in the city of Metropolitan Lima in Peru. The findings suggest that chatbots are not only innovative tools, but also strategic ones for telephone companies seeking to improve customer satisfaction and loyalty. The implementation of appropriate chatbots can transform the customer experience, providing a more agile, personalized and effective service, thus seeing a close relationship between the dimensions of the chatbot with the satisfaction and loyalty perceived in consumers. In a world where these variables are key to business survival, chatbots represent an opportunity to create exceptional experiences. Uncover how cutting-edge AI chatbots are revolutionising customer satisfaction and loyalty in the competitive telephone service industry, offering transformative, personalised, and efficient interactions.

Keywords: Chatbots, Customer Satisfaction, Loyalty, Telephone Services, Digital Innovation

1. Introduction

Today, we live in an era where consumers spend more time in digital environments, seeking services in an accessible and fast way, regardless of location, time or channel (Escobar, 2016). In Peru, delays in customer service and low information accuracy have negatively impacted sales and customer satisfaction (Gestión, 2018). Consumers value convenience, personalisation and efficiency in all their interactions with brands. Companies face the challenge of remaining robust and efficient in all their digital channels to attract and retain customers, seeking their preference and loyalty (Hasberg et. al., 2016). In response to digitalisation and business issues, several countries have incorporated chatbots as an effective solution to address customer queries and concerns through AI (Dhaoui, 2014).

The main purpose of the paper is to draw insight into the relation between the use of Chatbots and the perception of customer satisfaction and loyalty, with a focus on the telephone service sector that has been criticized for poor customer care. This is further echoed by the study by Anda Peru (2021), stating issues such as slow service, poor customer care, and bad processes. This study tries to comprehend the relationship that the use of chatbots, satisfaction (S), and loyalty (L) perceived in consumers of telephony services in Metropolitan Lima (LM) would have in 2024. The research studies three dimensions: dimensions such as chatbot interactions (I), personalization (P), problem resolution (RP) capabilities, which are related to influences on perceived S and L. The following will present the research objectives of analysing such relationships and its effect on perceived S and L. Overall Objective: To analyse the relationship between the use of chatbots, "S," and "L" in consumers of telephony services in "LM" in 2024. The specific objectives vary along the above-mentioned dimensions. The research aims at extending theoretical knowledge on customer satisfaction by using chatbots, aligning with Feine et al. (2019). It also aims to update the conceptual framework on chatbots and customer experience, identifying gaps and establishing a solid foundation for future research, as suggested by Xu et al. (2023). Furthermore, it seeks to provide information on tools to improve customer satisfaction in business strategies, following Dhaoui (2014). The research has practical relevance, as it will analyse the usefulness of chatbots in customer satisfaction among users of telephony services in Lima, influencing investment decisions and strategies of consolidated entities, like Sanny et al. (2020). According to Antonio et al. (2022), the results will provide guidance and practical knowledge for domestic and international consumers, helping them to understand the benefits of chatbots and their proper employability. The migration of customers to digital channels has increased interest in chatbots in the Peruvian economy because of their novel nature and the improvements they promise

in digital offerings (Medina, 2019). Chatbots stand out not only for their 24-hour availability, but also for their ability to collect valuable information from users (Guzmán, 2020). The importance of chatbots as an additional method of customer service in the Peruvian market is underlined, with high growth potential in digital developments aimed at improving customer satisfaction, according to INEI (2023).

Regarding the background, it can be mentioned that relevant findings with similar views were found among several authors, such as the studies by Surjandy & Cassandra (2023), Naqvi et al. (2023), Bhattacharya & Sinha (2022) agree on the idea of a positive relationship in the e-commerce context, highlighting factors and such as response time, reliability and chatbot usability as key factors of the customer's "S" and "L". Meanwhile, Naqvi et al. (2023), in their study entitled "Impact of service agents on customer satisfaction and loyalty: mediating role of Chatbots", with focus on the essence of fashion retail brands in Pakistan, find that chatbots can provide personalised treatment that improves the quality of communication and, consequently, the customer's "S" and "L". Bhattacharya & Sinha, looking at the banking sector, find that chatbots are crucial for improving customer interactions, aiding and recommendations that increase customer's perceived "S" and "L".

Naqvi et al. (2023) and Antonio et al. (2022) agree on the importance of the "P" in the customer-chatbot "I" to increase customer "S". Naqvi et al. emphasise that chatbots can offer personalised treatment by adapting to individual customer needs, leading to a higher "S" and "L". Antonio et al., in "Study Literature Review: Discovering the Effect of Chatbot Implementation in Ecommerce Customer Service System Towards Customer Satisfaction", further argue that the implementation of chatbots does not guarantee high levels of "S" if there is no adequate "P" in the conversation with the user.

Sanny et al. (2020), in "The analysis of customer satisfaction factors which influence chatbot acceptance in Indonesia", Zhang et al. (2023), Eren (2021) and Feine et al. (2019) provide a measured view of the elements that affect the customer's "S" with chatbots. Sanny et al. recognise factors such as usability, brand image development, personality and ease of use as crucial determinants of the customer's "S". Zhang et al. (2023), in "Emotional expression by artificial intelligence chatbots to improve customer satisfaction: Underlying mechanism and boundary conditions", highlight the importance of emotionality in the "I", while Eren (2021) highlights the relevance of received performance, perceived trust and company reputation. Feine et al. (2019) introduces sentiment analysis as a tool to improve customer "S", demonstrating its usefulness in understanding chatbot behaviour and being able to adjust it according to the user's needs.

Huang et al. (2023) and Xu et al. (2023) address the comparison between chatbots and human service in relation to customer "S". Huang et al., in "Can chatbot customer service match human service agents on customer satisfaction? An investigation in the role of trust", find that, while chatbots contribute to improving customer "S", there is room for improvement compared to human attention. On the other hand, Xu et al. (2023) explore the mixed effects of chatbot-human "I" on customer "S", concluding that chatbots with accurate responses are preferred over those with social orientation biases, highlighting the importance of accuracy in "I".

Chung et al. (2020), in "Chatbot e-service and customer satisfaction regarding luxury brands", and Xu et al. (2023) focus on the importance of accuracy in chatbot responses. Chung et al. find that the accuracy of the information provided by chatbots, along with the credibility of the information, significantly affects the customer's "S". Xu et al., on the other hand, highlight that chatbots with concise responses are more highly valued, evidencing that the accuracy of responses is a crucial component in influencing the customer's "S".

In the theoretical framework of this research, three key variables are presented: the independent variable, which are the service agents (chatbots), and the dependent variables, which are the customer's "S" and the customer's "L". Chatbots are defined as a type of AI that use Natural Language Processing (NLP) to understand and process human language, enabling conversations in text or voice format (Shawar and Atwell, 2007). ELIZA, the first chatbot, was developed in 1960 by Joseph Weizenbaum at MIT. Since then, significant advances have been made with systems such as WeChat (2009) and personal assistants such as SIRI and Alexa. In real life, chatbots are AI systems that interact with users through a chat interface, designed to simulate human conversations, help, answer questions or perform specific tasks. They are widely used in customer service, sales and technical support.

The qualities of a chatbot can be assessed in four dimensions: entertainment, trendiness, customization and problem-solving accuracy, credibility and communicative competence, i.e. the ability to converse effectively (Chung et al., 2020). Naqvi et al. (2023) proposed four dimensions of service agents: Interaction as a social quality, Personalisation for adapting to customer needs, Problem Resolution (RP) as an effective solution, and the last one which it was not taking into consideration is Entertainment. These dimensions are essential to verify

the ransmission and processing of language by chatbots. The design of chatbots uses NLP techniques and AI algorithms, such as machine learning and neural networks, to improve their interaction capabilities. Human-Computer Interaction (HCI) theory is also relevant, focusing on the design of interfaces that facilitate effective human-computer interaction (Dix et al., 2004). The dependent variable of customer "S" is defined as the emotional reaction to the quality of the product or service received (Silva et al., 2021). Mora Contreras (2011) extends this definition by considering a sequence of emotional states that culminate in a positive or negative response before and after the purchase. Chiou and Droge (2006) suggest that customer "S" occurs when products or services meet or exceed expectations. In practice, customer "S" reflects how well a product or service meets prior expectations. In light of the above, this research prefers the Chiou and Droge definition over that of Silva et al. (2021). However, it is pertinent to mention that the cognitive-affective customer "S" model, developed by Caro and Garcia (2007), considers that the behaviour behind the "S" is marked by rational judgements (cognitive) and emotional aspects (affectivity). The dimensions of this model include perceived information quality, perceived delay time and positive emotions during the interaction with the chatbot. There are two approaches to how emotions influence on "S": one view sees emotions as mediating the relationship between cognition and "S" (Bigné and Andreu, 2002), while the other sees them as independent sources of "S" (Oliver, 1993).

As for the dependent variable of customer "L", this refers to the degree to which a customer remains loyal to a company or brand and continues to purchase its products or services over time. Customer "L" is closely related to customer "S", as a satisfied customer is more likely to develop "L". According to Dick and Basu (1994), the customer "L" can be understood as a deep commitment to repurchase or continue using a product or service in the future, despite situational influences and marketing efforts that might cause a change in behaviour.

Customer "L" can be measured along several dimensions, such as repurchase intention, recommendation of the product or service to others, and resistance to switching to competitors. According to Oliver's (1999) "L" Model, "L" develops in four stages: cognitive, affective, conative and action. The cognitive stage is based on the consumer's beliefs about the quality of the product or service; the affective stage includes the consumer's feelings towards the brand; the conative stage refers to the customer's intention to continue purchasing; and the action stage involves the performance of loyal behaviours, such as repurchase and recommendation.

In practice, customer "L" can also be measured through metrics such as customer retention rate, purchase frequency, market share, willingness to recommend the brand (NPS) and price sensitivity. In addition, surveys and purchase behaviour analysis can be conducted to assess "L" (Zeithaml et al., 1996)

The general hypothesis of this research is: "The use of chatbots positively influences the perceived "S" and "L" of consumers of telephony services in Metropolitan Lima 2024". In line with was previously stated with the problem and objectives, there are six specific hypotheses in relation to the three dimensions brought about using chatbots.

The first hypothesis would be "the interaction of chatbots positively influences the "S" in consumers of telephony services in Metropolitan Lima in the year 2024". The second hypothesis would be "the interaction of chatbots positively influences the "L" in consumers of telephony services in Metropolitan Lima in the year 2024".

Both hypotheses are in line with Sanny et al. (2019), Antonio et al. (2022) and Naqvi et al. (2023).
The third hypothesis would be "the "P" of chatbots positively influences the "S" in consumers of telephony services in Metropolitan Lima in the year 2024". The fourth hypothesis would be "the "P" of chatbots positively influences the "L" in consumers of telephony services in Metropolitan Lima in the year 2024", both according to Chung et al. (2020), Eren (2021) and Naqvi et al. (2023); rejected by Xu et al. (2023).

The fifth hypothesis would be "The "PR" provided by the chatbot positively influences the "S" in consumers of telephony services in Metropolitan Lima in the year 2024". The sixth hypothesis would be "The "PR" provided by the chatbot positively influences the "L" in consumers of telephony services in Metropolitan Lima in the year 2024". Both according to Zhang et al. (2023) and, Moran and Agüero (2022), rejected by Huang et al. (2023).

2. Methods

The focus of this research was quantitative because it could contribute to the resolution of practical problems, knowing the reality through limited and measurable data. In relation to the scope, it is descriptive-correlational with a "non-experimental" cross-sectional design, where data can be placed in space-time. In this study, the focus was on consumers of telephone services in Metropolitan Lima in the year 2024.

In relation to the design of the model, we considered the population data of Metropolitan Lima up to January 2024, where we found that the capital had 10,292,408 inhabitants (Gestión, 2024). It was also further narrowed down to those people who used the internet via mobile phone in the capital, as it is understood that by using and having access to the internet, users could make queries to their mobile phone company's chatbots. To this end, it was found that 94.1% of the population of Metropolitan Lima that is older than 6 years of age complies with the above (INEI, 2023). Therefore, by performing a simple multiplication, we have a population of 9,345,507 inhabitants.

According to this population a sample of 130 observations is adequate for PLS-SEM as it ensures reliable and robust estimates (Hair et al., 2017). In relation to the type of sampling it will be non-probabilistic, as the present research will be bounded with certain parameters seen above, and finally regarding the sampling strategy, this will be Snowball. The data collection instrument was an improved, adapted, and refined version based on an instrument by Naqvi et al. (2023). The article has been tested and published in the English Language, so it was translated into Spanish (free translation) for practical research purposed. It is also important to mention that moderating variables are not being considered as part of the model.

On the data collection side for the present research, it was through dissemination via email and social networks. The results collected were tabulated in Excel for better data manipulation, coded and the PLS-SEM method was used. Finally, descriptive statistics were used, taking into consideration Cronbach's Alpha, estimated parameters and correlation coefficient to analyse the results.

3. Results and Discussion

The JAMOVI platform was used to calculate the previously collected data, which has been tabulated both in filter questions and in relation to the questions asked for each variable, in the case of the dependent variables, and to the independent variable in relation to its dimensions, both on a Likert scale. Thus, the structural equation model (SEM) is presented in Figure 1, where each circle represents each variable. Recall that, Personalisation is manifested by the letter "P", Problem Solving is "RP", Interaction is "I", Loyalty is "L" and Satisfaction is "S".

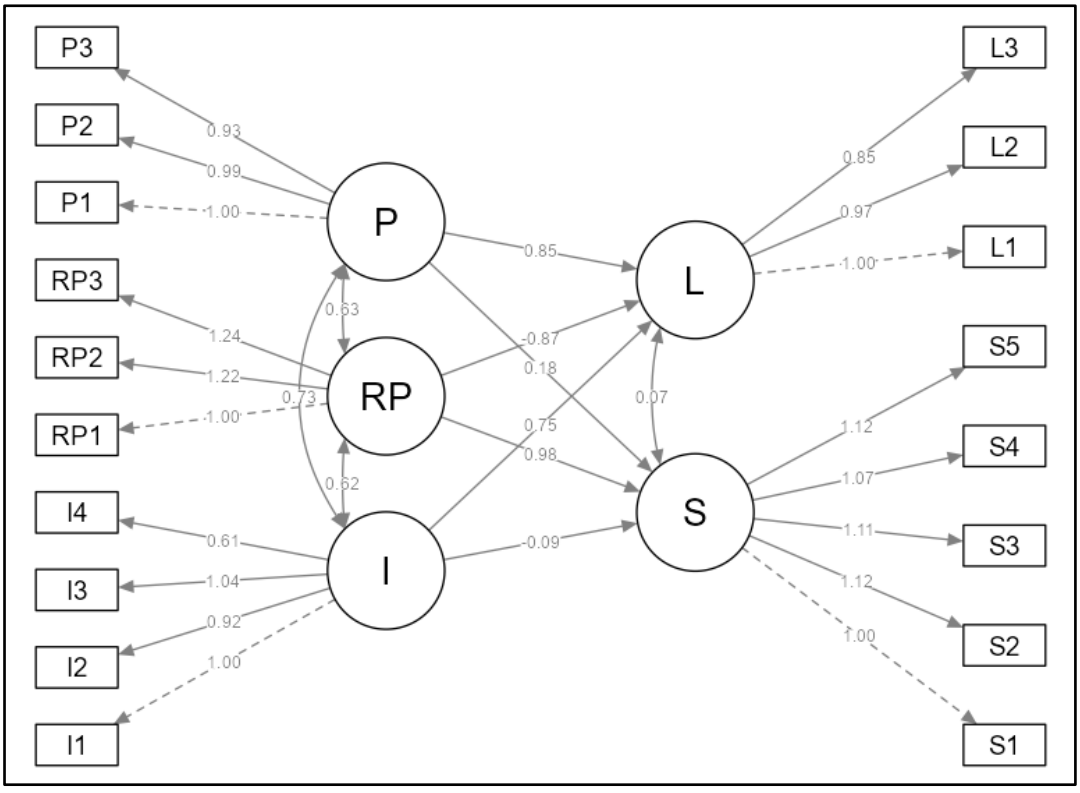


Figure 1: SEM Model

Dashed lines in the model generally represent hypotheses that are being tested and do not have strong empirical confirmation.

Table 1: Estimated model parameters.

				95% Confidence Intervals				
Dep	**Pred**	**Estimate**	**SE**	**Lower**	**Upper**	**β**	**z**	**p**
S	I	-0.0913	0.253	-0.5870	0.404	-0.0939	-0.361	0.718
S	RP	0.9773	0.408	0.1777	1.777	0.8525	2.396	0.017
S	P	0.1768	0.161	-0.1385	0.492	0.1854	1.099	0.272
L	I	0.7503	0.409	-0.0510	1.552	0.7806	1.835	0.066
L	RP	-0.8684	0.633	-2.1091	0.372	-0.7667	-1.372	0.170
L	P	0.8512	0.296	0.2720	1.430	0.9035	2.881	0.004

Table 2: Measurement model.

				95% Confidence Intervals				
Latent	**Observed**	**Estimate**	**SE**	**Lower**	**Upper**	**β**	**z**	**p**
I	I1	1.000	0.0000	1.000	1.000	0.879		
	I2	0.923	0.0370	0.850	0.995	0.811	24.92	< .001
	I3	1.040	0.0292	0.983	1.098	0.914	35.58	< .001
	I4	0.607	0.0765	0.457	0.757	0.533	7.94	< .001
RP	RP1	1.000	0.0000	1.000	1.000	0.746		
	RP2	1.217	0.0592	1.101	1.333	0.907	20.57	< .001
	RP3	1.242	0.0615	1.122	1.362	0.926	20.21	< .001
P	P1	1.000	0.0000	1.000	1.000	0.896		
	P2	0.989	0.0329	0.924	1.053	0.886	30.07	< .001
	P3	0.934	0.0357	0.864	1.004	0.837	26.14	< .001
S	S1	1.000	0.0000	1.000	1.000	0.855		
	S2	1.122	0.0333	1.057	1.188	0.959	33.66	< .001
	S3	1.108	0.0332	1.043	1.173	0.947	33.38	< .001
	S4	1.068	0.0340	1.001	1.135	0.913	31.39	< .001
	S5	1.124	0.0354	1.054	1.193	0.961	31.75	< .001
L	L1	1.000	0.0000	1.000	1.000	0.844		
	L2	0.966	0.0514	0.866	1.067	0.816	18.79	< .001
	L3	0.851	0.0626	0.728	0.973	0.718	13.59	< .001

Table 3: Model Fit Indices

			95% Confidence Intervals		
Type	**SRMR**	**RMSEA**	**Lower**	**Upper**	**RMSEA p**
Classical	0.055	0.053	0.027	0.074	0.394
Robust	0.052				
Scaled	0.052	0.100	0.083	0.117	< .001

Table 4: Model used vs reference model

	Model
Comparative Fit Index (CFI)	0.999
Tucker-Lewis Index (TLI)	0.999
Bentler-Bonett Non-normed Fit Index (NNFI)	0.999
Relative Noncentrality Index (RNI)	0.999

	Model
Bentler-Bonett Normed Fit Index (NFI)	0.996
Bollen's Relative Fit Index (RFI)	0.995
Bollen's Incremental Fit Index (IFI)	0.999
Parsimony Normed Fit Index (PNFI)	0.814

Regarding the RMSEA indicator, which, according to Xia and Yang (2019), "assesses how well the model, with the estimated parameters, fits the covariance matrix if it were available". In this case, the value came out to be 0.051 which indicates an acceptable model fit. Also, in relation to the CFI (Comparative Fit Index), which is an "(…) incremental fit index that compares the fit of a hypothetical model with that of a reference model" (Xia and Yang, 2019), a value of 0.999 it can be concluded that the model has a very strong fit and is adequate to explain the relationships between the variables being analysed.

The results of this research provide an interesting insight into the influence of chatbots on the "S" and "L" of consumers of telephony services in Metropolitan Lima in 2024.

The provided PLS-SEM model analyzes the relationships between several dimensions: Personalization (P), Problem Solving (RP), Interaction (I), Satisfaction (S), and Loyalty (L). The analysis of the results shows that the interaction has a non-significant negative relationship with customer satisfaction (coefficient: -0.0913, p-value: 0.718), which could be because the quality of the interaction is not consistently perceived as positive. by clients. On the other hand, the ability to solve problems has a positive and significant relationship with customer satisfaction (coefficient: 0.9773, p-value: 0.017), suggesting that effective problem-solving increases satisfaction. Personalization has a positive but non-significant relationship with customer satisfaction (coefficient: 0.1768, p-value: 0.272), indicating that customization alone is not a determining factor in satisfaction.

Regarding loyalty, interaction has a marginally significant positive relationship with customer loyalty (coefficient: 0.7503, p-value: 0.066), suggesting that good interaction can influence loyalty, but not conclusively. The ability to solve problems has a non-significant negative relationship with customer loyalty (coefficient: -0.8684, p-value: 0.170), which is counterintuitive and could indicate that problem solving does not always translate into loyalty. In contrast, personalization has a positive and significant relationship with customer loyalty (coefficient: 0.8512, p-value: 0.004), indicating that personalization is a key factor in fostering loyalty.

The results of the measurement model show that the construct indicators have high and significant loadings, except for the Interaction indicator I4, which has a lower loading (0.607), which could suggest problems with this item, this is an opportunity to improve future research. The Problem Solving and Personalization constructs have indicators with high and significant loadings, which indicates that they adequately measure the constructs. Customer Satisfaction, measured by indicators S1 to S5, and Customer Loyalty, measured by L1 to L3, also present very high and significant loadings, indicating that they are good measures of their respective constructs.

A negative coefficient on structural relationships, such as RP to L, may indicate an unexpected inverse relationship and may be due to problems with the operationalization of the constructs, cultural differences, or unmet customer expectations. Given that this research is original in a geographical context not extensively explored, this finding constitutes an opportunity to explore this phenomenon in detail rather than a weakness.

Values of 1 in the indicator loadings indicate that these are perfect reflections of their respective constructs, which can occur when the construct is measured by a single indicator or when the model has been standardized in this way.

For the results that we will call unexpected, the following alternative explanations are proposed.
Interaction and Satisfaction: The negative relationship could indicate that the quantity of interaction is not as important as its quality. Excessive interactions could be perceived as annoying or invasive by customers.
Problem Solving and Loyalty: Problem solving could be linked to previous serious problems that reduced initial loyalty, and even if they are resolved, the damage to loyalty could already be done.

4. Conclusions

In conclusion, personalization is a critical factor for customer loyalty, the ability to solve problems significantly increases customer satisfaction, although it does not have a significant impact on loyalty, and interaction has a marginal impact on loyalty and has not a significant impact on satisfaction, which suggests that the quality of

the interaction must be improved. It is recommended to improve the quality of the interaction, encourage personalization and review the problem resolution strategy to understand why it does not translate into loyalty.

It is necessary to note that analysis has highlighted both the expected and unexpected results of structural equation modeling using PLS-SEM for these study variables in a little explored geographic context. Alternative explanations for the unexpected results have been proposed and future lines of research have been suggested to address these issues. Based on the findings and the proposed alternative explanations, the following lines of future research are suggested: Quality vs. Quantity of Interactions, to investigate the influence of the quality and quantity of interactions on customer satisfaction, differentiating between types of interaction.
Delve into the impact of Previous Problems, thus studying the impact of previous problems on loyalty and how problem resolution can restore, but not necessarily improve, loyalty. Although further research is crucial to better understand these dynamics and incorporate cultural or geographic variables in future research.

References

Anda Peru (2021) '¿CUÁL ES LA SITUACIÓN ACTUAL DEL CUSTOMER EXPERIENCE EN EL PERÚ?' Available at: https://revista.andaperu.pe/cual-es-la-situacion-actual-del-customer-experience-en-el-peru/#:~:text=En%20Activa%2C%20realizamos%20un%20estudio,supermercados%20y%20tiendas%20por%20departamento

Antonio et al. (2022) 'Discovering the Effect of Chatbot Implementation in E-commerce Customer Service System Towards Customer Satisfaction', Institute of Electrical and Electronics Engineers. Available at: https://doi.org/10.1109/isemantic55962.2022.9920434

Chen, Q., Lu, Y., Gong, Y. and Xiong, J. (2023) 'Can AI chatbots help retain customers? Impact of AI service quality on customer loyalty', Internet Research, 33(6), pp. 2205-2243. Available at: https://doi.org/10.1108/intr-09-2021-0686

Chiou, J. (2006) 'Service Quality, Trust, Specific Asset Investment, and Expertise: Direct and Indirect Effects in a Satisfaction-Loyalty Framework', Journal of the Academy of Marketing Science, 34(4), pp. 613-627. https://doi.org/10.1177/0092070306286934

Chung, M., Ko, E., Joung, H. and Kim, S. J. (2020) 'Chatbot e-service and customer satisfaction regarding luxury brands', Journal of Business Research, 117, pp. 587–595. Available at: https://doi.org/10.1016/j.jbusres.2018.10.004

Dhaoui, C. (2014) 'An empirical study of luxury brand marketing effectiveness and its impact on consumer engagement on Facebook', Journal of Global Fashion Marketing, 5(3), pp. 209–222. Available at: https://doi.org/10.1080/20932685.2014.907605

Dick, A. S. and Basu, K. (1994) 'Customer Loyalty: Toward an Integrated Conceptual Framework', Journal Of The Academy Of Marketing Science, 22(2), pp. 99-113. Available at: https://doi.org/10.1177/0092070394222001

Dix, A., Finlay, J., Abowd, G. D. and Beale, R. (2004) Human-Computer Interaction. 3rd edn. Pearson.

Eren, B. A. (2021) 'Determinants of customer satisfaction in chatbot use: evidence from a banking application in Turkey', International Journal of Bank Marketing, 39(2), pp. 294–311. Available at: https://doi.org/10.1108/ijbm-02-2020-0056

Escobar, A. (2016) 'The impact of the digital revolution in the development of market and communication strategies for the luxury sector (Fashion Luxury)', Central European Business Review, 5(2), pp. 17–36. Available at: https://doi.org/10.18267/j.cebr.149

Feine, J., Gnewuch, U., Morana, S. and Maedche, A. (2019) 'A taxonomy of social cues for conversational agents', International Journal of Human-Computer Studies, 132, pp. 138–161. Available at: https://doi.org/10.1016/j.ijhcs.2019.07.009

Feine, J., Morana, S. and Gnewuch, U. (2019) 'Measuring Service Encounter Satisfaction with Customer Service Chatbots using Sentiment Analysis', Karlsruhe Institute of Technology. Available at: https://aisel.aisnet.org/cgi/viewcontent.cgi?article=1248&context=wi2019

Gestión (2018) 'Un 67% de clientes se aleja de un servicio por mala atención', Gestión, 8 August. Available at: https://gestion.pe/economia/67-clientes-aleja-servicio-mala-atencion-240918-noticia/?ref=gesr

Gestión (2024) 'Lima: ¿Cuántos habitantes existen y en qué distritos se concentra la mayor población?', Gestión, 21 January. Available at: https://gestion.pe/peru/aniversario-de-lima-cuantos-habitantes-hay-en-la-capital-y-en-que-distritos-se-concentra-la-mayor-poblacion-sjl-smp-comas-vmt-noticia/#:~:text=Lima%2C%2021%2F01%2F2024,que%20equival%C3%ADa%20a%2010%2C292%2C408%20habitantes

Guzmán, C. (2020) 'Cuatro aplicaciones de la inteligencia artificial más usadas por las empresas peruanas'. Available at: https://pqs.pe/actualidad/tecnologia/cuatro-aplicaciones-de-la-inteligencia-artificial-mas-usadas-por-las-empresas-peruanas/

Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2017). *A primer on partial least squares structural equation modeling (PLS-SEM)* (2nd ed.). Sage Publications.

Hagberg, J., Sundstrom, M. and Egels-Zanden (2016) 'The digitalization of retailing: an exploratory framework'. Available at: https://www.econbiz.de/Record/the-digitalization-of-retailing-an-exploratory-framework-hagberg-johan/10011595543

Hernández-Sampieri (2018) Metodología de la investigación. Las rutas cuantitativa, cualitativa y mixta. McGraw Hill.

Huang, D., Markovitch, D. G. and Stough, R. A. (2023) 'Can chatbot customer service match human service agents on customer satisfaction? An investigation in the role of trust', Journal of Retailing and Consumer Services, 76, 103600. Available at: https://doi.org/10.1016/j.jretconser.2023.103600

INEI (2023) 'ESTADÍSTICAS'. Available at: https://www.inei.gob.pe/estadisticas-indice-tematico/

Jones, T. and Taylor, S. (2007) 'The conceptual domain of service loyalty: how many dimensions?', Journal of Services Marketing, 21(1), pp. 36-51. Available at: https://doi.org/10.1108/08876040710726284

Jenneboer, L., Herrando, C. and Constantinides, E. (2022) 'The Impact of chatbots on Customer Loyalty: A Systematic literature review', Journal of Theoretical and Applied Electronic Commerce Research, 17(1), pp. 212–229. Available at: https://doi.org/10.3390/jtaer17010011

Medina, E. (2019) '¿Cuál es la situación actual y potencial de la Inteligencia Artificial en el Perú?'. Available at: https://archivo.gestion.pe/panelg/situacion-actual-y-potencial-inteligenciaartificial-peru-2208564

Misischia, C. V., Poecze, F. and Strauß, C. (2022) 'Chatbots in customer service: Their relevance and impact on service quality', Procedia Computer Science, 201, pp. 421–428. Available at: https://doi.org/10.1016/j.procs.2022.03.055

MIT Sloan (2021) 'Machine learning explained', MIT Sloan, 21 April. Available at: https://mitsloan.mit.edu/ideas-made-to-matter/machine-learning-explained

Mora Contreras, C. (2011) 'La calidad del servicio y la "S" del consumidor'. Available at: https://www.redalyc.org/pdf/4717/471747525008.pdf

Naqvi, M. H. A., Zhang, H., Naqvi, M. H. and Li, K. (2023) 'Impact of service agents on customer satisfaction and loyalty: Mediating role of chatbots', Journal of Modelling in Management. Available at: https://doi.org/10.1108/jm2-01-2023-0004

Oliver, R. L. (1999) 'Whence consumer loyalty?', Journal Of Marketing, 63(4_suppl1), pp. 33-44. Available at: https://doi.org/10.1177/00222429990634s105

Porter, M. E. (2008) La Ventaja Competitiva de Michael Porter.

Sanny, L., Susastra, A., Roberts, C. C. and Yusramdaleni, R. (2020) 'The analysis of customer satisfaction factors which influence chatbot acceptance in Indonesia', Management Science Letters, pp. 1225–1232. Available at: https://doi.org/10.5267/j.msl.2019.11.036

Shawar, B. A. and Atwell, E. (2007) 'Chatbots: Are they Really Useful?', Journal for Language Technology and Computational Linguistics, 22(1), pp. 29–49. Available at: https://doi.org/10.21248/jlcl.22.2007.88

Silva-Treviño, J. G., Macías-Hernández, B. A., Tello-Leal, E. and Delgado-Rivas, J. G. (2021) 'La relación entre la calidad en el servicio, "S" del cliente y "L" del cliente: un estudio de caso de una empresa comercial en México', CienciaUAT, pp. 85–101. Available at: https://doi.org/10.29059/cienciauat.v15i2.1369

Surjandy, S. and Cassandra, C. (2023) 'The Effect of Using Chatbots at e-Commerce Services of Customer Satisfaction, Trust, and Loyalty', 2023 International Conference On Computer, Control, Informatics And Its Applications. Available at: https://doi.org/10.1109/ic3ina60834.2023.10285799

Xia, Y. and Yang, Y. (2019) 'RMSEA, CFI, and TLI in Structural Equation Modeling With Ordered Categorical Data: The Story They Tell Depends on the Estimation Methods', Behavior Research Methods, 51(1), pp. 409-428.

Xu, Y., Niu, N. and Zhao, Z. (2023) 'Dissecting the mixed effects of human-customer service chatbot interaction on customer satisfaction: An explanation from temporal and conversational cues', Journal of Retailing and Consumer Services, 74, 103417. Available at: https://doi.org/10.1016/j.jretconser.2023.103417

Xu, Y., Zhang, J. and Deng, G. (2022) 'Enhancing customer satisfaction with chatbots: The influence of communication styles and consumer attachment anxiety', Frontiers in Psychology, 13. Available at: https://doi.org/10.3389/fpsyg.2022.902782

Zeithaml, V. A., Berry, L. L. and Parasuraman, A. (1996) 'The Behavioral Consequences of Service Quality', Journal Of Marketing, 60(2), pp. 31-46. Available at: https://doi.org/10.1177/002224299606000203

Zhang, J. et al. (2023) 'Emotional expression by artificial intelligence chatbots to improve customer satisfaction: Underlying mechanism and boundary conditions', Tourism Management, 100, 104835. Available at: https://doi.org/10.1016/j.tourman.2023.104835

Relationship Between Occupational Stress Level and Readiness Towards Knowledge Sharing Among IT Sector Employees

Ewelina Krzyżowska
Czestochowa University of Technology, Poland

ewelina.krzyzowska@pcz.pl

Abstract: In the era of a knowledge-based economy, effective knowledge management, including knowledge sharing, is one of the determinants of organizational performance. Therefore, the task of companies should be to optimize the process of knowledge sharing, which is achieved by, among other things, a thorough understanding and use of the factors that affect this process. **Aim**. The purpose of the article was to study the relationship between the level of occupational stress and readiness towards knowledge sharing among IT Sector Employees. **Method.** A cross-sectional study model was applied. The study included 98 employees from the IT industry. The study used the Perceived Stress at Work Scale (PSaW) by Chirkowska-Smolak and Grobelny and a self-designed survey including: demographic data, work-related variables and questions about knowledge sharing with co-workers. **Results**. In the surveyed group of IT workers, greater readiness to share knowledge was found among employees who showed lower scores on the PSaW scale. In addition, significant relationships were found between the study variables according to the selected variables, including that among women with low rates of perceived stress at work, older women showed greater willingness to share knowledge compared to younger women. Furthermore, in terms of work-related variables, the results showed that among men declaring high rates of stress, those with shorter seniority were more willing to share knowledge compared to men with longer seniority. **Conclusions:** The research findings significantly broaden knowledge in the sphere of the factors influencing the effective organization of the knowledge management process, particularly knowledge sharing under stressful work conditions. This knowledge can be useful especially for IT managers.

Keywords: Knowledge Sharing, Stress Level, Employees

1. Introduction

Contemporary socio-economic conditions (e.g. rising inflation, turbulent global political situation) make it difficult for businesses to function and force them into strong competition to maintain their position. It is in an organization's interest to take care of every aspect of its functioning in order to keep up with market demands and ensure its competitiveness. One important aspect of an organization's functioning, especially in the era of a knowledge-based economy, is effective knowledge sharing (KS). KS involves the exchange of knowledge between at least two parties in a reciprocal process that allows the knowledge to be reshaped and made meaningful in a new context (Willem, 2003). Importantly, proper implementation of KS can be particularly important for organizational performance (Muhammed, Zaim, 2020). Organizations should therefore ensure that this process is carried out taking into account both the impact of various KS determinants, as well as solutions to improve the process (e.g. in the IT sector knowledge transfer is strengthened by extending the individual beyond the formal communication channels, such as: computer networks, electronic bulletin boards, etc. (Zheng, 2017)). The quality of KS implementation in an organization can be affected by technological, organizational, as well as individual factors (Paroutis, Al Saleh, 2009). One of the factors determining KS may be the level of stress experienced by individuals at work. This article attempts to verify the significance of selected KS determinants by answering the following question: is there a relationship between the level of perceived stress at work and readiness to share knowledge? When testing the aforementioned relationship, selected demographic and work-related factors were also taken into account.

2. Literature Review and Research Background

The unstable economic situation due to recent events, such as the pandemic, war, rising inflation, and the cost of living, has significantly affected the labor market and working conditions. Workplace stress has become a common experience. The results of a survey conducted in 2022 by GoodHabitz together with the research agency Markteffect on a sample of 24,235 employees in various positions, industries, and countries around the world indicate that one in five employees (18%) experienced significant signs of stress or burnout in the previous year (GoodHabitz, 2022). For Polish employees, this rate was 23%. Work-related stress generates a serious financial burden for societies around the world. The results of a narrative review indicate estimates that range from €54 million to €280 billion depending on the country (Shaholli, Mantione, La Torre, 2023). The results also suggest that lost productivity due to absenteeism and presenteeism has a greater economic impact compared to the medical expenses.

In practice, it is observed that there is still a prevalence in certain organizations of the tendency to accumulate knowledge rather than to share it (Ismail, Yusof, 2009). This is because knowledge can be perceived by an employee as private property – a valuable resource – which results in a greater tendency to hoard it rather than share it (Zhang, Song, Song, 2020). At the same time, this propensity may become more pronounced especially in stressful situations. To the author's knowledge, few empirical works verify a direct relationship between stress experienced and readiness towards KS, so there is still a lack of research in this area. This relationship was confirmed in a study by Marques et al. (2019) which revealed a positive relationship between organizational stress and disengagement from knowledge sharing and between stress and maturity in knowledge management. In contrast, research by Ford et al. (2015) indicated that poor health and worries are associated with more disengagement from knowledge sharing. Fang (2017), on the other hand, highlights the role of negative affect, such as anxiety, in knowledge hiding.

In an attempt to clarify the basis of the relationship between stress experienced at work and readiness towards KS, it is worth noting some characteristics of stress. Stress, which is an integral part of a person's life, including a professionally active person, can be defined using the words of Lazarus and Folkman (1984) as: "a particular relationship between the person and the environment that is appraised by the person as taxing or exceeding his or her resources and endangering his or her well-being". Stress is therefore the result of the interaction between the individual's capabilities and the demands of the environment. In turn, according to Hobfoll's (2006) theory, stress is recognized when: 1) there is a threat of resource loss, 2) there is an actual resource loss, or 3) there are no gains following resource investment. Stress is therefore an internal state of the individual determined by the perception of the aforementioned circumstances. The stress response involves three levels: physiological (including: accelerated heart rate, increased blood pressure, bronchodilation, pupil dilation), psychological (including: narrowing of the attention field, reduced concentration, impaired ability to adequately assess the situation, impaired memory, anxiety attacks), and behavioral (including: appetite disorders, sleep disturbances, nervous tics) (Kashubska, 2023). In the area of stress-induced psychological changes, the consequences for the functioning of cognitive processes, including attention, may be particularly relevant to the issue at hand. Research suggests that in a situation of heightened tension, an individual may experience a restriction or narrowing of the field of attention – so-called *attentional tunneling*. This phenomenon can be defined as "the allocation of attention to a particular channel of information, diagnostic hypothesis, or task goal, for a duration that is longer than optimal, given the expected cost of neglecting events on other channels, failing to consider other hypotheses, or failing to perform other tasks" (Wickens, Alexander, 2009). In a stressful situation, the perceptual field may be narrowed, and the scope or span of behavior tends to be restricted to those elements which contribute most to the direction of behavior, or to those elements which appear to be the most dangerous (Staal, 2004). Thus, under stressful conditions, employees may be particularly preoccupied with aspects that constitute the content of stressful experiences, while they may be less focused on other activities, especially extracurricular work activities. Based on this, it can be suspected that readiness towards KS under conditions of experienced occupational stress may be lower than under conditions of perceived psychological comfort in the workplace. In order to verify this relationship, the following research question has been formulated:

Is there a relationship between the level of perceived occupational stress and readiness towards knowledge sharing among IT sector employees?

Exploring the indicated relationships and their determinants among Polish IT sector employees is also justified by the lack of similar empirical work, at least to the knowledge of the author, conducted with the participation of such a group of respondents. . Thus, the findings would constitute an important supplementation of research gaps in this sphere.

3. Methodology

3.1 Participants

The research was conducted among the employees of an IT sector company based in central Poland. The conditions for participation in the study were employment in the company for at least six months, knowledge of written Polish and voluntary consent to participate in the study. The research was conducted using online technology, anonymously. Respondents who agreed to participate completed questionnaires that were made available to them remotely. Among the employees invited to the study, consent to take part in the research was expressed by 103 people. Ultimately, the research group consisted of 98 people (5 people did not complete all questionnaires): 36 women and 62 men declaring Polish citizenship. The sample was heterogeneous in terms of

age, workplace education and job seniority (aged between 28 and 56: M=40.9; SD=8.7, the seniority of the employees surveyed ranged from 0.5 to 11 years: M=5.3; SD=2.8). Detailed characterization of the analyzed group is presented in Table 1.

Table 1: Characteristics of the study group

		N	%
Employees	women	36	36.7
	men	62	63.3
Education	higher	69	70.4
	secondary	29	29.6
Workplace	IT application specialist	34	34.7
	service support specialist	12	12.2
	designer and computer systems analyst	25	25.5
	programming specialist	27	27.6
		M	**SD**
Age (years)		40.9	8.7
Job seniority (years)		5.3	2.8

3.2 Measures

The study used a self-designed survey that takes into account the following data: sex and age of the person surveyed, education, as well as position held and job seniority in the firm analyzed. The survey also included the following question relating to knowledge sharing: *How often do you pass on your specialized knowledge to other employees (apart from situations when passing on the knowledge results directly from your superior's instructions)?* Respondents answered the aforesaid question on a five-point scale as follows: 1-never, 2-rarely, 3-sometimes, 4-often, 5-very often.

The *Perceived Stress at Work (PSaW) Scale* by Chirkowska-Smolak and Grobelny was used to measure perceived stress at work (Chirkowska-Smolak, Grobelny, 2016). The scale consists of 10 questions which the respondents use to evaluate their beliefs about unpredictability, lack of control and being overwhelmed by events at work in the month preceding the survey. Respondents answer the questions using a five-point scale (0 – never, 1 – almost never , 2 – sometimes, 3 – quite often, 4 – very often). The scale scores obtained in the survey range from 0–40, where a higher score indicates a higher rating of stress severity. The Cronbach's alpha reliability coefficient in the survey conducted with 537 people was 0.85.

3.3 Data Analysis

The study had a cross-sectional design. Due to the failure to fulfill the assumptions of the normality of distribution, as well as the unequal distribution of the numbers of the sub-groups compared, non-parametric tests were used for statistical analysis. Spearman's rank correlation was used to assess the relationship between the level of perceived stress at work and readiness towards KS, as well as to evaluate the association of selected factors with readiness towards KS in study groups with different levels of stress. The level of statistical significance was accepted as $p<0.05$. The calculations were performed using STATISTICA 13.3 statistical software by StatSoft.

4. Results

The study revealed an overall average level of stress in both the female and male study groups (respectively: M =26.72, SD = 10.5; M = 24.96, SD = 9.42). When considering the distribution according to the severity of perceived stress in both groups, the highest number of respondents showed high levels of perceived stress at work. The detailed test findings are presented in Table 2.

Tabel 2: Results of the perceived stress at work (PSaW) severity survey by gender

Level of Stress		n	M	SD
women	total	36	26.72	10.5
	low	6	7.67	3.39
	medium	14	20.50	3.44
	high	16	34.81	2.67
men	total	62	24.96	9.42
	low	10	10.00	2.00
	medium	14	20.36	3.15
	high	38	34.89	4.30

The results of testing the relationship between perceived stress at work and readiness towards KS revealed a negative statistically significant relationship between the variables ($p<0.05$). This means that the higher the level of perceived stress at work, the lower the readiness to share knowledge among the employees surveyed. The results of the study are presented in Table 3.

Table 3: Relationship between severity of perceived stress at work and readiness towards KS

Spearman's r	P
-0.732	0.000

Groups of respondents with different levels of perceived stress at work (low, medium and high) were distinguished in order to find out the significance of selected factors (age, seniority) for the variable readiness towards KS in relation to the level of perceived stress at work. Subsequently, the relationships of factors (age, seniority) and readiness towards KS were verified in the specified groups of respondents. As a result of testing the relationship between age and readiness towards KS in the study group (men and women) according to the level of perceived stress at work, a statistically significant correlation ($p<0.05$) was obtained only in the group of women reporting low levels of perceived stress at work. The results indicate that in the group of women with low stress levels, older age is associated with greater readiness towards KS. On the other hand, in terms of the seniority variable, a statistically significant negative correlation ($p<0.05$) was revealed only in the group of men reporting high levels of perceived stress at work. This relationship means that in this group, shorter seniority is associated with greater readiness towards KS. Details of the relationships tested are shown in Tables 4 and 5.

Table 4: Relationship between age and readiness towards KS in the study group (men and women) according to the level of perceived stress at work (PSaW)

	Level of stress	Spearman's r	p
women	low	0.198	0.043
	medium	0.346	0.224
	high	0.376	0.150
men	low	0.577	0.080
	medium	-0.249	0.389
	high	0.001	0.993

Table 5: Relationship between seniority and readiness towards knowledge sharing in the study group (men and women) according to the level of perceived stress at work (PSaW)

	Level of stress	Spearman's r	p
women	low	0.097	0.854
	medium	0.198	0.496
	high	-0.149	0.579
men	low	-0.073	0.839
	medium	-0.089	0.759
	high	-0.655	0.000

5. Discussion

Based on the survey, it can be concluded that there is a relationship between the level of perceived occupational stress and readiness towards KS among IT Sector Employees. Lower levels of perceived stress at work promote readiness towards KS among the employees surveyed, while higher levels of perceived stress are associated with lower readiness towards KS. This result is consistent with other studies cited in the literature review (Fang, 2017; Ford et al., 2015; Marques et al., 2019), which emphasize the negative impact of stress and negative affect on readiness towards KS. The results obtained can be explained by referring to the phenomenon of *attentional tunneling* which justifies the narrowing of the scope of attention and the amount of information processed in a

stressful situation. Easterbrook (1959) explained this mechanism in his theory, arguing that in a situation of strong emotional arousal, there is a focus on the most important stimuli associated with the arousal and a disregard for stimuli less relevant to the situation. The mechanism of changes associated with selective attention under stress is confirmed by numerous empirical studies (Chajut, Algom, 2003; LeBlanc, 2009; Vedhara et al., 2000).

On this basis, it can be concluded that employees who experience high levels of stress at work focus primarily on the source of the stress and the possibility of removing it. In contrast, knowledge sharing undertaken voluntarily between employees is an extracurricular activity that requires cognitive engagement and strains attentional resources. According to the concept of attentional selectivity, voluntary KS-related activity may therefore be overlooked in favor of content that is prioritized in light of the stress experienced. As an extracurricular and optional activity, it may also give way to meeting occupational requirements that are obligatory and determine one's continued employment. Interesting results were also obtained regarding the relationship of selected factors and readiness towards KS according to the level of perceived stress at work. The study revealed that in the group of women with low levels of stress, older age was associated with greater readiness towards KS, while in the group of men declaring high levels of perceived stress at work, shorter seniority was associated with greater readiness towards KS. The higher propensity to share knowledge among older women compared to younger women is also confirmed by the results of other studies (Burmeister, Fasbender, & Deller, 2018; Dunham, Burt, 2011; Krzyżowska, 2023). This propensity can be explained by the soft skills expertise increasing with age, especially in terms of cooperation, as well as the development of empathy (in women it can be stimulated through motherhood), all of which are conducive to KS behaviors.

At the same time, the above-mentioned relationship became apparent only in the group of women declaring low rates of perceived stress at work. This may mean that experiencing stress plays a key role in readiness towards KS in the surveyed group of IT employees – in the least stressed group, older women are more willing to share knowledge than younger ones, while in the groups with medium and high levels of stress, similar relationships did not emerge. It is likely that the moderate and intense stress experienced reduces readiness towards KS in a similar way regardless of the age of the respondents. In men, no correlation between age and readiness towards KS emerged in any of the groups due to the level of perceived stress at work, which means that for women who report minimal stress at work, age will be more important for readiness towards KS than for those men who rate their stress at work at a similar level. Furthermore, it can be concluded from the results that age does not determine the readiness towards KS of the men surveyed, both for those who experience and those who do not experience stress at work.

In contrast, seniority proved to be a significant variable in the group of men indicating high rates of stress, where the shorter the seniority, the greater the readiness towards KS. The result may be surprising in view of some studies that indicate that professional experience and job security are conducive to KS (Bartol et al., 2009; Doulani, Mohammadi, Bradar, 2020; Mehrizi, 2016), or other studies by the author, where employees with more than 5 years of seniority showed greater readiness towards KS than employees working for less than 5 years (Krzyżowska, 2023). Indeed, seniority determines the development of one's professional competence, sense of efficacy and confidence in one's professional functioning, thus influencing the growth of work experience which has a strong effect on knowledge sharing in the workplace (Oye, Salleh, Noorminshah, 2011). However, the aforementioned studies did not take into account the stress factor, which may have a significant moderating effect on the relationship in question (the relationship was revealed only in the group that indicated the highest rates of stress at work). It is worth noting that very severe stress can affect one's way of responding, resulting in a greater tendency toward automatic, instinctive reactions, the kind that aim at survival (Bourne, Yaroush, 2003). Perhaps younger men who are still uncertain of their competence and their professional position when confronted with a highly stressful situation are more inclined to share the knowledge they already have, hoping that, according to the rule of reciprocity, other employees will also share their knowledge with them. Moreover, they want to get into the good graces and win over the community of co-workers in this way. Thus, this may be a kind of automatic reaction "aimed at survival" and ensuring a stable professional position in a relatively new professional environment, which ultimately results in a greater readiness towards KS in this group than in the group of highly stressed employees with longer seniority.

This relationship therefore points to more detailed connections with readiness towards KS resulting from the influence of variable coexistence, which can be found against the background of the main relationship studied – stress and readiness towards KS. Interestingly, similar relationships did not emerge in the women's group; it is possible that women are less likely than men to evaluate work as a resource that they would have to care about first under conditions of severe threat. However, these suppositions require detailed empirical verification.

6. Conclusions

The aim of the research presented herein was to provide an answer to the following research question posed in this paper: *Is there a relationship between the level of perceived occupational stress and readiness towards knowledge sharing among IT sector employees?* The research findings acquired from a group of employees of the IT sector indicates that in the surveyed group of IT employees, a higher readiness towards KS was found among employees who scored low in terms of perceived stress at work. Furthermore, when testing the relationship in question, significant connections were found when selected variables were taken into account, such as age (among women with low rates of perceived stress at work, older women showed greater readiness towards KS compared to younger women) or seniority (among men reporting high rates of stress, those with shorter seniority showed greater readiness towards KS than those with longer seniority).

Conclusions drawn from the results of this study highlight the importance of the stress experienced for the functioning of the employee in the workplace and the organization as a whole. As highlighted in the introduction, KS is important for organizational performance, and workplace stress is a factor that generally has a negative impact on employees' readiness towards KS, especially the kind of readiness that does not stem from anxiety. In the IT industry, this is all the more important because IT services are among the knowledge-intensive services in which most activities are intellectual tasks (Khatri et al., 2010). The process of knowledge exchange in IT organizations should therefore be constantly improved, and this should be achieved, among other things, by understanding the determinants of KS.

The conclusions from the research imply significant practical recommendations for the managers of the IT sector:

1. It is important that they are aware of the negative impact of stress on employees' intrinsic motivation towards KS and thus that they implement stress prevention programs in the workplace and measures to counteract the consequences of stress experienced by employees at work.
2. It is important that, in the context of stimulating positive motivation towards KS, they pay particular attention to younger women who do not declare high stress and men with high rates of perceived stress at work with long seniority.

References

Bartol, K. M., Liu, W., Zeng, X., Wu, K., (2009) „Social Exchange and Knowledge Sharing among Knowledge Workers: The Moderating Role of Perceived Job Security", *Management and Organization Review*, 5, 2, 223–240.

Bourne, E., L., Yaroush, R. (2003) "Stress and Cognition: A Cognitive Psychological Perspective", Unpublished Manuscript, NASA Grant NAG2-1561.

Burmeister, A., Fasbender, U., Deller, J. (2018) „Being perceived as a knowledge sender or knowledge receiver: A multistudy investigation of the effect of age on knowledge transfer", *Journal of Occupational and Organizational Psychology*, 91, 3, 518–545.

Chajut, R., Algom, D. (2003) "Selective attention improves under stress: Implications for theories of social cognition", *J Pers Soc Psychol.*; 85:231–248.

Chirkowska-Smolak, T., Grobelny, J. (2016) „Konstrukcja i wstępna analiza psychometryczna Kwestionariusza Postrzeganego Stresu w Pracy (PSwP)", *Czasopismo Psychologiczne*, 22, 131-139.

10.14691/CPPJ.22.1.131

Doulani, A., Mohammadi, S., Bradar, R. (2020) „Investigating the Relationship between Job Security and Knowledge Sharing Behavior influenced by Organizational Culture among Librarians of Government Academic Libraries in West Azarbaijan Province and East Azarbaijan Province", *Library and Information Sciences*, 23, 3, 145-168.

Dunham, A. H., Burt, C. D. B. (2011) „Organizational memory and empowerment", *Journal of Knowledge Management*, 15, 5, 851–868.

Easterbrook, J. (1959) "The effect of emotion on cue utilization and the organization of behavior", *Psychological Review,* 66(3), 183–201.

https://doi.org/10.1037/h0047707

Fang, Y.-H. (2017) "Coping with fear and guilt using mobile social networking applications: Knowledge hiding, loafing, and sharing", *Telematics and Informatics*, 34, 5, 779–797.

https://doi.org/10.1016/j.tele.2017.03.002

Ford, D., Myrden, S., Jones, T. (2015) "Understanding "disengagement from knowledge sharing": Engagement theory versus adaptive cost theory", *Journal of Knowledge Management*, 19, 3, 476 – 496.

http://dx.doi.org/10.1108/JKM-11-2014-0469

GoodHabitz (2022), Raport: Pozytywny wpływ na zdrowie psychiczne i dobre samopoczucie pracowników, [Retrieved from https://goodhabitz.com/pl-pl/zdrowie-psychiczne-i-dobre-samopoczucie-twoich-pracownikow/]

Hobfoll, S. E. (2006), Stres, kultura i społeczność, GWP, Gdańsk.

Ismail, M.B., Yusof, Z.M. (2009) „Demographic factors and knowledge sharing quality among Malaysian government officers", *Communications of the IBIMA*, 9 (1), 1-8.
Kaszubska, A. (2023) *Stres w pracy. Poradnik dla pracownika*, Państwowa Inspekcja Pracy.
Khatri, N., Baveja, A., Agrawal, N.M., Brown, G.D. (2010) „HR and IT capabilities and complementarities in knowledge-intensive services", *The International Journal of Human Resource Management*, 21(15), 2889–2909.
Krzyżowska, E. (2023) "Gender Differences and Readiness Towards Knowledge Sharing among Remote Working IT Sector Employees", European Conference on Knowledge Management, 24, 733-740. 10.34190/eckm.24.1.1393.
Lazarus, R. S., Folkman, S. (1984), *Stress, appraisal, and coping*, Springer, New York.
LeBlanc, V. R. (2009) "The Effects of Acute Stress on Performance: Implications for Health Professions Education", *Academic Medicine,* 84(10):p S25-S33,
DOI: 10.1097/ACM.0b013e3181b37b8f
Marques, F., La Falce, J., Marques, J., De Muylder, C. (2019) "The relationship between stress and maturity in knowledge management", *International Journal of Organizational Analysis*. 27, 4, 1504-1521. https://doi.org/10.1108/IJOA-06-2018-1461
Mehrizi, F. Z. (2016) „Investigating the relationship between job security and knowledge sharing behavior with the mediator of organizational culture in Ayandeh Bank", *Mediterranean Journal of Social Sciences*, 7(3 S2), 161–166.
Muhammed, S., Zaim, H. (2020) "Peer knowledge sharing and organizational performance: the role of leadership support and knowledge management success", *Journal of Knowledge Management,* 24(10), 2455-2489. https://doi.org/10.1108/JKM-03-2020-0227
Oye, N.D., Salleh, M., Noorminshah, A. (2011) „Knowledge Sharing in Workplace: Motivators and Demotivators", *International Journal of Managing Information Technology (IJMIT)*, 3, 4, 71-84.
Paroutis, S., Al Saleh, A. (2009) "Determinants of Knowledge Sharing Using Web 2.0 Technologies", *Journal of Knowledge Management*, 13(4), 52-63.
Shaholli, D., Mantione, G., La Torre, G. (2023) "Work-related stress costs assessment: a narrative review", *Clin Ter.*; 174(5): 456-460.
doi: 10.7417/CT.2023.2464. PMID: 37674456.
Staal, M. A. (2004) *Stress, Cognition, and Human Performance: A Literature Review and Conceptual Framework,* CA: NASA Ames Research Center, Moffett Field.
Willem, A. (2003) *The Role of Organization Specific Integration Mechanisms in Inter-Unit Knowledge Sharing*, PhD Dissertation at Vlerick Leuven Gent Management School, Ghent University, Belgium.
Wickens, C. D., Alexander, A. L. (2009) "Attentional tunneling and task management in synthetic vision displays" *Int. J. Aviat. Psychol*., 19 (2): 182–199.
https://doi.org/10.1080/10508410902766549
Vedhara, K., Hyde, J., Gilchrist, I.D., Tytherleigh, M., Plummer, S. (2000) "Acute stress, memory, attention and cortisol", *Psychoneuroendocrinology*; 25: 535–549.
Zhang, Z. S., Song, F., Song, Z. B. (2020) "Promoting knowledge sharing in the workplace: Punishment v. reward", *Chaos Solit. Fract*., 131, 518.
doi: 10.1016/j.chaos.2019.109518
Zheng, T. (2017) „A Literature Review on Knowledge Sharing", *Open Journal of Social Sciences*, 5, 51-58.

Informal Learning and its Moderating Effect Between Employability and job performance of Young Recent Graduates in Their First job

Giancarlo Medroa Delgado
University of Lima, Peru

gmeddel@ulima.edu.pe

Abstract: The purpose of this paper is to examine the effects of knowledge management through informal learning on the relationship between employability and job performance of recent graduates in their first jobs. A quantitative, cross-sectional survey of 392 graduates of business school management programs at 4 universities in Lima, Peru was conducted to study the relationship between employability and job performance as moderated by informal learning inside and outside the work environment. It is confirmed that informal learning positively moderates the relationship between employability and job performance of recent graduates. However, informal learning impacts the employability dimensions differently. The results challenge traditional methods of learning and training inside and outside the work environment and provide new insights for knowledge management, talent management and their induction, training and development programs for a dynamic workforce with digital skills developed since the university stage. The implications of limiting employees' access to informal learning activities may limit future employability and job performance; employees can develop knowledge and competencies through informal learning activities on their own initiative, however, it is important to facilitate this process within the organization's processes. This study provides further evidence of the relationships between employability, informal learning and job performance in young recent graduates. In addition, it provides knowledge on how business schools can include informal or non-instructional learning activities in their curricula, thus generating self-learning skills for upcoming graduates and improving their skills and competencies.

Keywords: Knowledge Management**,** Informal Learning, Employability, job Performance, Recent Graduate, First job.

1. Introduction

Currently, the increase in local competition, the globalization process and the constant changes in the field of management, have highlighted the need to emphasize the importance of investing in the development of employees' skills to ensure the survival of organizations and achieve business sustainability. In this sense, it confirms the importance of human resources development to ensure the development of employees' skills and prepare them for the current operational, commercial and administrative requirements that the environment demands. Likewise, it is important that the development of these skills be generated from a university preparation stage and thus establish a transition from university to the most productive career for all stakeholders. It is stated that learning as a means for personnel development leads to this achievement by promoting the Employability (EMP) of the collaborator and his performance in the workplace (Dunphy et al., 1997). Kolb (1984) defines learning as a process in which knowledge is generated through the transformation of experiences through a cyclical process involving experience, observation, conceptualization and experimentation. The theory emphasizes the central role of experience in learning. This cycle is continuous, and individuals can enter it at any stage. The theory also suggests that individuals have different learning styles based on their preferences for these stages, known as divergent, assimilative, convergent and accommodative.

Learning can have a place both inside and outside an organization and offers the possibility of improving Job Performance (JOB). It is stated that the ability to learn is one of the fundamental attributes of human beings and involves them in their development. Much of this development is informal, occasional, sporadic and in some cases random. Learning on the job can occur in several different ways, not just formally (Leslie et al., 1998).

As business becomes faster and faster and the rate of innovation accelerates, employees feel a certain degree of pressure to be competitive within their organization as well as in the labor market by seeking to improve their skills and competencies to develop their EMP levels and improve their JOB. EMP is based on a broad range of competencies, EMP is also defined as the continuous fulfillment, acquisition or creation of work through the optimal use of competencies, in other words, the possession of certain competencies should enable employees to obtain, retain or create work for themselves (Brockner et al., 2006). Collaborators who perceive themselves as highly employable feel less threatened by the environment, experience less stress and improve their JOB (Gerken et al., 2015). In that sense, recent graduates by developing employability competencies can develop attitudes of adaptability towards new work experiences and thus be more prepared to an increasingly demanding and competitive work dynamic. To address this dynamic, the concept of EMP has generated great interest in talent management departments and in the academic environment, the same interest has been received by studies that analyze the development of skills and competencies of employees through effective

and novel learning processes (Kyndt et al., 2009).

For the moment the debate has concluded that the traditional methods of training in the work environment should be questioned, and further research should be done on the importance of using competence development strategies that are based on an integration of Formal Learning (FL) and Informal Learning (IL) as determining tools in knowledge management (Kock and Ellström, 2011). Underestimating IL can undermine the spontaneous nature of learning, claims that one type of learning is better or worse than the other should be avoided, both types of learning can be applied in organizations, both have advantages (Malcolm et al., 2003). IL is fundamental in the performance of collaborators in organizations, but it is not a replacement for FL or institutional education; although FL is more productive if it is designed and planned, the need for organizations to have informal information that increases learning based on experience is evident (Marsick and Watkins, 2016). It is stated that much of the knowledge and learning that occurs in organizations is accidental and informal, this characteristic does not contribute to the sustainability of these companies in the medium and long term; based on this context it is proposed to use knowledge-based learning methods that give an IL structure for the benefit of companies (O'Brien et al., 2019).

Just as various types of learning influence performance, it is also argued that learning is essential for improving EMP. There is sufficient evidence finding several positive outcomes of learning on employees' EMP, such as confidence, openness to change, and competitiveness (Crouse et al., 2011). Van der Klink et al. (2014) have studied the effects of education and training on EMP among employees and found positive effects. Van Der Heijden et al. (2009) affirms the positive effect between IL and EMP of employees. Similarly, Lecat et al. (2018) report positive relationships between IL and occupational specialization and optimization. These findings confirm the relationship between IL and its positive influence with EMP.

Recent studies have analyzed the relationship between EMP, JOB and IL, finding a strong relationship between the variables; however, no research has addressed the moderating relationship of IL between EMP and JOB of young recent business school graduates in their first work experience.

The research questions are:

- Is IL a suitable knowledge management method to foster the EMP of newly graduated employees?
- What are the most appropriate learning methods to improve the JOB of newly graduated employees in their first work experience?
- Are there learning methods that intervene positively or negatively in the relationship of EMP and JOB?

2. Literature Review

Formal training programs cannot adequately prepare employees for all possible scenarios and are usually not designed to equip people for continuous learning on the job; employees need to acquire new knowledge and skills continuously through informal programs as non-curricular means (Tannenbaum and Cerasoli, 2013). In Sambrook's (2005) research, it is suggested that for the achievement of JOB, the use of both FL and or IL should be encouraged, in other words, both forms of learning should be integrated to maximize the benefits of employee development. Individual learning in the workplace takes place through the dynamic interaction between FL and IL, so it may be difficult to conceive of either form being successful without adding another form of component. In the same vein, employee learning has a profound impact on the success of modern organizations. Well-designed, timely, and novel formal and non-formal training programs can drive JOB (Cerasoli et al., 2018). Staff development was found to have an indirect effect on JOB through informal methods learning. Moreover, the indirect effect of staff development on JOB through IL became stronger in small and medium-sized firms. (Choi and Jacobs, 2009). It is confirmed that IL as a process within staff development practice positively impacts on JOB. It can be concluded that learning strategy is key to JOB, and that IL is of particular importance (Lejeune et al., 2021).

EMP skills encompass a range of competencies that are crucial for individuals to succeed in the labor market. Although formal education has traditionally been considered the primary means of acquiring these competencies, there is growing recognition of the importance of IL in enhancing EMP (Bates et al., 2004). IL, which takes place outside of traditional educational settings, plays an important role in the development of personal and professional competencies that can improve an individual's confidence and overall EMP (Bates et al., 2004). Research suggests that EMP competencies are most effectively developed when they are integrated into the academic curricula of different disciplines, rather than being limited to stand-alone "EMP courses" (Wickramasinghe and Perera, 2010). This integration ensures that students are explicitly taught and

encouraged to cultivate these skills alongside their academic pursuits, thus enhancing their preparation for the labor market (Wickramasinghe and Perera, 2010). EMP skills encompass a wide range of competencies, such as teamwork, problem solving, adaptability, and resilience (Scott et al., 2017). Employers highly value communication and problem-solving skills, indicating the importance of these competencies in curriculum design to meet labor market needs. Furthermore, combining FL with feedback-seeking behaviors, a type of IL is particularly advantageous for developing the complex skills needed in the workplace (Elsen et al., 2022). While formal education remains essential for acquiring professional skills, IL complements formal training by fostering interpersonal skills, decision-making abilities, and problem-solving skills, which are in high demand by employers (Taute, 2014). The synergy between formal training and IL not only improves people's EMP, but also contributes to their continuous professional development (Taute, 2014). Therefore, the relationship between IL and EMP is increasingly recognized as a vital element in preparing individuals, by integrating EMP competencies into formal education, recognizing the value of IL experiences, and emphasizing the development of a diverse set of competencies, individuals can improve their EMP and stand out in today's competitive labor market.

Previous studies, although they have not empirically examined the relationship between IL, EMP and JOB, in recent business school graduates in their first jobs, have provided several findings suggesting a positive association between the variables. However, it is noteworthy that IL had a more significant impact compared to formal training; that is, the research results clearly demonstrate that IL activities play a crucial role in individual JOB than FL activities. Therefore, it can be concluded that IL is a key factor in improving job performance by developing relevant competencies. The studies by Froehlich et al. (2014) and Van Der Heijden et al. (2009) collectively suggest that both FL and informal are expected to have a positive impact on individual JOB. This study, like Froehlich et al. (2014), considers that employees are employable, have extensive technical knowledge about their field of work, are attentive to contextual changes and are resilient to the changes imposed on them. In this sense, only 3 of the 5 dimensions of the (Van der Heijde and Van der Heijden, 2006) model linked to the characteristics indicated above will be analyzed.

3. Theoretical Framework

3.1 Formal Learning and Informal Learning

The learning theory proposed by Marsick and Watkins (2016) points out 2 types of learning; the first one is the FL that is characterized by being a planned learning, certified and developed in courses provided in higher education institutions; and the second one the IL is the one that is learned in the daily activities at work, where the learning is given by the active participation of workers in the organization's projects, as well as the rotation of personnel within the organization. It has been known for some time that more learning occurs in the workplace than just what happens in formal training classrooms. Brockner et al. (2006) have identified the different forms of workplace learning as formal, informal and incidental. FL (training), of course, are discrete planned events (experiences) used to instruct people on how to perform specific defined jobs. It is usually institutionally sponsored and highly structured. IL can occur in institutions, but it is typically not classroom-based or highly structured, and control of the learning is in the hands of the learner, not determined by the organization. AF includes an expressed goal of the organization and a defined process.

Workplace learning occurs through a dynamic interaction between FL and IL. They feel that FL stimulates IL, and that IL often leads to engaging in more structured learning activities (Shipton et al., 2002). The two types of learning complement each other and lead to new improvements and innovations, workplace learning does not occur for its own sake, but to achieve organizational and individual goals. Organizational goals include increasing worker participation in decision making and expanded job responsibilities. Workplace learning is defined as a means of addressing employee development that is consequently designed to improve the likelihood of achieving individual and/or organizational performance, or as an individual process designed to achieve learning toward the attainment of personal and professional goals (Park et al., 2019).

3.2 Employability

The concept of EMP focuses on three areas: labor market outcomes, the individual's responsibility to develop and maintain transferable skills due to the increasing prevalence of inter-organizational careers (Hall, 2004), and the relativity of EMP in terms of both supply and demand in the labor market (Rothwell and Arnold, 2007). Based on extensive literature and empirical research, five employable employee competencies (or dimensions

of EMP), knowledge, work experience, anticipation and optimization, personal flexibility, corporate sense and balance, were identified (Van Der Heijden et al., 2009). EMP is conceptualized as a form of job-specific active adaptability that enables workers to identify and take advantage of career opportunities. Thus, EMP facilitates movement between jobs, both within and between organizations. Although EMP does not ensure actual employment, it improves the likelihood that an individual will obtain a job. An individual is employable to the extent that he or she can effectively leverage personal factors to negotiate environmental demands (Fugate et al., 2004).

3.3 Job Performance

For Tsui et al. (1997), the JOB is generated in four dimensions, from the employer's perspective, on the relationship between them and their subordinates. These become, firstly, the Quasi Spot Contract defined as the pure economic exchange, where the employer offers short-term economic incentives in exchange for specific contributions from the employee. Secondly, the Mutual Investment, which involves unspecified, broad obligations open to both parties, where the incentives offered by employers go beyond monetary rewards. Third, the Underinvestment type relationship, where in the employment relationship the employee is expected to assume broad and unlimited obligations while the employer reciprocates with specific, short-term monetary rewards with no commitment to any investment in the subordinate's training or career life. Finally, within the unbalanced approach is the overinvestment relationship, where the employee is characterized by performing only a specific set of work-focused activities while the employer offers open-ended and wide-ranging rewards that include benefits such as training and commitment to a lifetime of career opportunities.

On the other hand, the theory of Rich et al. (2010) defines the variable of JOB as that "additional value attached to a company from a set of behaviors or behaviors that an employee contributes both directly and indirectly to the objectives of the organization". In this study, the author conducted an analysis that supports the hypothesis that job engagement is related to perceived organizational support, value congruence and core self-evaluations, and the two dimensions of job development, which are task performance and organizational citizenship behavior. It is also mentioned that JOB does not only include task performance, but also includes behaviors that contribute to companies in a less direct way such as a favorable social and psychological environment for the performance of work involved to the core tasks. It has also been determined that JOB is made up of 3 components. The first is role behavior, the second is organizational citizenship behavior that benefits the organization, and the third is organizational citizenship behaviors that benefit the individual (Williams and Anderson, 1991).

In view of the above, this research work formulates the following hypotheses.

H1: EMP is positively and significantly associated with JOB.

H2: IL is positively and significantly associated with JOB.

H3: IL positively moderates the relationship between EMP and JOB.

4. Methodology

4.1 Sample Design

A cross-sectional quantitative survey was conducted among 392 graduates of business school management programs from 4 universities in Lima, Peru, to study the relationship between employability and job performance moderated by informal learning inside and outside the work environment. A quantitative methodology was applied where a structured questionnaire was used to collect responses from the subject of interest, which required between 8 to 10 minutes to complete. All respondents were informed of the objective of the research and the strictly academic purposes of the present investigation were confirmed. The characteristics of the cases surveyed are shown in Table 1. The first section of the research instrument included filter and control questions, in this section it was verified if the respondents were in their first work experience and if they were recent graduates. The following sections contained a section for the evaluation of the hypotheses of this article. The responses for the constructs were measured through Likert methodology, under a 5-point scale (1=strongly disagree, 5=strongly agree). The constructs measured were the following: Informal Learning (Froehlich et al., 2014), Employability (Van Der Heijden et al., 2009) and Job Performance (Williams and Anderson, 1991).

Table 1: Descriptive statistics

	Frequency	%
Number of employees per company		
Less than 10	218	55.6%
Between 11 to 20	46	11.7%
Between 21 to 50	128	32.7%
Company's Operating Time		
3 to 5 years	70	17.9%
5 to 10 years	167	42.6%
More than 10 years	155	39.5%
Genre		
Male	199	23.7%
Female	193	76.3%

4.2 Measures

In the context of this study, IL is operationally defined as respondents' subjective perception of the extent to which they actively participate in unstructured or spontaneous learning activities in their workplace, as well as the level of support provided by the organization to foster a culture conducive to learning at work. The study examined 4 dimensions of IL, including actively seeking information (IS), seeking feedback from both supervisors (SF) and colleagues (CF), as well as seeking help (HS) when needed (Froehlich et al., 2014). The measurement of the variable EMP focuses on a competency-based approach, emphasizing its advantages for both career and company outcomes (Van Der Heijden et al., 2009). EMP is considered a multidimensional concept with five correlated dimensions: (occupational expertise, anticipation and optimization, personal flexibility, corporate meaning and balance). For this research, priority is given to how employees themselves value their employability (Fugate et al., 2004). This is in line with previous studies, which suggest that perceived employability is more important than appraisal (equally subjective), since employees act on their own perceptions. Occupational experience (EXP), anticipation and optimization (ANT), and personal flexibility (FLEX) will be considered.

JOB refers to the perception that individuals have of their ability to fulfill the assigned tasks and responsibilities conferred on them by the employing organization. To assess and gauge the level of JOB, this research used the 3 dimensions of performance originally conceived by Williams and Anderson (1991), where 3 dimensions are identified as in-role behavior (IRB), organizational citizenship behavior that benefits the individual (OCBI) and organizational citizenship behavior that benefits the organization (OCBO).

5. Results

5.1 Validity and Reliability

The conceptual model (Figure 1) was tested using Smart PLS 4.0, a sophisticated and widely recognized software tool). To assess the efficacy and reliability of the model, a comprehensive evaluation was conducted, including measurement of item loadings, internal consistency, reliability, convergent validity, and discriminant validity. The detailed results of these evaluations are meticulously presented in Tables 2 and 3, providing an overview of the model's performance.

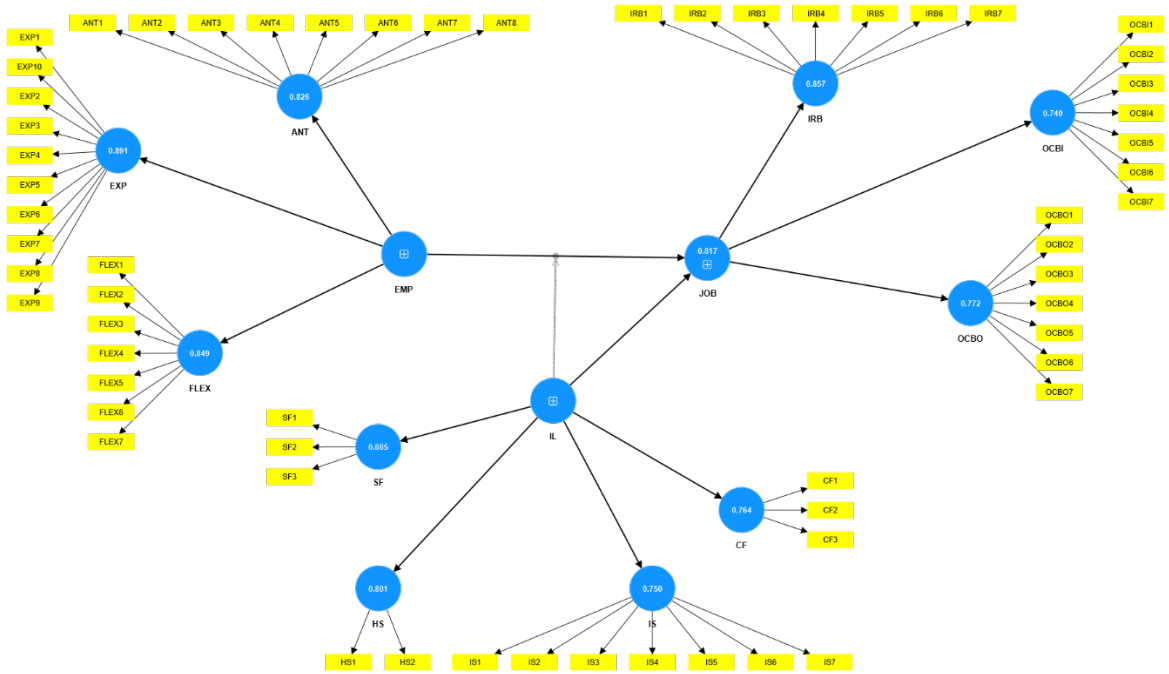


Figure 1: Structural Model

A crucial aspect that was examined during the evaluation was the loadings of the items used. It was observed that all item loadings exceeded the threshold of 0.50, which is considered statistically significant and indicative of convergent validity (Hair et al., 2014). This finding is highly relevant and reinforces the validity of the model, as it demonstrates that the constructs investigated accurately measure the intended concepts. This is a significant finding, as it provides further support for the robustness and reliability of the conceptual model.

Reliability was another important criterion assessed in this study and was evaluated using two widely accepted metrics: Cronbach's alpha and AVE composite reliability. The results of these assessments revealed that the model exhibits a high level of reliability. Specifically, an AVE value equal to or greater than 0.5 and a Cronbach's alpha indicator greater than 0.7 are considered indicative of an adequate model. In this case, all AVE values and Cronbach's alpha indicators exceeded these thresholds, which further reinforces the reliability and validity of the conceptual model investigated (Hair et al., 2014).

In addition to assessing the reliability and convergent validity of the model, an analysis was also performed to determine its discriminant validity. This analysis was intended to measure the differences between each construct and to assess whether they were distinct from each other. The results of the discriminant validity assessment were very encouraging, as they indicated that the square root of each AVE was greater than the correlations of the constructs. This result is significant, as it suggests that the constructs investigated measure unique and distinct concepts, which demonstrates the model's ability to discriminate between different constructs effectively (Hair et al., 2014). Overall, the results of this comprehensive evaluation strongly support the investigated conceptual model. The robustness and reliability of the model offers favorable results obtained in terms of convergent validity, reliability and discriminant validity.

Table 2: Measurement properties

Construct	Dimension	Cronbach's Alpha (>0.7)	AVE (>0.5)	CR (>0.7)
EMP	ANT	0.938	0.699	0.940
	EXP	0.960	0.734	0.960
	FLEX	0.927	0.697	0.929
IL	HS	0.855	0.874	0.857
	IS	0.894	0.613	0.903
	CF	0.935	0.884	0.935
	SF	0.942	0.896	0.942
JOB	IRB	0.946	0.758	0.948

Construct	Dimension	Cronbach's Alpha (>0.7)	AVE (>0.5)	CR (>0.7)
	OCBI	0.917	0.669	0.921
	OCBO	0.887	0.596	0.893

Note: Average variance extracted (AVE), composite reliability (CR).

Table 3: Discriminant validity Fornell - Larcker analysis

	ANT	CF	EXP	FLEX	HS	IRB	IS	OCBI	OCBO	SF
ANT	0.836									
CF	0.588	0.94								
EXP	0.784	0.62	0.857							
FLEX	0.753	0.621	0.815	0.835						
HS	0.594	0.699	0.69	0.719	0.935					
IRB	0.702	0.665	0.807	0.751	0.773	0.871				
IS	0.642	0.666	0.691	0.675	0.731	0.731	0.783			
OCBI	0.666	0.645	0.653	0.647	0.596	0.696	0.708	0.818		
OCBO	0.658	0.571	0.703	0.639	0.654	0.739	0.648	0.643	0.772	
SF	0.527	0.684	0.586	0.562	0.642	0.618	0.541	0.567	0.579	0.947

5.2 Structural Equation Model and Hypothesis Testing

The coefficient of determination was 0.817 (see Figure 1) for JOB, which indicates a substantial level of determination (Hair et al., 2012) generated by EMP and IL. That is, there are other determinants for JOB that will need to be the product of further research.

The first hypothesis, H1, indicates that EMP has a positive and significant effect on JOB. Table 4 indicates that a positive and significant effect can be traced between the variables (β = 0.429; T-value = 6.607 and p = 0.000). Therefore, H1 should be accepted. The second hypothesis, H2, indicates that IL has a positive and significant effect with JOB. Table 4 indicates that a positive and significant effect can be plotted between the variables (β = 0.454 T-value = 6.942 and p = 0.000). Therefore, H2 should be accepted. The third hypothesis, H3, indicates that IL has a positive and significant moderating effect with EMP and JOB. Table 4 indicates that a negative and significant effect can be traced between the variables (β = -0.035; T-value = 3.026 and p = 0.002). Therefore, H3 should be not accepted.

Variance inflation factors (VIF) were also calculated to detect multicollinearity between variables. VIFs greater than 10 indicate high and unacceptable levels of multicollinearity between constructs (Hair et al., 2014). The VIFs for the relationship between variable items ranged from 1.415 to 4.803, suggesting that the level of multicollinearity between these variables is acceptable.

Table 4: Hypothesis testing

	Coefficients	T-Value	p-Value	Hypothesis
EMP → JOB	0.429	6.607	0.000	H1 - Accepted
IL → JOB	0.454	6.942	0.000	H2 - Accepted
IL x EMP → JOB	-0.035	3.026	0.000	H3 – Not Accepted

5.3 Discussion

Driven by the increasing presence of demands for goal achievement, the competitiveness of local markets, the high rate of innovation, EMP, among other factors, put human resource managers on alert to develop efficient human talent management strategies to cope with all these demands of the labor market. Therefore, this research paper set out to investigate the effects of IL activities on the EMP and JOB of business school management program graduates in their first work experiences. Two general conclusions can be drawn from the results. First, the performance of learning activities generates EMP increases JOB; this relationship is driven by IL.

This study provides strong evidence supporting the thesis that IL play a crucial role in improving EMP and overall, JOB, which highlights the importance of continuous workplace learning and the development of employability competencies in business schools through IL. The relationship between IL, EMP and employee

JOB has been extensively studied in the literature. Research by Froehlich et al. (2014) highlights that IL contribute significantly to improving EMP, which in turn improves job performance. This conclusion is corroborated by Heijden et al. (2009), who highlight the importance of IL in increasing employee performance. In addition, Eldor and Harpaz (2015) discuss how learning climate influences performance behaviors, indicating a strong connection between learning environments and employee performance. In addition, Rowden's (2002) study confirms the dynamic interaction between IL in the workplace, further highlighting the importance of both types of learning in improving job satisfaction and, consequently, job performance. In addition, Raykov's (2014) research suggests that employer support for innovative work positively influences employees' job satisfaction, which can lead to improved JOB. Furthermore, the study by Sukor et al. (2018) demonstrates a positive relationship between workplace IL and job satisfaction, indicating that continuous workplace learning contributes to increased levels of job satisfaction. This aligns with the findings of (Daryoush, 2013), which suggest that workplace learning directly influences employee task and contextual performance.

The acquisition of EMP competencies is influenced by factors such as transformational leadership, IL and reflective practice (Elsen et al., 2022). EMP competencies are not only crucial for job acquisition, but also for job retention and career progression. The learning environment, curriculum design and teacher quality significantly influence the competencies acquired by students. In addition, lifelong learning plays a vital role in the improvement of EMP, especially in self-employment scenarios later in life. In conclusion, the development of EMP competencies is a multifaceted process that involves a combination of IL, reflective practice, soft skills and a conducive learning environment. These competencies are essential not only for getting a job, but also for career advancement and adaptability in a constantly evolving labor market.

Contrary to what was initially formulated, IA is a tool that, according to the results, decreases the relationship between EMP and JOB. Thus, further research should be carried out to analyze the different types of learning and their moderating relationship; it is possible that formal learning is a determining factor in completing the analysis model as analyzed by Froehlich et al (2014)

The results of this research provide additional support for previous research on the relationship between IL, EMP, and JOB of business school management program graduates in their first work experiences. Few studies examine learning outcomes in this segment; in fact, previous studies have only paid attention to employee performance without specifying the timing of the work experience. The findings suggest that schools and academic departments should develop employability competencies through informal learning to produce more efficient and productive graduates; this development can be generated through extra-academic activities such as study circles, seminars, workshops and lectures. Likewise, extra-academic activities can be developed through the technological tools of distance education.

References

Bates, M., Bell, B., Patrick, C., & Cragnolini, V. (2004). Developing generic skills at university, during work placement and in employment: graduates' perceptions. Higher Education Research and Development, 23(2), 147-165.

Brockner, J., Flynn, F. J., Dolan, R. J., Ostfield, A., Pace, D., and Ziskin, I. V. (2006). Commentary on "radical HRM innovation and competitive advantage: The Moneyball story." Human Resource Management, 45(1), 127-145.

Cerasoli, C. P., Alliger, G. M., Donsbach, J. S., Mathieu, J. E., Tannenbaum, S. I., & Orvis, K. A. (2018). Antecedents and Outcomes of Informal Learning Behaviors: a Meta-Analysis. Journal of Business and Psychology, 33(2), 203-230.

Choi, W., & Jacobs, R. L. (2009). Influences of Formal Learning, Personal Learning Orientation, and Supportive Learning Environment on Informal Learning. Human Resource Development Quarterly, 2(1), 1-9.

Crouse, P., Doyle, W., & Young, J. D. (2011). Workplace learning strategies, barriers, facilitators and outcomes: A qualitative study among human resource management practitioners. Human Resource Development International, 14(1), 39-55.

Daryoush, Y. (2013). Improving job performance: workplace learning is the first step. International Journal of Education and Literacy Studies, 1(1), 100-107.

Dunphy, D., Turner, D., & Crawford, M. (1997). Organizational learning as the creation of corporate competencies, 16(4), 232-244.

Eldor, L. and Harpaz, I. (2015). A process model of employee engagement: the learning climate and its relationship with extra-role performance behaviors. Journal of Organizational Behavior, 37(2), 213-235.

Elsen, J., Vermeeren, B., & Steijn, B. (2022). Valence of formal learning, employability and the moderating roles of transformational leadership and informal learning in the public sector. International Journal of Training and Development, 26(2), 266-284.

Froehlich, Dominik Emanue, Beausaert, S., Segers, M., & Gerken, M. (2014). Learning to stay employable. Career Development International, 19(5), 508-525.

Fugate, M., Kinicki, A. J., & Ashforth, B. E. (2004). Employability: A psycho-social construct, its dimensions, and applications. Journal of Vocational Behavior, 65(1), 14-38.

Gerken, M., Beausaert, S., & Segers, M. (2015). Working on professional development of faculty staff in higher education: investigating the relationship between social informal learning activities and employability. Human Resource Development International.

Hair, J. F., Sarstedt, M., Hopkins, L., & Kuppelwieser, V. G. (2014). Partial least squares structural equation modeling (PLS-SEM): An emerging tool in business research. European Business Review, 26(2), 106-121.

Hair, J. F., Sarstedt, M., Ringle, C. M., & Mena, J. A. (2012). An assessment of the use of partial least squares structural equation modeling in marketing research. Journal of the Academy of Marketing Science, 40(3), 414-433.

Hall, D. T. (2004). The protean career: A quarter-century journey. Journal of Vocational Behavior, 65(1), 1-13.

Kock, H., & Ellström, P. E. (2011). Formal and integrated strategies for competence development in SMEs. Journal of European Industrial Training, 35(1), 71-88.

Kolb, D. A. (1984). Experiential learning: Experience as the source of learning and development. Prentice Hall.

Kyndt, E., Dochy, F., & Nijs, H. (2009). Learning conditions for non-formal and informal workplace learning. Journal of Workplace Learning, 21(5), 369-383.

Lecat, A., Beausaert, S., & Raemdonck, I. (2018). On the Relation Between Teachers' (In)formal Learning and Innovative Working Behavior: the Mediating Role of Employability. Vocations and Learning, 11(3), 529-554. https://doi.org/10.1007/s12186-018-9199-x.

Lejeune, C., Beausaert, S., & Raemdonck, I. (2021). The impact on employees' job performance of exercising self-directed learning within personal development plan practice. International Journal of Human Resource Management, 32(5), 1086-1112.

Malcolm, J., Hodkinson, P., & Colley, H. (2003). The interrelationships between informal and formal learning. Journal of Workplace Learning, 15, 313-318.

Marsick, V. J., Volpe, M., & Watkins, K. E. (1999). Theory and Practice of Informal Learning in the Knowledge Era. Advances in Developing Human Resources, 1(3), 80-95.

O'Brien, E., McCarthy, J., Hamburg, I., & Delaney, Y. (2019). Problem-based learning in the Irish SME workplace. Journal of Workplace Learning, 31(6), 391-407.

Park, W., Sung, C. S., & Byun, C. G. (2019). Impact of unlisted small and medium-sized enterprises' business strategies on future performance and growth sustainability. Journal of Open Innovation: Technology, Market, and Complexity, 5(3).

Raykov, M. (2014). Employer support for innovative work and employees' job satisfaction and job-related stress. Journal of Occupational Health, 56(4), 244-251.

Rich, B., Lepine, J., & Crawford, E. (2010). Job engagement: antecedents and effects on job performance. Academy OfManagement Journal, 53(3), 617-635.

Rothwell, A., & Arnold, J. (2007). Self-perceived employability: Development and validation of a scale. Personnel Review, 36(1), 23-41.

Rowden, R. (2002). The relationship between workplace learning and job satisfaction in u.s. small to midsize businesses. Human Resource Development Quarterly, 13(4), 407-425.

Sambrook, S. (2005). Factors influencing the context and process of work-related learning: Synthesizing findings from two research projects. Human Resource Development International, 8(1), 101-119.

Scott, F., Connell, P., Thomson, L., & Willison, D. (2017). Empowering students by enhancing their employability skills. Journal of Further and Higher Education, 43(5), 692-707.

Shipton, H., Dawson, J., West, M., and Patterson, M. (2002). Learning in manufacturing organizations: What factors predict effectiveness? Human Resource Development International, 5(1), 55-72.

Sukor, M., Shah, I., & Ruai, M. (2018). Impact of informal workplace learning on job satisfaction. Sains Humanika, 9(1.1).

Tannenbaum, S. I., & Cerasoli, C. P. (2013). Do team and individual debriefs enhance performance? A meta-analysis. Human Factors, 55(1), 231-245.

Taute, F. (2014). An evaluation of the impact of a life skills programme in the workplace. Social Work/Maatskaplike Werk, 43(3).

Tsui, A. S., Pearce, J. L., Porter, L. W., & Tripoli, A. M. (1997). Alternative Approaches to the Employee-Organization Relationship: Does Investment in Employees Pay off? The Academy of Management Journal, 40(5), 1089-1121.

Van der Heijde, C.M. and Van der Heijden, B.I.J.M. (2006), “A competence-based and multidimensional operationalization and measurement of employability”, Human Resource Management, Vol. 45 No. 3, pp. 449-476.

Van Der Heijden, B., Boon, J., Van Der Klink, M., & Meijs, E. (2009). Employability enhancement through formal and informal learning: An empirical study among Dutch non-academic university staff members. International Journal of Training and Development, 13(1), 19-37.

Van der Klink, M., Van der Heijden, B. I. J. M., Boon, J., & Williams van Rooij, S. (2014). Exploring the contribution of formal and informal learning to academic staff member employability: A Dutch perspective. Career Development International, 19(3), 337-356.

Wickramasinghe, V. and Perera, L. (2010). Graduates', university lecturers' and employers' perceptions towards employability skills. Education + Training, 52(3), 226-244.

Williams, L. J., & Anderson, S. E. (1991). Job Satisfaction and Organizational Commitment as Predictors of Organizational Citizenship and In-Role Behaviors. Journal of Management, 17(3), 601-617.

The Smart Socially Innovative City Advancing in Italy

Mauro Romanelli[1], Paolino Fierro[2] and Roberta Oppedisano[1]
[1]University of Naples Parthenope, Department of Business and Economics, Via G. Parisi, 13 – 80132 Napoli
[2]PEGASO Telematic University, Department of Economics and Management, Napoli, Italy

mauro.romanelli@uniparthenope.it
paolino.fierro@unipegaso.it
roberta.oppedisano@uniparthenope.it

Abstract: Cities of tomorrow are planning a smart city framework in order to drive urban growth and social innovation. The aim of the study is to elucidate that cities aim at dealing with urban innovation issues, designing a smart city view in order to shape the city an urban community as an engine of collaborative and innovative spaces. The study relies on the analysis of one case study. The city of Firenze is rethinking on the urban future, adopting a smart city framework that supports a collaborative view for social innovation, enabling smartness as a capability to develop social issues and contribute to urban value. The findings elucidate that a smart city framework enables the city to evolve as urban community and engine of social innovation, shaping urban collaborative meeting places for innovation.

Keywords: Smart Cities, Smart Communities, Urban Innovation, Social Innovation.

1. Introduction

The future of a smart society relies on cities able to play a proactive role in engaging the urban stakeholders that contribute to constructing a virtuous pathway for social innovation within urban spaces. Cities of tomorrow will be intelligent, smart, socially innovative by driving community-led and people-driven innovation, leading to smart city development and shaping collaborative urban ecosystems for innovation (Mora *et al.*, 2023; Dolmans *et al.*, 2023; Nam and Pardo, 2011; Eger, 2005), fostering smart innovative communities (Caragliu and Del Bo, 2019; Appio, Lima and Paroutis, 2019; Paskaleva, 2011). Sustainable urban future relies on social innovation for good life, by promoting collaborative and multi-actor innovation, and following a human-centred view to smart urban innovation (Yigitcanlar, 2021; Sørensen and Torfing, 2018; Nilssen, 2019). As organizational spaces (Knox, 2010), and net action (Czarniawska, 2002), cities shape urban communities that contribute to supporting collaborative spaces for social innovation, adopting a smart view to urban growth to improve the quality of social life for citizens (Lazariou and Roscia, 2012), and following a human-centric view for a smart, socially innovative urban community (Costales, 2022). Smart city planning supports the city to shape an urban community (Gil-Garcia *et al.*, 2016), and relies on driving community development (Stratigeia, 2012) and fostering urban collaborative innovation (Dolmans *et al.*, 2023). The smart city enables the city as human-centred, collaboration-driven and socially innovative community. Urban innovation refers to a sociotechnical innovation (Meijer and Thaens, 2018). Cities use the potential offered by digital and intelligent technologies to shape human-centred, innovation-led urban communities that enhance collective intelligence and cooperation (Yigitcanlar *et al.*, 2023), leading to net action and multi-actor collaborative spaces and processes, opening up to knowledge-led and technology-driven social innovation, by involving civil society, research, private and public organisations (Czarniawska, 2002; Zhang and Wang, 2022; Sørensen and Torfing, 2018).

While there are many studies that focus on smart city visions and approaches as means to drive sustainable urban development, few studies investigate the role of smart city planning and vision as a driver of urban innovation. Which urban future development do cities aim to achieve? How do cities interpret a smart social vision to urban innovation and growth? The research question refers to how cities are rethinking the urban future, shaping the city as socially innovative urban community. As intelligent communities, cities are planning the future urban development by selecting a smart view to driving urban growth and innovation, and shaping future urban innovative communities. The case study concerns the choices of *Firenze Smart City Plan*. It is analysed and presented. The aim of this study is to elucidate how smart city urban planning enables cities to rethink on the urban future, by designing smart socially innovative communities. Cities are adopting a smart city framework, becoming engines of sustainable, social growth and innovation by strengthening urban multi-actor collaboration. Smart city strategy, planning and policies contribute to shaping the city as socially inclusive and innovative urban community. The paper is articulated in five sections. After introduction and theoretical background, in the third section methodological section follows. Findings, discussion and conclusions are set out.

1.1 Towards Cities as Smart Social Innovation-led and Collaboration-Driven Communities

As organisational spaces (Knox, 2010), arenas of innovation (Zhang and Wu, 2019), cities are following a smart view in order to drive urban competitiveness, ensure better quality of life and support innovation in long-term horizon (Appio, Lima and Paroutis, 2019; Paskaleva, 2011). Sustainable urban development relies on cities that adopt a smart city vision in order to contribute to public value creation and innovation (Pardo, Gil-Garcia, Gascó-Hernández, Cook and Choi, 2021). The smart city is emerging as the hub for driving smart global societies (Joss *et al.*, 2019). A city is going smart by shaping a smart community in order to drive urban innovation and achieve sustainable and inclusive growth, focusing on people and human capital, and shaping innovation-led as well as inclusive and people-centred communities (Nam and Pardo, 2011; Paskaleva, 2011), by fostering collaborative planning and innovation towards citizen-centred and societal smart cities (Alizadeh and Sharifi, 2023). Smart cities contribute to enhancing the role of the urban community as an agent of collective action, as the driver and the issue of smart city initiatives, policies and applications in order to promote the urban wellbeing for citizenry and drive the city a better place for work and life, encouraging public and private actors that work together Gil-Garcia, Pardo and Nam, 2016; Stratigeia, 2012). Smart cities contribute to bottom-up, cooperative and multi-actor innovation (Dolmans *et al.*, 2023; Sørensen and Torfing, 2018). As engines of social innovation (Anttiroiko, Valkama and Bailey, 2014), human-centric smart cities help enable urban platforms for technology-driven social innovation (Costales, 2022). Smart-led urban innovation relies on cities that intentionally and proactively shape technology-driven processes for new and creative ideas and qualitative urban change, enhancing collaborative approaches (Meijer and Thaens, 2018; Mora, Deakin, Reid and Angelidou, 2019). Smart urban innovation relies on city's smartness as the ability to attract and mobilize human capital in collaboration with urban actors and stakeholders by using information and communication technologies (Meijer and Bolívar, 2016). Promoting a smart city growth supports cities to meet social challenges and urban sustainability priorities, following collaborative approaches and developing capabilities within smart urban ecosystems for innovation (Mora, Appio, Foss, Arellano and Zhang, 2020; Gupta, Panagiotopoulos and Bowen, 2023). As smart innovative communities (Eger, 2005; Nam and Pardo, 2011), cities contribute to the community development and transformation driving urban innovation and supporting stakeholder collaboration, leading to multi-actor and cooperative processes for urban wellbeing (Nilssen, 2019), by engaging citizens in social open innovations (Paskaleva, 2011), and focusing on smart, sustainability-oriented, social and human-centred innovation (Tura and Ojanen, 2022).

2. Methodological Section

The study employed a qualitative, descriptive and exploratory methodology to analyse how cities are rethinking on the future urban development, shaping smart urban innovation and communities, rediscovering the smart city framework as an opportunity to drive social innovation issues. As engines of urban innovation and socially inclusive growth, cities are adopting a smart city vision to support urban innovation and growth, revitalising the city as a community. The study focuses on one exploratory and illustrative case study with regards to Firenze, a city which is planning urban growth by going smart by rethinking on smart urban future for becoming a smart socially innovative urban community in order to explore and provide a comprehensive understanding of a phenomenon still in progress and emerging in contemporary times, whereas the boundaries between the phenomenon and the context are not clearly evident, by following a case study methodology through an empirical inquiry without the rigidity of a predefined structure for observations and analysis (Yin, 2009). The study relies on the analysis of a document related to urban planning framework. The research method involved case selection and data collection from policy document as the smart city strategy framework drawn from *Firenze Smart City Plan* as the information source in order to collect and analyse data and information, and to investigate how an Italian city is planning the urban future development, shaping the urban community as an engine of urban innovation and social growth, coherently with a smart city view. Investigating smart city strategy design helps to understand the pathway of cities shaping urban social innovation (Angelidou, 2017; Mora and Bolici, 2017; Sancino and Hudson, 2020). The case study refers to the smart city vision as urban development framework in order to revitalise the city as socially innovative community towards urban sustainability.

3. Findings

Cities are planning the future urban development by selecting a smart vision to urban growth and innovation. In particular, in Firenze the pathway for a smart city-led urban innovation is following a social innovation view. The urban community aim at becoming an agent of social change by strengthening information, involvement, integration and innovation, and relies on reinforcing urban energies and competences provided by private, no

profit, business, research and academia, public actors that are involved in collaborative processes for urban value creation. Rethinking smart innovative cities relies on driving smart city planning and implementation in order to shape cities as smart-driven, innovation-led and human-centred communities. One single case study is analysed and presented. In Europe, cities are rethinking about the urban future by adopting a smart vision planning in order to support innovation and drive sustainable urban development, shaping innovative and intelligent communities.

In Italy, the city and the municipality of Firenze is understanding the importance of designing the urban planning as hub for innovation by following a smart city framework, and using the potential of digital and contemporary technologies in order to shape the city as community which is working to stimulate and drive urban innovation processes, by involving private and public urban stakeholders to build collaborative spaces for innovation and value co-creation for wealthy urban communities and better quality of urban life. The idea of urban planners is to provide guidelines that contribute to freeing urban energies, competences and intelligences in order to create spaces for social innovation and change, empowering citizens, private, public and no profit actors to identify innovative solutions for policy and services co-production that help contribute to improving the urban life and sustainability of a city that is becoming a socially innovative community.

In the *Firenze Smart City Plan*, cities are living organisms made up of people within the process of urban transformation, leading to intelligent urban communities. Smart urban innovation relies on citizens who are able to play a proactive role in identifying some pathways for urban development and quality of life improvement. In particular, planning a smart urban vision supports the city as an engine of innovation and a community of people able to produce meanings and culture, and to enhance human and civil progress. Promoting smartness relies on using information and communication technology in order to make cities more innovative, sustainable and intelligent communities that are capable to drive innovation, reinforcing social relationships within urban ecosystems. A smart city refers to a city that is changing and constructing new social, urban, and economic responses to environmental and historical pressures. The smart city plan is an open space for debate, confrontation, exchange of information and knowledge among all urban stakeholders which support urban, social and economic development. A smart city master plan helps the city to drive a continuous pathway for sustainable urban innovation, and to improve the quality of life within community, and relies on distributed and collective leadership and vision. Planning a smart city framework for urban growth should support city to image its future focusing on a city learning to becoming a community where all the urban stakeholders contribute to urban value creation processes and issues, advancing towards social innovation view. Smart urban innovation relies on promoting collaboration among all the involved stakeholders (public administration, research centres, cultural institutions, businesses, associations, groups, citizens) along the urban value chain. A smart city strategy and practice relies on promoting open innovation by involving the urban stakeholders and embracing the four *Is*: the *integration* of all possible aspects in charge of a municipality's competences and background; the *innovation* as the development of innovative services and solutions through digital and interactive information technology; the *involvement* as a means to enable stakeholders to identify, plan, share, and implement strategic, long-terms vision and goals; and the *information* relies on the use of information and communication technology as a way to reinforce and consolidate the relationships between municipality and citizens, by monitoring the implementation of urban smart strategy.

This analysis elucidates that the city of Firenze is designing the urban planning and rethinking about the future of urban communities, adopting a smart vision in order to shape the city as sustainable and innovative community by strengthening a collaborative framework, and designing urban collaborative spaces that enable various stakeholders to drive innovation processes in order to improve the quality of life of citizens within urban communities.

4. Discussion and Conclusions

The concept and practice of smart city is related to urban innovation issues. The smart city planning enables a way to drive social innovation within urban spaces. Thereby, the smart city framework is emerging as a platform and label that is encouraging the efforts, the competences and organisational arrangements of cities towards social innovation as the issue for achieving urban sustainability beyond the potential offered by technology. Cities of tomorrow are planning the urban future as well as smart innovative urban communities that contribute to ensuring high quality of urban life, shaping urban communities as *loci* of social innovation. Smart cities and communities contribute to sustainable urban growth and social innovation. As engines of urban innovation and smart communities, cities drive multi-actor collaborative innovation, transitioning from a technology-enabled to a community-oriented and human-centric approach, putting the people first, focusing on human and social

capital, promoting community development, shaping urban collaborative and socially innovative spaces, and strengthening stakeholder participation and involvement to drive urban collaborative, inclusive and innovation-led communities.

In the city of Firenze, the smart city planning focuses on searching for bringing together integration, innovation, involvement, and information. The smart city framework enables several urban stakeholders to work together for shaping the urban community as an engine of social innovation. Planning a smart city view means enhancing the potential of technology as an enabler of urban, social and collaborative innovation and community development. As engines of innovation, cities are tracking a smart city-led pathway for future urban innovation, by strengthening community participation and driving social and collaborative innovation within urban spaces for urban wealth. Socially inclusive and technology-led innovative urban communities make the city a better place for social value creation and social innovation. Cities of the future will aim at understanding the potential of information technology in order to adopt a human-centred vision to developing the city as smart, socially innovation-driven community. Further research perspectives imply to investigate how other Italian cities are planning the urban future, following a smart city vision and framework to urban innovation and growth.

References

Alizadeh, H., & Sharifi, A. (2023). Toward a societal smart city: Clarifying the social justice dimension of smart cities. *Sustainable Cities and Society*, *95*, 104612.

Angelidou, M. (2017). The role of smart city characteristics in the plans of fifteen cities. *Journal of Urban Technology, 24*(4), 3-28.

Anttiroiko A.-V., Valkam P., & Bailey S.J. (2014). Smart cities in the new service economy: building platforms for smart services*. AI&Society, 29*(3), 323-334.

Appio, F.P., Lima, M., & Paroutis, S. (2019). Understanding Smart Cities: Innovation ecosystems, technological advancements, and societal challenges. *Technological Forecasting & Social Change, 142*, 1-14.

Caragliu, A., & Del Bo, C.F. (2019). Smart innovative cities: The impact of Smart City policies on urban innovation. *Technological Forecasting and Social Change, 142*, 373-383.

Chang, J.I., Choi, J., An, H., & Chung, H.Y. (2022). Gendering the smart city: A case study of Sejong City, Korea. *Cities, 120,* 103422.

Comune di Firenze (2015). *Firenze Smart City Plan*.

Costales, E. (2022). Identifying sources of innovation: Building a conceptual framework of the Smart City through a social innovation perspective. *Cities, 120,* 103459.

Czarniawska, B. (2002). Remembering while Forgetting: The Role of Automorphism in City Management in Warsaw. Public Administration, *62*(2), 163-173.

Dolmans, Sharon A. M., van Galen, Wouter P. L., Walrave, Bob, den Ouden, Elke, Valkenburg, Rianne, & Romme, A. Georges, L. (2023). A Dynamic Perspective on Collaborative Innovation for Smart City Development: The role of uncertainty, governance, and institutional logics. *Organization Studies, 44*, 1577–1601.

Eger, J.M. (2005). Smart communities, universities, and globalization: Educating the workforce for tomorrow's economy. Metropolitan Universities, *16*(4), 28-38.

Gil-Garcia, J.R, Pardo, T.A., & Nam, T. (2016). A Comprehensive View of the 21 Century City: Smartness as Technologies and Innovation in Urban Contexts. In Gil-Garcia, J.R. *et al.* (eds), Smarter as the New Urban Agenda. A Comprehensive View of the 21st Century, City (pp. 1-21). Public Administration and Information Technology, Cham: Springer.

Gupta, A., Panagiotopoulos, P., & Bowen, F. (2023). Developing capabilities in smart city ecosystems: a multi-level approach. *Organization Studies*, 01708406231164114.

Joss, S., Sengers, F., Schraven, D., Caprotti F., & Dayot, Y. (2019) The Smart City as Global Discourse: Storylines and Critical Junctures across 27 Cities. *Journal of Urban Technology, 26*(1), 3-34.

Knox, H. (2010). Cities and organisation: The information city and urban form. *Culture and Organization, 16*(3), 185-195.

Lazariou. G.C., & Roscia, M. (2012). Definition methodology for the smart cities model. *Energy, 47*(1), 326332.

Meijer, A., & Bolívar, M.P.R. (2016). Governing the smart city: a review of the literature on smart urban governance. *international review of administrative sciences*, *82*(2), 392-408.

Meijer, A.J., & Thaens, M. (2018). Urban Technological Innovation: Developing and Testing a Sociotechnical Framework for Studying Smart City Projects. *Urban Affairs Review 54*(2), 363387.

Mora, L., Appio, F.P., Foss, N.J., Arellano-Gault, D., & Zhang, X. (2020). Boosting urban sustainability through organizing collaborative ecosystems for smart city development. *Organization Studies*.

Mora, L., Appio, F.P., Foss, N. J., Arellano-Gault, D., & Zhang, X. (2023). Organizing for Smart City Development: Research at the crossroads. Introduction to the Special Issue. *Organization Studies*, *44*(10), 1559-1575.

Mora, L., Deakin, M., Reid, A., & Angelidou, M. (2019). How to overcome the dichotomous nature of smart city research: Proposed methodology and results of a pilot study. *Journal of Urban Technology*, *26*(2), 89-128.

Mora, L., & Bolici, R., (2017). How to Become a Smart City: Learning from Amsterdam, in Smart and Sustainable Planning for Cities and Regions, ed. A. Bisello, D. Vettorato, R. Stephens, P. Elisei, pp. 251-266, Springer: Cham.

Nam, T., & Pardo, T.A. (2011). Smart city as urban innovation with dimensions of technology, people and institutions. Proceedings of the 5th international conference on theory and practice of electronic governance, ACM, 185-194.

Nilssen, M. (2019). To the smart city and beyond? Developing a typology of smart urban innovation. *Technological Forecasting & Social Change, 142*, 98-104.

Pardo, T.A., Gil-Garcia, J.R., Gascó-Hernández, M., Cook, M.E., &Choi, I. (2021). Creating Public Value in Cities: A Call for Focus on Context and Capability. In Estevez, E., Pardo, T.A., Scholl, H.J., *Smart Cities and Smart Governance. Towards the 22nd Century Sustainable City* (pp. 119140). Cham: Springer.

Paskaleva, K.A. (2011). The smart city: A nexus for open innovation? *Intelligent Buildings International, 3*(3), 153-171.

Sancino, A., & Hudson, L. (2020). Leadership in, of, and for smart cities–case studies from Europe, America, and Australia. Public Management Review, *22*(5), 701-725.

Sørensen, E., &Torfing, J. (2018). Co-initiation of collaborative innovation in urban spaces. *Urban Affairs Review*, *54*(2), 388-418.

Stratigeia, A. (2012). The Concept of 'Smart Cities'. Towards Community Development? *Networks and Communication Studies, 36*(3-4), 375-388.

Tura, N., & Ojanen, V. (2022). Sustainability-oriented innovations in smart cities: A systematic review and emerging themes. *Cities, 126*, 103716.

Yigitcanlar, T. (2021). Smart City Beyond Efficiency: Technology-Policy-Community at Play for Sustainable Urban Futures. *Housing Policy Debate, 31*(1), 88-92.

Yigitcanlar, T., Xia, B., Cortese, T.T.P., & Sabatini-Marques, J. (2023). Understanding City 4.0: A Triple Bottom Line Approach. *Sustainability*, *16*(1), 326.

Yin, R. K. (2009). Case study research: Design and methods. Thousand Oaks, CA: Sage

Zhang, S., & Wang, X. (2022). Does innovative city construction improve the industry-university-research knowledge flow in urban China? *Technological Forecasting & Social Change, 174*, 121200.

Zhang, F., & Wu F. (2019). Rethinking the city and innovation: A political economic view from China's biotech. *Cities, 85*, 150-155.

Becoming Reflective Practitioners in the Music Business

Tone Vold, Hanne Haave, Ole Jørgen Ranglund and Carl-Henrik Wahl
Inland Norway University of Applied Sciences, Rena, Norway

Tone.vold@inn.no
Hanne.haave@inn.no
Ole.ranglund@inn.no
carl-henrik.wahl@inn.no

Abstract: This case study is from the music business production where we have investigated how supervisors at music camps develop as reflective practitioners. We have investigated the process of how the supervisors gradually become aware of their tacit knowledge and are able to make it explicit, following the SECI-model through reflecting. It is also interesting to identify how they maintain a production focus throughout each process of conducting the music camps, but at the same time opens up for reflection and learning. As the lecturers also work at a music production company, and we have sought to unveil how becoming reflective practitioners have made a difference when it comes to executing their profession. Hence, trough qualitative investigations we have interviewed the supervisors and their co-workers in their organization to unveil how this has had an impact in their organization and contributed to enhanced organizational knowledge.

Keywords: Reflection, Reflective Practice, Tacit and Explicit Knowledge, Reflective Practitioners

1. Introduction

At the Inland Norway University of Applied Sciences, Business School, Norway, we offer a bachelor's degree in music business and production. One of the courses is about developing and producing songs. In this course, the lecturers being from a professional music production company (The Woods) offer the students music camps lasting from 10 am in the morning till 10 pm in the evening. After a short introduction to the theme for the music camps, the students are divided into groups. These groups are carefully put together by the lecturers. Their experiences from music camps at their company and previous experience at the university have provided them with insights that allow them to organize the groups in such a way that they are able to develop a song during the camp.

Although experienced the organizing nearly 100 music camps, they are still developing within their trade, also due to their work at the university. The experiences they gain from working with the students provide them with input as the students vary in their experience with developing songs. Not only do they provide their students with work like settings such as music camps (Vold et al., 2023), they also learn more themselves for each camp held.

In this case study we have followed the informants over a period of 3 years. During this period, we have watched the lectures develop into what we would associate with "reflective practitioners". Johns (2009) states that "*A reflective practitioner Is someone who lives reflection as a way of being*" (p. 3).

In this paper we will present data collected from the different types of informants; the lectures/practitioners and their colleagues at The Woods. Through these investigations we will establish if they have indeed become reflective practitioners and if they are able to utilize the knowledge and being reflective practitioners back in their work at The Woods.

We have drawn on theory on reflection and reflective practice (Schön, 1987, Schön, 1991, Johns, 2009, Moon, 2004), as well as looked at how they are able to articulate their tacit knowledge (Polanyi, 1967, Tsoukas and Vladimirou, 2001, Cook and Brown, 1999) on their way of becoming reflective practitioners. We have also observed how they share knowledge and experiences with their colleagues at The Woods, much similar to theory on Communities of Practice (Lave and Wenger, 1991).

Through utilizing qualitative research methods, we will present and discuss our data before we conclude.

2. Theoretical Foundations

As a basis for becoming a "reflective practitioner" lies reflection. Reflection offers a deeper learning opportunity and may provide us with different perspectives. Being able to reflect – and not just think (Dewey, 1910) – both prior to an action, during an action, after an action, and even a while after action allows us to learn from different viewpoints and each will contribute with something somewhat different.

Donald Schön is a major contributor within the area of understanding the importance reflection (Schön, 1987, Schön, 1991). Schön presented different approaches to reflecting such as reflection-in-action and reflection-on-action, the first being to reflect during the course of the action – with the opportunity of changing the action, the latter being reflection posterior to an action – then to see if it would be other solutions.

A definition of reflection is provided by Boyd and Fales (1983) as : "the process of creating and clarifying the meaning of experiences [present and past] in terms of self [self in relation to self and self in relation to the world]. The outcome of the process is changed conceptual perspective. The experience that is explored and examined to create meaning focuses around or embodies a concern of centra l importance to the self." (p. 101). They further points to stages of reflection, such as identification or clarification of concern, openness to new information from external and/or internal sources, and deciding upon acting on the outcome of the reflective process (Boyd and Fales, 1983). Hence, this perspective also takes in a constructivist approach.

Another theorist, Johns (2009), claim: "Learning trough reflection also takes place on a more deliberative level. Indeed, through reflection, practitioners become more mindful and increasingly sensitive to their intuitive responses." (p. 6). Hence, Johns are arguing for an intuitiveness which may resemble or build on tacit knowledge. Tacit knowledge is knowledge that is hard to explain and to make explicit (Polanyi, 1967). Often it is embedded in actions and reactions. It is also a part of the total knowledge base of a person.

Johns also brings in mindfulness as a perspective regarding reflection. According to Holmes (2017) "reflection require mindfulness" (p. 22). One must understand the "Self" in order to understand how learning will affect oneself and how to utilize the learning from experiences. Hence, learning is ultimately about creating connections between synapses in the brain (Bransford et al., 1999) and research shows that the neuroplasticity of the brain is affected by self-reflection and mindfulness (Holmes, 2017).

Hence, both to understand the physical explanation of learning as well as understanding how this is connected to identification, increasing a knowledge base through experiencing and reflecting shows how complex the process of becoming a reflective practitioner may be.

Regarding developing reflective practitioners Boud, Keogh and Walker (1985) allows for enabling practitioners to see their development through three key stages; 1) returning to experience, 2)attending to feelings, and 3)re-evaluating experience. In the latter it is about re-examining experiencing, associating new knowledge to previous knowledge, integrating new knowledge with previous knowledge, and change behaviour according to the new knowledge.

However, it is also about being open to and curious about new knowledge and practices. Gadamer (1975) claims : "*the opening up and keeping open of possibilities is only possible because we find ourselves deeply interested in that which makes the question possible in the first place. To truly question something is to interrogate something from the threat of our existence, from the centre of being*". We interpret this to be about being willing to learn and to change.

Understanding is also important although there are resisting factors that will work against change (Johns, 2009). One of these factors is tradition. To change beliefs and perceptions are difficult. Creswell (1998) claims that knowledge is embedded in the interpretations people create; it is acquired through discussions about these interpretations. It is influenced by personal biases and values, expressed in a personal and intimate manner, and it evolves and emerges, deeply connected to the context in which it is examined. Hence, change is depending on the ability of doing the "double loop" learning (Argyris and Schön, 1996). Argyris and Schön (1996) developed the model of single and double loop learning. They then also coined the terms "espoused theory" and "theory in use". "Espoused theory" is about values and views that *guide* the behaviour and "theory in use" is about how one actually behaves (Argyris and Schön, 1996).

According to Daniels (2002) a tool for reflecting on practice is peer coaching or cognitive coaching. Cognitive coaching comprises three key components: (a) establishing a trusting relationship, (b) fostering a desire for learning and growth, and c) collaborating autonomously while maintaining interdependence with others.

Lastly, we would like to include a typology of reflection based on Johns (2009) which describes different types of reflecting:

Reflection on experience	Reflection on a situation or experience after the event with the intention of gaining insights that may inform the future practice in positive ways	Doing reflection
Reflection in action	Pausing within a particular situation or experience in order to make sense of and reframe the situation in order to proceed towards desired outcomes	
The internal supervisor	Dialoguing with self whilst in concersation with another in order to make sense	
Reflection within the moment	Being aware of the way one is thinking, feeling, and responding within the unfolding moment whilst holding the intent to realise my vision. It involves dialoguing with self to ensure interpreting and responding congruently to whatever is unfolding and having mental acuity to change ideas rather than being fixed to certain ideas	
Mindfulness	Seeing things for what they really are without distortion, whilst holding the intention of realising desirable practice	Reflection as a way of being

Figure 1: A typology of reflective practices, based on Johns (1991, p. 10)

This theoretical foundation has been important for our understanding of how to do research on developing reflective practitioners. To see if we are able to understand their "Self" in the educational setting and to support their reflections about their previous practices, their present practice and to record if/how this has affected their way of reflecting about how they perform their jobs.

3. Method of Inquiry

In this study, we are four researchers who have followed an education program, bachelor's degree in music business and production over the period from 2021 to 2023. In particular we have studied the part of the study program that organizes music camps. The camps are carried out in five sessions over an academic year. We have followed two cohorts of students and their teachers. In total, 4 teachers and 20-25 students have participated per year. The group of teachers are the same four, while the students group change each year. Our methodological approach has been qualitative with a longitudinal design (Patton, 2002). We have followed the teaching program as observers and carried out participatory observation (Patton, 2002). In addition, we have conducted several formal recorded semi-structured interviews along with informal individual conversations and group conversations with both students and teachers during the sessions (Patton, 2002, Dalen, 2011). Our respondents are three of the teachers and three student groups, as well as a number of individual students. We also have interviewed the teachers in between the music camps. The data consists of transcripts from the recorded interviews, field notes written during and us after participating in the lessons. The data material has been analyzed by reading through field notes, and transcripts, as well as listening to the recordings. This has resulted in findings that show how the teacher- student relation is conducted and developed. We have also findings that give us insight in the development of the teachers as reflective practitioners. Along in the process we have discussed our findings in the research group. Our findings are also presented and discussed with the two teachers to have their opinion on the subject of a deeper understanding of the process of becoming better reflective practitioners.

4. Results and Discussion

Here we will present the results from our longitudinal investigations. The findings show two different relations; the relationship between students and lecturers/supervisors, and the relationship between the researchers and lecturers/supervisors.

4.1 The Practical Supervision – Student – Teacher Relationship

We joined the teachers in the studios and observed the tutoring situation. The students and the teacher discussed ideas for arrangements for the song they were to create. We experienced that they had a good communication and dialogue where the students received feedback from the teacher on their ideas and they developed them together. Afterwards, we asked the students how they perceived the teachers' feedback. They expressed that they perceived him more as an experienced colleague who gave some good advice than as a teacher who gave instructions.

This may indicate that the teachers have been able to create an understanding of collegial equality. The teacher is a music producer like the students are, only more experienced. This is similar to the phenomenon that Solberg (1996) describes, where she is able to incorporate the role of researcher into a type of producer role that she takes part in together with her informants. The production setting means that they meet as equal participants, in our case it is about the students accepting the feedback, (for the most part) and agreeing. This resembles also the peer coaching and cognitive coaching (Daniels, 2002). They have established a trusting relationship; they have fostered a desire for learning and growth and the supervisor is able to appear as collaborating with the students.

The lecturers/supervisors also appear to aid the process of reflection with their students. They encourage the students to evaluate and rethink if they are heading the "wrong" way. Much like Boud et al. (1985) they allow for "enabling practitioners to see their development as reflective practitioners through three key stages; 1) returning to experience, 2)attending to feelings, and 3)re-evaluating experience". Sometimes this require the students also to do a double loop (Argyris and Schön, 1996) in the learning process as they may rethink and maybe change some of the basic knowledge they brought with them to the university. It may be that their basic assumptions are wring and that they require that they are open and curious. They thus sometimes need to do as Gadamer (1975) suggest; to open up and keep open for possibilities, as they are generally truly interested in developing as songwriters even if they need to reset from time to time. Some students find this very hard as they may have thought they were good songwriters when they applied for university, only to discover that they still have a lot to learn.

4.2 Developing the Reflective Practitioner – The Researcher – Lecturer Relationship

When we started out doing research on our colleagues and the particular feature of song camps in this study program, the lecturers were very positive and welcoming. However, it took some conversations before they were able to reflect on their own practice. When they did start their reflections, they started to emerge as reflective practitioner (Schön, 1987, Schön, 1991). Statements like: **"**These are things I didn't know I could do until you and I sat down and talked about it" show how they are then able to open up for peer coaching. They have of course been students themselves at one time, having to come to terms with the fact that they were not necessary the best songwriters when they entered their own education. Although having evolved and had quite a few hits on the billboards, they are still humble to the fact that they keep learning. A statement such as: "It was only after we spoke that I could visualize what was going to happen.... the stages in how to make a song." Here it is referred to an interview where we as researchers pushed one of our informants (lecturer/supervisor) out of his comfort zone and asked him to explain to us why he behaved differently in the different groups. He then had to explain that he knew how far they needed to have developed the lyrics, the melody, the recordings and the production in order to manage to make a song within the time frame. This turned out to have been *tacit knowledge* (Polanyi, 1967) as he "just knew this by experience". This is knowledge obtained by hosting, supervising and producing hundreds of groups professionally in his organization (The Woods) and at the university. By being enabled to explain and externalize this knowledge, we as researchers were able to take part in this knowledge.

Our informant also claimed: "I wouldn't have been able to make this model if we hadn't had that conversation" and "The model has helped me a lot in my work" which indicate that the SECI-model (Nonaka and Takeuchi, 1995) has been in use. By socializing, externalizing, allowing his colleagues take part in this knowledge and combine it with their own knowledge, they can by reflection and utilizing it, be able to internalize this knowledge and make it their *tacit knowledge.* It has also been of use to them in their work at the university as they are now able also to explain this to their students in order to make *them* understand and comply to this model.

Hence, we see a development with our colleagues that follow the typology of Johns (2009). They are able to reflect on experience as well as in action and pause to make sense and reframe if necessary. They are dialoguing with us as well as with themselves. They have become very aware of how they are thinking and feeling and

responding and have been clear about discussing different interpretations with us after themselves having reflected. They even seem to have obtained a certain mindfulness as they are trying to make sense and understand different behavior both within the university setting and within the frames of their organization (The Woods). They have largely absorbed *reflection as a way of being* and thus become *reflective practitioners.*

5. Conclusion

We find that the arrangement around the song camps has developed from being more of a purely production perspective, to also incorporating and placing great emphasis on the learning perspective where reflection leads to tacit knowledge being externalized. The teachers are well on their way of becoming stronger aware about their "Self" as reflective practitioners and they seem to have a better understanding of their own developmental process and learning process. The schemes have always had clear structures, these have now become more conscious and thus subject to developing and improvement.

The different aspects of reflections have been implemented by the lecturers/supervisors and they are now imposing this way of learning to the students at the university by making also the students become more aware of their capabilities, who they are as songwriters and how they can learn to become better practitioners as well as reflective practitioners.

The lecturers ability to embrace reflection as a tool for change in themselves as well as in their practice has allowed them to become reflective practitioners that has adopted reflection as a way of being.

References

ARGYRIS, C. & SCHÖN, D. 1996. *Organizational Learning II. Theory, Method, and Practice* New York, Addison-Wesley Publishing Company, Inc.

BOUD, D., KEOGH, R. & WALKER, D. (eds.) 1985. *Reflection: Turning Experience Into Learning,* London: Kogan Page Ltd.

BOYD, E. M. & FALES, A. W. 1983. Reflective Learning: Key to Learning from Experience. *The Journal of humanistic psychology,* 23**,** 99-117.

BRANSFORD, J. D., BROWN, A. L. & COCKING, R. R. 1999. *How People Learn : Brain, Mind, Experience, and School,* Washington, National Academies Press.

COOK, S. D. N. & BROWN, J. S. 1999. Bridging Epistemologies: The Generative Dance Between Organizational Knowledge and Organizational Knowing. *Organization science (Providence, R.I.),* 10**,** 381-400.

CRESWELL, J. W. 1998. Qualitative inquiry and research design : choosing among five traditions. Thousand Oaks, Calif.: Sage Publications.

DALEN, M. 2011. *Interview as research method,* Oslo, Universitetsforl.

DANIELS, D. C. 2002. Becoming a reflective practitioner. *Middle School Journal,* 33**,** 52-56.

DEWEY, J. 1910. *How we think,* Boston, Heath.

GADAMER, H.-G. 1975. Hermeneutics and Social Science. *Cultural hermeneutics,* 2**,** 307-316.

HOLMES, K. 2017. Mindfulness as a Practice of Professional Life: A Reflective Learning Journey with Second Year Teachers. *The Journal of Educational Thought (JET)/Revue de la Pensée Éducative,* 50**,** 21-42.

JOHNS, C. 2009. *Becoming a reflective practitioner*, John Wiley & Sons.

LAVE, J. & WENGER, E. 1991. *Situated learning - Legitimate peripheral participation,* Cambridge, Cambridge University Press.

MOON, J. A. 2004. *A handbook of reflective and experiental learning: theory and practice,* London, RoutledgeFalmer.

NONAKA, I. & TAKEUCHI, H. 1995. *The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation,* New York, Oxford University Press.

PATTON, M. Q. 2002. *Qualitative research & evaluation methods*.

POLANYI, M. 1967. *The tacit dimension,* Garden City, N. Y, Doubleday.

SCHÖN, D. A. 1987. *Educating the reflective practitioner,* San Francisco, Calif., Jossey-Bass.

SCHÖN, D. A. 1991. *The reflective practitioner : how professionals think in action,* Aldershot: Avesbury.

SOLBERG, A. 1996. Experiences from field work. *In:* HOLTER, H. & KALLEBERG, R. (eds.) *Qualitative methods in social sciences.* Oslo: Universitetsforlaget.

TSOUKAS, H. & VLADIMIROU, E. 2001. What is organizational knowledge? *Journal of management studies,* 38**,** 973-993.

VOLD, T., HAAVE, H., WAHL, C.-H., RANGLUND, O. J. & KOULAEI-VAN OEST, A. 2023. Preparing for work-life through work-like situated learning: A case study. *European conference on knowledge management,* 24**,** 1421-1428.

Innovative Approach: Leveraging Design Thinking for Enhancing Knowledge Sharing in Knowledge Intensive Firms

Hamid Roham, Elham Kamouri Yousefabad, Sepideh Aghajani, Mohammadreza Shahbazi rad and Mohammad Ali Avestam
Mapna Turbine Blade Engineering and Manufacturing CO.

hamid.roham@outlook.com
elham.kamoori@gmail.com
s.aghajani86@gmail.com
shahbazi.reza@live.com
avestam@gmail.com

Abstract: Purpose: This research delves into the intricate challenges of knowledge management (KM) within technical departments of knowledge-intensive firms (KIFs), with a specific focus on preserving critical knowledge amidst employee turnover. Recognizing the four main components of KM—people, process, content/IT, and strategy—and emphasizing the paramount importance of individuals in KM alongside the human-centric approach of design thinking (DT), the study aims to enhance KM processes, particularly knowledge sharing (KS), utilizing DT to fortify organizational success. **Methodology:** This study utilizes mixed method action research, which includes in-depth interviews and observations, immersion and questionnaire to collect employee insights. Thematic analysis is utilized to identify key challenges. Employing the DT framework, the research progresses through problem definition, ideation, prototyping, testing, and iterative refinement stages, following the structured steps of DT. **Findings:** Thematic analysis identifies persistent KM challenges, encompassing individual, organizational, and technology barriers. These challenges are effectively addressed through innovative solutions developed with DT principles, leading to tangible enhancements in KM processes. Iterative cycles of prototyping and testing further refine these solutions, particularly in facilitating KS among employees. **Originality:** This research demonstrates the efficacy of DT in addressing KM challenges within KIFs. Through prioritizing human-centric problem-solving, DT's iterative and learning-oriented nature boosts organizational efficiency and stimulates innovation. The direct engagement of end-users in solution design further highlights the cost-effectiveness of this approach, ultimately enhancing KM outcomes. **Contribution:** The study presents solutions tailored to the unique challenges of KM, transferable not only within the technical department but also across KIFs. Given the prevalence of unsuccessful KM implementations, the human-centric ethos of DT emerges as a pragmatic and economical approach for diagnosing and mitigating KM obstacles. Nonetheless, the study highlights the adaptability of DT in addressing specific KM issues, offering a pathway for other departments to tackle their KM challenges effectively.

Keywords: Knowledge Management, Knowledge Sharing, Knowledge Intensive Firms, Design Thinking, Innovative Solutions.

1. Introduction

KM has become a crucial factor in ensuring organizational success and the continuity of their operations (Xue, 2017). KM encompasses the processes of creating, generating, capturing, storing, sharing, and utilizing knowledge to enhance individual performance (Ismail & Yusof, 2010). KS has been recognized as the key process for enabling organizational learning and innovation, which is particularly essential. It is crucial for organizations aiming to leverage their knowledge as an asset to gain a competitive advantage, such as KIFs. These firms depend heavily on knowledge and expertise to function, innovate, and compete in their markets. They prioritize knowledge creation, acquisition, transfer, and application to support their business goals and secure a competitive edge.

Maintenance departments play a crucial role in ensuring optimal equipment performance and sustainability. The knowledge of maintenance employees is invaluable for identifying problems, preventing breakdowns, and enhancing performance. With rapid technological advancements, KM in maintenance is becoming increasingly important.

Problem-solving skills are recognized as essential for innovative organizations in the 21st century. These skills enable organizations to overcome challenges, seize opportunities, and maintain a competitive edge. DT, a non-linear, collaborative, and iterative process, is a problem-solving approach that addresses complex problems and creates new human-centered solutions (Boersma, 2017). DT combines what is desirable from a user perspective with what is technically feasible and economically viable to generate innovative ideas. The values that DT can provide include innovative solutions, customer orientation and integration, asking the right questions, divergent thinking, tangible results, an agile approach, and risk reduction. As people are the most critical element in KM and the DT process is a human-centered approach specifically for solving complex problems, this study aims to

revisit the challenge of improving KM through the lens of DT. The integration of KM and DT became the central theme of this research.

Given the risk of knowledge loss, revisiting the topic of KM in the maintenance department has been prioritized. Prior to this research, although some steps had been taken towards KM in the maintenance department, the results were not tangible, and voluntary KS was not a common practice (Roham et al.). In other words, despite the high value placed on knowledge within the organization, KS was not an ingrained value. The investigation into the practical challenges encountered by knowledge users in maintenance departments of KIFs revealed insights into the enablers and barriers to KM and KS. The results highlighted various factors influencing efficient KM and KS, including the lack of a standardized language for recording experiences, the fear of sharing unsuccessful outcomes, and the reluctance of technical personnel to document reports (Roham et al.). Their findings indicate that KS is uncommon in maintenance departments. In these departments, individuals are often rewarded for their knowledge rather than their willingness to share it, presenting a complex problem. This study explores KM challenges in maintenance department of a KIF, particularly in preserving critical knowledge during employee turnover. This study demonstrates that by integrating DT and engaging employees throughout the process, along with utilizing iterative refinement, it aims to enhance KS with a focus on human-centric solutions. This approach is especially effective in preserving critical knowledge during employee turnover.

2. Literature Review

2.1 The Role of People and Communication in KM and KS

KM fundamentally revolves around people—how they develop, exchange, and utilize information. Therefore, KM programs should address both the gathering and communication aspects. The gathering aspect focuses on connecting individuals to knowledge, involving the capture and dissemination of specific information. Conversely, the communication aspect emphasizes connecting individuals with other knowledgeable people, thereby enhancing the flow of tacit knowledge through improved human interaction and communication processes (Mostofa et al., 2020). The success of KM initiatives hinges on effective KS (Wang & Noe, 2010). Even the most advanced technology will be ineffective if individuals are unwilling to share their knowledge (Zheng, 2017).

2.2 Unveiling DT: Unleashing Creativity

DT is a specialized approach used to address complex challenges and to cultivate innovative solutions through a human-centered approach involving multidisciplinary teams. It is termed "human-centered" because it places the needs and interests of people at the core of its strategy (Mostofa et al., 2020). It is commonly referred to as an iterative problem-solving and innovation process within organizations. This approach is rooted in specific principles, such as prioritizing user needs and embracing multidisciplinary, while employing distinct methods like creative thinking, visualization, and experimentation (Rösch et al., 2023). In this research, the double diamond process model, developed by the UK Design Council in 2005 was used in the DT process. This model is represented by a simple diagram illustrating the divergent and convergent stages of the design process, giving it the distinctive shape of a double diamond (Tschimmel, 2012). The model is also known as the 4D model because each phase begins with the letter 'D': Discover, Define, Develop, and Deliver. Figure 1, presents this model.

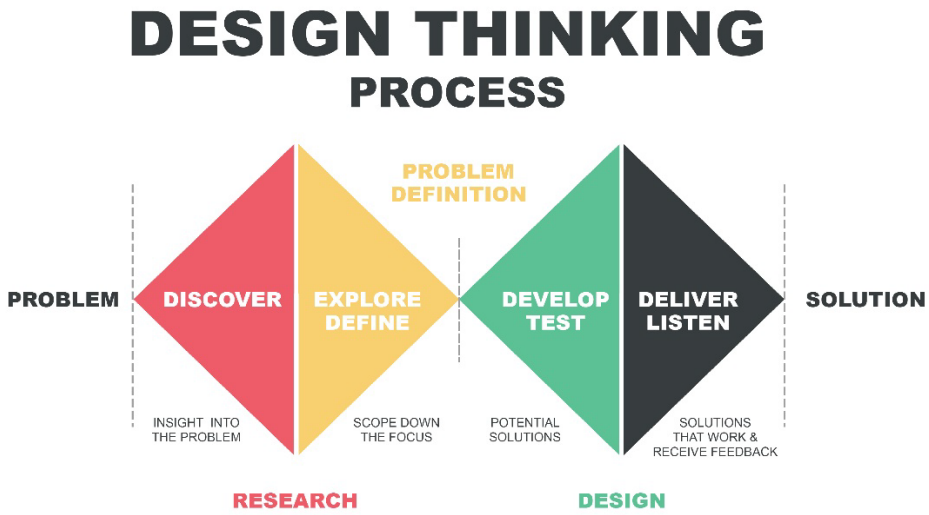


Figure 1: Double diamond model (based on UK Design Council).

DT stages have been defined as follows (Tschimmel, 2012):

1. Discover: The first quarter of the Double Diamond represents the project's initial divergent phase, where the designer explores new opportunities, gathers information, identifies trends, and uncovers insights. This stage involves developing empathy maps and personas to deeply understand the employees' needs, frustrations, and motivations.
2. Define: The second quarter, which concludes the first Diamond, is the Definition stage. Here, initial insights are reviewed, selected, or discarded, serving as a filter for refining ideas. This stage synthesizes the findings from the empathy phase into a clear problem statement.
3. Develop: In this stage, multidisciplinary teams use DT tools such as brainstorming, sketches, scenarios, renderings, and prototypes to develop, iterate, and test solutions within the company. Creative techniques encourage innovative thinking. Prototypes are iteratively refined based on feedback from the testing phase, involving multiple cycles of prototyping and testing until the solutions are optimized to meet employees' needs effectively.
4. Deliver: In the final phase, the convergent Deliver stage, the final concept undergoes final testing, is approved, produced, and launched.

2.3 Applying DT to KM

The trend of KS fostering innovation extends to design consultancies, where the fast-paced environment pressures designers to produce innovative solutions rapidly (Wu, 2020). Many believe that KM is struggling to survive, but the emergence of human-centered DT offers a revitalizing solution (Boersma, 2017). By incorporating the core elements of DT—Experimentation, Collaboration, Human-centeredness, and Optimism (ECHO)—KM can flourish. This powerful combination maximizes the value of knowledge in ways that truly connect with individuals. It enables KM practitioners to develop solutions that better resonate with the people they serve (Boersma, 2017). The future of KM has been apparent for quite some time: it lies in DT and may well be recognized as Knowledge DT (Boersma, 2017). Some KM systems already embody this human-centered philosophy (Mostofa et al., 2020). By incorporating essential knowledge into every phase of the DT process, organizations can develop innovative solutions that adjust to changing customer needs and provide more effective results (Numprasertchai & Numprasertchai, 2024) .

2.4 Research Gaps, Research Objectives and Research Questions

2.4.1 Research Gaps

Exploring the literature reveals that employing DT for addressing KM and KS challenges is a relatively novel approach. The research delves into the intricate challenges of KM within technical departments of KIFs, Traditional methods have dominated the strategies used to tackle KM issues, with minimal exploration into the integration of DT. This study highlights the paramount importance of individuals in KM, aligning with the human-

centric approach of DT. The research demonstrates the efficacy of DT in enhancing KM, presenting a significant gap and potential for further innovative research in this underexplored area.

2.4.2 Research Objectives

Facilitating KS in the maintenance departments has always been one of the challenges for KIFs and several initiatives have been undertaken in this regard. The objective of this research is to enhance KS within the maintenance department of KIFs.

2.4.3 Research Question

How can DT principles be effectively applied to overcome KM challenges, specifically in KS, within the technical departments of KIFs amidst high employee turnover?

3. Method

3.1 Research Design

This study employs mixed method action research to explore and address the challenges of KM and KS within maintenance department of a KIFs, with a particular focus on preserving critical knowledge amidst employee turnover. Action research is chosen for its iterative, participatory nature, which aligns well with the objectives of engaging researchers and employees in the process of identifying problems and developing practical solutions. Additionally, DT is integrated into the action research method to leverage its human-centric and innovative approach to problem-solving. Action research in this study follows a cyclical process of planning, acting, observing, and reflecting, which is conducted collaboratively with participants from a maintenance department. This methodology is particularly suitable for addressing real-world problems in a dynamic environment, allowing for continuous feedback and refinement of solutions. DT is incorporated into the action research process to enhance the development of KM solutions. The DT framework involves four key stages: discover, define, develop and deliver. These stages are embedded within the action research cycles to ensure a thorough understanding of user needs and iterative improvement of solutions.

3.2 Questionnaire Design

The research questionnaire was designed with three objectives: (1) identify problems employees face in KS, (2) evaluate changes in knowledge levels pre- and post-prototype implementation, and (3) measure improvements in KS due to the proposed idea. The construction of the questionnaire was guided by prominent references, including Fullwood (2014), Karamitri et al. (2020), Oyemomi (2017), Wu (2020), and Welschen (2014). Leveraging the expertise and findings from above mentioned sources, the questionnaire was crafted and then refined through multiple feedback rounds by three experts in KM and DT, enhancing its validity and relevance to the research objectives. To quantify attitudes and opinions, a 7-point Likert scale was employed for the closed-ended questions.

Data Collection: This study was conducted in a KIF with 1,250 employees, including 108 maintenance personnel. Out of these, 25 maintenance employees were selected for interviews and to answer the questionnaire, alongside 5 stakeholders and KM experts.

Data collection used four primary tools:

1. **In-depth Interviews:** Semi-structured interviews with stakeholders to gather insights into their experiences and perceptions of KM and KS.
2. **Observations:** Direct observation of daily operations and KM practices to identify unspoken challenges and behaviors.
3. **Immergence:** Researchers immersed themselves in the work environment to uncover informal practices and subtle dynamics.
4. **Questionnaire:** Distributed to collect quantitative data on KS behaviors and assess the effectiveness of KM strategies.

3.2.1 Data Analysis

A thematic analysis is conducted on the collected data to identify recurring themes and patterns related to KM challenges. This involves coding the data and categorizing it into key themes. The findings from the thematic analysis guide the subsequent stages of the DT process.

3.2.2 Validation and Reliability

Multiple data sources (In-depth interviews and observations, immergence and questionnaire) are triangulated to ensure the validity and reliability of the findings. Additionally, participant feedback is continuously sought during the DT stages to validate the relevance and practicality of the proposed solutions.

3.2.3 Biases

Biases in research can lead to misleading conclusions, but efforts were made to minimize them. Collecting data from a single company introduces potential bias, so diverse participants from various power-interest levels were included. To reduce interpretation bias, targeted questions evaluated proposed solutions, and stakeholder interview responses were mapped onto empathy maps (Thinks, Says, Feels, Actions).

4. Results

In this section, the results obtained from combining action research and DT have been presented according to DT stages Initially, the primary problem statement in the DT process was defined as follows: How can the process of recording and retrieving experiences and lessons learned by maintenance personnel of key equipment and machinery be transformed to be user-friendly and efficient? The goal is to reduce equipment downtime, minimize redundant work and associated costs, and mitigate the risk of losing valuable knowledge from experienced individuals in key areas. This problem statement was defined with the following objectives:

- Enhance the user-friendliness and efficiency of the system for recording and retrieving experiences and lessons learned.
- Reduce equipment downtime.
- Minimize redundant work and associated costs.
- Lower the risk of losing valuable accumulated knowledge when experienced personnel leave the organization.

A crucial aspect of the DT process is empathy. At the beginning of the DT process, it is essential to accurately identify user needs, where empathy plays a key role. Empathy is crucial to correctly define user needs, as these often differ from what users explicitly state. Proper empathy can uncover these actual needs.

4.1 Discover

In the first stage of the double diamond model, stakeholders were analyzed based on their power and interest regarding KM and their influence on the subject. The main stakeholders were then identified. Thirty in-depth interviews were conducted with these stakeholders. The results led to identifying of the primary user needs and a refined problem definition.

The revised problem statement is as follows:

How can the process of recording and retrieving experiences and lessons learned in the maintenance and repair of key equipment and machinery be transformed to enhance human interactions, facilitate network communications, and be user-friendly and efficient? This transformation should mitigate the risk associated with losing key knowledge and, over time, decrease equipment downtime, rework, and associated costs.

This problem statement was defined with the following objectives:

- Long-term improvement: Enhance methods for recording and retrieving experiences in the maintenance unit to reduce equipment downtime and associated costs.
- Enhanced interactions: Improve human interactions and facilitate communication to boost the effectiveness of KS.
- Quality reporting: Increase the number of high-quality reports on equipment failures, including detailed work descriptions, technical data, lessons learned, and ineffective methods.
- Frequent referencing: Encourage frequent referencing of the recorded histories of key machinery.

The results indicated that maximizing participation in the designed KM process requires creating conditions that enhance human interactions and network communications.

In the first stage of the double diamond model (Discover), two categories of information were collected: primary information from in-depth interviews, observation, and immersion, and secondary information from studying various sources, benchmarking three successful organizations and interviewing experts.

This research involved a comprehensive review of KM literature, benchmarking of three successful companies, and interviews with several experts. Key insights include:

- Rewarding collective performance: A common barrier to improving KS is the tendency of companies to reward individual performance, which promotes the notion of "knowledge is power" and contradicts a KS culture. Rewarding collective performance can mitigate this issue.
- Granting ownership rights: Acknowledging and granting ownership rights to knowledge creators fosters a sense of value and responsibility.
- Building trust and commitment: Establishing trust and commitment in communications is crucial for effective KS.
- Real-time reporting: Emphasizing the importance of recording reports in real-time ensures accuracy and timeliness.
- Sharing failure experiences: Normalizing the sharing of failure experiences can provide valuable learning opportunities and prevent repeated mistakes.
- Contextual best practices: Recognizing that best practices from other organizations may not be suitable for your organization highlights the need for tailored solutions.
- People Over Processes: Prioritizing people over processes, infrastructure, and other elements is essential for the effectiveness of this project.

These insights underscore the importance of a supportive culture and strategic practices in enhancing KM.

4.2 Define

In the second phase, insights gathered from in-depth interviews, observations, immersion techniques, articles, books, expert interviews, and company benchmarks were thoroughly reviewed and analyzed. Given the high volume of insights, to converge the results, they were categorized into four groups: People, Process, IT/Content, and Strategy. Classifying all insights into these four categories not only helped converge the information but also assisted in identifying more suitable solutions for existing problems. Additionally, insights that were frequently mentioned were given higher priority. Table 1 summarizes the most frequently mentioned insights.

Table 1: Summary of key insights from primary and secondary sources

Category	Insight
People	• Maintenance operation and planning conflict resolution • Collaboration • Enhancement of communication between maintenance employees and operators of equipment • Importance of recognition methods • Employee engagement • Importance of face-to-face training • Lack of time • Considering generation gap in KS • Retention and promotion of experienced employees • Variety of motivational methods • Considering individuals' interests in training • Building trust among employees • Normalization of discussing failure experiences • Developing a customized KM process • Attention to diverse learning styles
Process	• Employee empowerment • Valuing KS in addition to knowledge • Embedding KM in process • Talent management • Avoid Knowledge Silos • Embed KS into performance evaluation • On-the-job training • Rewarding collective performance rather than individual performance • Management commitment to KM

Category	Insight
	• Empowering employees with soft skills • Learning by teaching • Considering knowledge-based intellectual property • Validation of knowledge by experts
Content & IT	• Inefficiency of the current KM system • Attention to information security • Easy access to the KM system from anywhere • Personalized KM system
Strategy	• Strategy alignment

4.3 Develop

In the third phase, the ideation process commenced, drawing from the insights obtained. Five ideation techniques were employed to generate and explore innovative ideas: reverse and combine from the SCAMPER method, brainstorming, the 666 method, and brain writing were employed to generate innovative ideas. Over 100 initial ideas were generated and reviewed using three lenses (desirability, sustainability, and feasibility), leading to a few final solutions being selected. Prototypes were then developed, tested, and refined through several iterations. Table 2 illustrates the existing problems, previously employed solutions aimed at improving KS but which have yielded unsatisfactory results, and finally, the innovative solutions derived from the integration of KM and DT. Further detailed explanations of each solution are provided below.

Table 2: Summary of problems, previous ideas, and new proposed solutions through the integration of DT and KM.

Problem	Previous ideas/ Solutions	New proposed ideas/ solutions through the integration of DT & KM
• Difficulty in typing reports • Character limits for report entries in the current KM system • Potential for forgetting repair details due to the inability to record reports immediately • Overlooking the gap between knowledge generation and application	• Attaching a Word file to the repair report in the software. • Providing requirement to use checklists during repairs	Solution 1: Easy access and diverse report recording (leveraging technological tools)
• Loss of knowledge development opportunities due to time constraints, lack of research, study, and trial and error conditions for solving equipment issues. • Difficulty of knowledge transfer between novices and experienced workers during key equipment repairs or construction projects.	• Training by novices • presence of novices alongside experts during key equipment repairs	Solution 2: Maintenance lab
• Risk of losing valuable knowledge from experienced staff • Insufficient documentation of successful actions and failures • Inability to differentiate between high-quality and mediocre work • Increased costs due to repeated failures from unshared lessons • Lack of a suitable platform for planning informal interactions that foster camaraderie	• Holding semi-formal meetings for various occasions, such as working breakfasts • Rewarding repair reports that are considered high-quality, outstanding, and valuable by unit managers	Solution 3: Organizational social network components including: - Success stories - Lessons learned from failures - Informal KS circles
• Infrequent consultation of previous documents and reports due to lack of motivation • Inadequate validation or insufficient review of prepared reports • Poor quality of generated reports	• Requiring the validation of reports produced in each department by the unit head • Rewarding high-quality reports as assessed by unit managers	Solution 4: Creating a collaborative environment for report validation

4.3.1 Solution 1: Easy Access and Diverse Report Recording (Using Technological Tools)

The solution utilizes technological tools such as a head camera, voice recorder, and speech-to-text software to record breakdown reports. The advantages of this solution include eliminating the need to type reports after work fatigue and ensuring that no details are overlooked during report recording. In many maintenance departments, their staff often view writing as an adversary, preferring hands-on problem-solving over documentation and formal KS.

4.3.2 Solution 2: Maintenance Lab

In maintenance departments, the emphasis is often on quick solutions to return equipment to production rapidly, leaving little room for trial and error, timely KS, or testing innovative problem-solving methods. This research proposes the establishment of a dedicated maintenance lab, which will significantly enhance KS by providing a structured environment for these activities. The maintenance lab will emphasize practical and research-oriented KS, enabling experienced and novice employees to collaborate effectively. By working together, novices can learn from seasoned professionals, facilitating KS and fostering teamwork and collaboration. This approach ensures that valuable knowledge and skills are transferred seamlessly between employees. In the lab, maintenance staff can perform repair maneuvers without risking damage to equipment, allowing for safe experimentation and knowledge generation. The lab's collaborative nature, with teams researching specific topics, will promote a stronger team spirit. Ultimately, the maintenance lab will serve as a hub for KS, where both practical experiences and research insights are shared and developed.

4.3.3 Solution 3: Organizational Social Network

This solution involves creating an organizational social network comprising three sections: success stories, failure stories, and informal knowledge circle. Particularly beneficial for novices and newcomers, the solution offers opportunity for sharing successes and failures, with ratings from supervisors and other colleagues. It encourages participation through the review of shared stories, increase the ability to give supplementary suggestions and comments. Knowledge circle offers a platform for sharing experience to enhance informal communication, build empathy, and reduce hierarchical barriers, and build trust.

4.3.4 Solution 4: Fostering a Participatory Environment for Validation of Reports

This solution enables report validation and rating by supervisors and other colleagues, with rankings displayed to reflect report quality. All participants in the report validation process receive points, fostering a participatory environment where individuals earn points by reviewing reports, providing supplementary suggestions, commenting, and validating them. The gamification approach to the award system has been integrated in all above-mentioned solutions to provide continuous motivation for engagement.

Simple and scalable prototypes are used instead of final products to examine how users interact with the designed solutions. User interactions and reactions are observed and measured. Prototyping helps avoid the time and cost associated with producing a final product. This study utilized some prototyping tools, such as a storyboard. Notably, the produced prototype, encompassing all proposed solutions, was presented in a focused group session attended by 30 stakeholders, receiving feedback. Each proposed solution was also individually tested and evaluated in various forms (qualitative and quantitative), with results discussed below.

4.4 Qualitative Evaluation

4.4.1 Solution 1: Easy Access and Diverse Report Recording

This solution was tested and validated in two iterations: audio recording and video recording using a mobile phone followed by recoding with a GoPro camera during repairs. The repair processes of two pieces of equipment were selected for testing and validation. Tables 3 and 4 summarize the results from in-depth interviews, immersion and iterations.

Table 3: Easy access and diverse report recording (iteration 1-audio recording)

Positive feedback	• Faster and easier report recording • Ability to express feelings during the work process by recording audio • Less time is needed for editing the report after converting audio to text compared to typing the entire report
Negative feedback	• Inadequate efficiency of solely recording audio reports for certain repairs • Need for editing the transcribed text due to spoken language • Influence of ambient noise, background noise, and noise from others on report quality
Improvement suggestions	• Enhance the ability to save images and files in various formats, alongside audio files • Suitable devices to improve the quality of recorded audio.
Actions taken in iterations	• Add an option for converting audio to text and enable editing of the transcribed audio reports

Table 4: Easy access and diverse report recording (iteration 2-video recording with mobile phone and headband)

Positive feedback	• Faster and easier report recording • Ability to capture all details and repair methods • No need to write down essential repair notes on paper • Transfer of helpful knowledge with little time
Negative feedback	• Causing headaches and pressure on the spine due to the weight of the camera on the head • The uncomfortableness of the camera holder • Effect of environmental noise • Need for high camera or mobile memory to record videos • Reluctance to use a head camera due to limitations in attaching hair implants or hair gel
Improvement suggestions	• Utilize suitable headgear and Go-Pro cameras for their lightweight nature and built-in stabilization features • Incorporate film editing capabilities • Employ a videographer assistant • Use headgear or camera mounts on pockets or chest straps • Ensure oversight of the quality and quantity of generated content

In the next iterations, head-mounted Go-Pro cameras were utilized due to their lighter weight compared to mobile phones and their advanced stabilization features. This simpler and more efficient equipment increased the likelihood that visual reports were consistently used, enhancing documentation and communication processes.

4.4.2 Solution 2: Maintenance Lab

To test and validate this solution, maintenance employees were asked to use this lab for repairing and testing machine components. The effectiveness of solution was evaluated using in-depth interviews and immersion, with the results summarized in Table 5.

Table 5: Maintenance lab

Positive feedback	• Practical learning is more effective than theoretical learning • experienced and novice staff • Possibility of team building with multidisciplinary members • Preventing potential damage from testing on equipment • Possibility for creativity and further learning in repair methods • No time constraints for immediate results • Opportunity for trial and error • Enhancing teamwork and covering each other in order to achieve goals
Negative feedback	• Concerns and worries about the volume of daily tasks and routines • Lack of standardization in the environment for conducting specific tests and laboratory conditions • Lack of concentration due to environmental noise
Improvement suggestions	• Consider environmental requirements for specific tests. • Ensure all documents and technological facilities are available in the laboratory

4.4.3 Solution 3: Organizational Social Network

This solution consists of two parts: 1) success and failure stories and 2) knowledge circle. To test success and failure stories, a specific group in the organizational social network was used. Initially, the group's purpose was announced to all users via a message from the department's deputy. Recognizing that managers should lead by example in KM and normalize sharing failure experiences, a manager shared a personal failure story. Subsequently, other group members began sharing their success and failure stories. The summary of the in-depth interviews and actions taken in iteration based on observation and analysis is presented in Table 6.

Table 6: Success and failure stories

Positive feedback	• Facilitates individuals in gaining visibility with managers and colleagues • Boosts motivation by allowing individuals to express themselves within the group • Offers the opportunity for direct communication with managers • Enables appreciation of individuals for their valuable work • Serves as a suitable platform to replace individual and group meetings
Negative feedback	• Lack of active participation in the solution due to insufficient trust and transparent reward mechanisms • Fear of being Judged by colleagues • Distress and discouragement stemming from the undervaluation of individuals' stories • Neglect of the importance of introducing teammates in group narratives • Failure to record details of experiences
Improvement suggestions	• Focus more on improving interpersonal relationships.
Actions taken in iterations	• Allocate more scores for group stories compared to individual ones. • Increase manager participation in documenting stories • Assign double scores for documenting failure stories compared to success stories. • Establish a specific format for documenting stories

Knowledge circle solution was tested and validated by organizing informal circle focused on discussing various topics. A summary of the in-depth interview results with users is presented in Table 7.

Table 7: Knowledge circle

Positive feedback	• Effective learning has occurred • Improvement in the quality of relationships and better understanding of colleagues and its impact on facilitating KS
Negative feedback	• The effect of the volume of daily tasks and routine on attendance
Improvement suggestions	• Create a method for receiving participant feedback • Increase manager participation and have them serve as role models in the knowledge circle • Foster two-way interaction between presenters and audiences
Actions taken in iterations	• Hold two sessions led by two managers in a semi-formal setting. • Organize at least four more knowledge circles with a larger number of participants • Allocate time for discussion and knowledge exchange after presentations

4.4.4 Solution 4: Fostering a Participatory Environment for Validation of Reports

Due to time constraints in this research, testing and validation of this solution were conducted in a focused session and presented to users as a storyboard. User feedback is summarized in Table 8.

Table 8: Fostering a participatory environment for validation of reports

Positive feedback	• Expressing user satisfaction due to the possibility of increasing scores by studying other people's reports and commenting on them
Improvement suggestions	• Utilize a monitoring system for the reporting system rating given by users

4.5 Quantitative Evaluation

The quantitative results from the questionnaire are summarized in Table 9.

Table 9: Quantitative results

Measured parameters / Solutions	Improvement in KS atmosphere among colleagues	Willingness to share personal knowledge	Increase in personal knowledge compared to before	Recommendation to Implement the solution in other departments	Willingness to continue participation
Maintenance laboratory	61.8%	93%	90.4%	85.6%	100%
Easy access and diverse report recording	71.3%	87.9%	76.1%	77%	65.7%
Organizational social network	60.7%	53.5%	39.2%	86%	78.5%
Knowledge circles	85.4%	57.1%	80.9%	90.4%	90.5%

The quantitative results reveal significant findings: Maintenance Laboratory notably enhanced the KS atmosphere among colleagues, prompting a strong recommendation for implementation in other departments. Easy access and diverse report recording led to substantial improvements in the KS environment, albeit with somewhat lower recommendation rates and willingness to continue participation. Success and failure stories yielded moderate improvements in KS, with a high recommendation rate for implementation elsewhere. The Knowledge Circles concept showed the highest improvements in the KS atmosphere and personal knowledge, supporting its broad implementation across departments. These results affirm the effectiveness of various strategies in bolstering KS and advocate for their widespread adoption.

4.6 Deliver

Based on the results obtained, the solutions incorporating the GoPro camera and Knowledge Circle have successfully advanced to the delivery stage, which is now operational. The remaining solutions require further iterations to reach this stage.

5. Conclusion

The purpose of this research is to enhance KS within the maintenance department of a KIF. Facilitating KM in the maintenance department has consistently been a challenge for KIFs. The expertise and experiences of the staff are considered a major asset in problem diagnosis, failure prevention, and equipment performance improvement. Given the risk of knowledge loss, employing a creative solution to facilitate KM and KS was chosen as the focus of this study.

The innovative solution presented in this paper is using a human-centered DT approach, specifically tailored for solving complex problems. DT combines user desirability with technical feasibility and economic viability to generate innovative ideas. One of the strengths of the DT approach is empathy, which helps identify the real needs of individuals. In this study, three tools—interview, observation, and immersion—were used to empathize with users. The insights gained from these tools led to a reevaluation of the initial problem based on the users' actual needs.

Following the Double Diamond model, a wealth of information was discovered and converged into four categories: People, Process, IT/Content, and Strategy. Ideation then commenced, and all ideas were evaluated through the lenses of desirability, sustainability, and feasibility, ultimately selecting the most effective solutions. The selected solutions were tested and evaluated, yielding significant qualitative and quantitative results.

Based on the research objectives and results, it can be concluded that employing DT can enhance KM and KS within maintenance settings. The study reveals that DT, with its emphasis on empathy and user-centered design, is particularly effective in addressing complex and human-related problems.

Overall, the creative aspect of this paper lies in the application of the DT approach to solving the complex issue of KM and the effective integration of these two concepts. The results demonstrate the effectiveness of using the DT approach in this context. However, it is worth mentioning that the solutions derived are specific to the maintenance department of the reviewed KIF. Other organizations should customize their own KM systems with the DT process to fit their specific needs.

Limitations of study:

- Time-consuming testing and evaluating solutions with multiple iterations in the DT process.
- Limited target population to one company.
- Due to article length constraints, not all solutions could be presented despite their creativity and innovation.

Given the critical role of the maintenance department in maintaining the optimal performance and sustainability of industrial equipment and systems, the high value of the knowledge possessed by employees in this department, and the importance of having an effective KM system, continuing this process is part of this team's future plan. As mentioned in the limitations, further repetition and testing of each solution until optimal results are achieved, remain part of the pathway to the final goals of this research.

References:

Bartol, K. M., & Srivastava, A. (2002). Encouraging knowledge sharing: The role of organizational reward systems. *Journal of leadership & organizational studies*, *9*(1), 64-76.

Boersma, A. (2017). The Future of KM? Design Thinking! And Here are 5 Elements to? ECHO? *Knowledge Management for Development Journal*, *13*(1), 25-30.

Fullwood, R. W. (2014). *An investigation of the factors that influence knowledge sharing between academics* Manchester Metropolitan University].

Ismail, M. B., & Yusof, Z. M. (2010). The impact of individual factors on knowledge sharing quality. *Journal of Organizational knowledge management*, *13*(1), 1-12.

Karamitri, I., Kitsios, F., & Talias, M. A. (2020). Development and validation of a knowledge management questionnaire for hospitals and other healthcare organizations. *Sustainability*, *12*(7), 2730.

Mostofa, S. M., Othman, R., Mukherjee, D., & Hasan, K. K. (2020). A comprehensive framework of design thinking approach in knowledge management: A review in academic context. *Journal of Education Culture and Society*, *11*(2), 281-294.

Numprasertchai, S., & Numprasertchai, H. (2024). The Integration of Knowledge Management and Design Thinking for Improving Problem-Solving Skills: A Case Study of a Service Agency. *Development*, *23*, 25.

Oyemomi, O. O. (2017). *The Impact Of Organisational Factors On Knowledge Sharing Performance* University of Plymouth].

Roham, H., Gomes, J. F., Tourehei, A. R. S., Yousefabad, E. K., Aghajani, S., Avestam, M. A., Behnam, A., Malekmohammadi, A., & Shahbazi Rad, M. R. (2023). Unlocking the Potential of Knowledge Management and Sharing in Knowledge Intensive Companies' Maintenance Departments: Barriers, Enablers, and Recommendations.

Rösch, N., Tiberius, V., & Kraus, S. (2023). Design thinking for innovation: context factors, process, and outcomes. *European Journal of Innovation Management*, *26*(7), 160-176.

Swart, J., & Kinnie, N. (2003). Sharing knowledge in knowledge-intensive firms. *Human resource management journal*, *13*(2), 60-75.

Tschimmel, K. (2012). Design Thinking as an effective Toolkit for Innovation. ISPIM Conference Proceedings,

Wang, S., & Noe, R. A. (2010). Knowledge sharing: A review and directions for future research. *Human resource management review*, *20*(2), 115-131.

Welschen, J. E. (2014). An investigation of the impact of extrinsic and intrinsic motivators on organisational knowledge sharing.

Wu, E. C. (2020). Design knowledge sharing platform for designers.

Xue, C. T. S. (2017). A literature review on knowledge management in organizations. *Research in Business and Management*, *4*(1), 30-41.

Zheng, T. (2017). A literature review on knowledge sharing. *Open Journal of Social Sciences*, *5*(03), 51.

Simulation of Discovering Market Opportunities Using AI Methods

Stefan Trzcielinski and Grzegorz Pawlowski
Department od Management Systems, Faculty of Engineering Management, Poznan University of Technology, Poznan, Poland

stefan.trzcielinski@put.poznan.pl
grzegorz.pawlowski@put.poznan.pl

Abstract: Due to the strong turbulence that exists in the business environment, the view is sometimes articulated that the time horizon of decisions is no longer a hallmark of strategic management. Opposing views argue that a turbulent environment changes the trajectory of reaching future objectives determined by strategic decisions. Such trajectories require the company to be agile, which is manifested by seizing opportunities. Opportunities arise because the environment is volatile. An example of market opportunity is the unsatisfied demand for products. Buyers are driven by different motives when choosing between products that are alternative to them. From the producer's point of view, the purchase is therefore random. As a consequence, the alignment of the offered product portfolio with the actual purchasing decisions of customers is undetermined. In this article, we address the problem of determining the product portfolio structure expected by customers, i.e. one that is consistent with their future purchasing decisions. We hypothesise that this problem can be represented by a model of flows between alternative resources. Problems of this type are solved using Markov Chain Monte Carlo (MCMC) methods. In order to discover the expected demand (opportunity), we simulated the flow model we developed using the Metropolis-Hastings algorithm, which is a special case of the MCMC method used in AI. Due to operating on numerical data, such simulations fall under quantitative research. In the article, we present a model of customer flows between alternative products and then the simulation result, which is the expected value of these flows (stationary point). We convert this value into the structure of the product portfolio using a model of customer purchasing decisions that we have developed. The obtained results confirm the effectiveness of our method and have significant practical value, especially for SMEs. It also enables the assessment of the company's product strategy based on real sales data. The application of our methodology is limited to discovering opportunities in situations where purchasing decisions are influenced by variable environmental factors, causing irregular purchases by individual customers. It is useful, for example, in discovering opportunities in markets such as Household Articles, Furniture, Vehicles, Equipment Repairs, Construction, and many others.

Keywords: Opportunity Discovery, Artificial Intelligence, Markov Chain Monte Carlo Method, Metropolis-Hastings Method, Alternative Products Portfolio

1. Introduction

Within contemporary decision support systems (DSS), several IT technologies are starting to clearly dominate due to the rapid increase in access to large amounts of data and the techniques for processing them with the help of artificial intelligence (Provost & Fawcett, 2013). Among these are commonly used tools such as Business Intelligence, Big Data Analytics, and Data Mining, which aim to conduct in-depth analysis of previously collected or real-time data. These are usually employed for forecasting based on historical data, with further analysis conducted using established techniques such as regression analysis, time series analysis, data flow, or qualitative modelling.

Simultaneously, in many areas of economic activity, research is being conducted on prediction in the absence or insufficient amount of data. The approaches used in such studies include data imputation technologies, bootstrap techniques, Bayesian techniques, and generative learning (Jha et al, 2022). They supplement the dataset with artificial data and rely on meta-learning focused on improving the efficiency of learning (Arulkumaran et al, 2017), on the principle of trial and error based on random events, where the search for the optimal decision can be achieved, for example, by sampling the model using the Monte Carlo simulation method (Vodopivec et al, 2017).

The detailed aim of this paper is to describe a decision system related to variable demand for selected goods under random information about possible customer choices (their purchasing preferences). This problem can be framed in terms of resource flow with a specific probability of changing the decision on the selection of a product group. Resource flow research is successfully described by System Dynamics models (Gary et al, 2008), which allow iterative determination of resource changes over time, where an essential condition for describing the model system is the explicit knowledge of differential-integral equations determining the system's dynamics, i.e., the flows between resources. Unfortunately, the analysed problem of variable demand for selected product groups does not adhere to strict analytical records. The issue studied in the work is non-deterministic and an effective way to solve it is the stochastic approach. Here we will limit ourselves to probabilistic techniques based on Bayesian inference (Box and Tiao, 2011), the essence of which is to take into account uncertainty and assign

probabilities to various decision hypotheses or parameter values based on available data. The practical implementation of the above idea is Markov chains (Baum and Petrie, 1966), which describe the evolution of a system in which future events depend only on the current state of the system, and not on the entire history. It is assumed that the state of the system is determined by a set of current parameters, which are a sufficient basis for making a decision (via a flow matrix defining the probabilities of change) in order to create a space of solutions in successive steps. Usually, Markov chains converge to a so-called stationary state—a specific expected value (Kurtz, 1981). However, it should be noted that there are particular cases where, for example, the system behaves periodically and exhibits several stationary states (cyclically following each other) for the same set of input data and exceptional situations where a Markov chain does not become stationary in finite time (Cappé et al, 2005).

2. Literature Review

The modelling of sales and demand creation has been the subject of numerous analyses, considering product characteristics, customer preferences, financial conditions, economic indicators, and market conditions. Methods and techniques used in this area include classical time series models (Rippe et al., 1976), analysis of non-deterministic business cycles and turning points (Hamilton, 1990), the application of dynamic programming to study demand cycles (Briffaut and Lallement, 2010), monitoring changes in demand using the Monte Carlo method (Klug, 2011), and forecasting macroeconomic variables on the stock market using hidden Markov chains (Nguyen and Nguyen, 2015).

Decision models are the subject of numerous theoretical studies (Fülöp, 2005). Depending on the form and functional description of the optimisation problem, traditional optimisation techniques, linear programming, non-linear programming, or discrete optimisation can be used (Nemhauser et al., 1989). For studying supply and demand issues, so-called Multiple Criteria Decision Making methods (MCDM) are used. These methods involve examining a decision matrix in which the set of all admissible decisions is a discrete set containing a finite, predetermined number of possible solution variants.

Since 2015, there has been a rapid increase in the use of AI in financial analysis, marketing, and business (Ellefsen et al., 2019; Bahoo et al., 2024; Stone et al., 2020). AI is now widely used in the field of analysing customer decision processes, although the problem is posed more broadly and concerns the comprehensive analysis of customer behaviours. The result is targeting customers to tailor offers to target customers, including policies of setting individual prices (discounts) to maximise profit per unit (Marinchak et al., 2018). Methods used to determine potential customer decisions and influence them include quantitative research (surveys, interviews), focus groups (studying feelings about products, services, brands), customer observations, and online behaviour analysis (A/B testing). Using AI tools, individualised relationships with customers are built, paying close attention to factors such as trust, satisfaction, commitment, engagement, and loyalty (Yau et al., 2021).

Another approach that supports decision-making processes is computer simulations. They are used, for example, to estimate the probability of achieving different levels of return on investment, considering various factors such as market conditions, costs, and technological uncertainty (Platon and Constantinescu, 2014). Decision modelling using the Monte Carlo (MC) method allows comparing different options in terms of their expected value and risk, such as comparing different investment strategies related to asset allocation (Cesari et al., 2003). The use of multi-attribute decision-making methods supported by computer simulations enables the identification of potential threats to a project or decision, identification of specific negative factors and determining how they will impact the project's outcome (Mojtahed et al., 2010). In the case of reinforcement learning (Sutton & Barto, 2018), the simulation scenario models a range of decision sequences, which is currently one of the most dynamic areas of artificial intelligence development.

MC modelling can also be applied more broadly within so-called probabilistic programming, which has now become one of the main branches of machine learning and an important element of data analysis (Ghahramani, 2015). Learning from data involves transforming previously defined probability distributions—by observing real data—into posterior distributions generated artificially after observing the data (this is called the application of probability theory to learning from data). The importance of this method is growing rapidly due to the possibility to train very complex models based on computer simulations to classify and predict events in such systems. In the case studied in this paper, these techniques allow searching for business solution spaces to identify opportunities.

It is also worth noting that the use of simulations in learning processes will soon enable the implementation of so-called embodied artificial intelligence, which is a step towards realising the idea of artificial general intelligence (AGI) (Duan et al., 2022).

3. Research

3.1 Materials and Methods

We present the discovery of opportunities using AI methods on the example of global production of jackets made of alternative materials, which are cotton, leather, cashmere and agave fibres. The necessary data on the production volume and demand flows between market fractions corresponding to these products, as well as demographic characteristics of buyers, were obtained using Chat 4.0. We used this technology due to its capabilities of searching and analysing distributed and fragmented databases.

We simulate the states of the system, which is created by customer flows and thus purchase streams between market fractions. The expected result is the proportion between these streams. In order to represent the full characteristics of the studied system, simulation modelling is employed using the Monte Carlo method (Kroese and Rubinstein, 2012). Data collected in this process allows for obtaining higher-level statistics - they are the basis for cluster analysis, multiple regression or correlation (Newbold et al, 2013), which in turn leads to the use of AI technology.

The most popular simulation method with wide application, and appropriate for solving the problem presented in this work, is the Markov Chain Monte Carlo (MCMC) algorithm (Chib, 2001). Monte Carlo Methods are numerical techniques used to approximate solutions to problems that may be difficult to solve analytically, using random samples. Markov Chains is a subset of stochastic models used in Monte Carlo methods. They describe systems transitioning between different states where the probability of transitioning to a given state depends only on the current state. The Metropolis Algorithm is a specific case of Markov Chains (Metropolis and Ulam, 1949; Hastings, 1970. It is a technique used to generate samples from a difficult-to-sample probability distribution by iteratively proposing new states and accepting or rejecting them with a certain probability. The transition from the current state A to a new state B satisfies a proposed symmetric transition function, meaning that the probability of transitioning from A to B is the same as transitioning from B to A. The Metropolis-Hastings Algorithm (M-H) is an extension of the Metropolis algorithm that allows the use of any proposal function, not just a symmetric one. This means that the probability of transitioning from A to B can be different from transitioning from B to A. By allowing asymmetric transition functions, the Metropolis-Hastings algorithm is more flexible and can be more efficient in sampling from complex probability distributions. The state space determined in this way forms the basis for the mathematical analysis of the system, allowing for the creation of higher-order statistics. Modelling the studied system using variable output parameters ultimately allows for the construction of a state diagram.

3.2 Modelling Purchase Flow Streams

In this article we will focus on the example of jackets made from four types of materials: cotton, leather, cashmere, and agave. Purchase decisions are influenced by a range of factors, which can be grouped into the following categories:

1. Economic Factors
    - Price: Cotton jackets are usually cheaper, making them more accessible to a wider range of consumers. Leather jackets are more expensive, limiting their purchase to those with higher incomes. Cashmere jackets are among the most expensive, classifying them as a luxury product. The price of agave fibre jackets varies, but due to the rarity of the material, they can be more expensive.
    - Buyer's Income: Buyers with higher incomes are more likely to purchase more expensive materials, such as leather and cashmere.
2. Demographic Factors
    - Age: Younger consumers may prefer cheaper and more common materials like cotton. Older consumers may be more inclined to purchase durable materials like leather and cashmere.
        - Gender: Men may more frequently choose leather jackets, whereas women might prefer cashmere due to its softness and elegance.

3. Cultural Factors
    - Fashion and Trends: Fashion plays a significant role in material choice. Fashion trends may promote a specific material in a given season. Marketing campaigns greatly influence the perception of a material as fashionable or luxurious.
    - Lifestyle: People leading active lifestyles may prefer cotton for its comfort and ease of care. Conversely, buyers who value elegance and prestige may choose leather or cashmere.
4. Ecological Factors. Environmental Awareness: Growing ecological awareness may prompt buyers to choose more environmentally friendly materials, such as organic cotton or agave fibres. Additionally, they may avoid leather due to concerns about animal welfare.

Taking into account the partial overlap of the characteristics of the above-mentioned groups with the characteristics of such buyer types as Fashion Enthusiasts, Tech-Savvy Consumers, Professional and Business Executives, Health-Conscious Consumers, Luxury Lifestyle Seekers Kotler and Armstrong (2010), Rogers (1983) and Euromonitor (2021), Chat GPT 4.0 estimated the share of these four groups in the global market as follows: Pragmatists - 36%; Extravagant - 17%; Prestige Seekers - 34%; Eco-conscious - 13%.

People enjoy variety, so although they have preferences, they also buy substitutes to meet their diverse expectations. For instance, when purchasing jackets or clothing more broadly, the shift from cotton may occur as more buyers seek ecological alternatives. In the case of leather, growing ethical awareness encourages buyers to avoid products made from this material. Additionally, the high price of leather may drive people to seek cheaper alternatives. The move away from cashmere to alternative materials may be due to its high price and fashion trends. Although agave fabric is ecological, its relatively small supply might prompt buyers to purchase alternative products.

Taking into account the above trends influencing the change of purchasing decisions, Chat GPT 4.0 estimated the potential redistribution of preferences and the flow of the customers stream between the market fractions, which is the result of random purchase decisions (Figure 1). The share of each fraction is 100%. Such data can be obtained from sales reports as well as through market condition surveys in individual market fractions. It is important to note that we are dealing with percentage shares rather than absolute values.

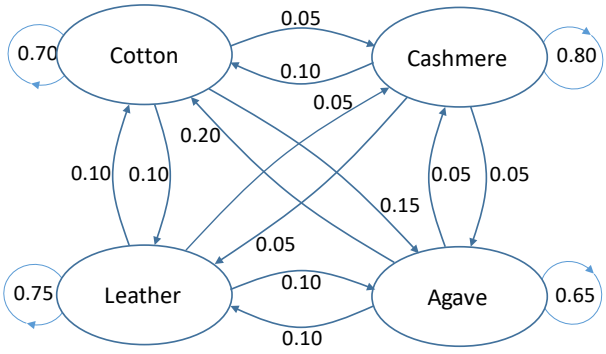


Figure 1: Model of potential flow of the purchase streams of jackets between market fractions

3.3 Modelling Buyers' Purchase Decisions

When making a purchase, customers take into account a number of functional, economic, and social features of these products, assigning different ranks to these features (Table 1).

Due to the preference for the highest-ranking features, four groups of buyers can be distinguished:

1. Pragmatist – These buyers choose cotton for its softness and breathability, making it comfortable to wear, especially in warm conditions. Cotton is relatively easy to wash and iron, and its versatility allows it to be used in various styles, from casual to more formal.
2. Extravagant – These buyers prefer leather jackets because of their elegant and luxurious look, which is highly valued in fashion. Leather is very durable and can last many years with proper care. Each leather product has a unique appearance due to natural variations in the leather, adding to its uniqueness.

Table 1: Ranks of features of four types of materials

Material	Breathability	Comfort	Durability	Warmth	Ease of Care	Affordability	Sustainability	Style/Aesthetic	Status Symbol
Cotton	5	5	3	2	5	5	4	4	2
Leather	3	4	5	4	3	2	3	5	5
Cashmere	4	5	3	5	4	1	2	5	5
Agave	2	3	4	2	3	4	5	3	3

The individual ranks mean: (1) Very Low, (2) Low, (3) Moderate, (4) High, (5) Very High.

Source: Own study based on: Peterman (2024), Sewport Support Team (2024a), Leather Naturally (2024), Endorfeen (2024), Sewport Support Team (2024b), Hulle, Kadole, and Katkar (2015).

3. Prestige Seeker – These buyers opt for cashmere as it is a symbol of high status. Cashmere is exceptionally soft and pleasant to the touch, making it one of the most luxurious materials. It is also lightweight and warm, which is especially valuable in colder months, and ensures good breathability.
4. Eco-conscious – These buyers choose agave because it is a fast-growing plant, making it a more sustainable material option. Agave fibres are very strong and durable, although less commonly used in clothing compared to other materials.

Taking into account the partial overlap of the characteristics of the above-mentioned groups with the characteristics of such buyer types as Fashion Enthusiasts, Tech-Savvy Consumers, Professional and Business Executives, Health-Conscious Consumers, Luxury Lifestyle Seekers Kotler and Armstrong (2010), Rogers (1983) and Euromonitor (2021), Chat GPT 4.0 estimated the share of these four groups in the global market as follows: Pragmatists - 36%; Extravagants - 17%; Prestige Seekers - 34%; Eco-conscious - 13%.

Despite preferring certain products, people also buy alternative products that meet their diverse needs. For jacket buyers, and more broadly clothing, the following external factors influence changes in purchase preferences: shifts in fashion trends, seasonal changes, effective marketing campaigns, economic downturn, income level, increasing ecological awareness, and corporate social responsibility initiatives. Under the influence of these factors, buyers make purchase decisions based on the following criteria:

1. Value for Money – 0.16 (Nielsen Global Survey, 2024)
2. Functionality and Maintenance – 0.14 (McKinsey & Company, 2024)
3. Comfort and Reliability – 0.14 (Cotton Incorporated, 2024)
4. Budget Sensitivity – 0.10 (Sheehan, 2023)
5. Luxury and Exclusivity – 0.09 (Bain & Company, 2023)
6. Statement and Uniqueness – 0.09 (Euromonitor International, 2021)
7. Status and Sophistication – 0.09 (Avery and Gupta, 2022)
8. Material Quality and Craftsmanship – 0.09 (MarketResearch.com, 2024)
9. Sustainability and Eco-friendliness – 0.04 (Nielsen, 2024)
10. Ethical Production and Sourcing – 0.04 (Ethical Consumer, 2024)
11. Natural and Organic Materials – 0.04 (Busalim, Fox, Lynn, 2022)

The weights of these criteria were proposed by Chat GPT 4.0 considering the importance of features of the four products for the types of buyers: Pragmatist, Extravagant, Prestige Seekers, and Eco-conscious. Using these weights and the impact of these criteria on purchase decisions, the weighted average purchase decisions for each buyer type were determined (Table 2).

Both the criteria and their weights as well as the impact on purchasing decisions can be determined by examining buyers' preferences and their tendency to purchase alternative products. The data in Table 2 corresponds to the following buyer profiles:

- PRAGmatist – Middle-income earners who prioritize practicality and cost-effectiveness. Often found in professions that require durability and comfort in clothing, such as teachers, office workers, and manual laborers. Generally middle-aged adults, around 30-50 years old equally distributed between male and female. They are typically from regions with moderate to warm climates, such as parts of North America, Europe, and Asia. They represent a significant portion of the population, likely around 30-40% of the market.

Table 2: Weight matrix of purchase decision of jacket buyers

Type of customer	Fabric	Fabric			
		Cotton	Leather	Cashmere	Agave
Pragmatist	Cotton	0,65	0,10	0,05	0,20
Extravagant	Leather	0,10	0,60	0,25	0,05
Prestige Seekers	Cashmere	0,05	0,20	0,70	0,05
Eco-conscious	Eco-conscious	0,30	0,05	0,10	0,55

- EXTRAvagant – Higher-income individuals who can afford luxury and statement pieces. Typically involved in high-paying jobs such as executives, artists, and celebrities. Younger to middle-aged adults, around 25-45 years old with a small predominance of men who often purchase leather jackets. They live in urban areas and regions with a strong fashion culture, such as major cities in the United States, Europe, and Asia. They represent smaller niche market, possibly around 10-15% of the market.
- PRESTige Seeker – Wealthy individuals who seek high-status and premium quality products. Common among high-ranking professionals like executives, lawyers, and entrepreneurs. They are older adults, typically 35-60 years old with predominance females, as cashmere is often associated with luxury women's fashion. They presumably live in affluent areas worldwide, such as upscale neighbourhoods in North America, Europe, and Asia. They represent a very niche market, likely around 5-10% of the market.
- ECO-conscious – Middle to upper-middle-income individuals who can afford to prioritize sustainability. They can be found among a variety of professions but with a higher representation among educators, healthcare professionals, and those in the environmental sector. They are younger to middle-aged adults, around 25-45 years old with small predominance of females who are often more active in sustainability efforts. They live in urban and suburban areas with a strong focus on sustainability, often found in parts of North America, Europe, and Oceania. They represent the growing segment, potentially around 15-20% of the market.

3.4 Simulation

Using the data on the flow of purchase streams (Figure 1) the potential demand for jackets made of cotton, leather, cashmere and agave was generated. The demand was determined using a method developed by us, based on the Markov Chain Monte Carlo (MCMC) and the Metropolis-Hastings (M-H) algorithm in 1000 steps of simulation (Figure 2). Each step can be interpreted, for example, as one day. Then this figure shows the fluctuation of the purchase stream of each product on subsequent days.

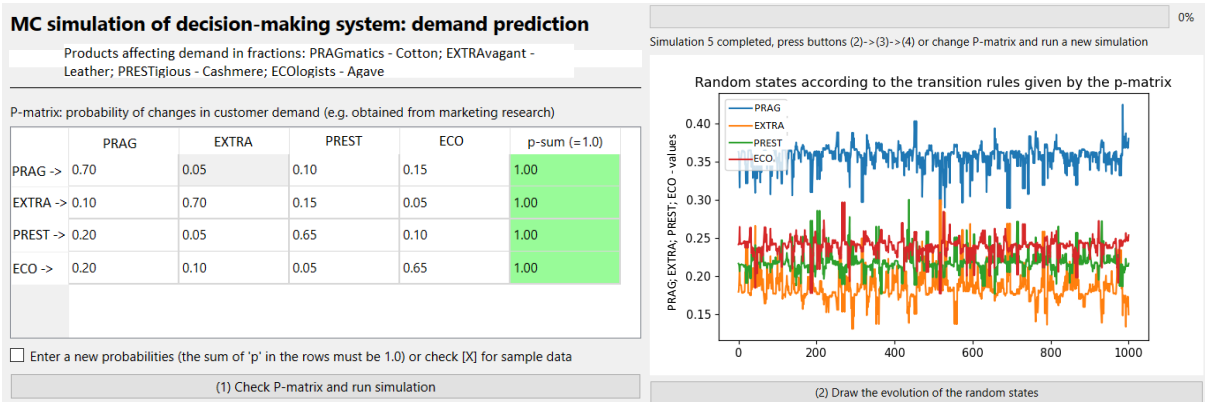


Figure 2: Probability of the flow of the purchase stream and the random distribution of this stream

Figure 3 shows simulated random states of the purchase stream of the four products under consideration. Each point on the horizontal axis of Figure 2 corresponds to one point in Figure 3. The coordinates of these points determine the proportions between the purchase streams of the products under consideration in the individual market fractions. Since the figure is made in 3D, one fraction (PREST) has been omitted. Despite this, the density of points in this figure shows well how the system is approaching the state represented by the stationary point, which is the expected state (averaged from 1000 iterations). This point corresponds to the proportion of purchases, amounting to 36%, 18%, 21% and 24%, respectively for the Pragmatist, Extravagant, Prestige Seeker,

and Eco-conscious fractions. It is worth noting that there can be an infinite number of distributions (Figure 2), but for each of them the stationary point of the system will be the same.

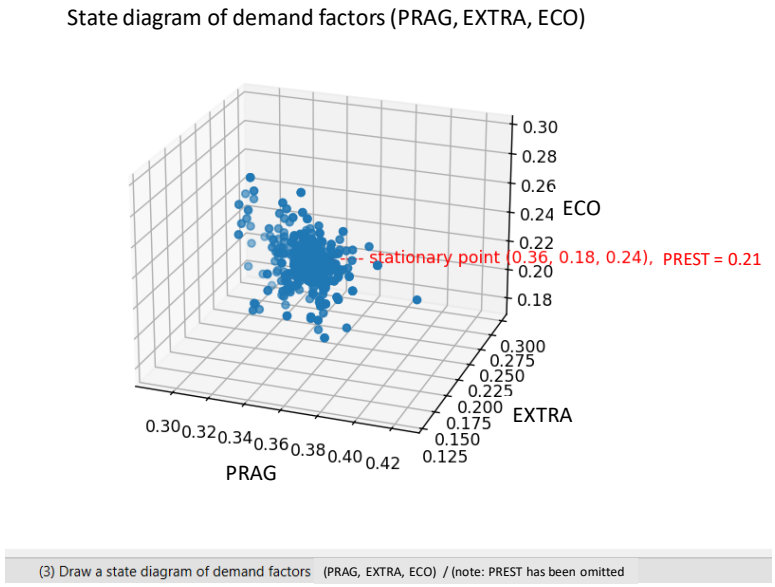


Figure 3: System state diagram in 1000 simulation steps

The stationary point shown in Figure 3 abstracts from the profile of buyers making purchases in the different market fractions. In each fraction, purchases are made by various buyers, not just those who prefer the product specific to that fraction. This is why there are flows between fractions, which in our case are shown in Figure 1 and also in the table in Figure 2. However, this does not mean that there is no buyer profile behind the stationary point. In our case, we identified this profile based on the purchasing criteria, their weights, and their impact on purchasing decisions, as presented in Section 3. 3, particularly in Table 2 and the table in Figure 4. Taking into account the profiles of Pragmatist, Extravagant, Prestige Seeker, and Eco-conscious buyers, the proportion between the purchase flows of the four considered types of products is 40%, 14%, 20%, and 26% respectively.

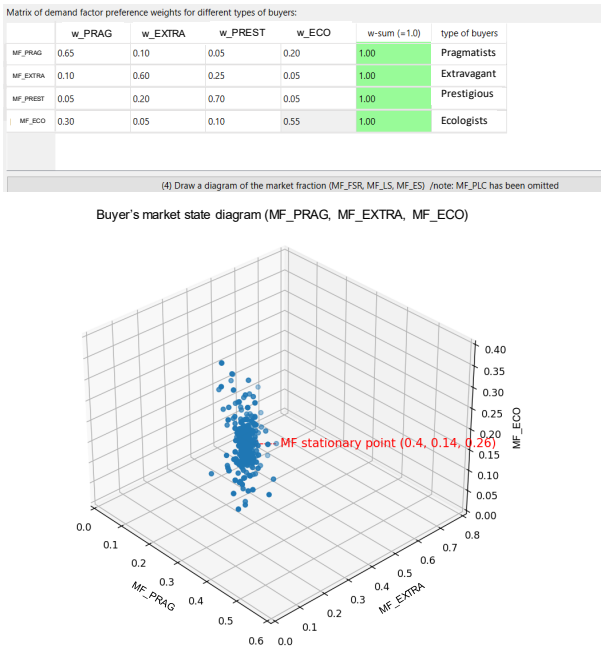


Figure 4: Stationary pint of the jackets buyers' market state

4. Discussion and Conclusions

In the problem that is the subject of this article, the opportunity is the gap between the proportion of products available on the market and the proportion expected by buyers. Taking into account: (1) the global production volume of cotton, leather, cashmere and agave fibre in 2023, (2) the consumption of these raw materials for clothing production, (3) the share of jacket production in clothing production, (4) the material consumption standards for the production of one jacket, it is possible to estimate the number of jackets made of cotton, leather, cashmere and agave produced on a global scale. The share of production of these products is 95.065%, 4.748%, 0.164%, 0.023%, respectively. The summary of the expected and available shares and thus the opportunity constituting the demand gap is presented in Table 3.

Table 3: Demand gap in the jacket segment

Fabric	Expected demand	Estimated current supply	Gap	Opportunity
Cotton	40,00%	95,07%	-55,07%	
Leather	14,00%	4,75%	9,25%	Increase production
Cashmere	20,00%	0,16%	19,84%	Increase production
Agave	26,00%	0,02%	25,98%	Increase production

In order to define the profile of buyers, we have formulated the following criteria: financial status, type of work, education, living conditions, gender, age, and potential population. According to these criteria, based on the following reports: Statista. "Apparel Market Report"; Nielsen, "Consumer Research Report"; U.S. Bureau of Labor Statistics, "Consumer Expenditure Survey"; Urban Institute, "Urban and Suburban Population Reports"; Verified Market Reports, "Formal Wear Market Size, Share and Trends"; Market Research.com, "Trusted market research and industry insights", Chat GPT 4.0 has developed demographic profiles of current and potential jacket buyers. The current supply of jackets is targeted to buyers with middle financial status who perform jobs that require comfortable clothing, like teachers, administrative workers, and service sectors. They live in cities and suburbs and have access to a wide range of clothing stores and shopping centres. These are both men and women with slight predominance of women, who might be more interested in clothing variety all the specified criteria. On the other hand, buyers with expectations consistent with the results of our simulation have a higher financial status and are entrepreneurs, professionals in technology, creative industries, or managers. They have higher education. They are residents of large cities and metropolises with access to stores offering luxury and ecological clothing products. These are people aged 30-45, mostly women, who are more likely to lead in eco-movements and sustainable fashion. This population constitutes 5-10% of buyers of jackets. Promotion should be directed to this group to take advantage of the opportunity of unmet demand.

The methods and AI algorithms we employed yielded results that enable the identification of opportunities for producers of alternative products. This opportunity arises from the existence of unfulfilled demand for certain products. In our case, this applies to jackets made from leather, and especially from cashmere and agave fibres. For these latter two, the differences between the simulated demand and the analytically estimated supply are very significant. Their rational reduction requires market segmentation and identification of segments whose demand is not satisfied. In our case, the basis for segmentation is the demographic profile of buyers. Comparing the buyer profiles for the simulated and actual proportions of purchase flows for each product allows us to identify the customer types whose satisfaction of needs leads to the use of a market opportunity.

Our analysis of the global market case confirmed that the challenge of discovering opportunities arising from unmet demand for alternative products and shaping a product portfolio to balance this demand can be effectively addressed using MCMC methods, particularly the Metropolis-Hastings algorithms. This method can be employed even when data is limited to the probability of purchase flow between market fractions corresponding to these products. Such data can be obtained from sales reports or through conducting marketing research. This characteristic makes the method particularly useful for SMEs, which typically do not employ AI methods based on Big Data. This is possible because the method generates its own dataset based on the previously defined purchase flow matrix. A significant modification we introduced is the consideration of purchase decision weights, which means taking into account the buyer profile. This provides data for market segmentation and thus the basis for identifying segments with unmet demand, creating a market opportunity.

While MCMC and M-H algorithms are fully adequate for identifying opportunities with defined probabilities of purchase flow between market fractions, the reliability of the solutions obtained depends on the accuracy of the data on these flows and the weights of purchase decisions. The data in the purchase flow matrix is relatively easy to obtain, especially for SMEs. However, determining the weights of purchase decisions requires a multi-criteria assessment of the factors influencing buyers. Our experience indicates that these weights are correlated with the purchase flow, but the mechanism of this dependency is not defined. This issue is the subject of our ongoing research because even small changes in weights significantly impact the simulated production portfolio.

References

Arulkumaran, K., Deisenroth, M. P., Brundage, M., & Bharath, A. A. (2017) „Deep reinforcement learning: A brief survey", *IEEE Signal Processing Magazine*, Vol *34* No.6, pp 26-38.

Avery, J. and Gupta, S. (2022) "Farfetch: Digital Transformation for Luxury Brands." *Harvard Business School Teaching Note 522-061*, https://www.hbs.edu/faculty/Pages/item.aspx?num=61654 (access in May 2024).

Bahoo, S., Cucculelli, M., Goga, X. (2024) „Artificial intelligence in Finance: a comprehensive review through bibliometric and content analysis", *SN Bus Econ* Vol 4, No. 2, p 2-46.

Bain & Company (2023) "Report: Luxury Goods Worldwide Market Study", https://www.bain.com/about/media-center/press-releases/2023/global-luxury-goods-market-accelerated-after-record-2022-and-is-set-for-further-growth--despite-slowing-momentum-on-economic-warning-signs/

Baum L. E., Petrie T., (1966), „Statistical Interference for Probabilistic Functions of Finite State Markov Chains", *The Annals of Mathematical Statistics*, Vol 37, No. 6, pp 1554–1563.

Box, G. E. and Tiao, G. C. (2011) *Bayesian inference in statistical analysis*, John Wiley & Sons, New York.

Briffaut J. P., Lallement P. (2010) „Volatility Forecasting of Market Demand as Aids for Planning Manufacturing Activities", *Service Science & Management*, No. 3, pp 383–389.

Busalim, A., Fox, G., Lynn, T. (2022) "A systematic literature review and future research agenda", [online], International Journal of Customer Studies, 2022, No. 46 pp 1804–1828, file:///C:/Users/Lenovo/Downloads/Consumer_behavior_in_sustainable_fashion_A_systema.pdf

Cappé O., Moulines E., Rydén T., (2005) *Inference in Hidden Markov Models*, Springer, New York.

Cesari, R., and Cremonini, D. (2003) „Benchmarking, portfolio insurance and technical analysis: a Monte Carlo comparison of dynamic strategies of asset allocation", *Journal of Economic Dynamics and Control*, Vol *27*, No. 6, pp 987-1011.

Chib, S. (2001) „Markov chain Monte Carlo methods: computation and inferencje". *Handbook of econometrics*, Vol 5, pp 3569-3649.

Cotton Incorporated (2024) "Cotton Incorporated Consumer Survey", *Cotton Incorporated Lifestyle Monitor*, https://www.cottoninc.com (Access in May 2024).

CyberPublicity (2024), "Fashion Enthusiasts", https://www.cyberpublicity.com/programmatic-advertising/hobbies-passions/fashion-enthusiasts/) (access in May 2024).

Duan, J., Yu, S., Tan, H. L., Zhu, H., & Tan, C. (2022) „A survey of embodied ai: From simulators to research tasks", *IEEE Transactions on Emerging Topics in Computational Intelligence*, Vol 6, No. 2, pp 230-244.

Ellefsen, A. P. T., Oleśków-Szłapka, J., Pawłowski, G., & Toboła, A. (2019) „Striving for excellence in AI implementation: AI maturity model framework and preliminary research results". *LogForum*, Vol 15, No. 3.

Endorfeen (2024) "Cashmere – Understanding The Impact of That Luxury Fabric", https://endorfeen.com/cashmere-understanding (access in May 2024).

Ethical Consumer (2024) "Fashion and Clothing Guide"; https://www.ethicalconsumer.org/fashion-clothing (Access in May 2024)

Euromonitor International (2021) "Global Consumer Types: Who They Are and How They Live", *Euromonitor International*, July 2021, www.euromonitor.com (access in May 2024).

Fülöp, J. (2005)." Introduction to decision making methods", In BDEI-3 workshop, Washington, pp. 1-15.

Gary, M. S., Kunc, M., Morecroft, J. D., & Rockart, S. F. (2008) „System dynamics and strategy", *System Dynamics Review: The Journal of the System Dynamics Society*, Vol 24, No. 4, pp 407-429.

Ghahramani, Z. (2015) „Probabilistic machine learning and artificial intelligence", *Nature*, Vol 521, pp 452-459.

Hamilton J. D. (1990) „Analysis of Time Series Subject to Changes in Regime", *Journal of Econometrics*, Vol 45, No. 1–2, pp 39–70.

Hastings, W. K. (1970) „Monte Carlo sampling methods using Markov chains and their applications", *Biometrika* Vol 57, No. 1, p 97-109.

Hulle, A., Kadole, P., and Katkar, P. (2015) "Agave Americana Leaf Fibers", *Fibers*, No. 3, pp 64-75.

Jha, S., Gong, D., Wang, X., Turner, R. E., & Yao, L. (2022) „The neural process family: Survey, applications and perspectives", *arXiv preprint arXiv:2209.00517*.

Klug F., (2011), „Automotive Supply Chain Logistics: Container Demand Planning using Monte Carlo Simulation", *International Journal of Automotive Technology and Management*, Vol 11, No. 3, pp 254–268

Kotler, P., Armstrong, G. (2010) *Principles of Marketing*, Prentice Hall, Saddle River.

Kroese, D. P. and Rubinstein, R. Y. (2012) „Monte carlo methods", *Wiley Interdisciplinary Reviews: Computational Statistics*, Vol 4, No. 1, pp 48-58.

Kurtz, T. G. (1981) „The central limit theorem for Markov chains". *The Annals of Probability*, Vol 9, No. 4, pp 557-560.
Leather Naturally (2024) "Benefits of leather", www.leathernaturally.org (access in May 2024).
Marinchak, C., Forrest, E. and Hoanca, B. (2018) "Artificial intelligence: redefining marketing management and the customer experience", *International Journal of E-Entrepreneurship and Innovation*, Vol. 8 No. 2, pp 14-24.
MarketResearch.com (2024) "Report: Understanding Consumer Preferences in Apparel", https://www.marketresearch.com (Access in May 2024)
McKinsey & Company (2024), "Report: The State of Fashion 2024", *McKinsey & Company*, https://www.mckinsey.com/industries/retail/our-insights/state-of-fashion, (Access ib May 2024).
Metropolis N., & Ulam S. (1949) „The Monte Carlo metod*", Journal of the American Statistical Association* Vol 44, pp 335-341
Mojtahedi, S. M. H., Mousavi, S. M., & Makui, A. (2010) „Project risk identification and assessment simultaneously using multi-attribute group decision making technique", *Safety science*, Vol 48, No. 4, 499-507.
Nemhauser, G.L., Rinnoy Kan, A.H.G. and Todd, M.J. (1989), *Handbooks in Operations Research and Management Science: Volume 1 Optimization*, North-Holland, Amsterdam.
Newbold, P., Carlson, W. L., & Thorne, B. M. (2013). *Statistics for business and economics*. Pearson, London.
Nguyen N., Nguyen D. (2015) „Hidden Markov Model for Stock Selection", *Risks*, Vol 3, No. 4, pp 455–473.
Nielsen (2024) "2023 ESG Report", https://microsites.nielsen.com/globalresponsibilityreport (May 2024)
Nielsen Global Survey (2024), **"**Report: Nielsen Global Survey of Consumer Shopping Behavior", https://www.mintel.com/insights/consumer-research/global-consumer-trends (Access in May 2024)
Peterman, W. (2024) "The Advantages of Cotton Clothing", *Livestrong.com*, www.livestrong.com (May 2024).
Platon, V., and Constantinescu, A. (2014) „Monte Carlo Method in risk analysis for investment projects", *Procedia Economics and Finance*, Vol 15, pp 393-400.
Provost, F. & Fawcett, T. (2013) „Data science and its relationship to big data and data-driven decision ma king", *Big data*, Vol 1, No. 1, pp 51-59.
Rippe R., Wilkinson W., Morrison D., (1976) „Industrial Market Forecasting with Anticipations Data", *Management Science*, Vol 22, No. 6, pp 639–651.
Rogers, A.M. (1983) *Diffusion of Innovations,* The Free Press, New York.
Sewport Support Team (2024a) "What is Cotton Fabric: Properties, How its Made and Where", *Sewport*, https://sewport.com/fabrics-directory/cotton-fabric (access in May 2024).
Sewport Support Team (2024b) "What is Cashmere Fabric: Properties, How its Made and Where", *Sewport*, https://sewport.com/fabrics-directory/cotton-fabric (access in May 2024).
Sheehan, E. (2023) "Global Powers of Retailing: Revenue growth and continued focus on sustainability", Deloitte, February 2023, https://www2.deloitte.com/content/dam/Deloitte/at/Documents/presse/at-deloitte-global-powers-of-retailing-2023 (Access in May 2024).
Stone M., Aravopoulou E., Ekinci Y.,Evans G. ,Hobbs M., Labib A., Laughlin P. , Machtynger J., Machtynger L. (2020), „Artificial intelligence (AI) in strategic marketing decision-making: a research agenda", *The Bottom Line*, Vol. 33 No. 2, pp. 183-200 .
Sutton, R. S., & Barto, A. G. (2018), *Reinforcement learning: An introduction*. MIT Press, Cambridge.
Time & Space Media (2024) "Market Segmentation in Fashion: Tailoring Success for Today's Audiences", https://timespacemedia.com/market-segmentation-in-fashion-tailoring-success-for-todays-audiences (access in May 2024).
Vodopivec, T., Samothrakis, S., & Ster, B. (2017) „On monte carlo tree search and reinforcement learning", *Journal of Artificial Intelligence Research*, Vol 60, 881-936.
Yau, K. L. A., Saad, N. M., & Chong, Y. W. (2021) „Artificial intelligence marketing (AIM) for enhancing customer relationships", *Applied Sciences*, Vol 11, No. 18, 8562.

A Guideline Enabling Knowledge Managers to Communicate Better with Business Managers

Pavel Kraus[1] and Manfred Bornemann[2]
[1]Swiss Knowledge Management Forum, Bern, Switzerland
[2]Knowledge Management Global Network KMGN and Intangible Assets Consulting GmbH, Graz, Austria

p.kraus@skmf.net
bornemann@ia-consulting.at

Abstract: Aligning Knowledge Management (KM) with overarching business strategies is considered as important for organizational success and sustainability. But this crucial element is often missing in the implementation and operation of KM. This paper explores the concept of "business alignment" within the context of KM, elaborating its critical role in enhancing collaboration, minimizing errors, and supporting optimal outcomes across the enterprise. We suggest a comprehensive definition of KM alignment, where KM activities are strategically integrated with business objectives, ensuring visible and measurable benefits to employees and executives. The research addresses key questions such as what constitutes an organization and how KM can facilitate its survival and growth. An organization is not merely a standalone entity but a collective endeavor that thrives on managing internal and external relationships. We argue that the effective alignment of KM with business strategies ensures that these relationships are optimized, thereby enhancing organizational resilience and adaptability. This holistic perspective visualizes the interconnected nature of businesses and highlights the essential role of KM. Our approach involves a systematic examination of business relationships and their alignment with KM practices. We analyze one case study from the construction industry, illustrating how strategic KM initiatives contribute to their sustained success. Additionally, we propose a set of Key Performance Indicators (KPIs) derived from real-world scenarios, linking them to specific business needs and challenges. These KPIs serve as a roadmap for C-level managers, guiding them in integrating KM into their strategic frameworks. The findings underscore the value of KM in mitigating risks associated with poor relationship management. We provide a process and actionable insights for business leaders on leveraging KM to foster innovation, streamline processes, and enhance overall performance. The paper concludes with practical recommendations for implementing KM solutions tailored to different organizational maturity levels and industry contexts.

Keywords: Knowledge Management, Business Alignment, Organizational Strategy, Key Performance Indicators, Relationship Management, Business Sustainability

1. Introduction to business alignment

The discipline of Knowledge Management (KM) has often struggled to become a top priority for C-level managers. Several factors contribute to this, including organizational, cultural, and economic challenges. Drucker (1999) noted that many organizations prioritize short-term financial performance over long-term strategic initiatives. Similarly, Davenport and Prusak (2000) observed that KM initiatives require substantial investment in technology and human resources, with returns that are not immediately visible. Dalkir (2011) reiterated that KM often yields primarily intangible benefits that are hard to measure in the short term.

C-level executives typically focus on initiatives with clear, quantifiable returns on investment. Additionally, according to Nonaka and Takeuchi (1995), KM is sometimes perceived as misaligned with core business goals or as a support function rather than a strategic initiative.

Other topics, such as digital transformation, cybersecurity, innovation, R&D, sustainability, corporate social responsibility, customer experience, and operational efficiency, are often perceived as having a more immediate impact on the organization's bottom line. Consequently, they dominate top executives' agendas.

For knowledge managers, the contribution of "knowledge" to all these tasks seems obvious – yet it is not prioritized. One way to change this situation is to improve communication. Following Bornemann et al. (2007), this usually starts with some form of inventory – identifying available knowledge assets – and connecting them to the business model. Once the contribution of knowledge becomes visible and understood in terms of its impact on the bottom line, both knowledge workers (experts) and C-level managers can align their efforts and collaborate more effectively.

1.1 Challenges in the C-Level

Over the past decades, many KM initiatives have failed (Kraus, 2015), sharing the same fate as other change management initiatives (Kotter, 1996). Consequently, economic and corporate growth have been lower than expected, and organizations face survival threats. One reason for this failure is that knowledge managers did not

adopt the business perspective of C-level managers and thus failed to effectively communicate the relevance of knowledge management. The link between organizational threats, operational problems, and KM as a solution needs to be demonstrated and firmly established.

We formulate the following hypotheses:

- H1: KM can improve the operational situation of organizations.
- H2: Linking KM to organizational problems and vice versa is an effective way to get management's attention.
- H3: Connecting KM solutions to organizational problems and tying them to Key Performance Indicators (KPIs) increases value creation.
- H4: Tying KM to the personal priorities and KPIs of C-Level executives increases chances for implementation.

The foundations for H1 are discussed in the conceptual background section and are supported by cited literature. Similarly, H2 aligns with mainstream KM thought, culminating in Drucker's frequently cited adage, "what gets measured gets done," implicit in his early work (e.g., Drucker, 1967). H3 follows these ideas, similar to the strategy implementation recommendations by Kaplan and Norton's "Balanced Scorecard" (BSC) since 1992. While not all attempts to implement BSCs have been successful, the general idea has become part of the business mainstream. Since the early 2000s, measures and KPIs for KM have been developed. The remaining challenge is to suggest a scalable method to implement H4 and test the results, which will be demonstrated in section two. Some of the operations problems, which increase the chance to get the attention of business managers are listed in random order in **table 1**.

Table 1: Selection of operational problems that typically attract management attention

Project teams exhibit slow progress due to insufficient collaboration among individuals or business units	Frequent reinvention of solutions due to inefficient information retrieval or lack of oversight
High rate of specialist retirements	Prolonged onboarding time for new employees
Need for upskilling through cross-domain knowledge or information transfer	Lack of comprehensive oversight for effective action
Increasing complexity in process coordination due to insufficient communication between administrative units	Customers struggle to find answers independently, leading to excessive reliance on human support
Inefficient information retrieval	High turnover of knowledge workers
Suboptimal resource utilization	

Linking KM solutions to these operational problems and contributing to resolving them will increase the likelihood of not only winning C-level attention but also becoming a long-term partner. A detailed guideline was presented by a KMGN project team (Kraus, 2024).

1.2 Interpreting Value as more then Shareholder Value

The concept of maximizing shareholder value, developed by Rappaport (1998) and others, builds on Jensen's Agency Theory (1986) and Stewart's Economic Value Added (1991). However, these authors did not emphasize Drucker's crucial point: the importance of prioritizing customer interests to generate profitable outcomes. Drucker expanded the idea of value creation from merely focusing on financial metrics to considering the entire value chain, including the customer perspective (Drucker, 1954). He further elaborated on the essential role of knowledge workers in value creation (Drucker, 1969), a discussion that continues today (Denning, 2022).

Corporations should focus on their purpose ("Why are we here?") and how value is created. The alignment of knowledge workers emerges from clear leadership on vision, transparency on resources and processes, and performance status (Drucker, 1973). Principles of self-organization (von Foerster and Zopf, 1962) may apply but require the context of the organization and KM systems (ISO 30401). These are all prerequisites for a sound business model that defines how and through which processes value is created.

2. Conceptional Background on KM and Alignment

We follow Kraus et al. (2020) and Oberschmid (2007) in their definitions of Knowledge Management (KM) as the "targeted design of framework conditions and processes in an organization, with special consideration of the production factor knowledge. The focus here is on creating and networking individual knowledge and applying this in value creation processes" (Oberschmid, 2007). This definition aligns with ISO 30401 (2018) and other academic scholars such as Drucker (1959), Mandl (1998), and Probst (1999).

To continue the discussion in the context of "business aligned KM", we suggest the following working definition:

Knowledge management (KM) is considered business aligned when:

1. The strategy of KM activities is firmly tied to the business strategy or other relevant aspects that ensure the survival of the organization.
2. This alignment is clearly visible to the business personnel, especially to executives.

Business alignment, particularly in the context of KM, is a well-studied field. The alignment of KM strategies with business strategies is crucial for ensuring organizational survival and effectiveness. Several authors in the field of KM have discussed this topic:

- Nonaka (1994) emphasized the importance of aligning knowledge creation processes with business strategies.
- Teece (1997) discussed the dynamic capabilities framework, which includes the strategic management of knowledge resources to align with business strategies for innovation and competitiveness.
- Davenport and Prusak (1998) presented research on the strategic management of knowledge and how aligning KM practices with business strategies can enhance organizational performance.
- Zack (1999) explored the necessity of aligning KM initiatives with organizational strategies to support decision-making and innovation.

These discussions connect organizational knowledge and capabilities with implications for innovation, competitiveness, and strategic decision-making.

2.1 Storytelling and KM

For successful KM, it is ideal that executives and knowledge workers support each other in achieving organizational objectives. Storytelling is an effective management method to facilitate this alignment (Brown, 2004; Schein, 2010). When both groups tell the same stories, alignment is more likely to be achieved. This supports our hypotheses H1 and H2.

Storytelling is effective in KM because it narrates and explains the connection between KM and business operations:

- Simplifies Complex Ideas: Storytelling translates complex KM concepts into tangible narratives, making them easier to understand.
- Engages Stakeholders: Stories are engaging and can capture the attention of both knowledge workers and executives.
- Creates a Shared Vision: When knowledge workers and executives share the same stories, it fosters a shared understanding and vision.

2.2 KM emerges in four levels as suggested by David Gurteen

David Gurteen's framework for KM includes four levels: Information Management, Knowledge Sharing, Sensemaking and Decision Making, and Behavior, Community, and Leadership (Gurteen, n.d.). While Gurteen presents these levels in an ascending order, we believe they can be implemented flexibly. Importantly, the fourth level—Behavior, Community, and Leadership—is crucial for the success of the other levels.

Four Levels of KM:

- **Information Management**: Centralized capture, storage, and distribution of information using IT systems and databases.
- **Knowledge Sharing**: Peer-to-peer learning through tools like peer assists and communities of practice, emphasizing personal knowledge sharing.
- **Sensemaking, Decision Making, and Innovation**: Utilizing facilitated discussions to create shared context, make informed decisions, and innovate.
- **Behavior, Community, and Leadership**: Empowering individuals to act on knowledge and fostering a community where leadership is a shared practice, not confined to formal positions of authority.

The four-level categorization is useful because many organizations have very different understandings of KM. In some organizations, KM is limited solely to information management and information technology. This corresponds to the “basic KM level” by Gurteen. Other companies might focus mainly on “networking among experts”. According to Gurteen, the third and fourth levels have almost nothing to do with technology or IT.

2.3 Connecting MBO and KPI to align KM with business objectives

The role of knowledge managers is to take a holistic view, identify critical areas, and determine how to make targeted improvements in knowledge and information management. Defining these targets involves selecting KPIs that align with those agreed upon with C-level executives during their annual performance appraisal.

2.3.1 Define MBO and KPI:

- **Management by Objectives (MBO):** A performance management approach where managers and employees work together to set, monitor, and achieve specific objectives.
- **Key Performance Indicators (KPIs):** Measurable values that indicate how effectively an organization is achieving its key business objectives.

2.3.1 Steps to Align KM with Business Objectives:

1. Identify organizational objectives and goals.
2. Define specific KM targets that support these objectives.
3. Develop KM KPIs that align with C-level executives' KPIs.
4. Monitor and adjust KM activities based on KPI performance.

2.3.1 Categories of Goals and KPIs:

- **Viability:** Ensuring the organization's survival is a top priority.
- **Operations:** Enhancing the organization's value creation capacity is essential.
- **Market:** Addressing stakeholder impacts, including customers and suppliers.
- **Technology:** Managing technological constraints and leveraging enablers.
- **Regulation:** Integrating regulatory requirements that impact the organization's opportunity space.

Table 2 provides examples of goals, challenges, and KPIs categorized into four perspectives: Viability, Operations, Market, Technology, and Regulation. Each perspective includes specific goals and KPIs that align with business objectives and help measure the effectiveness of KM initiatives.

Table2: Challenges and KPIs relevant for survival of organizations grouped in four levels

Perspective	Information Management	Knowledge Sharing	Sensemaking, Decision Making, and Innovation	Behavior, community and leadership
Viability	Analyzing financial risk for the organization	Lack of employees for sustainable a viable operation	Underestimated application of AI	Foreseeing and counteracting lack of business continuity
Operations	Media disruption	Processes improvements	Increased productivity or capacity, incl. time and cost savings	Missing technology adoption / Low technological adoption
Market	Ambiguity	Disregarded changes in customer needs	Loss of relevance in the market in growth or market share	Sales discontinued due to impaired social acceptance of products or operations
Technology	Lack of shared taxonomies and information architecture	(not addressed)	Sales discontinued due to outdated technology (process or product)	Resistance to change
Regulation	Lack of compliance regarding information storage and regulatory standards	Legal and regulatory risks	Limited freedom of operation	Underrated ecological sustainability and related regulatory aspects

Tables 3-6 contain the KM reference points related to our categories. We found a positive influence of these reference points to attracting C-Level attention. Please note that not all categories are supported by reference points.

Table3: KM reference points on level 1 by category

Category	**Reference points on level 1**
Viability	Simultaneous change management from old status to the new one.
	Securing management consensus on the impact (KPIs) of this action upon the business process and context.
	Continuous improvement on the guidelines and information management process.
	Capture measurable impact directly within a business process and context.
Operations	Bring all the stakeholders together and harvest their expectations and needs.
	Harvest all previous and current good practices regarding business initiatives.

Category	**Reference points on level 1**
	Fast access to relevant information based on the business context and user needs.
	Fast understanding and learning from information within context.
	Speedy operational action based on understood information.
Market	Become aware of all types of information relevant to the business context.
	Continuous communication of the impact (KPIs) of KM actions on the business process and context.
Technology	Selection of IT Tools and IM practices that support all the following steps.
	Create an information architecture and taxonomy relevant to the business context.
	Creation of high-quality information (Guidelines and Training).
Regulation	Clarify who needs what kind of information access and how quickly.
	Agreed rules among stakeholders for information handling and management.

Table 4: KM reference points on level 2 by category

Category	**Reference points on level 2**
Viability	Identify and focus on areas where there are business risks.
	Capture the benefit of learning activities and resulting actions and make them tangible.
	Continuous communication of tangible results to executives, thus further promoting and embedding these activities.
	Time to competence (time it takes for employees to be fully productive in their jobs).
	Pre- and post-measurement intervention.
Operations	Help people to turn their personal learnings (from work) into re-shareable and re-usable learnings (Teaching + Documentation).
	Motivation for knowledge sharing by SMEs and willingness to learn on the part of knowledge recipients.
	Promote a culture of turning failures into learnings.
	Foster learning activities within a shared context with SMEs (1:1 or as a CoP).
	Making personal access to internal subject matter experts affordable (1:1).
	Connect sharing activities and SMEs to defined processes and process steps (Anchor Points).
	Platform connecting SMEs with learners using business context, e.g., regular CoP meetings. Trust is essential through rules and culture.
	Define time and place to share knowledge and learn that leads to actions within business process and context.
	Use mentors to promote 70-20-10 learning, which will make knowledge more redundant and prevent re-inventing the wheel.
Regulation	Create a list of subject matter experts and a taxonomy of internal subject matters.

Table 5: KM reference points on level 3 by category

Category	**Reference points on level 3**
Viability	Advocate Innovation as a masterstroke to remain ahead of competition.
	Measure the impact of context decisions both qualitatively and quantitatively.
	Develop feedback mechanisms on all of level 3 activities to become a learning organization.
Operations	Promoting a culture of cross-silo collaboration, enabling CoPs.
	Build an environment to co-create/manage and contribute to innovation, growth and satisfaction.
	Set-up CoPs that use a portfolio of innovative KM techniques, interaction formats or workshop designs aimed at supporting business strategy and processes.
	Resulting in sense-making through alignment, conversations, visualizations and workshops leading to decisions out of shared context.
	Make this KM portfolio a standard methodology that is systematically used and integrated within daily business processes.
	This means bringing people together within business and subject matter context (CoP).
	Leading to business and bottom-line relevant decisions and actions based on understanding of shared context.
Regulation	Alignment of business needs and strategy with CoPs providing knowledge to cover key business areas.
	Continuously communicating CoPs and KM techniques to management as standard procedure to make decisions.

Table 6: KM reference points on level 4 by category

Category	**Reference points on level 4**
Viability	Empowered leadership by either executives or collaborators - company culture and trust.
	Support the deeper understanding of people and the business case.
Technology	Regular utilization of KM techniques and their enforcement in day-to-day business processes by employees and line managers.
Operations	Connected to current business campaigns.
Market	Establishing customer understanding to make sensible trade-offs among contradictory factors (quality, cost, time).
Regulation	Create the ability to act on regulation based on practical and conceptual experience.

Level 4 (behavior, community and leadership) has a strong impact on all levels before. For example, without leadership support, we cannot implement a sound information management system. Additionally, collaboration is required to implement any solution at any of the first three levels.

Empowered leadership by both executives and collaborators is fundamental to fostering a company culture based on trust. Solid psychological security within the organization ensures that individuals feel capable and confident in their actions. Leaders, human resources (HR), and organizational development (OD) professionals must be well-versed and trained in knowledge management (KM) techniques and methods. The regular application and enforcement of KM techniques in everyday business processes by employees and line managers is essential. Transformative behavioral change should be built upon a shared understanding and deep insight. Finally, it is important to support a deeper understanding of both individuals and the business case at hand.

3. Example and Discussion of aligning KM to C-level concerns

This section illustrates how aligning KM initiatives with C-level concerns can be achieved using a case study from the construction industry (Schoos, 2018). We will discuss the use of storytelling and connecting KM activities to management goals and KPIs.

3.1 Case Study: Construction Industry

In the construction industry, a significant challenge was identified: a lack of knowledge among employees, leading to financial risks for the organization. This problem was broken down into specific causes and consequences using methodologies like Root Cause Analysis (RCA) and Failure Mode and Effects Analysis (FMEA) – see figure 1.

3.1.1 Problem Identification

- **Primary Problem:** Lack of knowledge among employees.
- **Causes:** Insufficient experience as contractors and project managers; Limited direct personal interaction; Isolation on construction sites.

3.1.1 Consequences

First Tier Consequences:

- Loss of time due to inquiries and insufficient experience.
- Waiting for information due to limited interaction.
- Repeated errors in construction and project management due to isolation.

Second Tier Consequences:

- Delays in construction completion and additional costs for the building owner.
- Work overload for employees due to repeated errors.

Third Tier Consequences:

- Lack of resources for follow-up projects.
- Increased reliance on external resources to compensate for internal inefficiencies.

Fourth Tier Consequence:

- Financial risks for the organization.

The structure of this problem-resolution process aligns with RCA and FMEA principles by demonstrating how initial problems propagate through a series of intermediate effects to impact organizational objectives. This cascading effect is crucial for understanding the broader implications of seemingly isolated issues.

3.2 Connecting KM to Management Goals and KPIs

To align KM initiatives with management goals, it is essential to identify relevant KPIs and demonstrate how KM can impact these metrics. Based on this case study the following goals and KPIs support our categories:

- **Viability:** Reducing project delays and costs to ensure organizational survival.
- **Operations:** Enhancing knowledge sharing to improve operational efficiency.
- **Market:** Improving customer satisfaction by delivering projects on time and within budget.
- **Technology:** Utilizing advanced KM tools to streamline information flow.
- **Regulation:** Ensuring compliance with industry standards through better knowledge management.

Linking KM activities to these goals and KPIs allows knowledge managers to demonstrate the value contribution of KM. For example, reducing project delays through improved knowledge sharing can be directly tied to financial performance metrics, making it easier to justify KM integration to C-level executives.

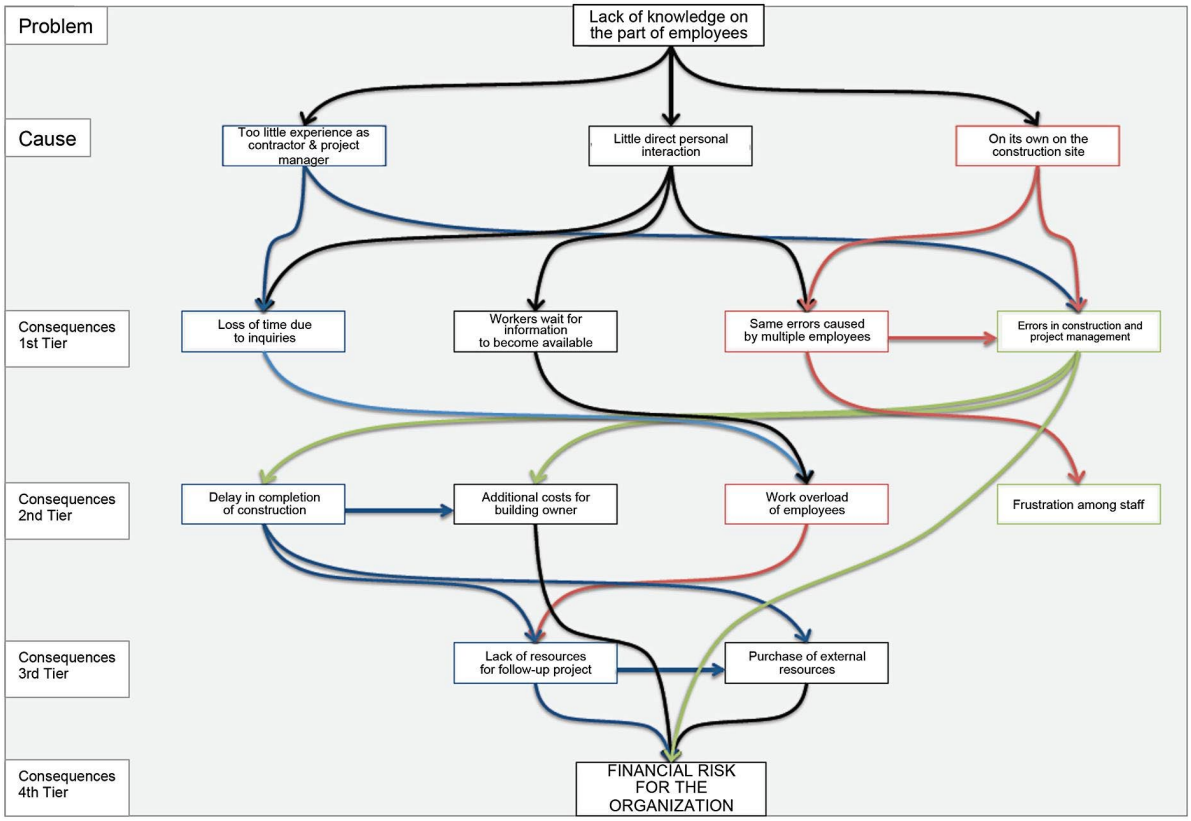


Figure 1: KM story example from construction industry (based on Schoos, 2018)

3.3 Practical Implementation

To implement KM solutions effectively, knowledge managers should follow a structured approach:

1. **Identify Critical Areas:** Use methodologies like RCA and FMEA to pinpoint key knowledge gaps and their consequences.
2. **Develop a Narrative:** Create a compelling story that links KM initiatives to organizational challenges and goals.
3. **Define KPIs:** Establish clear KPIs that align with management goals and measure the impact of KM activities.
4. **Engage Stakeholders:** Communicate the narrative and KPIs to C-level executives and other stakeholders to gain their support.
5. **Monitor and Adjust:** Continuously monitor the impact of KM initiatives on the defined KPIs and adjust as needed.

Aligning KM initiatives with C-level concerns requires a clear understanding of organizational goals and the ability to communicate the value of KM through compelling narratives and relevant KPIs. A structured approach helps knowledge managers to demonstrate the impact of their activities on the organization's success.

4. Conclusion and recommendations

This paper explored the alignment of Knowledge Management (KM) activities with organizational objectives, underscoring the importance of aligning KM efforts with the goals of senior management. Our findings indicate that alignment is achieved when KM activities meaningfully contribute to organizational success. This necessitates an initial analysis of managerial goals to facilitate this alignment.

To bridge the gap between KM initiatives and organizational priorities, we developed a method for knowledge managers to articulate the necessity of KM to C-level executives. This method maps knowledge gaps to critical business issues, empowering knowledge managers to demonstrate the essential role of KM in achieving organizational objectives. The direct effect of KM activities on business outcomes surpasses the opinion of Davenport that KM returns are not immediately visible.

The effectiveness and efficiency of this method were illustrated through real-world case studies, each clearly linking knowledge issues to their consequences across four tiers. The hierarchical structure of these consequences supports building a compelling narrative. The more KM solutions address these consequences, the more relevant the KM program becomes.

4.1 H1: KM can improve the operational situation of organizations.

Our case study showed that KM initiatives, such as improved knowledge sharing and information management, led to more efficient operations. For example, reducing project delays and errors through better knowledge management resulted in increased operational efficiency. The positive impact on operational efficiency, as demonstrated in the construction industry case study, confirms that KM can significantly improve the operational outcome of organizations.

4.2 H2: Linking KM to organizational problems and vice versa is an effective way to get management's attention.

Linking KM initiatives directly to organizational challenges, such as financial risks and project delays, supports capturing the attention of C-level executives. This connection was crucial in demonstrating the relevance of KM to business performance. The use of storytelling and clear communication of how KM addresses specific business problems effectively gained management attention and support.

4.3 H3: Aligning KM solutions to organizational problems and tying them to Key Performance Indicators (KPIs) increases value creation.

Establishing KPIs that align with organizational goals and measuring the impact of KM initiatives on these KPIs helped in demonstrating the value of KM. Tracking the reduction in project delays and cost savings provided tangible evidence of KM's contribution to value creation. The alignment of KM activities with KPIs related to organizational goals, such as operational efficiency and financial performance, increased the perceived value of KM solutions among C-level executives.

4.4 H4: Tying KM to the personal priorities and KPIs of C-Level executives increases chances for implementation.

Personalizing KM initiatives to address the specific priorities and KPIs of C-level executives, such as improving operational efficiency and reducing costs, increased the likelihood of implementation. This personalized approach ensured that KM initiatives were seen as directly relevant to executive priorities. Tailoring KM activities to the personal goals of C-level executives facilitated their buy-in and support, leading to successful implementation of KM solutions.

Acknowledgements

This paper benefits from a project to develop a guideline for "Business Aligned KM" by the Knowledge Management Global Network (KMGN) during 2023 with an international team led by Dr. Pavel Kraus (SKMF, Switzerland) and Dr. Manfred Bornemann (GfWM, Austria) including the following contributors: Joshua Azaki, South Africa; Sergio Gisbert, United Kingdom; Dr. Moria Levy, Israel; Glenroy London, Trinidad & Tobago; Sabyasachi Parida, Hong Kong; Dr. Gil Regev, Switzerland; Lynne Schneider, USA; Bart Verheijen, Netherlands.

The authors would like to acknowledge the use of OpenAI's GPT-4.o for assisting in the development and refinement of the manuscript. The AI provided suggestions and edits to enhance the clarity and coherence of the text. All final content, interpretations, and any errors remain the sole responsibility of the authors.

References

Bornemann M.; Alwert, K. (2007): The German Guideline for Intellectual Capital Reporting, Journal for Intellectual capital.

Bornemann, M. Reinhardt, R. (2008): Handbuch Wissensbilanz – Umsetzung und Fallbeispiele. ESV.

Brown, J. S., Denning, S., Groh, K., & Prusak, L. (2004). Storytelling in Organizations: Why Storytelling Is Transforming 21st Century Organizations and Management. Butterworth-Heinemann.

Dalkir, K. (2011). Knowledge Management in Theory and Practice. MIT Press.

Davenport, T. H., & Prusak, L. (2000). Working Knowledge: How Organizations Manage What They Know. Harvard Business Review Press.

Davenport, T.H. and Prusak, L. (1998) Working Knowledge: How Organizations Manage What They Know. Harvard Business School Press.

Drucker, P. F. (1999). Management Challenges for the 21st Century. Harper Business.

Drucker, P.F. (1959) The Landmarks of Tomorrow. Harper & Brothers.

Drucker, P.F. (1973) Management: Tasks, Responsibilities, Practices. Harper & Row.

Gurteen, D. (n.d.). The Four Levels of Knowledge Management. Conversational Leadership. Available at: https://conversational-leadership.net/four-levels-of-knowledge-management/ [Accessed 15 Jul. 2024].

International Organization for Standardization (2018) ISO 30401:2018 Knowledge Management Systems – Requirements. ISO. Available at: https://www.iso.org/standard/68683.html (Accessed: 10 July 2024).

Jensen, M. C. (1986). Agency costs of free cash flow, corporate finance, and takeovers. American Economic Review, 76(2), 323-329.

Kaplan, R. S., & Norton, D. P. (1992). The balanced scorecard: measures that drive performance. Harvard Business Review, 70(1), 71-79.

Kotter, J.P. (1996) Leading Change. Boston, MA: Harvard Business School Press.

Kraus, P. (2015) 'Wie Wissensmanagement-Projekte nachhaltig scheitern. Auf dem Weg zu einer Erfolgslogik', in Beier, H., Schmidt, U. and Klett, D. (eds.) WISSENSMANAGEMENT beflügelt: Wie Sie einen unbegrenzten Rohstoff aktivieren. Berlin: Akademische Verlagsgesellschaft AKA.

Kraus, P. and Bornemann, M. (eds.) (2020) D-A-CH Wissensmanagement Glossar 2020. Gesellschaft für Wissensmanagement. Available at: https://www.gfwm.de/wp-content/uploads/2020/01/D-A-CH_WM-Glossar_2020.pdf (Accessed: 10 July 2024).

Kraus, P. and Regev, G. (2017) 'Beyond Activities: Business Process Models from a Knowledge Management Perspective'. BPMDS Lessons Learned from Practice, pp. 81-89.

Kraus, P. and Bornemann, M, (eds) (2024): A guideline enabling knowledge managers to communicate better with business managers. Available at: https://www.skmf.net/en/resources/kmgn-report/

Mandl, H. and Reinmann-Rothmeier, G. (1998) Wissensmanagement: Informationsverarbeitung im Kontext von Arbeit und Lernens. Verlag Hans Huber.

Nonaka, I. (1994) 'A Dynamic Theory of Organizational Knowledge Creation'. Organization Science, 5(1), pp. 14-37. DOI: 10.1287/orsc.5.1.14.

Nonaka, I., & Takeuchi, H. (1995). The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation. Oxford University Press.

Oberschmid, H. (ed.) (2007) Das Praxishandbuch Wissensmanagement - Integratives Wissensmanagement. 1st edn. Wissensmanagement Forum.

Probst, G.J.B., Raub, S. and Romhardt, K. (1999) Managing Knowledge: Building Blocks for Success. John Wiley & Sons.

Rappaport, A. (1998). Creating Shareholder Value: A Guide for Managers and Investors. 2nd ed. New York: Free Press.

Schein, E. H. (2010). Organizational Culture and Leadership. 4th ed. San Francisco: Jossey-Bass.

Schoos, K. (2018) Wissensmanagement im Baumanagementbüro. Master's thesis (unpublished). Lucerne University of Applied Sciences and Arts – Engineering & Architecture.

Stewart, G. B. (1991). The Quest for Value: A Guide for Senior Managers. New York: Harper Business.

Teece, D.J., Pisano, G. and Shuen, A. (1997) 'Dynamic Capabilities and Strategic Management'. Strategic Management Journal, 18(7), pp. 509-533. DOI: 10.1002/(SICI)1097-0266(199708)18:7<509::AID-SMJ882>3.0.CO;2-Z.

Von Foerster, H. and Zopf, G.W. Jr. (eds.) (1962) Principles of Self-Organization: Transactions of the University of Illinois Symposium. London: Pergamon Press.

Zack, M.H. (1999) 'Developing a Knowledge Strategy'. California Management Review, 41(3), pp. 125-145. DOI: 10.2307/41166000.