



Proceedings of the 18th European Conference on Innovation and Entrepreneurship

**hosted by Universidade Portucalense
Porto, Portugal**

21-22 September 2023



Volume Two

**Edited by
Fernando Moreira and Shital Jayantilal**

Proceedings of the
18th European Conference on Innovation
and Entrepreneurship
ECIE 2023

Hosted By

Universidade Portucalense
Porto, Portugal

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E-Book ISBN: 978-1-914587-87-0

E-Book ISSN: 2049-1069

Book version ISBN: 978-1-914587-86-3

Book Version ISSN: 2049-1050

Published by Academic Conferences International Limited

Reading, UK

+44-118-972-4148

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ECIE Preface

These proceedings represent the work of contributors to the 18th European Conference on Innovation and Entrepreneurship (ECIE 2023), hosted by Universidade Portucalense, Porto, Portugal on 21-22 September 2023. The Conference Co-Chairs are Fernando Moreira and Shital Jayantilal both from Universidade Portucalense, Porto, Portugal.

ECIE is now a well-established event on the academic research calendar and now in its 18th year the key aim remains the opportunity for participants to share ideas and meet the people who hold them. The scope of papers will ensure an interesting two days. The subjects covered illustrate the wide range of topics that fall into this important and ever-growing area of research.

The opening keynote presentation is given by Prof Doutor Eurico Brilhante Dias, ISCTE Business School, University of Lisbon, Portugal speaking on *“The Importance of an Innovation Ecosystem as a Driver for Exports and Economic Growth”*. The second day of the conference will open with an address from Giuseppe Sofo, McKinsey Fintech, UK and Germany, on the topic of *“Fintech and the new Generation of Entrepreneurs Changing the way Business is done”*.

With an initial submission of 260 abstracts, after the double blind, peer review process there are 112 Academic research papers, 6 PhD research papers, 4 Masters Research papers, and 6 work-in-progress papers published in these Conference Proceedings. These papers represent research from Australia; Austria; Brazil; China; Colombia; Cyprus; Czechia; Denmark; Finland; France; Germany; Greece; India; Ireland; Israel; Italy; Lebanon; Lithuania; Malaysia; Malta; Netherlands; New Zealand; NIGERIA; Norway; Peru; Poland; Portugal; Republic of Korea; ROMANIA; Singapore; Slovakia; South Africa; Spain; Switzerland; Thailand; Tunisia; UK; United Arab Emirates; UK and the USA.

We hope you enjoy the conference.

Fernando Moreira and Shital Jayantilal

Universidade Portucalense, Porto
Portugal
September 2023

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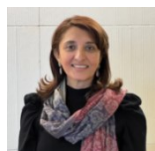
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Biographies

Conference Chairs



Fernando Moreira has been a member of the Science and Technology Department at Portucalense University since 1992, currently as a Full Professor, and a visiting professor at the University of Porto Business School. He was the head of the Science and Technology Department from May 2018 until February 2022. He is graduated in Computer Science (1992), M.Sc. in Electronic Engineering (1997) and PhD in Electronic Engineering (2003), both at the Faculty of Engineering of the University of Porto and Habilitation (2018). He teaches subjects related to undergraduate and post-graduate studies. He supervises several PhD and M.Sc. students. He is a (co-)author of more than 200 scientific publications with peer-review on national and international journals and conferences. He serves as a member of the Editorial Advisory Board for several journals and books. He organized several special issues from JCR journals. He has already regularly served as a member of Programme and Scientific committees of national and international conferences. He was the MSc in Computation coordinator during the last ten years. He holds editorial experience, and he is co-editor of several books. He is associated with NSTICC, ACM and IEEE. His principal research areas are mobile computing, ICT in Higher Education, Mobile learning, Social business and Digital transformation. He was awarded Atlas Elsevier Award in April 2019



Shital Jayantilal currently, is the Head of the Department of Economics and Management at Portucalense University. She lectures under graduate and graduate courses in Strategy and Strategic Management. She, has a PhD in Business Studies from Externadura University (2016) and a degree in Economics from the Faculty of Economics, University of Porto (1999). She is also a practitioner and an experienced Senior consultant, with more than 15 years hands-on experience in aiding more than 50 SMEs and family firms, across diverse industries promoting their sustainability and enhancing trans-generational family business wealth. Presently, she is a member of the research unit REMIT – Research on Economics, Management and Information Technologies, Porto. Her main topics of research are Main research interests: Family Firms; Strategy; and Game Theory, and has published in various international journals. Having been awarded by Entrepreneurship and Innovation Exchange and Family Business editorial teams, the 2021 Schulze Publication award.

Keynote Speakers



Eurico Brilhante Dias holds a degree in Business Management, a Master's degree in Business Sciences, and a Ph.D. in Business Sciences. He is a Professor at ISCTE-IUL (ISCTE Business School) and served as a Deputy in the XIII, XIV, and XV Legislatures. He was also the Secretary of State for Internationalization during the XXI and XXII Constitutional Government. As a Member of Parliament, he served as the Vice-Chairman of the Committee on European Affairs and as a member of the Committee on Budget, Finance, and Administrative Modernization. He has served as the Director of the Management Degree at ISCTE and as the Coordinator of Master and Postgraduate Studies at INDEG ISCTE. He has spoken at national and international events, including EIBA 2012, the World Investment Forum, and the Progressive Economy Conference. He has published work in Business Logistics, Macro logistics, and the determinants of attracting Foreign Direct Investment and the Internationalization of SMEs. He is a member of the Order of Economists and the National Secretariat of the PS. Currently, he is the President of the PS Parliamentary Group.

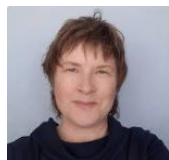


Giuseppe Sofo is a Fintech Expert and Client Advisor, part of McKinsey Fintech Practice leadership. He lives and works between London and Berlin, where he leads client relationships with fintech companies and investors. He also runs the EMEA McKinsey Fintech Connect programmes, which are bootcamps for senior executives of banks, investment funds, tech and fintech companies to engage and start working together. In his client service, Giuseppe serves a number of fintech startups, PE firms, VC funds, large banks and some fintech hubs. He supports clients mainly on B2B Sales acceleration and shaping equity narrative, and focuses on Digital Banking, Core Banking, Open Finance and Sustainability. Beyond the McKinsey work, Giuseppe is a passionate music lover and DJ and also cofounded a few startups, including a global community for music producers.

Mini-Track Chairs



Nasser Abouzakhar is the director of Anzar Property Investment Limited which was founded in 2017 and the author of the book *Real Estate Investment: In the pursuit of building income-producing assets to grow your wealth*. He is an award-winning author and a regular guest on the BBC Arabic TV channel. Between 2004 and 2019, he worked at different universities in the UK as an academic, teaching and researching different technology-related subjects. Nasser has a good understanding of the property investment business and finances. He has firm relationships with professionals in banking, legal, accounting, and valuation which assist with his responsibility as the company director. He leads a highly professional and experienced property management team.



Carol Air has a PhD in entrepreneurship and is a Lecturer in purchasing and supply chain management at Aberdeen Business School, in Aberdeen, Scotland. Carol is currently working on a number of business innovation and pedagogical projects in which she is exploring the application of design thinking approaches. Carol is supervising doctoral students undertaking projects in innovation, entrepreneurship and design thinking.



Nikolaos Apostolopoulos, PhD, is an Assistant Professor in European Policies in Sustainability and Entrepreneurship at the University of Peloponnese and visiting fellow at the Neapolis University Pafos. He also acts as scientific advisor at the Labour Institute of General Confederation of Labour (INE/GSEE) in Greece. He is co-editor of the edited volumes entitled: “Universities and Entrepreneurship: Meeting the Educational and Social Challenges”, “Entrepreneurship and the Sustainable Development Goals and Entrepreneurship”, “Institutional Framework and Support Mechanisms in the EU”.



Teresa Dieguez, Specialist on Strategy and Entrepreneurship at Polytechnic Institute of Cávado and Ave (IPCA), Portugal. She founded her first company in 1995 and in 2007 she took a Master on Innovation and Technological Transfer. Now, Teresa is a professor and a co-promotor of different businesses and activities. She is a Social Judge, and she is taking her PhD on Social Sustainability and Development.



Isabel Ferreira, PhD in IS and Technology, from the University of Minho, Portugal. Research collaborator in the group IS and Technologies for the Transformation of Organizations and Society, University of Minho. Isabel, has been teaching in Higher Education since 2001, Polytechnic Institute of Cávado and Ave. Research interests: e-government, electronic public procurement, public policies, social innovation, and active learning methodologies.



Heather Fulford has experience leading research and knowledge transfer projects with small business and third sector organizations in the UK. Her research interests lie in enterprise and social innovation. Heather is currently leading a project exploring the use of design thinking for business process improvement in SMEs, and is also engaged in a social innovation project work using systems thinking and design thinking approaches. Heather is supervising several doctoral projects focused on aspects of innovation, enterprise and design thinking.



Paula Loureiro, PhD student in Business Sciences, with several publications in the areas of Human Resources Management and Organizational Behavior. Paula has been teaching in Higher Education since 1998. Experience in coordinating disciplinary areas of the Management Department. Research interests: Career Management, Skills management, Equal opportunities, and diversity management.



Alexandros Kakouris, PhD, PhD, is an Assistant Professor in entrepreneurial learning and education at the Department of Management Science and Technology of the University of Peloponnese and at the Hellenic Open University. He holds PhD in Physics, PhD in Entrepreneurship and a MSc in Adult Education. His special interests concern: fostering entrepreneurship and innovation to science graduates, context-aware entrepreneurship,

support of youth entrepreneurship through teaching and counselling as well as nascent entrepreneurship, transformative and experiential learning. He is on the editorial board of International Journal of Management Education.



Margaret Mangion holds a Doctorate in Social Sciences from the University of Leicester (UK). She is Director and Senior Lecturer at The Edward de Bono Institute for Creative Thinking and Innovation at the University of Malta, where she has been lecturing on creativity, innovation and leadership since 2012. Dr Mangion represents Malta as an ambassador for World Creativity and Innovation Week/Day events. She is a member of a number of International Societies and her work has been published in peer-reviewed conference proceedings, edited books and journals. Margaret has considerable experience in the public and private sector.

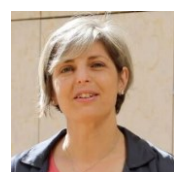


Florinda Matos is a Professor at Iscte Business School - University Institute of Lisbon and an Integrated Researcher at DINÂMIA'CET – Iscte, Centre for the Study of Socioeconomic Change and the Territory. She is the founder and president of the Intellectual Capital Association (ICAA). She is researching the area of Intellectual Capital and Knowledge Management, Innovation, Organizational Resilience, Digital Transformation & Sustainable Development.



Renato Pereira, PhD in Management Sciences, is Professor of Entrepreneurship, Innovation, and International Business at Iscte Business School, Lisbon, Portugal. His research interests cover the organizational implications of creativity and innovation, the role of emerging technologies on new business opportunities, and valuation methods of innovative start-ups.

Jordan Srour is



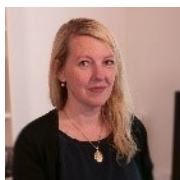
an associate professor of operations management at the Lebanese American University (LAU). She holds a PhD in Logistics Management from the Rotterdam School of Management, Erasmus University. With a background in both mathematics (BA from Carleton College) and transportation (MSE from UT Austin), her research and teaching focuses on data analytics for management problems across a variety of domains. Dr. Srour also serves as the Assistant Provost for Educational Resources and Innovation.



Christy Suciu works in the College of Business and Economics at Boise State University. Her research into design thinking is published in the Academy of Management Learning and Education with a paper titled, “The Need for Design Thinking in Business Schools.” Her book “Design Thinking and Strategy” (Suciu & Kaupins) is used in 3 different MBA “Design Thinking and Strategy” courses. She is the director for “The COBE Innovation Challenge.” She is also a consultant for major global companies such as HP, Blue Cross, Micron, and Wells Fargo.

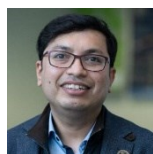


Andreas Walmsley, PhD, is Associate Professor in Business at Plymouth Marjon University. He conducts research in entrepreneurship, especially entrepreneurship education, graduate entrepreneurship and responsible entrepreneurship. He is on the editorial boards of the journals Entrepreneurship Education and Pedagogy and the International Journal of Entrepreneurial Behaviour and Research.



Birgitte Wraae, PhD, is an Associate Professor in Entrepreneurship at the Faculty of Business and Technology and the Department of Applied Business Research at UCL University College Denmark. Her research interests are in entrepreneurship, especially entrepreneurship education: identity formation, emancipation, and employability. She excels in doing research in connection with the entrepreneurial learning space. She has recently published a book on the entrepreneurial learning journey.

Workshop Facilitators



Rajiv Vaid Basaiawmoit, Ph.D., MBA, is the Head of Sci-Tech Innovation & Entrepreneurship at Aarhus University, Denmark. He is an award-winning Entrepreneurship Educator and works at the intersection between innovation, entrepreneurship, interdisciplinary-collaboration and gamification. He designs and embeds Entrepreneurship into curricular education. He is an invited speaker at many conferences and events around the globe and he has spoken on various well-known platforms such as TEDx, ECS and NATO-CoE.

Author Biographies

Nasser Abouzakhar is the director of Anzar Property Investment Limited, founded in 2017 and the author of the book *Real Estate Investment: In the Pursuit of building income-producing Assets to grow your wealth*. Nasser is a TEDx speaker, award-winning author, and a regular guest on the BBC TV channel for over 100 live TV interviews, including the *Homes Under the Hammer* TV show. Between 2004 and 2019, he worked at different universities in the UK as an academic, teaching and researching different technology-related subjects. Nasser has a good understanding of the property investment business and finances. He has firm relationships with professionals in banking, legal, accounting, and real estate valuation, assisting with his responsibility as the company director. He leads a highly professional and experienced property management team.

Ricardo Abreu obtained a bachelor's degree in consumption sciences by the Portuguese Institute of Marketing Administration (IPAM). He holds a master's degree in sociology, innovation and society, and a PhD in innovation public policy, obtained at ISCTE-IUL. He is a professor and researcher at ISCTE-IUL and IPAM, focusing on innovation, technology, consumer and market behavior.

Amiruddin Ahamat is an Associate Professor at Universiti Teknikal Malaysia Melaka, Malaysia. He received his doctorate from the University of Sheffield, UK. He has been an active academic and researcher at numerous institutions in different countries. He is an active researcher with more than 10 research grants secured locally and abroad, valued at USD 50,000.00.

Idayuwati Binti Ahmad from Malaysia and currently doing my PhD from Universiti Tun Hussein Onn Malaysia (UTHM) Malaysia. My major field of research is SMEs development in the rural areas of Malaysia. Moreover, I am a Director of Twinmarissa Group Resources, running my own business setup as an entrepreneur in Johor and Malacca.

Toluwanimi Akaehomen is an entrepreneur and a researcher, with research interests in immigrant entrepreneurship/innovation, enterprise/entrepreneurship education and training, and leadership. She has published in a peer-reviewed publication in the areas of female immigrant entrepreneurship and Entrepreneurship education and training. She is in her final year of her PhD programme at Coventry University, UK.

Susana Aldeia is an Assistant Professor at the Portucalense Unversy (UPT) and Polytechnic Institute of Maia (IPMAIA) . She holds a Phd in Taxation and a DEA from the Vigo University (Spain) in Tax Law; a postgraduation in Taxation from the IPCA and a degree in Accounting, also from the IPCA.

Muazam Ali is a PhD student of Universiti Tun Hussein Onn Malaysia, recently completed and submitted my final thesis. My interest fields of research are entrepreneurship development, entrepreneurial intention and digital entrepreneurship. Moreover, I have also presented and published more than six research papers in international conferences and research journals. And I have five years' professional experience of government and international organizations.

Esli Sichem Almazan-Rivera is a Business Faculty student in the Banking and Financial Administration career at the Universidad Privada del Norte in Lima, Peru.

Sofia Anastasiadou, is the Head of Department of Statistics and Insurance Science, University of Western Macedonia, Greece. She is Professor of Statistics and Research Methodology, Biostatistics and Biomedicine

Research Methodology. He has published more than 300 research papers in high-ranking scientific journals and international conferences.

Eleni Anastasopoulou is an Agronomist and Ph.D. candidate in agri-food entrepreneurship and sustainable rural development at the University of Peloponnese. Her main research focuses on food policy, sustainable entrepreneurship, applying innovation, and digitalization to ensure high-quality food. She is the author/co-author of 5 peer-reviewed publications (SCI journals), 1 book chapter, and has 13 contributions to international conferences.

Ioannis Anastasopoulos is a Civil Engineer and PhD candidate in strategies and policies for tourism real estate investments and mixed-use developments, at the Department of Tourism Studies, at the University of Piraeus. He holds a Master's degree in Governance and Public Policies at the University of Peloponnese.

Roberta Dutra de Andrade, PhD Student is Management professor at the Federal University of Ceará and Unicatólica de Quixadá, also lectures at the University of Beira Interior. Junior researcher at NECE-UBI and FCT Portugal fellowship holder. PhD student at the University of Beira Interior interested in entrepreneurship and knowledge management in entrepreneurial ecosystems.

Jorge Antunes obtained a bachelor's degree in modern and contemporary history, and a master's degree in science, innovation, and society, obtained at ISCTE-IUL. He also holds a postgraduate diploma in science and technology management and policies from NOVA University of Lisbon. Currently, Jorge Antunes is a R&D project director at COIN – Innovation Consulting.

Ján Bajčan is a Comenius University graduate from Bratislava, who attained a management degree and honoured their skills in the energy industry. Fuelled by a desire to make a lasting impact in the environmental and green energy sector, they strive to lead the way towards sustainable solutions. Passionate, knowledgeable, and driven, they are poised to revolutionize the future of energy for a greener world.

Raphael Bar-El is Professor Emeritus at Ben Gurion University and faculty member of the of the Applied Economics Department at Sapir College. He specializes in regional economic development and innovation policy, with extensive experience in Israel, Brazil, Ethiopia and other countries. Was head of the Economic Planning Authority in Israel.

Thibaut Batal is a PhD student in creativity at Cesi, France. Engineer in computer science and applied mathematics, he worked for a few years for a startup in VR and now investigate how to increase group creativity through immersive environments. His leitmotiv is to help entertainment media to positively influence their psychological consequences.

Patrícia Beličková has been a PhD student at the Faculty of Mass Media Communication since 2022. Her work primarily revolves around conducting scientific research and publishing in the field of emotions in marketing and neuromarketing. She places significant emphasis on integrating knowledge from behavioral sciences and customer psychology.

Harry Bell is a researcher at the School of Management at Swansea University, UK, where he received his PhD in business management in 2022. His current research focus is innovation and technology adoption in healthcare. He has industry experience in the clinical trials sector, and currently undertakes a knowledge transfer partnership with CPR Global Tech.

David J. Bentolila is Head of the Graduate program of Logistics and Global Supply Chain in Ruppin Academic Center, Israel. Also CEO of Bento Consultants Ltd. His areas of interest are logistics, supply chain, innovation, entrepreneurship, and quality. He has long experience in innovation and development projects in Israel, Latin America, Africa and Asia.

José Jacinto Bilau is a Professor at Department of Management at Institute of Beja, Portugal, and researcher at CEFAGE-UE. His main research areas are entrepreneurship and entrepreneurial finance.

Beat Birkenmeier is a lecturer of Entrepreneurship & Innovation at University of Applied Sciences and Arts Northwestern Switzerland. He received his DSc in Management, Technology and Economics from the Swiss Federal Institute of Technology (ETH) Zurich. In addition to his research and teaching activities, he works as a management consultant with a strong focus on innovation management.

Lamia Bouaziz is an assistant professor of finance and accounting at Manouba University, Tunisia. She is a reviewer in several journals such as African Development Review. In 2021, she participated in [the Financial Economics Meeting conference](#) (p24); and [Fintech, Business Ecosystem and Economic Development conference](#). Her main research areas are bank stability, institutional reforms, entrepreneurship and innovation.

Ascensão Braga is a professor of Management at Polytechnic Institute of Guarda, Portugal. She received her PhD in Management from Évora University in 2005. Her main research area is management.

Dario Brand is an Online Marketing Freelancer at Marketing.MBA. He graduated with a Master's Degree in Online Communication at the Anhalt University of Applied Sciences. His research interests include the metaverse, artificial intelligence and social media.

Tiina Brandt is a principal lecturer of leadership and HR at Haaga-Helia University of Applied Sciences, Finland. Her doctoral dissertation was about personality and leadership in 2005. She is actively publishing in international journals, and she has interest building up the projects with companies. Her research interests are related to individual qualities in organizations and fostering entrepreneurship.

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Realization of Entrepreneurial Intentions in Global Crises: A Qualitative Study

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Abstract: Managers have at least two social roles in their job position: One is to keep the business running while the other role searches for entrepreneurial opportunities to exploit. Both roles have one aspect in common: the security of the organization's existence, in short term as manager and in long term as entrepreneur. Our paper compares entrepreneurial intentions - the mental preparation to follow entrepreneurial goals – as well as the realization of these intentions in crises. The research question is: how do global crises affect the realization of entrepreneurial intentions? The approach is explorative, describes four directions of entrepreneurial intentions and what happened during their realization. We conducted two qualitative interview series, partly structured with two sequentially partly standardized guidelines, one in 2018/19 with 13 participants, the follow-up series in 2022/23 with 10 of the 13. The intentions of the interviews from 2018/19 were assigned to four directions: four of the wholesaling managers intended no to low collaboration in the familiar markets (direction I), four sought high collaboration in the familiar markets (II), two wanted no to low collaboration but to engage in unfamiliar markets (III), and three were looking for high collaboration in unfamiliar markets (IV). During the second interview series we confronted the participants with their intentions. The responses of 2022/23 show that global crises influenced the entrepreneurial intentions in different ways. Despite several crises between the two interview series, three wholesalers followed their intentions. All others changed directions. While some managers struggled with the situation and postponed or even discarded the intentions others saw new opportunities and exploited them. Consequently, it can be stated that crises can nevertheless maintain intentions and/or lead to new ideas. In times of a crisis, it is advisable to continue to keep both roles: the manager role must guide the company through the crisis, while at the same time ensuring its existence by exploiting opportunities as entrepreneur. For this purpose, we derived entrepreneurial paths from the results: (1) focus on existing business in familiar market, (2) expansion of the business segment in familiar market, (3) entering unfamiliar markets.

Keywords: Entrepreneurship, Crisis, Wholesale, Collaboration, Market

1. Introduction

Managers are interested in the security of their organization's existence. On the one hand, this means to keep the business running daily. On the other hand, managers must observe the current situation on behalf of the exploitation of opportunities to stay competitive through further value generation which bears a certain risk. One individual is confronted in its actions by these two social roles (Schumpeter, 1939) – being the manager of daily business and the entrepreneur exploiting opportunities.

The action of exploitation is limited by the social situation, in general or temporarily. General limitations are, e.g., being a small or medium-sized enterprises (SME) with less resources than larger firms, the organizational business capabilities to generate current values which might not be sufficient for exploitation (Adner, 2017; Fleischer et al, 2007; Weber et al, 2019). Temporary limitations are the current situation of a single market or even a global crisis affecting several markets which may influence entrepreneurial activities.

The COVID-19 pandemic as well as the Russia-Ukraine war offered research insights in the field of entrepreneurship in times of global crises (see for example Callegari and Feder, 2022, Kuckertz and Brändle, 2022 or Thukral, 2021). In this paper we answer the research question: *how do global crises affect the realization of entrepreneurial intentions?* Therefore, we provide insights of 13 enterprises in German wholesale – seven SMEs and six large enterprises according to the definition of the European Union (IfM Bonn, 2023) – and compare the entrepreneurial intentions from 2018/19 retrospectively with their realization. Wholesale is an important economic sector in Germany generating value in almost every industry and branch. An enterprise is categorized as wholesale if their main value is generated through the purchase and sale of goods in large numbers to commercial users (Ausschuss für Definitionen zu Handel und Distributionen, 2006). Wholesalers are mainly family businesses and structured like SMEs even if the numbers of employees and their annual revenue

are comparable to large enterprises. According to the Federal Department of Statistics (Destatis, 2022) wholesale generates twice the revenue of retailers with half the employees:

Table 1: Economic numbers in German wholesale and retail (Source: Destatis, 2022)

	Wholesale	Retail (as comparison)
Annual Revenue	1.3 tri. €	0.6 tri. €
No. of employees	1.8 mil.	3.5 mil.
No. of companies	138k	322k

The following chapter provides the related work this paper is embedded. Further, we describe the methodology, present our findings, and as a result three entrepreneurial paths. The paths emerging from our results are first assumptions and limited to our methodological approach as well as to the subject of investigation.

2. Related Work

Entrepreneurship is the identification and exploitation of business opportunities by individuals (Liguori et al, 2018). Opportunities are divers, vary in their expected value and stimulate their own exploitation (Shane and Venkataraman, 2000). The identification of one opportunity initiates the process of entrepreneurial action (Kirzner, 1973). This deliberate action follows a specific series of subsequent actions of one individual, and its organization by means of a plan. The plan is the entrepreneurial intention, “[a] state of mind directing a person’s attention (and therefore experience and action) toward a specific object (goal) or a path to achieve something (means). [...] Entrepreneurial intentions are aimed at either creating a new venture or creating new values in existing ventures” (Bird, 1988). Furthermore, the current economic situation enables or restricts entrepreneurial action, for example a worldwide crisis. A global crisis is not necessary an organizational crisis.

An organization is in crisis if its reaction does not solve the problem threatening its existence (Fink et al, 1971). The intensity of a crisis can be observed in the degree of adaptation that is necessary to successfully solve the problem (Fink et al, 1971). However, an organizational crisis can also be an opportunity to reach its goals (Milburn et al, 1983). Recent global crises, disrupting supply chains worldwide (Ivanov and Das, 2020; Ponis and Ntalla, 2016) can be an opportunity or danger for an entrepreneurial intention (Davidsson et al, 2021). Reaction or adaption to the new situation enables creativity and innovative responses (Thukral, 2021) enabling entrepreneurship.

The managers we interviewed are set in the following frame of entrepreneurial actions: (1) if SME having less resources than large enterprises, (2) being active in different markets with individual sets of opportunities, (3) main value creation being the trade of goods in a global supply chain, and therefore (4) value creation was directly or indirectly affected by the global crises in recent years.

This leads to two fields of entrepreneurial activity for this paper. On the one hand, collaboration, through which resources can be bundled, and on the other hand, markets in which products and services are offered.

Assuming that entrepreneurial intention is the intention of organizational growth – as Bird (1988) suggested by creating new value in existing enterprises – regarding the market as well as the product or service it provides, Ansoff (1957) identified four (entrepreneurial) strategies: (1) market penetration with the current product on the current market, (2) product development and offering a new product on the current market, (3) market development with the current product on a new market and (4) diversification and with new product lines in new markets.

Exploiting business opportunities is restricted in the organization’s capabilities generating the current value. Collaborations with other organizations and their set of capabilities remove this limitation or create new opportunities (Adner, 2017). Hence, interorganizational collaboration itself is an entrepreneurial activity (Kusa, 2017), and at some point of an organizational growth natural (Greiner, 1998). Casals (2011) sees several benefits for SMEs to collaborate: better position in market competition, risk sharing as well as exploiting new business opportunities, among other things. In a highly competitive market collaboration in a network – so called business ecosystems – is seen as inevitable (see for example Moore (1993), Adner (2017), and Weber et al. (2020)).

3. Research Methodology

The paper follows a heuristic approach according to Kleining and Witt (2000) for the exploration of social phenomena. The premise is that global crises affect entrepreneurial intentions by resetting the frame of entrepreneurial action. We see qualitative heuristics as an adequate way to explore how global crises affect entrepreneurial intentions. Both interview series were semi-structured with two different guidelines. According to the respective research question the interview series 1 in 2018/19 was a focused interview, the interview series 2 in 2022/23 a problem-centric interview. The participating enterprises were wholesalers and first arbitrarily selected in 2018 by the German southwestern wholesale association following the research specifications of diversity in enterprise size, revenue and traded good. Table 2 shows an overview of the participants. “E#” is an abbreviation for ‘enterprise’. All interviews were recorded and transcribed.

Table 2: Overview of enterprises

#	No. of employees	Revenue in mil. EUR	Goods	Position of the interviewee
E1	27	4	Dentist supplies	Managing Director
E2	70	20	Door sheets	Managing Director
E3	93	240	Fuels	Managing Director
E4	131	53	Supplies for rubber and plastic manufacturing	Managing Director
E5	77	45	Rolling bearings for manufacturer	Managing Director
E6	68	21	Metal and sanitary supplies	Managing Director
E7	19	5	Butcher supplies	Managing Director
E8	1.189	424	Window and door sheets	Board Member
E9	1.227	878	Farmer supplies	Division Manager
E10	191	58	Electrical and sanitary supplies	Managing Director
E11	361	219	Drug distribution for pharmacies	Division Manager
E12	330	250	Books for retail	Managing Director
E13	190	50	Wall paints and painting supplies	Managing Director

3.1 Interview Series 1 (2018/19)

The focused interview method sets a stimulus for the interviewee for an affective response (Hopf, 2004). The research question within the interviews was: *What are entrepreneurial intentions in wholesale?* For this interview the stimulus was a statement by a painter made in a newspaper’s online outlet interview (Tagesspiegel, 2018). On the question where the future is headed asked by the journalist, the painter responded:

“Distribution will change to the maximum. For us, this means that *wholesale*, where we buy our wall paints, *will change*. Traditional distribution will no longer exist in the future” (emphasis by authors).

We set the stimulus with the open question “Where are *you* heading?” emphasizing the ‘you’ to create the moment for an affective response.

Transcripts were evaluated using the content analysis according to Mayring (2014). A codebook was formed on inductive categories during the first analysis. The categories were set on the market of the intended exploitation (familiar or unfamiliar) and the intention of interorganizational collaboration.

3.2 Interview Series 2 (2022/23)

The second interview series followed the problem-centric method of qualitative interviews: the interviewer follows the narrative response of the interviewee within the given framework conditions and set around a specified problem (Witzel, 2000). In this case the framework conditions are: being the entrepreneur of an enterprise in wholesale, the problem was a recent global crisis. The research question was: *How does a global crisis affect entrepreneurial intentions in wholesale?* The guideline was adjusted for each interview to the enterprise and the responses given in interview series 1. The codebook was preset on codes regarding the context of acting in recent crises as well as a retrospect on the entrepreneurial intentions in 2018/19. Statements were interpreted hermeneutically pursuing an understand of the interviewees’ situation (Kinsella, 2006).

4. Findings

Table 3 opposes the enterprises' intentions of 2018/19 to their actual business described in the interview series of 2022/23. If or to what extent the reality matches the intentions is considered in the following.

In the interview series 2022/23, organizational changes in management were observed in two of the companies considered. E8 had a change in top management. E12 were acquired by competitors. Due to these organizational changes, no statement can be made about how recent crises have affected these companies, so the interviews are not included in the findings and conclusion as well as excluded from table 3. E6 sent a short statement via email explaining the competitive situation in its market.

Table 3: Entrepreneurial Intention vs. Reality

E#	Intention in 2018/19	Reality in 2022/23
E1	Adding value via services to the traded good (e.g., documentation, presentation)	Supplement by disinfection manufacturing and trading in medical and non-medical sector
E2	Overall services around the product via collaborations	Acquisition of technical staff members enabling the overall services. No collaboration needed
E3	Convenient store in gas station transforms to coffee shop with new collaborations	Restructuring of gas station became unaffordable; collaboration with other fuel wholesaler for customer payment
E4	Customer with low volume to generate production capabilities and project management skills	Acquisition of production plant to continue to provide customer with goods filling crisis-related gap in the supply chain
E5	New services via collaborations (e.g., in maintenance)	Plans were postponed due to challenges in the supply chain
E6	Being one of the last three competitors	Intention unchanged
E7	Overall services around the product via collaborations	Overall services were implemented; enterprise was sold in 2019
E9	Overall services around the product via collaborations (e.g., a digital service-portal)	Overall services around the product via collaborations (e.g., a digital service-portal)
E10	Central platform provider for wholesale in construction in collaboration with other wholesalers	No collaborations due to missing openness to new business models of wholesalers
E11	Overall services around the product via collaborations	No collaboration due to differences in the orientation
E13	Collaboration with purchasing group	No collaborations due to crisis

The following paragraphs provide insights using original statements by the interviewees. These quotes reflect the situation of each wholesaler on how recent global crises affected their entrepreneurial intentions.

By saying *"Added value in service is important, including documentation, presentations or user films about the product. [...] there is actually a strong focus on them."* the interviewee of E1 points out clearly a service-focused intention to add value to the traded good. By 2022 E1 entered an unfamiliar market on account of the COVID-19 crisis: *"And that [pandemic] ultimately also influenced my decision to strategically position ourselves in such a way that we now see ourselves not only as a dental company, but also as a company in the medical sector with [...] disinfectants. [...] And we are in the process of building up a second pillar in the non-medical sector."* E1 identified new opportunities in a yet unfamiliar market and decided to prioritize these over the servitization-intentions.

Similar to E1, the managing director of E2 intended to focus on new services but via collaborations: *"We have to think about how we can restructure our business model to find a service component in this value chain in addition to the product component [...]"* After confrontation in the second interview with this former intention it turned out that E2 made a relatively large acquisition in 2021 gaining 15 service technicians benefitting from the crisis. This development enabled E2 *"the shift into trade-related services"* offering their customers additional services *"from electrics to access systems and automatic door drives"* without collaboration partners.

In 2018 E3 was willing to enter an unfamiliar market: *"We want to professionalize our store business. [...] get away from this 'corner shop image' [in a gas station] and specialize in the café business [...]"* A great extent of

collaboration with partners who are familiar with the 'café business' would have been needed, but the COVID-19 pandemic prevented necessary partnerships and implicated supply problems as well as skills shortage. The intentions *"ended up falling behind quite a bit because of Corona. [...] if you buy a coffee machine today, you'll be happy if it's delivered in half a year, [...] in terms of construction, modernization [...] We would like to modernize our gas station stores, which was not a problem five years ago. [...]"* Hence, recent global crises affected the entrepreneurial intention on a superordinate level.

Differently to E1-E3, E4 planned *"to generate project management competence to offer our customers production options for their really small quantities"*. The global crises in the past years affected the intentions: through subsidiaries new competencies could be built up: *"[S]ince 2018, we have also continued to work on our business model in the sense that we integrated a component assembly [...]"*. E4 had the opportunity to take over a production plant manufacturing the parts customers needed but were unable to obtain due to a disrupted supply chain.

E5 targeted to offer 'new services via collaborations': *"[...] but primarily I live from sales. [...] I can work [with] service companies with the one that has always done maintenance for the customer anyway"*. The response of 2022 provides insights in an enterprise hit by the COVID-19 crisis and the effects on the supply chain and price developments: *"So since the middle of last year [2021], these price increases have been there. [...] Because the supply chains were broken off by Corona [...]"*. In addition, customers expected E5 to take the risk in this uncertain market: *"[...] I must take the whole work and capital risk off his hands. I must take away the risk off whether he needs it at all. I must cover the supply chain issues and so on, [...] the challenge is to provide convenience for the customer."* In this situation, intended collaboration was postponed: *"So what I see as the most urgent collaboration now, which we are already working on, is a [collaboration] that fits in with our customers [...] if I want to look after pan-European customers in the maintenance business now."*

"My entrepreneurial goal is to be one of the last three companies in my purchasing association. [...]", E6 replied to the question of his entrepreneurial intentions in 2018. In 2023, according to a statement via email the company continues to feel the consequences of past crises but is still active in the field of metal and sanitary supplies. A second interview has not yet taken place.

E7 and E9 intended to set up 'overall services around the product via collaborations. E7: *"[...] In the future, we will focus more on networks, especially in logistics. [...] We want to offer our customers overall solution bundles in the future [...]"*. E7 realized its intention and was sold before COVID-19 and the Russian-Ukrainian war hit businesses. E9's intentions were neither affected in the recent years, new collaborations for all-around services and digital businesses could be set up in the familiar market. E9: *"We have a whole range of activities in the area of digitalization [...]. There are various state projects where we are also involved [...]. There is the Digital Farming Association, of which we [...] have become a member."*

For E10, the entrepreneurial intention of 2018 was to create a platform in collaboration with other wholesalers to offer a one-fits-all solution in the construction industry. However, *"that was one of the things that didn't work, because in B2B [...] everyone lives in their business model like that and tries to seal off as well."* Actions were taken in expanding the regional supply for goods availability as well as increasing the storage capacity in response of the Russian-Ukraine war, *"[a]nd in the direction of the customers that the degree of digitalization has also increased in our company"*.

E11 strongly intended in 2018 to seek new collaborations in a network for all-around services, even with competitors: *"Everyone recognized that we can only create added value for the pharmacist [...] by working together from different areas. [...] we must act as part of a network to be able to offer a powerful solution for our customers."* In the interview series 2 it turned out that acting towards the direction of high collaboration in the familiar market could not be pursued due to strategic management disagreements with the collaborating partners but not due to global crises aspects: *"And we actually wanted to offer our service to all pharmacies. Even the pharmacies that do not want to participate on this platform."*

"[...] We are very broadly positioned, and the problem is conveying this breadth [...] so we're working on getting a leaner range. [...]" E13 set their intention to a specification of the product portfolio in the interview of 2019. During the interview in 2022 due to crises a further enlargement of their product portfolio was necessary: *"[...] During the crisis, we sometimes had to switch to alternative products and significantly expand our product portfolio. [...] Well, it has proven to be more diversified. [...]"*. Hence, E13 did not pursue its intentions due to crises, but it turned out to be more efficient to go the opposite way from a narrow to a broader product range.

Table 4 provides an overview of all E# intentions and realization in comparison in terms of “collaborations” and “market”. The directions I-IV result from the different characteristics high/low and familiar/unfamiliar.

Table 4: Directions of entrepreneurial intentions and realizations

Intention 2018/19	Familiar Market	Unfamiliar Market
High Collaboration	II: E2, E5, E9, E11	IV: E3, E7, E10
Low Collaboration	I: E1, E4, E6, E13	III: E8, E12
Reality 2022/23	Familiar Market	Unfamiliar Market
High Collaboration	II: E9	IV
Low Collaboration	I: E2, E3, E4, E5, E6, E10, E11, E13	III: E1

5. Conclusion & Discussion

The findings of our interviews show that the recent global crises had very different effects on the enterprises interviewed and thus the entrepreneurial decisions have been very diverse. The analysis of the interviews shows that the way a crisis affects these wholesalers depend strongly on the organizational structure and on the respective domain in which these enterprises generate their value.

For example, suppliers of the automotive industry (due to COVID-19-related supply bottlenecks and short-time work) were significantly more affected by the global crisis than wholesalers of the food sector (see E9). A quote from E5 clarifies that on the organizational side there has been a constant demand to find new solutions to problems created by the crisis: *“Yes, it was a time marked by crises where one was constantly [... running] from one fire source to another. Orders were breaking away at the beginning of Covid times. [...] So, there were issues that came in that we actually thought we had forgotten.”*

The fact that company E4 was less affected by the crisis due to its domain, and was even able to benefit from it, becomes clear in the following quotation: *“We came through the corona pandemic very successfully, but of course we also had all the supply chain problems. However, we have not had any problems since we now source more regionally in the injection molding area [...] So we got through the crisis quite well. Also, because the industry focus that we have [...] has not suffered so much. In fact, we were able to benefit from it.”*

Based on the summarized interview results, we derived three paths the interviewees chose in their entrepreneurial action during the crises. These paths are briefly described below and depicted in figure 1.

Focusing on existing business: This path was chosen for different reasons. E5 and E6 felt a direct shock creating an organizational crisis. Especially in the already highly competitive market of E6 the global crises fueled their struggle of existence. The companies E5 and E3 had to put their intentions on hold due to the crisis and focused on stabilizing their core business. However, in comparison with E5, E3’s intention was interrupted indirectly due to unavailability of material and products in the disrupted supply chain (Ivanov and Das, 2020). The same disruption led to the decision of E13 to discard the leaner storage and instead expanded the portfolio with new products. All three enterprises – E3, E5 and E13 – ensured their deliverability as a crisis reaction. The managers of E10 and E11 changed their intentions unrelated to the crises. Both reached their limits in collaboration when they realized each partner has different organizational goals conflicting with their intention. E10 and E11 have no more intention for collaborations contrary to the assumption of its inevitability in highly competitive markets (Adner, 2017; Moore, 1993). In the categorization of Ansoff (1957) all six enterprises chose to further penetrate their familiar market with their products.

Expansion of the business segment: During the interviews, two sub-paths could be identified, how companies reacted to the crises to expand their existing business. On the one hand, E4 took the path of expanding its existing business field by setting up their *own production* to generate additional value but also to react to supply bottlenecks triggered by crises. As Milburn, Schuler and Watman (1983) assumed and already observed in the recent years (for example by Davidsson et al, 2021) E4 exploited a new opportunity in the event of global crises. E2, on the other hand, benefitted differently. While their original intention was based on the premise to create *new services* in collaboration with companies offering the necessary set of capabilities the crises situation offered the opportunity to integrate this set on their own by acquisitioning other companies. The intention of E9, on the other hand, was not at all effected by the crises. The enterprise created *new services* with collaboration partners in their market following assumptions of the network collaboration by Adner (2017) and

the enterprise development via collaboration by Greiner (1998). Path 2 follows Ansoff's (1957) categorization of product development or new products on the current market.

Entering unfamiliar markets: E1 did not follow its intention of further penetrating the current market as proposed in 2018. The company exploited new opportunities provided by the pandemic and shows entrepreneurial creativity like others did (Kuckertz and Brändle, 2022). The adaptation to the situation and providing a new product to its current market (disinfections in the medical sector) as well as expanding the product in unfamiliar market (the gastronomy) also follows the assumption about new opportunities in times of crises (Milburn et al, 1983). In Ansoff's (1957) matrix E1 is categorized in diversification expanding in an unfamiliar market with a new product.

These derived paths show that the interviewed enterprises have identified a variety of ways to handle the crises. How successful the paths are, will become clear during the next interview series in five years. The following figure summarizes these results.

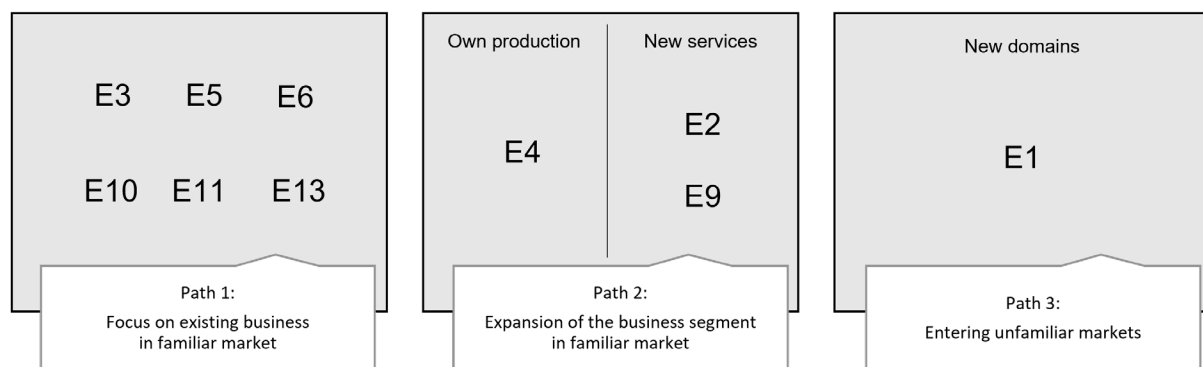


Figure 1: Entrepreneurial Paths

The two interview series show that the global crises had a strong influence on the entrepreneurial intentions of the wholesalers as defined in 2018/19. As a result of the crises, it could be observed that a stronger focus on physical products and the core business was undertaken than was foreseeable in 2018/19. One of the main topics in the interviews in 2018/19 was the development of new services. The interview series in 2022/23 showed that the relevance of the development of new services has become less relevant due to the global crises. The aspect of collaboration, which had a high priority for most interviewees in 2018/19, has also lost much of its relevance due to the disruption of supply chains. Contrary to the assumptions and observation in research about collaborations of the last decades (Adner, 2017; Moore, 1993; Weber et al, 2019) most of the planned collaborations were subordinated in the entrepreneurial plans by the interviewees during the crises.

6. Limitations and Outlook

Limitations are based on the explorative approach using qualitative methods. Results are not representative due to the sample size, the selection process, as well as the focus on wholesale. The research offers in-depth insights about the identification and actual exploitation of opportunities and how a crisis may affect these plans. The results of this paper offer many ways for future research. (1) Longitudinal panel study: We will further accompany these enterprises and interview them again about their current situation as well as their entrepreneurial intentions for the future. (2) Conducting a survey: the results have potential to create and test several hypotheses in this topic, e.g., if further wholesalers kept focus on their business and postponed their entrepreneurial intentions. (3) Qualitative study on exploitation: a study of intrinsic or extrinsic motivation in planning an exploitation and eventual doing it can be of research interest.

Acknowledgment

Interview series 1 was funded by the Ministry of Economy, Labor and Tourism of Baden-Wuerttemberg, Germany.

References

- Adner, R. (2017) "Ecosystem as structure: An actionable construct for strategy", *Journal of management*, vol. 43, no. 1, pp. 39–58.
- Ansoff, H. I. (1957) "Strategies for diversification", *Harvard business review*, vol. 35, no. 5, pp. 113–124.
- Ausschuss für Definitionen zu Handel und Distributionen (2006) *Katalog E, Definitionen zu Handel und Distributionen*, 5th edn, Cologne.
- Bird, B. (1988) "Implementing Entrepreneurial Ideas: The Case of Intention", *Academy of management review*, vol. 13, no. 3, pp. 442–453.
- Callegari, B. and Feder, C. (2022) "Entrepreneurship and the systemic consequences of epidemics: a literature review and emerging model", *International Entrepreneurship and Management Journal*, vol. 18, no. 4, pp. 1653–1684.
- Casals, F. E. (2011) "The SME co-operation framework: A multi-method secondary research approach to SME collaboration", *2010 International Conference on E-business, Management and Economics IPEDR*, pp. 118–124.
- Davidsson, P., Recker, J. and Briel, F. von (2021) "COVID-19 as External Enabler of entrepreneurship practice and research", *BRQ Business Research Quarterly*, vol. 24, no. 3, pp. 214–223.
- Destatis (2022) *Unternehmen, Beschäftigte, Umsatz und weitere betriebs- und volkswirtschaftliche Kennzahlen im Handel: Deutschland, Jahre, Wirtschaftszweige*, [online], <https://www-genesis.destatis.de/genesis/online?operation=previous&levelindex=1&step=1&titel=Ergebnis&levelid=1666853951228&acceptcookies=false#abreadcrumb>.
- Fink, S. L., Beak, J. and Taddeo, K. (1971) "Organizational crisis and change", *The Journal of applied behavioral science*, vol. 7, no. 1, pp. 15–37.
- Fleischer, J., Herm, M. and Ude, J. (2007) "Business capabilities as configuration elements of value added networks", *Production Engineering*, vol. 1, pp. 187–192.
- Greiner, L. E. (1998) "Evolution and revolution as organizations grow", *Harvard business review*, vol. 76, no. 3, pp. 55–64.
- Hopf, C. (2004) "Qualitative interviews: An overview", *A companion to qualitative research*, vol. 203, no. 8, p. 100093.
- IfM Bonn (2023) *SME definition of the European Commission*, [online], <https://www.ifm-bonn.org/en/definitions/uebersetzen-nach-english-kmu-definition-der-eu-kommission>.
- Ivanov, D. and Das, A. (2020) "Coronavirus (COVID-19/SARS-CoV-2) and supply chain resilience: A research note", *International Journal of Integrated Supply Management*, vol. 13, no. 1, pp. 90–102.
- Kinsella, E. A. (2006) "Hermeneutics and critical hermeneutics: Exploring possibilities within the art of interpretation", *Forum Qualitative Sozialforschung/Forum: Qualitative Social Research*, [online] vol. 7, no. 3, Art. 19, <http://nbn-resolving.de/urn:nbn:de:0114-fqs0603190>.
- Kirzner, I. M. (1973) *Competition and entrepreneurship*, Chicago, London, University of Chicago press.
- Kleining, G., Witt, H. and others (2000) "The qualitative heuristic approach: A methodology for discovery in psychology and the social sciences. Rediscovering the method of introspection as an example", *Forum Qualitative Sozialforschung/Forum: Qualitative Social Research*, [online], vol. 1, no. 1, Art. 13, <http://nbn-resolving.de/urn:nbn:de:0114-fqs0001136>.
- Kuckertz, A. and Brändle, L. (2022) "Creative reconstruction: A structured literature review of the early empirical research on the COVID-19 crisis and entrepreneurship", *Management Review Quarterly*, vol. 72, pp. 281–307.
- Kusa, R. (2017) "Interorganisational collaboration in view of the theory of entrepreneurship", *Studia i Materiały*, 1/2017 (23), pp. 83–93.
- Liguori, E., Winkler, C., Hechavarria, D. and Lange, J. (2018) "Interdisciplinary perspectives on entrepreneurial ecosystems", *Journal of Enterprising Communities: People and Places in the Global Economy*, vol. 12, no. 2, pp. 86–91.
- Mayring, P. (2014) "Qualitative content analysis: theoretical foundation, basic procedures and software solution2", [online], <https://www.ssoar.info/ssoar/handle/document/39517>.
- Milburn, T. W., Schuler, R. S. and Watman, K. H. (1983) "Organizational Crisis. Part I: Definition and Conceptualization", *Human Relations*, vol. 36, no. 12, pp. 1141–1160.
- Moore, J. F. (1993) "Predators and prey: a new ecology of competition", *Harvard business review*, vol. 71, no. 3, pp. 75–86.
- Ponis, S. T. and Ntalla, A. (2016) "Crisis management practices and approaches: Insights from major supply chain crisis", *Procedia Economics and Finance*, vol. 39, pp. 668–673.
- Schumpeter, J. A. (1939) *Business cycles: a theoretical, historical, and statistical analysis of the capitalist process*, New York, McGraw-Hill Book Company.
- Shane, S. and Venkataraman, S. (2000) "The promise of entrepreneurship as a field of research", *Academy of management review*, vol. 25, no. 1, pp. 217–226.
- Tagesspiegel (2018) *Malermeister Schultze: „Wir müssen uns neu erfinden“*, [online], <https://www.tagesspiegel.de/wirtschaft/wir-muessen-uns-neu-erfinden-4981879.html>.
- Thukral, E. (2021) "COVID-19: Small and medium enterprises challenges and responses with creativity, innovation, and entrepreneurship", *Strategic Change*, vol. 30, no. 2, pp. 153–158.
- Weber, P., Hiller, S. and Lasi, H. (2019) "Design and evaluation of an approach to generate cross-domain value scenarios in the context of the industrial internet of things: a capability-based approach", *2019 Portland international conference on Management of Engineering and Technology (PICMET)*, pp. 1–8.

- Weber, P., Hiller, S. and Lasi, H. (2020) "Identifying business potentials within an IoT ecosystem—An explorative case study in the industrial domain", *2020 American Conference on Information Systems (AMCIS)*.
- Witzel, A. (2000) "The Problem-Centered Interview", *Forum Qualitative Sozialforschung / Forum Qualitative Social Research*, [online], vol. 1, no. 1, Art. 22, <http://nbnresolving.de/urn:nbn:de:0114-fqs0001228>.

Public Funding and Innovation – NITEC: The Portuguese case

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Abstract: The topic of innovation and of economic development is unavoidable in national and international policies, as those are also fundamental to the daily life of firms and universities, as well as for each one of us as an element of change. To modern economies, innovation is crucial for the firms' performance. Therefore, governmental entities have built and endorsed initiatives and programs to promote innovation in firms. The European Innovation Scoreboard (European Commission, 2022) states that EU Innovation performance has increased by "about 10%-points since 2015 and there has been noticeable progress in the EU's global position". Public funding is ultimately a political instrument to increase the number of resources allocated to innovation activities. Financial subsidies have been the main instrument used by most of OECD countries to stimulate research and development activities (Gonsáles & Pasó, 2008). In this sense the aim of this paper is to understand what the outputs of an innovation incentive instrument in Portuguese firms were, considering internal innovation processes. Moreover, after the pandemic crisis, innovation became even more a critical topic, since the technological transformation has accelerated and from those derived transformations in human capital, technology, and technological access, to name a few. According to the Global Competitiveness Report 2020 countries should "expand public investments in R&D", as well as "create incentives that favour patient investments in research, innovation and invention" (Schwab, Klaus, Sahidi, 2020, p.6). It is important to consider the impact of political strategies and orientations have on the promotion of firms' innovation capacity and the way it is translated into innovation. In the scope of this study, it was select an incentive program to innovation, translated into the establishment of research and technologic development nuclei (NITEC- Núcleos de Investigação e Desenvolvimento Tecnológico – NITEC) on firms. This paper attempts to highlight the need to different and more qualitative approaches on the impact of public funding on innovation in private firms. It investigates the Portuguese case, since it was here that the RDI (research, development and innovation) norm was created and has a direct link with public funding strategies.

Keywords/Phrases: Innovation Systems, Public Funding, Innovation Ecosystems, Knowledge

1. Introduction

According to the Global Competitiveness Report 2013-2014 (Schwab, 2014) there is a close relation between the level of complexity of the firm's management system and the level of development and innovation of a country. It seems clear that more sophisticated business and management practices produce a higher efficiency in the production of goods and services. The sophistication of businesses and management systems concerns not only the comprehensiveness of a countries business networks, but also the individual quality of a firms' strategy and operation. In that report, competitiveness is defined as the sum of institutions and factors that determine a country level of productivity. The mechanisms that determine the potential growth of a country were also considered, namely: education and training, technological progress, macroeconomic stability, governance, firms' sophistication, and market efficiency, among others. Public funding is ultimately a political instrument to increase the number of resources allocated to innovation activities. Financial subsidies have been the main instrument used by most of OECD countries to stimulate research and development activities (Gonsáles & Pasó, 2008). Studies suggest that being granted with any type of direct help increases firms probability of conduction innovation activities (Huergo & Moreno, 2017). The way innovation support systems are design tend to promote more sophisticated management processes and firm's internal innovation systems (Sabala-Iturriagoitia, Voigt, Gutiérrez-Gracia, & Jiménez-Sáes, 2007). In this sense we try to understand what the outputs of an innovation incentive instrument in Portuguese firms were considering internal innovation processes.

The Portuguese economy is classified as an economy based on innovation (Schwab, 2017), being so, it is imperative that the investment on innovation systems is accomplished, as well as the stimuli to the creation of innovation and business networks, and the liaison to universities. The Portuguese economy is recognised as innovative and emphasises the importance of investing in innovation systems, fostering innovation networks, and connecting with universities. Portugal, as an EU member, has received substantial financial support through various frameworks since 1989, totaling over 107.7 billion euros by 2017. An additional 23 billion euros will be added through the Portugal 2030 framework. The earlier frameworks concentrated on economic infrastructure, human resource development, competitiveness, agriculture, rural and industrial development, and regional

potential. Subsequent frameworks integrated goals like human resource qualification, competitive factors, social cohesion, and sustainability and more importantly enhanced the investment on innovation. The most recent frameworks, including Portugal 2020 and Portugal 2030, prioritise intelligent, sustainable, and inclusive growth, digital and green transition, and investment in innovation.

From both the perspectives of Portuguese government and the European Commission, it is important to consider the impact that those political strategies and orientations have on the promotion of firms' innovation capacity and the way it is translated into innovation. In the scope of this study, NITEC program was selected as the incentive program to innovation to be analysed, which was translated into the establishment of research and technologic development nuclei (NITEC) on firms.

The creation of the NITEC initiative (was based on the Decree-Law 70-B/2000 of the 5th May and its specific regimentation on the regulation number 441/2003 of 28th of May, and it aims at the development of research and technological development (R&TD) units within firms.

A research and technological development (R&TD) unit was understood as a small team with permanent status, composed by three persons as a limit, exclusively dedicated to develop and endogenise technological skills within a company, and built in activities structured by projects that were translated into new products, processes or systems, or the introduction of significant improvements, with clear technologic upgrade, in products, processes or systems already existent¹.

Therefore, the main objectives of this unit were:

- To create internal R&TD activities within a firm, as well as to reinforce the drive to pursue these features.
- To promote technological knowledge endogenisation and improve firms' absorptive capacity.
- To allow an effective uprising of national companies through the marketing of technologically innovative products.

According to Gouveia (2005), in Portugal the effort to mobilise all agents of the education, science and technology systems had to be bigger so that the goals of Lisbon strategy could be met. During the last twenty years there has been a considerable growth of the education, science, and technological systems. Nevertheless, there is still the need to promote important changes in these systems so that it becomes more competitive and dynamic. There is an urgent need to engage it with organisations and firms that are responsible for economic growth and wealth. The development of R&TD units in firms has contributed to promote a closer collaboration between organisations of the science and technology system and firms.

Also, it contributed not just to the rising of a research and innovation activities, but also to a bigger demand of highly qualified jobs by firms, which led to significantly increase of private supported research, development, and innovation.

2. Methodology

The study was designed to capture the variety of changes that happened in the firms financed by NITEC funding. Information was collected on a significant number of instances: firms, university, and intermediary entities by interviewing participant-informants. Using theory-driven sampling (Eisenhardt, 2007), respondent were selected from the group of firms that were pioneers in applying for NITEC. Within these firms the firm's owners, CEO or the persons responsible for innovation process were elected.

The interview protocol was initially designed based on the literature analysis performed. The interviews check list was constructed based on previous studies, namely the study of Silvia Massa and Stefania Testa (Massa & Testa, 2008) on Italian Small and Medium Enterprises; the study of Garcia-Quevedo (García-Quevedo, 2004) on the relationship between public funding on R&D and private R&D expenditure; the study Becheikh, Landry and Amara (Becheikh, Landry, & Amara, 2006) on innovation processes and the internal and contextual factors driving it; and the study of Bougrain and Haudeville (2002) on SMEs' internal research capacities to exploit external scientific and technical knowledge and to use networks of innovators.

¹ <http://www.adi.pt/nitec.htm>

The main goal was to enable interviewees to express their opinion regarding the different topics raised by the questions, but also to discuss other issues that he/she may considered relevant for the study. All the interviews were recorded and later transcribed (*verbatim* transcription). For the interpretation of data, transcripts of interviews were entirely used, but also the information exchanged before and after recording. All these data enabled a greater understanding of key issues. Using the method of Miles, Huberman, & Saldaña (2014), we reduce raw data in structured and quantifiable data. The treatment of data by the cataloguing of the answers, identification of units of thought and frequency of response was used by authors as Noblet, Simon, & Parent (2011), Valkokari, Paasi, & Rantala (2012) and Hermans & Castiaux (2017).

In this case, it was identified key words in the answers collected which enabled the assessment of frequency of citation, keyword, or related words. Thus, it was possible to present and analyse the data quantitatively. Throughout this accounting, some phrases were selected that were relevant due to objectivity of content and because they sign a personal or common point of view with other entrepreneurs. So, we also present qualitative data for a better understanding of the issue.

The universe of research was a group of 68 companies unevenly distributed throughout the Portuguese territory. A non-disclosure agreement was signed with all respondents to ensure the confidentiality of the information provided.

Some measures to ensure validity were adopted. Issues of external validity were partially addressed by closely following the grounded theory approach, and by concentrating in the problem of internal validity and reliability and by cross-referencing the qualitative data with other sources, like NITEC final reports, results of the European Innovation Scoreboard, other studies about the outputs of public funding on firms' innovation systems. This triangulation approach increased confidence that the qualitative data were accurate, and that interpretation was true to the intentions of the interviewees.

Firms from the Porto, Aveiro and Viseu region that were granted funding by the NITEC program were part of the sample. These locations were selected not only because of its strong entrepreneurial activity, but also due to the close functional and administrative relationships, and convenience for data collection.

Besides the interviews, data from the NITEC final reports that were issued by the National Innovation Agency (ANI) was gathered, as a way of complementing the information amassed during the interviews. These reports also allowed to have information regarding the level of investment of firms, and the level of funding comprehended for each firm involved.

All data was analysed using NVivo software² that allowed a detailed analysis of specific topics, once all the information was encoded, and provided a systematic process in data analysis and research, increasing validity and reliability of the study.

3. Measuring innovation – indicators used by firms

The perception of what innovation is, and what it implies, is usually connect to the way their outcomes are measured. In this case, it is relevant to investigate what are firms' most used innovation indicators, as well as for funding agencies.

In the case of funding agencies, several innovation indicators are used to assess projects and their eligibility, that range from the quality of the project presented to its contribution to regional development. On the one hand, there are a set of indicators related to the project proposal's quality and feasibility, and to the ability of the firm to describe the existing state of the art using a technological and scientific language, and to clearly translate the mapping made of the several stages and outcomes of the project submitted. These set of indicators rely on the existing knowledge and human resources of the firm, as well as on the current status of R&D department or experience. In smaller firms this fact could appear as a barrier to innovation, as pointed out in the study of Massa and Testa (2008), since SMEs tend to have less available resources that can allocate time to measure the outputs and outcomes of innovation or that have the level of knowledge necessary to make it.

The degree of novelty related to the object of the proposal is also assessed and it is dependent of the context where it will be adopted, such as the firm itself, the national or international markets, which highlight the

² NVivo 12.1.0 (3068), QSR Internacional

concern that project's results should exceed the firm level, not only being able to reach the national market but also the international one.

On the other hand, there is a set of indicators that assess the impact of the project at both the firm level, and at regional and national economy level. More specifically, funding agencies look for projects that are able not just to improve firm's competitiveness, but also are able to contribute to the national economic development, as well as the development of the regions where the firms are located through the dissemination of knowledge, creation of jobs and human capital development. Also, if the project has impact on more than one region it receives a higher rate.

In the case of firms, and considering the answers of the interviewees, four different types of indicators were identified as being used by firms to measure innovation: *financial*, *innovation process*, *market* and *knowledge/know-how*. Also, most respondent firms have their innovation systems certified by the NP 4457 norm which implies that those firms have already implemented a set of indicators that are frequently used to measure its innovation activities.

The NP 4457 is a Portuguese norm, issued in 2007, that sets the management system requirements for research, management, and innovation (RDI). This norm has into consideration the recommendations of the Oslo Manual, the Kline and Rosenberg chain-linked model (Becheikh et al., 2006), and it is meant to be applied in all types of economic activities (industry and services). This model sees the company as an open system strongly connected to its surrounding environment, which implies that the model is attentive to the interactions inside the company and desires to stimulate them so that all innovation possibilities are taken into consideration. Innovation management is also about interface management, which represent the ability to communicate inside and outside the firm, to have the nuclear skills to innovate and learn to create a new innovation cycle (Iso, 2007). The interfaces are technological vigilance, technological cooperation, technological forecast, new customers/clients, internal and external analysis, intellectual property, internal creativity, organisation capability to conceive innovation structures and knowledge management (Iso, 2005). As stated by (Rocha, Lima, Amorim, Romero, & Crus-Cunha (2022, p.2) this standard defines the requirements of a research, development and innovation system (R&D+I) and is supported by the standard NP4458 that defines the requirements of an R&D+I project. NP4458 is meant to facilitate the systematisation of R&D+I project and improve its management. This standard is used as a reference to identify the project characteristics and ensure its planning, documentation, realisation and evaluation, and certified companies under NP4457, are expected to have more mature and defined project management practices, when compared to noncertified companies".

The *financial type indicators* are used as a barometer of the firm's innovation activity, which is then used to assess the level of investment to be made in the internal innovation processes. Regardless of the level of sophistication of the firm's internal innovation system, several respondent firms have a return-on-investment type of indicator, like new products' sales, gains of efficiency or savings."

The *innovation process* type of indicator is closely linked to the existence of a formal internal innovation process, and it aims at measuring the efficiency of the innovation process itself. Some indicators arise from the innovation process, like the total number of ideas, number of ideas that turn into a new product or process, number of new products launched in the market, turnover associated with new products commercialised. There is a clear effort to settle a typology of quantitatively measurable indicators, that help to support not only the end results of the innovation system, but also the different steps of the processes as well.

Time-to-market, customer satisfaction and the level of engagement are indicators highlighted by the interviewees as *market related indicators*. Market acceptance is seen as the ultimate indicator of a firm's ability to thrive in their innovation process. Market acceptance is also used to measure the level of novelty of the innovations produced. By comparing its product, process, or service with what is already presented in the market, firms can assess its position in the market, and thus define the strategy of releasing new products accordingly. The number of new markets added to the firm's area of operations, as well as the strengthening position on previous market segments and channels were also referred as related to the perception of the firm's innovative capacity.

Finally, the *know-how* that has generated inside the firm's innovations process is considered as an intangible resource worth measuring, according to the interviewees. Once again, the ability to create knowledge and transform it into new products, processes or even a new business area is underline as one of the capabilities that is boosted by internal innovation processes.

4. Main outputs that NITEC project had on firms.

From the 21 studied firms, only in one case the NITEC unit was discontinued, in the other cases the R&D units persist until today imbedded within the organisational culture, firms' procedures, and ways of doing. Nevertheless, comparing the initial structure of those units with what currently exists, only in three cases the units were restructured into an independent business area, since innovation and development services are presented to other firms as outsourcing. This type of innovation outsourced service represents an evolution of firm's internal innovation processes. Thus, the *creation of an innovation unit or department* was one of the main outcomes of NITEC program, along with the definition and establishment of internal innovation processes and innovation teams. This has led to some kind of *organisational innovation* since new organisational structure and culture were developed. Besides the development of a new department responsible for innovation, firms were able to hire qualified personnel which also improved firms' absorptive capacity.

Moreover, the development of *internal innovation systems* was key to improve a firm's innovation capacity. On the one hand, firms have put in place several strategies to gather innovation ideas from employees. On the other hand, the certification of the innovation process was considered relevant. As already mentioned, 14 of the firms that participated in our study are certified by the NP 4457 norm, and one more follows COTEC suggestions. The norm played an important role in what idea management, partnership and networks management, employees' involvement and innovation process mapping are concerned. As Dietrich (2018) noticed, organisational innovations are the result of the interactions between actors in firms structures. Organising the interactions and the knowledge that is born within is extremely important to reinforce the absorptive capacity of the firm (Acs, Braunerhjelm, Audretsch, & Carlsson, 2008). Besides the enhancement of the absorptive capacity of firms, firms that are involved in R&D and innovation activities are more prone in identifying innovation barriers and in overcoming it (D'Este, Iammarino, Savona, & Von Tunzelmann, 2012).

Those innovation systems also consider practices of open innovation, to make them more dynamic, faster, and creative. On the one hand, *partnerships with customers and suppliers* have been identified by interviewees as sources of innovation, thus playing an important role as innovation partners. These findings seem to go in accordance with the study of Massa & Testa (2008). Italian entrepreneurs do think that customers and suppliers are important in their innovation process, and that "innovation can emerge from disorderly interaction processes that can occur everywhere and among everyone" (Massa & Testa, 2008, p. 401). Agencies are also seen as a resource for innovation and market access since agencies belong to privileged networks of knowledge and project database.

5. NITEC program and innovation barriers

Apart from the impact on the development of different types of innovations, based on the interviews, it was possible to identify the effect of NITEC project on five different levels of the firms, mainly: *i) knowledge pool; ii) networks and partnerships; iii) internal innovation processes; iv) organisational culture; and v) market access*. Authors like Grabowski, Pamukcu, Szczygielski, & Tandogan (2015) and Bronsini & Piselli (2016) point out that public incentives may change firms innovation behaviour, namely through the establishment of collaboration projects with different context actors, and the increase of the propensity to cooperate, and the improvement of firms' innovation activities.

In the case of *knowledge*, it refers to the know-how and competences that were generated and improved within the firm during the timeframe of NITEC project. Several firms stretched the importance of this intangible output as a strategic resource.

Creating and building new knowledge has been seen like co-creation process brought about by multiple sources. NITEC program encouraged firms to hire new employees dedicated to innovation activities which, in turn, brought with them a set of new skills and knowledge. As stated by Braunerhjelm, Ding and Thulin (2018) new insights are brought by knowledge that is embodied in individuals. New knowledge has also been developed by the unfolding of the innovation process, trial and error, new experiments on new products, and new ways of doing differently builds up knowledge that later could be transferred into other innovation projects or other departments. The relationship with universities and being part of a wider network of relationships has also been a source of new knowledge.

The ability to take a part in *networks and partnerships* was also referred by the respondent as another important outcome of NITEC project. Firms of smaller dimension underline the fact that before NITEC the opportunities to participate in networks or partnerships with universities was difficult or inexistent. In fact, the smaller firms had

no experience in networks prior to NITEC. As several interviewees affirm, the NITEC provided the opportunity to bring the business and university worlds together.

Also, several respondents highlighted the changes in terms of *innovation internal processes*, through the selection and implementation of key performance indicators to evaluate innovation outputs, restructuring of firm's internal departments and supplying it with dedicated personnel. Therefore, through the implementation of a dedicated innovation unit, firms have redesigned their internal organisation. Moreover, NITEC nurtured the implementation of formal innovation processes which then fostered the firm's ability to respond to market needs, to reduce time-to-market and improve the ability to offer a new products or services. As already mentioned, firms have established processes of open innovation, where the external environment is scanned for knowledge and technologies that could be incorporated in the firm's innovations (outside-in process), as well as to spot opportunities to commercialise technologies that were developed internally by the firm (inside-out processes).

Additionally, to the impact on internal processes, NITEC unit had an influence on the organisation, building awareness to the internal innovation processes and its competitive advantages, namely in terms of how the market perceives the firm.

Deeply linked to the organisational culture impact, *market access* was another impact pointed out by the participant firms. The respondents underline the fact that a dedicated innovation team fine-tunes the firm response to market needs, decreasing time-to-market of new products, and promoting a more accurate positioning of the firm's products within market segments and channels. According to some respondents, NITEC unit allowed the firm to enter a new market channel, and it improved the market awareness of the firm. Also, NITEC unit allowed the exploration of new market opportunities both nationally and internationally, through gaining market knowledge.

6. Conclusions

Public funding agencies have the objective of supporting projects that foresee the creation of radical innovations, which then could have a significant impact at both economic and social levels. Consequently, these agencies use a set of indicators related to the quality of the project proposal, as well as the impact of the project not only on firms' competitiveness, but also at local and national economy. In turn, firms are exclusively concerned with the development of innovations that would improve their market positioning, sales, and production efficiency. Thus, firms use a set of indicators that are related to firms' business sustainability and growth. In both cases, these types of indicators are aligned with what each organisation think innovation is and its main outputs. Nevertheless, this may be translated as a barrier when firms are applying for projects supported by public funding agencies since those may perceive that the expected project outputs may not fulfill their expectations in terms of innovation outputs.

In sum, through the participation in the NITEC program firms were able to create internally a new unit or department dedicated to innovation equipped with highly skilled personnel. Therefore, firms were able to structure their innovation processes based on open innovation principles, taking benefit from the establishment of partnerships with customers, suppliers, and universities. Those organisations were, on the one hand, sources of innovation ideas and, on the other hand, partners in the development of innovations that could meet new market opportunities. Also, firms have implemented mechanisms to promote the participation of their employees in the different steps of the innovation process, such as idea generation, opportunity identification, and idea implementation. The development of new innovations, such as product, process, organisational, and marketing types of innovation, was also a side-effect of the NITEC projects.

Adding to the conclusions stated on Barbieri, Bragoli, Cortelessi, & Marseguerra (2020, p.128) study on public funding and innovation on Italian SMES, "public funding for innovative expenditure is not only a factor influencing firms' decisions to undertake innovative activities, but it is also a factor that determines the firm's innovative strategic choice", findings suggest, in the case of Portuguese SMES, that public funding not only condition the decision of investing in innovation processes, but it enhances the establishment of organisational processes and systems that lift innovation.

This papers also highlights the relevance of taking into consideration more quantitative indicators when looking into innovation results and scoreboards, hence there are side effect results that have significant results on firms' performance. Moreover, taking into consideration qualitative indicators can impact on the design of innovation programs and systems of finance, turning it more flexible and adjusted to SMEs.

Acknowledgments

This work was supported by the UIDB/05105/2020 Program Contract, funded by national funds through the FCTI.P.

References

- Acs, S. J., Braunerhjelm, P., Audretsch, D. B., & Carlsson, B. (2008). The knowledge spillover theory of entrepreneurship. *Small Business Economics*, 15–30. <https://doi.org/10.1007/s11187-008-9157-3>
- Barbieri, L., Bragoli, D., Cortelessi, F., & Marseguerra, G. (2020). Public Funding and Innovation Strategies. Evidence from Italian SMEs. *International Journal of the Economics of Business*, 27(1), 111–134. <https://doi.org/10.1080/13571516.2019.1664834>
- Becheikh, N., Landry, R., & Amara, N. (2006). Lessons from innovation empirical studies in the manufacturing sector: A systematic review of the literature from 1993-2003. *Technovation*, 26(5–6), 644–664. <https://doi.org/10.1016/j.technovation.2005.06.016>
- Bougrain, F., & Haudeville, B. (2002). Innovation, collaboration and SMEs internal research capacities. *Research Policy*, 31(5), 735–747. [https://doi.org/10.1016/S0048-7333\(01\)00144-5](https://doi.org/10.1016/S0048-7333(01)00144-5)
- Braunerhjelm, P., Ding, D., & Thulin, P. (2018). The knowledge spillover theory of intrapreneurship. *Small Business Economics*, 51(September 2017), 1–30. <https://doi.org/10.1007/s11187-017-9928-9>
- Bronsini, R., & Piselli, P. (2016). The impact of R&D subsidies on firm innovation. *Research Policy*, 45(2), 442–457. <https://doi.org/http://dx.doi.org/10.1016/j.respol.2015.10.008>
- D’Este, P., Iammarino, S., Savona, M., & Von Tunzelmann, N. (2012). What hampers innovation? Revealed barriers versus deterring barriers. *Research Policy*, 41(2), 482–488. <https://doi.org/10.1016/j.respol.2011.09.008>
- Dietrich, P. (2018). Mechanisms for Inter-Project Integration-Empirical Analysis in Program Context. *Project Management Journal*, 37(3), 49–61. <https://doi.org/10.1177/875697280603700306>
- Eisenhardt, K. M. (2007). Building Theories from Case Study Research, 14(4), 532–550.
- García-Quevedo, J. (2004). Do public subsidies complement business R&D? A meta-analysis of the econometric evidence. *Kyklos*, 57(1), 87–102. <https://doi.org/10.1111/j.0023-5962.2004.00244.x>
- Gonsález, X., & Pasó, C. (2008). Do public subsidies stimulate private R&D spending? *Research Policy*, 37(3), 371–389. <https://doi.org/10.1016/j.respol.2007.10.009>
- Hermans, J., & Castiaux, A. (2017). Contingent knowledge transfers in university-industry R&D projects. *Knowledge Management Research and Practice*, 15(2017), 68–77.
- Huergo, E., & Moreno, L. (2017). Subsidies or loans? Evaluating the impact of R&D support programmes. *Research Policy*, 46(7), 1198–1214. <https://doi.org/10.1016/j.respol.2017.05.006>
- Iso, N. P. E. N. (2005). Portuguesa Im pr es re doc pr um od uç ent ão e oib tró ida nic Im pr es re doc pr um od uç ent ão e pr lec oib tró ida nic, (Idi), 1–41.
- Iso, N. P. E. N. Norma portuguesa: Gestão da Investigação, Desenvolvimento e Inovação (IDI) Requisitos do sistema de gestão da IDI (2007).
- Massa, S., & Testa, S. (2008). Innovation and SMEs: Misaligned perspectives and goals among entrepreneurs, academics, and policy makers. *Technovation*, 28(7), 393–407. <https://doi.org/10.1016/j.technovation.2008.01.002>
- Miles, M. B., Huberman, A. M., & Saldaña, J. (2014). Chapter 5: Designing Matrix and Network Displays. *Qualitative Data Analysis A Methods Sourcebook*, 107–119. <https://doi.org/10.1136/ebnurs.2011.100352>
- Noblet, J. P., Simon, E., & Parent, R. (2011). Absorptive capacity: A proposed operationalisation. *Knowledge Management Research and Practice*, 9(4), 367–377. <https://doi.org/10.1057/kmrp.2011.26>
- Pires, L. M. (2015). 30 anos de Fundos Estruturais (1986-2015).
- Rocha, A., Lima, R. M., Amorim, M., Romero, F., & Crus-Cunha, M. (2022). Managing R&D and Innovation Projects: An Integrated Conceptual Model for Technology Transfer. *International Journal of Innovation and Technology Management*, 19(8), 27. <https://doi.org/10.1142/S0219877022500316>
- Schwab, Klaus, Sahidi, S. (2020). *The global competitiveness report: How countries are performing on the road to recovery*. World Economic Forum. Retrieved from www3.weforum.org/docs/WEF_TheGlobalCompetitivenessReport2020.pdf
- Schwab, K. (2014). *The global competitiveness report*. Retrieved from http://www.weforum.org/pdf/Global_Competitiveness_Reports/Reports/factsheet_gcr03.pdf
- Schwab, K. (2017). *Insight Report*. <https://doi.org/92-95044-35-5>
- Valkokari, K., Paasi, J., & Rantala, T. (2012). Managing knowledge within networked innovation. *Knowledge Management Research and Practice*, 10(1), 27–40. <https://doi.org/10.1057/kmrp.2011.39>
- Sabala-Iturriagaitia, J. M., Voigt, P., Gutiérrez-Gracia, A., & Jiménez-Sáez, F. (2007). Regional innovation systems: How to assess performance. *Regional Studies*, 41(5), 661–672. <https://doi.org/10.1080/00343400601120270>

Exploratory Study of Multidimensionality Elements of Small Entrepreneurs' Network Change and Development in the Southern Region of Malaysia

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Abstract: The research aims to empirically explore the multidimensionality elements in small entrepreneurs' network change and development during periods when the entrepreneurs face tipping points. Prior scholars have examined the mix of strong and weak links in small businesses and linked them to business development stages. For small firms to continue experiencing business growth, current literature must emphasize the connection between network strengths and overcoming tipping points. This research explores the multidimensional elements of small entrepreneurs' network change and development that contribute to their survival during the era of tipping points in the Southern Region of Malaysia. This qualitative research uses a multiple case study approach involving eight small firms in the southern region of Malaysia. The data collection methods include analysis of secondary documentation and in-depth interviews with the entrepreneurs using the critical incident interview technique. The data has been analyzed using NVIVO software and has employed Miles and Huberman's (1994) flows of analysis activity. Data triangulation was carried out by interviewing individuals who were seen as having strong or weak ties within the network and who were identified through interviews with the entrepreneurs. The findings enlighten two themes: the entrepreneur-level context and the dyadic-level context. The findings show that the multidimensionality of the individual entrepreneur is demonstrated through their demographic factors, personal values, experience, and capabilities. Therefore, they differ in responding to changes in their networks. Dyadic multidimensionality is found in the tie's content, structure, governance, and the dyadic life cycle. Finally, this research provides theoretical and methodological contributions and offers implications for entrepreneurs, government agencies and policy-makers.

Keywords: Small business network ties, strong ties, weak ties, network change and development

1. Introduction

Network ties are the associations a firm, especially the business owner, has with other entities in the business world, be it with other individuals, organizations or groups (Oskam et al., 2018). Understanding how a firm is connected to other entities, both inside and outside, is vital to running a successful enterprise. By leveraging their network ties, firms can access critical resources, collaborate with other businesses, gain a competitive advantage, and manage risk. Connections in a network are said to be "strong" when they are close and frequent and "weak" when they are further apart and less frequent (Omar et al., 2020).

When a firm is at a critical juncture, the two types of network ties can each contribute in unique ways. Strong network ties may make a firm feel safe and secure, especially in a more stable economic situation. They could link the firm with potential partners, suppliers, and customers who could prove helpful in the firm's operations (Kontinen & Ojala, 2011). However, when a firm is at a tipping point, such as when there has been a sudden shift in market conditions, it may be less beneficial to have strong network ties. This is because being overly dependent on network ties can hinder an organization's responsiveness to changing conditions (Hu et al., 2019).

Hu et al. (2019) added that a firm with weak network ties might gain access to new and useful information and knowledge that could be vital in helping it avoid a potential crisis. The firm might be exposed to novel concepts, points of view, and opportunities that it would not have normally come across if its ties were stronger. Furthermore, weak ties may lead to the discovery of new resources, such as customers or suppliers, that can aid the firm in continuing operations through transition periods. Therefore, a firm may gain from strong and weak

network ties at a given tipping point. The key is to establish a balance between the two to utilize both kinds of network ties to the fullest extent possible for the firm's benefit (Hu et al., 2019).

This study examined the multiple facets of entrepreneurs' network change and development that uphold their continued existence under challenging times. This study used eight small business case studies in Southern Malaysia to understand the multifaceted aspects that affect network transformation and how network strengths assist them in overcoming tipping points to promote business development through difficult times.

2. Literature Review

The value of network ties for small enterprises has been well recognized. According to published research, networks are vital to the success of small business enterprises. Small businesses can manage risk, stimulate innovation and growth, access essential resources, and build social capital by forging good partnerships with important stakeholders (Singh & Subrahmanya, 2018). In other words, understanding the various kinds of network ties and creating plans for establishing and upholding them over time is crucial for small firms.

This study addressed the lack of focus on certain network change dimensions in small enterprises. Network change can affect the entrepreneur's business and goals differently. Therefore, defining a single set of network change dimensions that applies to all scenarios is difficult. Thus, explain the necessity of focusing this study on small enterprises in a regulated population and a specific business sector. By identifying the important dimensions of small entrepreneurs, researchers can better understand network change motives and customize their network change strategies to overcome their tipping points.

2.1 Small Businesses Network ties

The term "small business network links" describes the personal and professional ties business owners maintain with others in their field. Suppliers, consumers, partners, competitors, industry groups, government agencies, and other stakeholders are all potential entities in this web of interdependence (Rawat, 2020).

Small entrepreneurs often build and maintain their networks through informal networks and personal ties where mutual respect, reciprocity, and shared interests underpin these relationships (Partanen et al., 2020). Most small businesses operate in a specific area; thus, their network of contacts is likely to be limited to local small businesses, consumers, and suppliers. For small businesses to have faith that their network partners will keep their word and operate in the company's best interests, it is vital to establish trusting connections first (Schreier et al., 2020). Smaller enterprises usually have less networking money than larger companies. Thus, they may have joined business associations, attended networking events, and used online media to build and maintain their networks (Easmon et al., 2019).

There are a few examples of network ties for small businesses; (i) supply network - Small businesses buy goods from trusted suppliers who can negotiate price, delivery time, and quality (Kumar et al., 2020), (ii) consumer network – customers' influence on the creative process by awareness to their requirements and a two-way feedback loop with businesses (Garas & Lapatinas, 2017), (iii) partner network – small enterprises collaborate to offer complementary goods and services to increase exposure and market access (Shevtshenko et al., 2019), (iv) industry associations network – small firms can join industry associations to connect, pool resources, and stay up to date on sector trends (Qiao et al., 2014), and (v) community network – small businesses may use local customers and resources by partnering with neighbourhood organizations like schools and non-profits to raise business visibility and support (Micholia et al., 2018).

2.1.1 Strong ties

Small entrepreneurs can improve their prospects of success and expansion by devoting time and effort to establishing and maintaining strong network connections (Rademacher & Wang, 2014). It is not uncommon for business owners to feel isolated and under constant pressure. In trying times, having a strong peer network that can provide emotional support and encouragement can be a tremendous source of comfort, hope, and drive (Krämer et al., 2021). Moreover, a strong peer network could potentially influence business owners' decision-making in a positive way (Liu et al., 2015). As such, it is highly recommended that owners of small businesses who want to expand their networks should engage in industry events, join professional organizations, and join online groups (Easmon et al., 2019). Additionally, they need to prioritize forming genuine connections predicated on trust and respect.

Strong business ties can help small businesses grow. A group of small entrepreneurs who meet frequently to share knowledge is an example of a strong group. These business owners usually have longstanding trust, respect, and familiarity (Tang et al., 2018). They may meet often to discuss industry trends, share advice, and provide moral support. Trust and support can be used to each party's advantage through these network ties. As such, it provides small entrepreneurs confidence, stability, and access to resources and opportunities that might otherwise be out of reach (Tang et al., 2018).

2.1.2 Weak ties

The term "weak ties" describes relationships with persons who are not close friends or family members (Krämer et al., 2014). In the same way that strong network ties can benefit a small business, weak ones can also be useful. Even if a piece of information or an idea is not readily available within the immediate network, a weak network tie might be. This may include knowledge of potential new technology, markets, or trends (Aral, 2016).

Incorporating people with different backgrounds and experiences into a company can spark new insights and ideas. Weak ties in a network might open the door to new and interesting relationships (Ryan, 2016). This is especially helpful for smaller companies serving certain niches. A valuable new customer or alliance may result, for instance, from a casual meeting at a networking event or a talk with a friend of a friend. Exposure and reach for a business might be increased even through weak ties to other networks (Nziku & Struthers, 2017). The exposure and reputation of a company can be boosted by establishing connections with people outside of its local network (Robinson & Stubberud, 2011).

To enhance their weak network ties, entrepreneurs should actively seek settings where they may interact with new people and do things outside their comfort zone (Mattie et al., 2018). This includes joining online groups, clubs, and non-speciality conferences. Entrepreneurs may meet someone with important information or connections at a convention unrelated to their field. As a result, the two parties may discuss new technologies or marketing tactics that the company owner had not considered. The encounter may lead to a reference to a possible client or collaborator. Without weak network ties, the business owner may have missed resources or opportunities. Fostering both strong and weak network links can help a small firm succeed and grow.

2.2 Network Change and Development

Small entrepreneurs' networks change over time. The multidimensionality of these changes and development can reveal the factors that shape small firm owners' networks throughout time. By considering the firm's structure, content, method, setting, and entrepreneur's unique features, researchers and entrepreneurs can improve small business growth and success tactics.

Their initial connection arrangement may affect a small entrepreneur's network change and development. The network's size, diversity of ties, ties' strengths, and degree of centralization are all factors to consider (Kontinen & Ojala, 2011). The relationships and exchanges inside a small company entrepreneur's network are the "content" of the entrepreneur's network (Aladejebi, 2020). Aladejebi added that factors such as relationship type (personal vs professional), resources shared (knowledge vs emotional support), and level of contact all have a role.

"Network change and development" describes how the network changes over time. This includes making new connections, strengthening existing ones, and cutting old ones (Bliemel et al., 2016). It also involves the influence of external events on the network and the formation of new network clusters or subgroups (e.g., changes in the market and shifts in the competitive landscape). Besides, change and development in a network can also be affected by the environment in which small entrepreneurs conduct their operations (Lama & Shrestha, 2011). This encompasses the larger socioeconomic environment, the institutional environment (e.g., regulations and policies), and the cultural and social norms that influence the interactions and conduct of network members (Lama & Shrestha, 2011). Above all, small entrepreneurs' traits play a crucial role in changing their networks. This includes their unique goals, comfort with uncertainty, and openness to new experiences.

3. Methodology

This qualitative interpretive study used in-depth interviews to examine southern Malaysian small enterprises' network ties' governance. The interviews covered the entrepreneurs' discussion network, a subset of their entire network that includes people with whom they often discuss business. The data collection process followed Miles and Huberman's (1994) and Morse's (1994) to pick sample respondents who fit the study's criteria and were

willing to take part in intensive, even intrusive, research (Hill et al. 1999). Respondents in this study were selected based on several criteria. They were either the founders or current major owners and managers of small businesses with annual sales turnover of less than RM3 million and employed less than 30 full-time workers; their businesses operated in southern Malaysia the food and beverages (F&B) industry. The F&B industry was chosen because it has been reported that the F&B sector was the quickest to adapt to the new norms and thrived during the pandemic (Lai et al., 2020). This situation exemplified the relevance of this research, which focused on network change and development through overcoming their tipping points of eight case studies. Semi-structured interviews which lasted between 40-minutes to 2-hour interview. Multiple readings of the interview transcripts were performed to ensure that the interpretations were made justifiably and to eliminate any bias that may have resulted from the researcher's good connection with the respondents.

The researchers examined trends and conducted case-by-case and comparative assessments. The data-gathering technique mirrors Eisenhardt's (1989) case study analysis theory development strategy, which studies a carefully selected subset through time and varied contexts to gain insight into the phenomena of interest. To verify the data's correctness and authenticity, the researchers employed a member-checking strategy, coding individually before comparing their data to ensure uniformity and precision (Birt et al., 2016). Following that, the researchers remarked on their research assumptions and perspectives, which reached a clear conclusion regarding the situation under consideration by being transparent about their role in affecting the research process and outcomes. Following the studies of Jack et al. (2008), interviews were transcribed verbatim and analyzed using thematic analysis techniques and NVIVO Software.

4. Research Results

Findings for each of the entrepreneurs are reported, where each business owner's "narrative" is presented to explore their experience and the strength of network ties during the course of their business. According to Eisenhardt (1989), this approach allows the distinctive patterns of each case to emerge before the researchers strive to generalize patterns across cases, which speeds up case comparison.

4.1 Case Description

There are eight cases under study, each of which describes small-business entrepreneurs. Table 1 summarizes the entrepreneur's gender, age, education, work experience, products they sell, business size (micro/small/medium), sales per year, full-time employees, and year of business initiation.

Table 1: The Summary of the Background Information of the Cases and their Firms

Cases No.	Gender (M=Male; F=Female), Age, Education	Work Experience	Products	Full-Time Employees	Business Initiation (Year)
1.	M, 38, SPM	2 years in the Livestock Company	Frozen Food – Kebab	30	1998
2.	M, 50, SPM	NIL	Spices & Grocery shop	15	1972
3.	M, 43, SPM	NIL	Ketchup	30	1990
4.	M, 50, Diploma of Management	10 years in the bank	Frozen food – Fish based	30	2007
5.	F, 45, SPM	NIL	Cookies (seasonal) & Bakery	4 and 60 (at peak)	1992
6.	F, 45, SPM	NIL	Cookies & Frozen Food	30 and 60 (at peak)	1994
7.	F, 50, SPM	NIL	Cookies & Trading	16	1987
8.	F, 46, SPM	5 years as a factory worker	Spices	7	1997

4.2 The Multidimensional Elements in Network Change and Development

This study identified a multidimensional component in network tie change and growth. According to Hite (2008), the multidimensionality perspective helps explain tie changes' intricacy. The results revealed two themes: the entrepreneur-level context and the dyadic-level context.

4.2.1 Theme 1: The entrepreneur-level context

The findings show that the multidimensionality of the individual entrepreneur is demonstrated through their **demographic factors, personal values, experience and capabilities**. The demographic factors include age, gender, previous working experiences and the family business background. Thus, network changes affect them differently.

Age. In Case 3, a 19-year-old entrepreneur, who started his business straight from school, did not know anyone in the business and relied heavily on his family, especially his parents. His lack of experience and seeing his parents doing business has inspired him to start a business that simultaneously became the source of financial and knowledge support. This contrasts with those who started their business venture later, such as in their late 30s. One example is Case 4, a banker turned entrepreneur who met numerous people and had vast business venture experience. However, in Case 3 above, as his firm grew and he aged, he met more individuals, giving him more options for strong ties.

Gender. Entrepreneurs' gender affects their business tie intensity. Four women entrepreneurs picked their spouses as strong ties, but the males did not. Culture and religion may explain this. Muslim women are taught to obey their husbands. Thus, women entrepreneurs in this study often consult their husbands before making major decisions.

Working experience. Entrepreneurs' network ties also depend on their past work experience. Case 4 has over five years of banking and entrepreneur loan funding experience. While working in the bank, he met several entrepreneurs who helped him start the business and find new prospects. Case 1's past work in a meat and poultry factory also shaped his relationship between network management and the poultry industry. He knew how to handle industry difficulties and which agency to contact. This supports Yu et al. (2021)'s arguments that network scopes vary by entrepreneur experience.

Family background. Entrepreneurs who had family members who owned businesses usually consider their family and parents their strongest ties, especially in the startup phase, as they had informally joined in and/or observed or helped with the business influence their network links. However, being excessively immersed in the same network circle of the parents' business network relationships limits network diversity, subsequently hurting business development.

Knowledge/Education. Knowledge is characterized as, firstly, academic qualification on knowledge of network ties acquired formally from a formal education system. Secondly, it involves tacit knowledge about network ties from their prior job, learning from others, and life experiences. In the former, entrepreneurs see their children with related academic credentials as their strong ties, while in the latter, they see their business partners as having all the skills they can gain from. This supports Kabir (2013), who suggested that tacit knowledge must be codified as an intellectual asset for an organisation to fully exploit its human capital knowledge.

To illustrate, in case 2, the father relies on the children's academic knowledge of mechanical and machine operations (son) and financial and marketing (daughter). *"My daughter... graduated from a Business Studies degree while my son [is] in robotic engineering. I was lucky having them in this field although I was not planning this initially when they finished high school. Their knowledge gives advantages to my business"*. Case 2 showed how his children's engagement improved business administration, financial management, and manufacturing efficiency. This has been supported by the claim made by his daughter: *"Although the knowledge I learnt for the Business Studies degree was just theories in most of the management books, and they are so much different... [in a] real life situation... I... applied them in my father's business, such as the SWOT marketing analysis"* (Daughter of Case 2).

Competencies and/or Skills. For Cases 5, 6, and 8, their husbands took on marketing duties due to their business experience. In case 1, the wife, who is well-versed in the firm's financial accounts and has an accounting degree, controls the business's cash flows in the startup phase. The wife's position increased to overseeing the purchasing and financial operation in the developing phase. The foregoing finding supports Alsos et al. (2014)'s notion that kin is important when their skills match the business' needs.

The variance in entrepreneurs' network ties is greatly influenced by their **personal values**. Case 2, an introverted businessman with a small network, provides evidence. Before his daughter took over the business, the father only had connections to his late father's suppliers, clients, and employees. This supports Klapper's (2008) claim that entrepreneurs' personalities, networking, and business success are linked, suggesting that their family history, education, and professional experience affect how they configure their networks. Case 5 said, *"My*

strong relationship between me and my distribution agent is based on the sense of responsibility... and it is very simple actually, whenever each of us performs our responsibility with... devotion, the level of trust will increase". This optimistic attitude increases trust since the better values they can offer, the more trust they will have in their relationships.

Experiences. Case 6's son-in-law is a land and building developer with a Business Diploma. Despite the differences between the food and construction industries, he leveraged his experience working with consumers, suppliers, and the firm's external stakeholders, such as clubs and associations. This is also evident in Cases 1,3,5 and 8. For instance, Case 1's friend's appointment to the firm's Board of Directors was linked to the necessity for business expansion. The findings suggested that Case 1 began to value his close friend's skills and experience as the firm progressed. A friend with expertise, skills, qualifications, and experience helps entrepreneurs take on greater projects locally and internationally, defining the firm's strategic vision and mission to achieve these goals. The dynamic network actor valued his network tie's human resources at a later time, adding greatly to the firm's growth.

4.2.2 Theme 2: Dyadic-level context

Dyadic multidimensionality is found in the tie's content, structure and governance as well as in the dyadic life cycle.

Multidimensionality of dyadic content

The findings suggest that tie content is multifaceted, serving multiple purposes in a single tie. Multiplexity occurs when different content travels across the tie. Thus, ties can serve many roles, increasing their multidimensionality. Thus, a tie's multidimensionality increases as it serves many roles. For example, a tie with a business partner provides advice, information, and emotional support during tipping periods. That is the case in Case 3, where the supplier supported and provided emotional assistance; meanwhile, Case 1's wife supported the firm by becoming its accountant.

Multidimensionality of dyadic structure

In relation to the multidimensionality of the dyadic structure, it is evident that Case 1's relationships with customers and suppliers are experiencing a two-way exchange. To illustrate, the reciprocal commitment between each other governs two-way business transactions, *"Suppliers and customers are the most important network ties in my business... they are providing two-way business transactions from which reciprocal commitment has originated, they become the supplier to my business as well as the customer"* (Case 1). This is consistent with Hite (2008), who argued that two-way ties indicate a reciprocal transfer of network content.

Multidimensionality of dyadic governance

Governance and network bases enable network exchange (Hoang and Antoncic, 2003). Entrepreneurs' relationships with their network ties affect how the network exchange works. The multidimensionality of dyadic governance has allowed the integration of different network bases and governance that governs tie strengths.

This study is governed by three main bases of network governance that are strong intimacy and emotional attachment (Kozan & Akdeniz, 2014), trust (Martins et al., 2019) and reciprocal commitment (Jorgensen et al., 2020). This analysis concluded that these three elements form the network ties of the eight cases and uncovered two new themes: human capital and attitude/values. This study also found that one aspect must be merged with another to form a strong network tie with the entrepreneur. This supports the argument by Hite (2008) that relational governance adds to the multidimensionality element of dyadic governance. The findings revealed the theoretical study by Hite (2008) in explaining the change and development of network ties. The two themes of entrepreneur-level context and the dyadic-level context provide rich explanations about the complexity of tie changes.

4.3 Roundtable Discussion

The research has uncovered several advantages and disadvantages of business network ties. Businesses may result in improved access to resources such as information, skills, technology, and funding when they are part of a well-connected network (Tendai, 2013; Zhao & Burt, 2018). Zhao and Burt added that a strong network tie could boost a company's competitive standing by attracting and retaining a broader customer base and opening doors to additional distribution channels and potential new markets. Firms can benefit from this by being associated with other well-respected businesses in the same network, which can help them grow their

operations and strengthen their competitive position (Mamédio et al., 2019). As a result, customers, investors, and other stakeholders may view the company with a higher degree of trust and confidence. The disadvantage of business network ties is that they can lead to a firm's dependence on other enterprises and organizations in the network, limiting its independence and ability to make autonomous decisions (Wincent et al., 2016). This can be especially troublesome if the network partner fails or faces a drop in performance. Business network ties can also limit a firm's network's diversity, limiting its access to new ideas, viewpoints, and prospects (Neneh, 2018). This can cause creativity and progress to stall. Other than that, one partner may have more information than the other due to a partner's position in a business network which can lead to opportunistic conduct and conflicts of interest, which can harm a partner's relationship (Pressey & Vanharanta, 2016). The following table summarizes the principal journals reviewed that contributing to the development of this research.

Table 2: Literature Overview of Business Network Ties

Business Network Ties	Remark	Source
Advantages	• Improve a business's standing in the market • Attract and retain a more diverse range of customers.	Tendai, (2013); Mamédio et al. (2019)
	• Facilitating access to supplementary distribution channels and prospective untapped markets.	Zhao & Burt (2018)
	• Enhanced accessibility to various resources, including information, skills, technology, and funding.	Tendai (2013); Zhao & Burt (2018)
Disadvantages	• Result in a company's reliance on external entities and institutions within the network.	Wincent et al. (2016)
	• Limit the diversity of a firm's network • Limiting access to fresh ideas, perspectives, and opportunities	Neneh (2018)
	• Creation of potential for conflict of interest and opportunistic behaviour	Pressey & Vanharanta (2016)

While establishing and maintaining business connections can be beneficial, there are risks and challenges that must be controlled. By managing the drawbacks of network dependence, restricted diversity, and information asymmetry, a well-designed and well-managed network can aid businesses in achieving their strategic goals and boosting their performance.

5. Conclusion

Network change and development in small businesses can be analyzed along a number of different variables, including those related to structures, resources, processes, relationships, and the external environment. These variables can affect entrepreneurs' ability to collaborate, the strength of their connections, and their prospects. By understanding network change variables, small entrepreneurs may prevent typical mistakes. Entrepreneurs must manage and sustain their entrepreneurial network contacts, in which they should understand the network members' relationships and tie intensity. As such, entrepreneurs must invest in network-nurturing activities to maintain partnerships. The investment could be in the form of money, time, energy and knowledge.

This study shows that government must pay more attention to and understand networking's advantages and disadvantages. Hosting entrepreneurs' conferences, business-matching opportunities, and other activities to enable information and knowledge exchange are among government initiatives to boost networking among small entrepreneurs. However, considering the strong and weak network ties of these entrepreneurs, it involves a complex procedure that takes time, which may frustrate agencies that want immediate solutions. Trust, reciprocal commitment, network ties' attitudes and human capital are needed for networking. Thus, long-term thinking is needed to identify entrepreneurs' strengths and weaknesses.

Future research could use the findings to investigate the correlation between network change dimensions and specific outcomes and explore which dimensions of network change are most effective in achieving desired outcomes. The scope of the study can be broadened in the future to include personal elements, such as the entrepreneurs' personality traits or cognitive biases, and how they influence their behaviour and the outcomes they experience.

References

Aladejebi, O. (2020). The Impact of Entrepreneurial Networks on The Performance of Small Business in Nigeria. *Archives of Business Research*, 8(3), 281–293.

- Alsos, G. A., Carter, S., & Ljunggren, E. (2014). Kinship and business: how entrepreneurial households facilitate business growth. *Entrepreneurship and Regional Development*, 26(1–2), 97–122.
- Aral, S. (2016). The Future of Weak Ties. *American Journal of Sociology*, 121(6), 1931–1939.
- Birt, L., Scott, S. E., Cavers, D., Campbell, C., & Walter, F. M. (2016). Member Checking. *Qualitative Health Research*, 26(13), 1802–1811.
- Bliemel, M. J., McCarthy, I. G., & Maine, E. (2016). Levels of Multiplexity in Entrepreneur's Networks: Implications for Dynamism and Value Creation. *Entrepreneurship Research Journal*, 6(3).
- Easmon, R. S., Kastner, A. N. A., Blankson, C., & Mahmoud, M. A. (2019). Social capital and export performance of SMEs in Ghana: the role of firm capabilities. *African Journal of Economic and Management Studies*, 10(3), 262–285.
- Eisenhardt, K. 1989 Building theories from case study research, *Academy of Management Review*, 14: 532–550
- Garas, A., & Lapatinas, A. (2017). The role of consumer networks in firms' multi-characteristics competition and market share inequality. *Structural Change and Economic Dynamics*.
- Hill, J., McGowan, P. and Drummond, P. 1999 The development and application of a qualitative approach to researching the marketing networks of small firm entrepreneurs, *Qualitative Market Research*, 2: 71–81.
- HITE, J. M. 2008. Evolutionary processes and paths of relationally embedded network ties in emerging entrepreneurial firms. *Entrepreneurship Theory and Practice*, 29, 113–144.
- Hoang, H., & Antoncic, B. (2003). Network-based research in entrepreneurship – A critical review. *Journal of Business Venturing*, 18, 165–187.
- Hu, H., Wang, L. Y., Jiang, L., & Yang, W. (2019). Strong ties versus weak ties in word-of-mouth marketing. *BRQ Business Research Quarterly*, 22(4), 245–256.
- Jack, S., Dodd, S. D., & Anderson, A. R. (2008). Change and the development of entrepreneurial networks over time: a processual perspective. *Entrepreneurship and Regional Development*, 20(2), 125–159.
- Jorgensen, J., Masuo, D., Manikowske, L., & Lee, Y. S. (2020). The Reciprocal Involvement of Family Business Owners and Communities in Business Success. *Sustainability*, 12(10), 4048.
- Kabir, N. (2013). Tacit Knowledge, its Codification and Technological Advancement. *Electronic Journal of Knowledge Management*, 11(3).
- KLAPPER, R. 2008. The Role of Social Capital in French Entrepreneurial Networks at Pre-organisation Stage Doctor of Philosophy, University of Leeds.
- Kontinen, T., & Ojala, A. (2011). Network ties in the international opportunity recognition of family SMEs. *International Business Review*, 20(4), 440–453.
- Kozan, M. K., & Akdeniz, L. (2014). Role of Strong versus Weak Networks in Small Business Growth in an Emerging Economy. *Administrative Sciences*, 4(1), 35–50.
- Krämer, N. C., Rösner, L., Eimler, S. C., Winter, S., & Neubaum, G. (2014). Let the Weakest Link Go! Empirical Explorations on the Relative Importance of Weak and Strong Ties on Social Networking Sites. *Societies*, 4(4), 785–809.
- Krämer, N. C., Sauer, V., & Ellison, N. B. (2021). The Strength of Weak Ties Revisited: Further Evidence of the Role of Strong Ties in the Provision of Online Social Support. *Social Media and Society*, 7(2), 205630512110249.
- Kumar, S., Narayanan, S., & Salvador, F. (2020). Innovation in supply networks—A research framework and roadmap. *Journal of Operations Management*, 66(7–8), 754–767.
- Lai, H. B. J., Abidin, M. N. Z., Hasni, M. T., Karim, M. K. A., & Ishak, F. a. C. (2020). Key adaptations of SME restaurants in Malaysia amidst the COVID-19 Pandemic. *International Journal of Research in Business and Social Science*, 9(6), 12–23.
- Lama, A. K., & Shrestha, A. K. (2011). Factors influencing in networking activities in SMEs : An exploratory study of factors that initiate networking activities in case of SMEs [MA Thesis]. Umea School of Business.
- Liu, C., Eubanks, D. L., & Chater, N. (2015). The weakness of strong ties: Sampling bias, social ties, and nepotism in family business succession. *Leadership Quarterly*, 26(3), 419–435.
- Mamédo, D. F., Gurgel, C. a. S., Szczepanik, D., & Kato, H. T. (2019). Strategic alliances and dynamic capabilities: a systematic review. *Journal of Strategy and Management*, 12(1), 83–102.
- Martins, H. C., De Siqueira, L. S., & Sousa, J. P. (2019). Activities in the Context of a Network, Trust and Internal Resources as Antecedents of the Effectiveness of Network Governance: a Study of the Impact on the Performance of the Companies Involved. *Brazilian Business Review*, 16(5), 431–452.
- Mattie, H., Engø-Monsen, K., Ling, R., & Onnela, J. (2018). Understanding tie strength in social networks using a local "bow tie" framework. *Scientific Reports*, 8(1).
- Micholia, P., Karaliopoulos, M., Koutsopoulos, I., Navarro, L., Vias, R. B., Boucas, D., Michalis, M., & Antoniadis, P. (2018). Community Networks and Sustainability: A Survey of Perceptions, Practices, and Proposed Solutions. *IEEE Communications Surveys and Tutorials*, 20(4), 3581–3606.
- Miles, M. and Huberman, A. 1994 *Qualitative Data Analysis* (London: Sage Publications).
- Morse, J. 1994 Designing funded qualitative research, in Denzin, N. and Lincoln, Y. (eds) *Handbook of Qualitative Research* (Thousand Oaks, CA: Sage Publications).
- Neneh, B. N. (2018). Customer orientation and SME performance: the role of networking ties. *African Journal of Economic and Management Studies*, 9(2), 178–196.
- Nziku, D., & Struthers, J. (2017). Female entrepreneurship in Africa: strength of weak ties in mitigating principal-agent problems. *Journal of Small Business and Enterprise Development*, 25(3), 349–367. <https://doi.org/10.1108/jsbed-03-2017-0115>

- Omar, S. Z., Higgs, M., Wei, C., & Ali, M. (2020). Network Ties' Governance in Entrepreneurial Networking of SMEs: Cases of the Owner-managers in the Southern Region of Malaysia. *Asian Academy of Management Journal*, 25(1).
- Oskam, I., Bossink, B., & De Man, A. (2018). The interaction between network ties and business modeling: Case studies of sustainability-oriented innovations. *Journal of Cleaner Production*, 177, 555–566.
- Partanen, J., Kauppila, O., Sepulveda, F., & Gabrielsson, M. (2020). Turning strategic network resources into performance: The mediating role of network identity of small- and medium-sized enterprises. *Strategic Entrepreneurship Journal*, 14(2), 178–197.
- Pressey, A. D., & Vanharanta, M. (2016). Dark network tensions and illicit forbearance: Exploring paradox and instability in illegal cartels. *Industrial Marketing Management*, 55, 35–49.
- Qiao, P., Ju, X., & Fung, H. (2014). Industry association networks, innovations, and firm performance in Chinese small and medium-sized enterprises. *China Economic Review*, 29, 213–228.
- Rademacher, M. A., & Wang, K. K. (2014). Strong-Tie Social Connections Versus Weak-Tie Social Connections. *Encyclopedia of Social Media and Politics*.
- Rawat, D. (2020). Business networks in an auto-component cluster: an exploratory study. *Journal of Asia Business Studies*, 14(3), 323–340.
- Robinson, S., & Stubberud, H. A. (2011). Social Networks And Entrepreneurial Growth. *International Journal of Management & Information Systems*.
- Ryan, L. (2016). Looking for weak ties: using a mixed methods approach to capture elusive connections. *The Sociological Review*.
- Schreier, C., Scherrer, S., Udomkit, N., & Farrar, J. (2020). Trustworthy Small and Medium-sized Enterprise Network Partners: Small and Medium-sized Enterprise Partnerships in the International Entrepreneurial Process. *Global Business Review*, 21(1), 88–107.
- Shevtshenko, E., Mahmood, K., & Karaulova, T. (2019). Enhancing the partner selection process in a Sustainable Partner Network. *IFAC-PapersOnLine*.
- Singh, R., & Subrahmanya, M. B. (2018). Network Cooperation, Innovation, Internationalization and Economic Performance of SMEs: An Exploratory Study. *Asian Journal of Innovation and Policy*, 7(3), 461–488.
<https://doi.org/10.7545/ajip.2018.7.3.461>, pp.132-142
- Tendai, C. (2013). Networks and Performance of Small and Medium Enterprises (SMEs) in Different Stages of the Life Cycle: A Case Study of a Small Business in the Netherlands. *Journal of Communication*.
<https://doi.org/10.1080/0976691x.2013.11884811>
- Tang, Y., Moro, A., Sozzo, S., & Li, Z. (2018). Modelling trust evolution within small business lending relationships. *Financial Innovation*, 4(1).
- Wincent, J., Thorgren, S., & Anokhin, S. (2016). Costly Ties: Social Capital as a Retardant of Network-Level Entrepreneurial Orientation. *Journal of Small Business Management*, 54(1), 229–243.
- Yu, W., Choi, M., & Zheng, J. (2021). How Do Different Types of Entrepreneurial Networks and Decision-Making Influence the Identification of Entrepreneurial Opportunities? *Frontiers in Psychology*, 12.
- Zhao, C., & Burt, R. S. (2018). A Note on Business Survival and Social Network. *Management and Organization Review*, 14(2), 377–394.

Relationship Marketing as an Innovative Strategy for Customer Loyalty in Customized Arrangements Companies

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Abstract: Over the years, the use of relationship marketing has been linked to customer loyalty so that companies can reach their customers in an innovative and effective way; knowing first the market, their customers and the products or services they offer. Likewise, achieving a great customer-company bond, for this reason the main objective of the research is to determine if there is a significant relationship between relationship marketing with the process of customer loyalty in customized arrangements companies, the study has a quantitative design, cross-sectional and correlational type, a survey was developed to 380 people with probabilistic sampling, the population was defined for men and women in Lima, the capital of Peru, The dimensions recognized were customer retention, communication, endomarketing, customer experience, information and internal marketing. The results showed that the location of these companies is of utmost importance for customers, and that customers in this area are very demanding in their requirements; on the other hand, a large percentage agreed with the services offered in these businesses since a good relationship is established between customers and employees. Finally, customers indicated that there is post-purchase follow-up and that the company has well-trained workers. In conclusion, it was obtained that most of the customers like to buy in this type of personalized arrangements stores and that they like to receive advice, the statistical inference tests also conclude that there is a significant relationship between relationship marketing and customer loyalty, thus verifying the hypothesis raised in the research.

Keywords: Innovation, relationship marketing, customer loyalty, customer experience, Peru.

1. Introduction

The concept of marketing has evolved over time, adapting to the recent challenges of each era and the demands of different societies. It is in this sense that the American Marketing Association (AMA), an institution that serves as a forum for new concepts, constantly updates the concepts of this area and it is not until 2004 that it includes the philosophy of relationship marketing in its definition (Burbano-Pérez et al., 2018; Cordova-Buiza, 2022a). Currently, relationship marketing has become an important factor for many companies in different fields, as it helps to maintain lasting relationships with customers. There are many variables that strengthen the competitiveness of companies, carrying out the creation of value for those who offer and demand, maintaining the relationship axis (Arosa and Chica, 2020). Likewise, customer loyalty has achieved great importance in recent years, since they are the ones who want to define the durability of the companies, the economies in other countries have the customer as their center since they are the ones who decide the future of many organizations with your purchase. And consumption (de Guzmán, 2014). Decoration items in recent years have suffered great losses due to the great increase in new similar businesses, as well as due to the situation we are going through lately, being a worrying favor since companies always seek to be updated on the latest trends. That is why, in this present investigation, we are going to learn more about our general problem: What is the relationship between relationship marketing and the customer loyalty process in the custom repair company?

1.1 Objectives

The objective of this research is to determine how relationship marketing is related to the customer loyalty process in the personalized arrangements company. Likewise, the proposed hypothesis is: Relationship marketing is related to the customer loyalty process in the personalized arrangements company.

2. Literature review

There are several theories, according to Salas (2017) the use of relationship marketing improves and preserves the relationship with customers in the long term, becoming a competitive advantage for the benefit of the company; Over the years, marketing has become more oriented towards relationship marketing, so that companies have a lasting relationship with their customers. For Martínez et al. (2017), the purpose of establishing relationships with customers is to achieve loyalty, likewise, the relational approach involves using new marketing and communication strategies, including the massive implementation of the Internet and mobile devices. Many companies do not develop relational marketing, which causes difficulty in selling their products, reducing their competitive advantage.

A great example of this is the recommendation which is the best advertising when customers say positive things about the company and motivate others to buy and try the benefits for themselves. Loyalty is understood as "a positive attitude, which implies the union of satisfaction of the client (formed by rational elements, affections and behaviors) with a stable and lasting consumption action (Agüero, 2014; Cordova-Buiza, 2022b). For Cabrera (2013) it is the stable relationship that has been achieved and earned over time, making the loyal client buy repeatedly from the company, as well as having a good reference and communicating positive things to people about the company.

Customer loyalty is the key for any business to grow, since the relationship with the customer is very satisfactory; Since relationship marketing appeared, it has consisted of attracting and maintaining a long-term relationship with the customer, being a competitive sale and a more oriented conception for the market that nowadays is always in constant change (Alcivar Acosta, 2018; Rocha-Vallejos et al., 2022). Relationship marketing is defined by 3 dimensions which are endomarketing, a very important technique to motivate the company's employees, customer retention through good service, keeping them satisfied and communication to have a better customer-company relationship. Likewise, the dimensions in customer loyalty include the management of complaints and claims to understand the customers and be able to give them an immediate solution, purchase experience developing satisfaction factors in each visit to the company and post-purchase behavior to know the opinions about the products and services offered by the company.

There are several precedents, one of them carried out in the Pharmaceutical Industry in the city of Cochabamba implemented relationship marketing, for the same reason that they understood that the objective of marketing is not only the promotion and commercialization, but it is a very important point to develop a special bond with their customers and win their loyalty and preference for their products. In a savings and credit cooperative in Ecuador, studies were conducted after presenting growth and strengthening over the decades, with a database of 465 observations, resulting in the variable that managed to retain their customers and so the greatest influence is the years spent in the market and not the quality of care to them.

The higher education institutions of the Colombian Caribbean use relationship marketing to describe the strengthening of internationalization, through questionnaires to the heads of international relations that helped them to decipher an evident identity in the established theme. Likewise, in the case of the hotel ventures of Cerro Alegre and Cerro Concepción, Valparaíso Chile, studies were carried out to strengthen and improve the company's relations with its customers using tools such as CRM. Customer Relationship Management, better known as CRM, is a tool that facilitates companies to become a customer-centric organization and establish a profitable and long-term relationship with them. Citing Millán Alonso (2014) Movistar reached two million customers in the loyalty plan, according to the operator, its users are benefiting from preferential treatment and the offers it provides, in addition to exclusive promotions, are already part of the Movistar loyalty program.

3. Methodology

According to the approach, it is quantitative since statistical studies will be carried out on each of the company's customers. According to the design, it is non-experimental, of transversal type, for the same reason that the information was collected at a single moment. Likewise, it has a correlational scope; since it sought to recognize the behavior of the two variables and see if there is a positive or negative result for custom arrangement businesses; its research is cross-sectional since it will be carried out over a period of time (Coria et al., 2013).

The population is the entire district of Los Olivos, men and women between the ages of 15 and 64 years; through the INEI of the last census of 2017, gave us 229 thousand 451 people. As a sample, it was obtained through probability sampling, being the population 229,451, the margin of error of 5% and the confidence level of 95%, and as a result 380 surveys will be conducted.

The population was defined through the inclusion and exclusion criteria; for the inclusion criteria, customers between 15 and 64 years old, customers belonging to the district of Los Olivos, customers who repeatedly buy arrangements or decorations, a population that is currently engaged in some activity, either in an employment agency or on their own. In addition, companies and other types of businesses that require the service and product offered. The exclusion criteria include people who do not have economic solvency.

4. Data Collection

In the present research study, the survey technique was used, in order to collect the necessary information with the opinions and attitudes they have towards the company, which will be applied to the most recently frequented clients in the business of personalized arrangements. The instrument used will be a questionnaire made up of the 6 dimensions of the variables studied with 20 items. The questionnaire was validated by experts. All this according to the theoretical approach of Palella and Martins (2012) who stated that the "expert judgment technique consists of providing an odd number of experts in the subject under study and that can be three, five or seven experts, a copy of the instruments with their corresponding response matrix" (p.173).

Google forms were used for data collection, this being a simple tool in times of pandemic and because it is digital it is easy to use, our sample is made up of people who are in the digital world.

5. Results and Discussion

A descriptive analysis was performed, explaining in detail and separated by variables accompanied by their three dimensions.

5.1 Numerical results

5.1.1 Demographics

Through the survey it was possible to clarify in Table 1 that our most common customers are women, but there is not much difference between them and the male gender. Also, the age range that has reached the most custom arrangements business is between 18 and 35 years old and all our respondents are from Los Olivos district.

Table 1: Demography

Age	N° of people	Percentage	Gender	N° of people	Percentage
18 35 years old	221	58%	Female	245	64%
36 56 years old	90	24%			
37 64 years old	69	18%	Male	135	3%
Total	380	100%			

5.1.2 Relationship marketing variable

The first dimension of relationship marketing is customer retention, with which four questions were asked, the first is whether the customer manages to find their product in the store, 34% indicated always and 41% almost always, then it can be said that the shop sells what the customer is looking for. The second question was if the opening hours were adapted to their daily routine where 26% indicated always and 44% almost always, then the opening hours would not change.

Table 2: Customer relationship

Measuring level	Find product in store		Operating hours match your routine	
	N° of people	%	N° of people	%
Always	129	34%	99	26%
Usually	156	41%	167	44%
Sometimes	72	19%	103	27%

Rarely	23	6%	11	3%
Never	0	0%	0	0%
Total	380	100%	380	100%

The third question was whether custom arrangements businesses are interested in knowing the tastes and preferences of their customers trying to be at the forefront, the answer obtained was that 301 people say that they always and almost always like the products sold. Finally, it was asked if the geographic location of the store has a positive impact and the results indicate that yes with 76% always and almost always.

Table 3: Customer interest and location analysis

Measuring level	N° of people	Percentage	N° of people	Percentage
	Interest in your customers		Geographical location	
Never	1	0%	2	1%
Rarely	11	3%	8	2%
Sometimes	67	18%	83	22%
Usually	157	41%	159	42%
Always	144	38%	128	34%
Total	380	100%	380	100%

The second dimension of the relational marketing variable is communication, one of the questions was if the client is satisfied with the service, 38% always feel satisfied, so it is necessary to improve the service and the percentage will be greater than 50%. The second question for this dimension was if the company sends messages to its customers seeking opinions about the service, which show 36% who always see this concern for the service provided. It should be noted that this strategy helps us to know what our customers want and what we can improve to retain them.

Table 4: Communication

Measuring level	Are you satisfied with the service?		Does the company care about the service provided?	
	N° of people	%	N° of people	%
Never	3	1%	4	1%
Rarely	11	3%	15	4%
Sometimes	59	16%	87	23%
Usually	163	43%	137	36%
Always	144	38%	137	36%
Total	380	100%	380	100%

According to the communication dimension, we can see that 40% of our clients answered that they are always demanding in this market, 38% almost always about the option of receiving information about promotions. Likewise, companies are interested in their clients through the creation of databases, in this way the company can send promotions or events, attracting interest and remembering that their clients are important to the company.

Table 5: Customer Requirement

Measuring level	Are you demanding when making a purchase?		Are you interested in receiving information or news about promotions?	
	N° of people	Percentage	N° of people	Percentage
Never	2	1%	3	1%
Rarely	6	2%	9	2%
Sometimes	76	20%	108	28%

Usually	144	38%	134	35%
Always	152	40%	126	33%
Total	380	100%	380	100%

5.1.3 Customer loyalty variable

The first dimension for this variable is internal marketing, two questions were asked, one to determine if the staff is trained to be able to advise the client and if it has compromise. As a result, 34% of the respondents stated that the level of staff counseling is very good and 42% had very good commitment. The results indicate that the staff should be trained and motivated to be able to raise the percentage in both items.

Table 6: Level of advice and commitment

Measuring level	N° of persons	Percentage	N° of persons	Percentage
	Level of advice		Commitment level	
Very bad	0	0%	0	0%
Bad	15	4%	10	3%
Regular	86	23%	73	19%
Good	150	39%	136	36%
Very good	129	34%	158	42%
Total	380	100%	380	100%

The second dimension was elaborated by 2 articles, the first was if the customer had noticed any bad behavior on the part of the staff within the company, 79% had never noticed some bad behavior, on the other hand, 21% have perceived it and this is something that is going to be considered and that is why the staff should not have discussions between colleagues because it is detrimental to the company. The second item was revealed if the worker knows how to give an efficient solution before the client pays for a product and the answer was that 38% always give the solution and 57% of the people do not give any solution.

Table 7: Level of internal communication and problem solving

Measuring level	N° of people	Percentage	N° of people	Percentage
	Internal communication level		Problem resolution	
Never	299	79%	0	0%
Rarely	31	8%	4	1%
Sometimes	13	3%	15	4%
Usually	20	5%	217	57%
Always	17	5%	144	38%
Total	380	100%	380	100%

For the following items, its known in detail that exists a follow-up after an acquisition of a product and the 37% of the people who were interviewed indicated that exist a follow-up after the acquisition of a product which shows that this process is necessary. Likewise, its remarkable the impact that has the advertising on personalized works and that's why 38% of people indicated that they always watch this kind of publicity of business and the other 38% usually watch this kind of advertisements.

Table 8: Post-Purchase monitoring and advertising

Measuring level	N° of people	Percentage	N° of people	Percentage
	After Purchase		Publicity	
Never	2	1%	0	0%
Rarely	11	3%	10	3%
Sometimes	60	16%	93	25%

Measuring level	N° of people	Percentage	N° of people	Percentage
Usually	165	43%	133	35%
Always	142	37%	144	38%
Total	380	100%	380	100%

5.2 Validation

Table 9 shows the mean of the dimensions of the Relationship Marketing variable, for the dimension of client's retention we have an indicator, the company is interested in knowing the tastes and preferences of customers, with an average of 4.14. For the communication dimension, the indicator that the client is demanding with the services provided with an average of 4.16. Finally, in the endomarketing dimension, the indicator the client receives correct advice on the service before making the purchase with an average of 4.10.

Table 9: Results of the variable "Relationship Marketing" according to dimensions and indicators

Dimensions	Indicators	Half
Customer Retention	¿Can you find the right product for every occasion?	4.04
	¿Do the opening hours fit into your daily routine?	3.94
	¿Is Lia Commercial interested in knowing your tastes and preferences trying to be at the fore front?	4.14
	¿Do you consider that the geographical location of the business is appropriate?	4.06
Communication	Based on your experience as a customer. ¿Do you consider yourself satisfied with the service?	4.14
	¿Do you receive messages from Lia Commercial asking for your opinion?	4.02
	¿Do you consider yourself a demanding client with the services provided by Commercial?	4.16
	¿Do you register your data and/or provide any additional information in the Lia Commercial database?	3.98
Endomarketing	When you arrive at the facility. ¿Are the staff in place and ready to serve you?	4.05
	¿Do you receive adequate advice on the service before making your purchase?	4.10

Table 10 shows the average of the dimensions of the customer loyalty variable, the first dimension being internal marketing, the indicator shows the commitment of workers for a better service, this gives an average of 4.17. As a second dimension of the customer experience, the worker's indicator in difficult situations provides an immediate and/or efficient solution, it gives an average of 3.72.

Table 10: Results of the variable "Customer loyalty" according to dimensions and indicators

Dimensions	Indicators	Half
Internal Marketing	¿Is Lia Commercial worker trained to give a proper advice?	4.03
	¿Do you notice the commitment of the workers to provide a better service?	4.17
Client's Experience	¿Do you often perceive or remember arguments due to poor communication?	1.49
	When you had a problem making a purchase, did the Lia Commercial employee who assisted me know how to provide an immediate and/or efficient solution?	3.72
Information	¿Do you know discounts and offers?	4.03
	¿Is the Lia Commercial worker motivated to offer the best experience in the services offered?	4.11
	¿Do you receive any type of post-purchase follow-up of the purchased service?	4.14
	Is the product information provided by Lia Commercial that appears on Facebook and Instagram appropriate for your needs?	4.08
	¿Do you consider that the staff is qualified to make any decision of the company?	4.17
	¿Would you recommend the Lia Commercial service?	4.20

Next, a correlational analysis will be detailed, which will allow us to see if our hypotheses are true. Using the Rho Spearman.

5.2.1 General hypothesis

Ho: There is no relationship between relationship marketing and customer loyalty at Lia Trading Company.

Ha: There is a relationship between relationship marketing and customer loyalty at the Lia Commercial Company.

Table 11: Relationship between relationship marketing and customer loyalty

			Relationship Marketing	Loyalty
Rho Spearman	Relationship Marketing	Correlation coefficient	1.000	.447**
		Follow. (Two-sided)		<.001
		N	380	380
	Loyalty	Correlation coefficient	.447**	
		Follow. (Two-sided)	<.001	
		N	380	380

** . Correlation is significant at the 0.01 level (bilateral).

Table 11 shows the result of the relationship between relationship marketing and customer loyalty, this gives Spearman's Rho correlation coefficient of 0.447, which indicates that the relationship is moderate and positive between the two variables mentioned, then we can deduce that if one variable increases the other will also increase and vice versa. The null hypothesis is rejected and the alternative hypothesis is accepted.

5.2.2 Specific hypothesis

Ho: There is no relationship between endomarketing within relationship marketing and customer loyalty in the Lia Commercial Company.

Ha: There is a relationship between endomarketing within relationship marketing and customer loyalty in the Lia Commercial Society.

Table 12: Relationship between final marketing and customer loyalty

			Endomarketing	Loyalty
Rho Spearman	Endomarketing	Correlation coefficient	1.000	.433*
		Follow. (Two-sided)		<.001
		N	380	380
	Loyalty	Correlation coefficient	.433*	
		Follow. (Two-sided)	<.001	
		N	380	380

** . Correlation is significant at the 0.01 level (bilateral).

Table 12 shows that between the endomarketing dimension and the customer loyalty variable, Spearman's Rho coefficient gives a result of 0.433, which indicates that there is a moderate relationship in the 380 customers surveyed.

5.2.3 Specific hypothesis

Ho: There is no relationship between relationship marketing customer retention and Lia Trading Company customer loyalty.

Ha: There is a relationship between relationship marketing customer retention and Lia Commercial Company customer loyalty.

Table 13: Relationship between customer retention and customer loyalty

			Customer Retention	Loyalty
Rho Spearman	Customer Retention	Correlation coefficient	1.000	.397**
		Follow. (Two sided)		<.001
		N	380	380
	Loyalty	Correlation coefficient	.397**	1.000
		Follow. (Two-sided)	<.001	
		N	380	380

** . Correlation is significant at the 0.01 level (bilateral).

Table 13 shows the relationship between the customer retention dimension and the customer loyalty variable, Spearman's Rho coefficient is 0.397, which indicates that it is a low correlation.

Ho: There is no relationship between communication within relationship marketing and customer loyalty at Compañía Comercial Lia.

Ha: There is a relationship between communication within relationship marketing and customer loyalty in the Lia Commercial Company.

Table 14: Relation between communication and Loyalty Customers

			Communication	Loyalty
Rho Spearman	Communication	Correlation coefficient	1.000	.403**
		Follow. (Two-sided)		<.001
		N	380	380
	Loyalty	Correlation coefficient	.403**	1.000
		Follow. (Two-sided)	<.001	
		N	380	380

** . Correlation is significant at the 0.01 level (bilateral)

As you can see in Table 14, the relationship between the communication dimension and the customer loyalty variable, Spearman's Rho coefficient gives a result of 0.403, which indicates that the correlation is moderate.

6. Conclusion

The main objective of this work was to discover if there is a correlation between our two variables, which are relationship marketing and customer loyalty. Regarding the descriptive analysis of the questions formulated in the first dimension of the relational marketing variable, this deduces that the majority of our audience is male, likewise, it also highlighted that the majority of clients prefer to buy from the Lia Commercial Company, accepting that the products are liked by the majority of customers. In the question about the second dimension, the highest percentage answered that they are almost always satisfied with the service provided. Finally, they also mentioned that they feel satisfied when receiving messages from the company, since it makes them feel special and that they consider themselves very demanding when purchasing any type of product.

Regarding the first dimension of the customer loyalty variable, the large percentage of customers affirm that they do feel that Lia Commercial workers are trained. In the next question of the second dimension, most of the clients affirmed that they had never witnessed any kind of internal problems among the workers. Likewise, the large percentage of clients mentioned that the workers are willing to answer any question. Finally, in the following items, customers announced that, if there is a post-purchase follow-up.

Regarding the correlational analysis, the Rho Spearman will be used and this is visible in table 11, there is a correlation of 0.447 with respect to the general hypothesis, which indicates that the relationship is moderate and positive between the relational marketing variable and customer loyalty. customer. Table 12 shows that there is a correlation of 0.433 with respect to the specific hypothesis, which indicates that there is a moderate relationship between the endomarketing dimension and the customer loyalty variable. Likewise, in table 13 it is notable that there is a low correlation of 0.397 with respect to the dimension of customer retention and the

loyalty variable. Finally, Table 14 shows that there is a moderate relationship of 0.403 between the communication dimension and the customer loyalty variable.

the target they want to obtain, for this is necessary to develop promotion strategies so that the company has notoriety (Estrella et al., 2012). On the other hand, Guede (2016); Medina et al. (2018); Guede and Filipe (2019) indicate that if companies want to increase their loyalty, they must have quality in all the services they offer, even the way they sell. However, Lafuente et al (2011); Serna and Díaz (2020) comment that to improve loyalty, the company has to establish a good relationship with the employees, trusting them so they will have a good deal with the client, then to know the types of customers, such as: the experienced (know the brand and what it offers) and the inexperienced (do not know the brand), Finally, do not stay with a single loyalty strategy to avoid competition.

To achieve customer loyalty, relationship marketing techniques must be used, such as endomarketing, communication and customer satisfaction; Today they are the challenges that the company must improve to obtain profitability (Flores, 2011). For Castañeda (2019), using endomarketing helps the company to establish itself completely, thanks to this the company can respond to customer demands, allowing the first customers (employees) to be motivated and committed.

One of the dimensions used was customer retention, this allows us to improve the profitability of the company, when the company retains more customers it obtains substantial savings and it is also less costly to serve loyal customers (Guadarrama and Rosales, 2015). Loyalty is a link between the customer and the company after having a good shopping experience and satisfaction (Salas, 2017).

As a conclusion to our objective, it was possible to determine that there is a relationship between relationship marketing and customer loyalty, thanks to Spearman's Rho it was evidenced that if relationship marketing is used then it is affirmed that customer loyalty is also used; and therefore, the existence of correlation is moderate. In the 10 items of the relational marketing variable, it is evident that Lía Comercial is progressing well, but it must focus on how the client feels when they visit the company and when they make a purchase, keep in touch with them.

References

- Agüero, L., Customer loyalty strategy. Available: <http://hdl.handle.net/10902/4474>, 2014
- Alcivar Acosta, S.V. (2018). Relationship marketing to generate loyalty to customers of Very Chic boutique, north sector, city of Guayaquil [engineering thesis, Universidad Laica Vicente Rocafuerte de Guayaquil]. Institutional Repository. Retrieved from <http://repositorio.ulvr.edu.ec/handle/44000/2122>
- Arosa-Carrera, C. R., and Chica-Mesa, J. C., Innovation in the relationship marketing paradigm. *Estudios Gerenciales*, vol. 36, no. 154, pp. 114-122, 2020.
- Burbano-Pérez, Á. B., Velástegui-Carrasco, E. B., Villamarin-Padilla, J. M., and Novillo-Yaguarshung, C. E. (2018). Relationship marketing and customer loyalty. *Knowledge Pole*, 3(8), 579-590. doi:10.23857/pc.v3i8.683.
- Cabrera, S., Customer loyalty in restaurant businesses. *Cuadernos del Centro de Estudios en Diseño y Comunicación*. Essays, vol. 45, pp. 155-164, 2013.
- Castañeda, S., Endomarketing and organizational learning: a tool for management. *NOVUM, journal of applied social sciences*, vol. II, no. 9, 184-196, 2019.
- Coria Páez, Ana Lilia, Roman, Isidoro Pastor, and Torres Hernández, Zacarías. (2013). Proposal of methodology to elaborate a scientific investigation in the area of Business Administration. *Thinking & Management*, (35), 2-24.
- Cordova-Buiza, F., Aguirre-Maldonado, M. F., and Alor-Rau, D. A. (2022a). The profile of the apple brand consumer: Electronic equipment and software in Lima-Peru. Paper presented at the *IEEE International Professional Communication Conference*, 2022-July 418-422. <https://doi.org/10.1109/ProComm53155.2022.00083>
- Cordova-Buiza, F., Urteaga-Arias, P. E., and Coral-Morante, J. A. (2022b). Relationship between social networks and customer acquisition in the field of IT solutions. *IBIMA Business Review*, 2022. <https://doi.org/10.5171/2022.631332>
- De Guzman, J., Relationship marketing strategy to achieve customer loyalty. *Apuntes Universitarios. Revista de Investigación*, vol. IV, no. 2, 25-42, 2014.
- Estrella Ramón, A. M., Jiménez Castillo, D., Ruiz Real, J. L., and Sánchez Pérez, M. (2012). How do SMEs compete in the international market? analysis of an export-oriented local cluster. *Investigaciones Europeas de Dirección y Economía de la Empresa*, 18(1), 87-99. Obtenido de [https://doi.org/10.1016/S1135-2523\(12\)60062-8](https://doi.org/10.1016/S1135-2523(12)60062-8)
- Flores, E., Relationship marketing as a differentiation strategy in customer loyalty in financial institutions located in Puno. *Comunicacion: Journal of Research in Communication and Development*, Vol. 2, No. 1, 39-51, 2011.
- Guadarrama, E. and Rosales, E., Relationship marketing: value, satisfaction, loyalty and customer retention. Analysis and theoretical reflection. *Science and Society*, vol. 40, no. 2, 307-340, 2015.
- Guede, J., Las relaciones en el marketing: una revisión a su evolución/Relationship in the marketing: A review of its evolution. *Anuario Jurídico y Económico Escurialense*, vol. 49, 459-474, 2016.

- Guede, J. and Filipe, A., The brand e-experience through social media and its influence on e-relationship quality and e-loyalty. Empirical analysis on travel websites. Cuadernos de Turismo, vol. 44, 351-380, 2019.
- Lafuente, A. and Bassa, C., The forgotten effects model in a crm strategy. Fuzzy Economic Review, vol. 16, no. 1, 3-19, 2011.
- Martinez-Sala, A. and Monserrat-Gauchi, J. and Campillo Alhama, C., The relational paradigm in the strategies of destination marketing organizations. Interactivity and social function in official tourism websites. Latin Journal of Social Communication, vol. 72, 374-396, 2017.
- Medina, P., Alcivar, S. and Benites, T., "Relationship marketing to generate loyalty towards customers of Very Chic boutique, north sector, city of Guayaquil.", Magazine Observatorio de la Economía Latinoamericana, 2018.
- Millán Alonso, S. (2014). Movistar reaches two million customers in the loyalty plan. Five days. Retrieved from https://cincodias.elpais.com/cincodias/2014/06/13/empresas/1402684737_131519.html
- Palella, S. and Martins, F. Methodology of Quantitative Research, 3rd Ed, FEDUPEL, 2012.
- Rocha-Vallejos, K. H., Rabanal-Altamirano, S. N., Robles-Fabian, D. A., and Cordova-Buiza, F. (2022). Does brand love strictly increase purchase intention? the case of Linio. *Innovative Marketing*, 18(4), 36-47. doi:10.21511/im.18(4).2022.04
- Salas Canales, H. J., Influence of relationship marketing in the organizational results of private educational institutions in the metropolitan area of Lima (Peru). Revista de Investigaciones Altoandinas, vol. 19, no. 1, 63-74, 2017.
- Serna, H. and Diaz, A., Measuring customer value. Desarrollo Gerencial, vol. 12, no. 1, 1-26, 2020.

Developing Green Entrepreneurship Skills in Indonesia; An Educational Perspective

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Abstract: This paper explores the critical nexus between Green Entrepreneurship and Sustainable Development, illuminating their combined potential as a powerful tool for mitigating environmental crises such as global warming and climate change. With a particular focus on burgeoning economies, especially Indonesia, it underscores the immense possibilities embedded within a proactive integration of sustainable practices into entrepreneurship. This not only paves the way towards climate neutrality but also cultivates competitive advantages in business enterprises. Despite the tremendous potential, the widespread adoption of Green Entrepreneurship has been persistently stifled by a profound lack of awareness, an alarming paucity of educational resources, and a dearth of specialised knowledge within the field. These factors collectively contribute to the unimpressive rate of implementation and relatively low acceptance of Green Entrepreneurship. To address this conundrum, this scholarly article undertakes a comprehensive gap analysis aimed at evaluating the future prospects of Green Entrepreneurship within Indonesia. It does so through a detailed examination of the development of Green Entrepreneurship skills from the perspective of educators. The study forms part of a broader initiative - the ASEAN Network for Green Entrepreneurship and Leadership (ANGEL) - a European-funded project devoted to equipping university graduates and disadvantaged societal groups with vital entrepreneurial skills geared towards sustainability. The analytical framework of the research draws upon a conducted survey among university faculty members, supplemented with a focus group discussion with participants involving a diverse mix of faculty, students, and administrative staff. The findings underscore a strikingly limited focus on Green Entrepreneurship within the curriculum. However, they also reveal a robust commitment and a strong willingness to infuse existing syllabi with Green Entrepreneurial facets. To accomplish this, the research identifies the need to surmount significant challenges, primarily those related to resource availability. Furthermore, the gap analysis points towards the need for amplifying collaboration among a broad spectrum of stakeholders. These include local businesses, government agencies, and the broader community. Such partnerships can significantly assist universities in crafting effective business school curricula that instil a sustainability mindset. Moving forward, the research proposes to extend its scope to embrace the viewpoints of community members. This would encompass a particular focus on traditionally marginalized groups, including women, minorities, and economically disadvantaged segments in both urban and rural communities.

Keywords: Green Entrepreneurship, Green Business, Sustainability, Entrepreneurial Education, Entrepreneurial Skills, Sustainable Development.

1. Introduction

The urgency of addressing environmental challenges and fostering sustainable development has become a global imperative. Environmental crises such as climate change and global warming underscore the urgent need to devise innovative and impactful solutions. One such powerful tool that holds tremendous promise is Green Entrepreneurship. This form of entrepreneurship integrates sustainable practices within business operations to not only mitigate environmental degradation but also leverage the emerging opportunities in the expanding green economy. The interplay of entrepreneurship and sustainable development can thus cultivate competitive advantages in business enterprises while concurrently working towards climate neutrality.

Despite the considerable potential of Green Entrepreneurship, its widespread adoption, particularly in developing economies such as Indonesia, is often thwarted by various barriers. These range from a deep-seated lack of awareness to an alarming scarcity of specialized educational resources and knowledge within the field. This collective inertia contributes to the slower-than-anticipated rate of implementation and acceptance of Green Entrepreneurship. In response to this pressing issue, our research embarks on a comprehensive gap analysis to explore the future potential and development of Green Entrepreneurship in Indonesia. The study is part of a broader initiative: the ASEAN Network for Green Entrepreneurship and Leadership (ANGEL) - a

European-funded project that aims to equip university graduates and disadvantaged societal groups with vital entrepreneurial skills for sustainability.

This research adopts a scientific perspective, focusing on the perceptions and insights of university faculty members. Specifically, a meticulous survey is conducted, supplemented by focus group discussions among a diverse cohort of faculty, students, and administrative staff. The goal was to shed light on the current state of Green Entrepreneurship education and the potential barriers hindering its expansion. The findings revealed a strikingly limited focus on Green Entrepreneurship within the current academic curriculum. Nevertheless, they also highlighted a strong willingness among the academic community to integrate Green Entrepreneurship principles into the existing educational framework. Further, overcoming the challenges related to resource availability emerged as a significant concern.

Additionally, the analysis underscores the need to promote collaboration among a broad range of stakeholders, including local businesses, government agencies, and the broader community. Such partnerships are instrumental in assisting universities in curating effective curricula that instill a sustainability mindset. As our research continues, we aim to broaden its scope to include the perspectives of traditionally marginalized community groups, aiming to foster an inclusive approach towards Green Entrepreneurship. This paper contributes to the burgeoning literature on Green Entrepreneurship by focusing on the often-overlooked perspective of educators and students. It also provides practical insights into the development and implementation of Green Entrepreneurship education in developing economies.

2. Literature Review

Green Entrepreneurship has emerged as a vanguard for integrating sustainable business practices, offering innovative solutions to pressing environmental challenges. Grounded in the pioneering work of Schaper (2016), Green Entrepreneurs are posited as the linchpin in championing environmental sustainability (Hockerts, 2015; Hockerts, 2017). By venturing into the green sector, these individuals seek to transform industries with sustainable product innovations, enhanced processes, and eco-friendly services that move industries towards a zero-waste paradigm (OECD, 2011). These entrepreneurs harness distinctive attributes, such as accountability and proactive problem-solving, to capitalize on green opportunities and innovate in ways that yield both environmental and economic benefits (Nasution et al., 2011; Caggese, 2012).

Indonesia serves as an intriguing backdrop for this discussion. With its dynamic young demographic contrasted against high youth unemployment rates, the country presents a dual challenge (Gunawan & Fraser, 2016). Indonesia's ambitious commitment to reducing its carbon emissions by up to 41% by 2020 underscores the growing importance of a green transition in its policy frameworks (Gunawan & Fraser, 2016). The country's unique decentralization policy since 2001 adds layers of complexity, spotlighting the challenges of governance over its diverse archipelago (Fraser, 2013). This intricate landscape makes Indonesia an apt case for delving into the intricacies of Green Entrepreneurship, especially among its youth. At the heart of entrepreneurial challenges, access to capital emerges as a recurring theme, more so for green businesses (Perri & Chu, 2012; Gujba et al., 2012). Traditional financial institutions often hesitate to fund ventures perceived as innovative or risky, a category into which many green enterprises fall (Lerner, 2010). However, the potential of these businesses lies in their ability to champion an ecologically balanced economy by pioneering sustainable solutions (Mukherjee et al., 2016).

Recent literature advancements, such as those by Moon et al. (2022), synergize the frameworks of EntreComp and GreenComp. While EntreComp outlines the essential competencies for entrepreneurial success, GreenComp reinforces the environmental ethos, urging businesses to strike a balance between profitability and ecological stewardship. A growing consensus in contemporary research highlights the urgency for businesses to intertwine sustainable and digital strategies. Marneros et al. (2023) underline the business benefits of sustainable practices, while Papageorgiou et al. (2021a, 2021b, 2021c) draw attention to the evolving landscape of entrepreneurial education in the digital age. Collectively, these studies emphasize the crucial interplay of sustainability, digitalization, and education in the modern business realm.

Despite the promising potential of Green Entrepreneurship, several impediments exist, particularly in emerging economies like Indonesia. Primary among these are limited awareness and a lack of dedicated educational resources (Gupta & Dharwal, 2022; Muo & Azeez, 2019). The transformative role of education in propagating Green Entrepreneurship remains a focal point, emphasizing the need for embedding sustainability within entrepreneurial curricula (Barton, 2010). Yet, a discernable gap exists in Indonesia's academic settings, with a conspicuous absence of Green Entrepreneurship in mainstream education (Gunawan & Fraser, 2016). To

actualize Green Entrepreneurship's potential, a collaborative approach encompassing academia, businesses, government, and communities is paramount (York & Venkataraman, 2010; Gunawan & Fraser, 2016). Despite the burgeoning discourse on the subject, there remains a noticeable gap in exploring the perspectives of educators and students, particularly in emerging contexts like Indonesia. This study aims to contribute to the literature by amplifying these often-sidelined voices, offering a richer understanding of the challenges and opportunities in fostering Green Entrepreneurship.

3. Methodology

This research adhered to a mixed-methods approach, as proposed by Creswell and Clark (2017) and Molina-Azorin (2012). This methodology enables the concurrent utilization of quantitative and qualitative data, thereby offering a holistic perspective on the subject of green entrepreneurship within the Indonesian context. The analytical framework of the research draws upon a conducted survey among a representative sample of thirteen university faculty members, supplemented with a focus group discussion with nine participants involving a diverse mix of faculty, students, and administrative staff. Initially, a comprehensive survey was deployed, inspired by the theoretical frameworks of Cohen and Winn (2007) followed by a focus group for triangulation purposes. The questionnaire was divided into five segments, each focusing on a specific aspect of the educators' perception and implementation of green entrepreneurship:

Demographics: This section collected data on the respondents' age, gender, educational level, position, and duration of association with the university. This information provided the context for subsequent demographic-based analysis.

Awareness: Drawing on the work of York and Venkataraman (2010), this segment assessed educators' understanding of green entrepreneurship, gauging their awareness of the concept and its application in a business context.

Integration: The survey sought to understand the extent to which green entrepreneurship was integrated into the current curriculum, capturing details about relevant courses, modules, and programs.

Challenges: This section asked respondents to identify the barriers to implementing green entrepreneurship education, facilitating the identification of key areas for improvement.

Future Aspirations: This final section gauged respondents' willingness and plans to integrate green entrepreneurship into their future teaching, helping to assess the potential for growth in this field.

Following the survey, a Focus Group Discussion (FGD) was conducted, guided by Krueger and Casey's methodology (2014). This discussion involved a select group of faculty members, students, and administrative staff. Grounded in Schaltegger's (2002) work on ecopreneurship and Gibbs' (2009) model for sustainability entrepreneurship, the FGD aimed to delve deeper into the issues identified in the survey and explore potential strategies for promoting green entrepreneurship education. Finally, ethical considerations were paramount in this research. All participants were informed about the study's objectives, procedures, potential risks, and benefits. Informed consent was obtained from each participant, thereby ensuring voluntary participation and respecting individual autonomy (Denscombe, 2017). Participant confidentiality and privacy were strictly maintained, with all personal identifiers removed or anonymized in the final presentation of the data. The data were securely stored and access was restricted to the research team. The ethical considerations of this study were reviewed and approved by a relevant ethics committee, demonstrating a commitment to uphold research integrity and maintain high ethical standards. In this way it was ensured that the findings of this study will be used exclusively for academic purposes and policy formulation, contributing to the advancement of green entrepreneurship education in Indonesia.

4. Results

The exhaustive analysis of the survey data, complemented by the Focus Group Discussion (FGD), has afforded a nuanced comprehension of the prevailing scenario of green entrepreneurship education in Indonesia. The survey unveiled a conspicuous commitment to green entrepreneurship and leadership at the university institutional level. However, this commitment contrasts with a discernible gap in its practical manifestation within the curriculum. While there exists a plethora of initiatives orbiting sustainability, dedicated programs that center on green entrepreneurship and leadership remain surprisingly sparse. Respondents shed light on several challenges: a pronounced disconnection between university environmental aspirations and the

tangible intricacies of business, suggesting a need for weaving environmental principles more seamlessly into the business curricula. Furthermore, the expressed concerns about the shortage of specialized experts in the domain and the limited resources apportioned to sustainability initiatives underscore the urgent need for a recalibrated focus in these areas. Beyond these concerns, there resonated a collective call for a more robust collaboration framework, emphasizing the indispensable role of cohesive, inter-stakeholder initiatives in advancing the green entrepreneurship agenda.

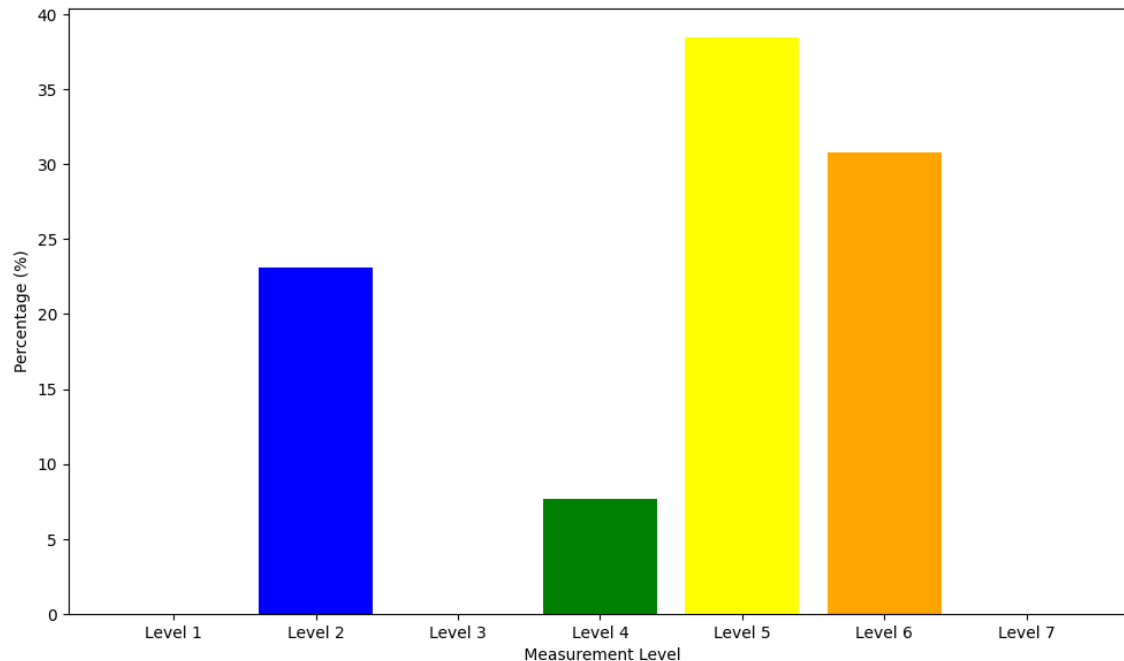


Figure 1: Presence of an Educational Collaborative Scheme with the Industry on Green Entrepreneurship and Leadership

Specifically, Figure 1 illustrates the existing collaborative dynamics between university and industry partners in green entrepreneurship and leadership. Among the respondents, 23.1% situated their institution's collaborative efforts at Level 2, indicating initial stages of partnerships. 7.7% identified with Level 4, signaling a moderate level of engagement. Notably, a combined majority of 69.3% placed their collaborations at Levels 5 and 6, reflecting matured and intensive engagements. However, the non-represented Level of 7 suggests areas that merit further improvement for enhancing the Educational Collaborative Scheme with the Industry on Green Entrepreneurship and Leadership. The survey findings showcase the educational institutions' commitment to fostering green entrepreneurship, highlighting both its strengths in higher-tier collaborations and areas requiring intensified focus. In the broader context of Indonesia's drive toward green entrepreneurship education would definitely play a significant role.

The Focus Group Discussion (FGD) outcomes harmonized with the survey's revelations, reiterating the university's unmistakable vow to sustainability and the existing lacunae in infrastructural and curricular support. Participants were unanimous in their call for a more integrated, multidisciplinary approach to green entrepreneurship. A recurrent theme was the demand for a comprehensive infusion of green principles throughout the curriculum, ensuring students grasp the full spectrum of sustainability's role in business. The FGD further underscored the lacuna of professionals with a formal grounding in sustainability, underscoring the pivotal role educators play in shaping the green entrepreneurs of tomorrow.

Our study bore further insights into the current deficiencies and latent opportunities for magnifying the resonance of green entrepreneurship in academia. The dialogues revealed a compelling consensus for embedding green entrepreneurship as a cornerstone within the academic curriculum rather than relegating it to the peripheries. This was coupled with an emphatic call for a surge in sustainability training, advocating for a comprehensive pedagogical approach towards green entrepreneurship and leadership. There was also a shared sentiment about the need for cultivating an environment that champions green ventures, a milieu characterized by mentoring, rich resources, and robust community support. In summation, the study's findings accentuate the pressing need to address the observed disparities in green entrepreneurship education. They

also delineate a roadmap for subsequent research and policymaking trajectories in Indonesia, spotlighting the instrumental role of synergetic endeavours amongst academia, industry, and governance in sculpting a generation proficient in the green economy's complexities.

5. Discussion – Conclusion

The results of this research study illuminate the existing gaps in the curriculum, the challenges faced by stakeholders, and the potential avenues for fostering green entrepreneurship and leadership. The survey findings underscored a perceptible commitment to green entrepreneurship and leadership at the university level. However, a notable disparity emerged between this commitment and the limited incorporation of sustainability-focused programs within the curriculum. The absence of specialized study programs in green entrepreneurship and leadership indicated a crucial area for improvement. Respondents expressed concerns over the misalignment of environmental ideals with practical business realities, emphasizing the need for sustainable initiatives to address fundamental business issues faced by small and medium enterprises. Additionally, sustaining and scaling up green entrepreneurship was hindered by inadequate financial resources, a lack of education and training in eco-friendly business practices, and the challenging market landscape, characterized by intense competition and fluctuating consumer preferences.

The Focus Group Discussion reinforced the survey results and provided valuable in-depth perspectives. It emphasized the urgency of adopting an integrated, multidisciplinary approach to green entrepreneurship and leadership. Participants advocated for the infusion of green concepts throughout the curriculum, enabling students to develop a holistic understanding of sustainability within the business context. Furthermore, they highlighted the dearth of experts with formal training and research in the specific field of sustainability, emphasizing the necessity of building faculty capabilities in this domain. The discussion also underscored the importance of fostering collaboration across disciplines, academia, industry, and government to create a supportive ecosystem that nurtures green businesses.

In conclusion, the gap analysis conducted at the university level has shed light on the state of green entrepreneurship education in Indonesia. While there exists a strong perceived commitment to sustainability at the university level, the actual curriculum dedicated to green entrepreneurship and leadership remains limited. The findings reveal the need for more focused and comprehensive study programs that address the specific challenges and opportunities presented by the green economy. To address these gaps, it is imperative to integrate sustainability concepts more prominently into the business curriculum, fostering a new generation of entrepreneurs who possess the knowledge and skills to operate successfully within the green economy. This integration should encompass not only theoretical knowledge but also practical training in eco-friendly business practices. Collaborations between academia, industry, and government are essential to create a nurturing environment for green entrepreneurship, offering access to resources, mentorship, and funding platforms for aspiring green entrepreneurs.

Moreover, the development of faculty expertise in the field of sustainability is crucial for fostering a culture of green entrepreneurship within the academic community. Investing in faculty training and research in sustainability-related areas will equip educators with the competence to inspire and guide students in their green entrepreneurial endeavors. Overall, the gap analysis carried out in this study provides valuable insights for policymakers, educational institutions, and stakeholders in Indonesia to devise targeted interventions that promote and advance green entrepreneurship education. By harnessing the potential of green entrepreneurship, Indonesia can pave the way towards a sustainable and resilient economy, addressing environmental challenges while fostering innovation and economic growth.

Acknowledgements

This work was supported by the Erasmus + Program of the European Union: Project ANGEL - ASEAN Network for Green Entrepreneurship and Leadership (ANGEL, 619421-EPP-1-2020-1-MY-EPPKA2-CBHE-JP).

References

- Barton, D. (2010) "Green growth in Asia: An opportunity for business", *Global Asia*, Vol 4, No. 4, pp 32-34.
- Caggese, A. (2012) "Entrepreneurial risk, investment and innovation", *Journal of Financial Economics*, Vol 106, pp 287-307.
- Cohen, B. and Winn, M. I. (2007) "Market imperfections, opportunity and sustainable entrepreneurship", *Journal of Business Venturing*, Vol 22, No. 1, pp 29-49.
- Creswell, J. W. and Clark, V. L. P. (2017) *Designing and conducting mixed methods research*, Sage Publications.

- Denscombe, M. (2017) *The good research guide: For small-scale social research projects*, McGraw-Hill Education (UK).
- Fraser, K. (2013) "Is Indonesia producing enough business graduates to assist its development aspirations?", *Industry and Higher Education*, Vol 27, No. 2, pp 85-88.
- Gibbs, D. (2009) "Sustainability entrepreneurs, ecopreneurs and the development of a sustainable economy", *Greener Management International*, No. 55, pp 63-78.
- Gujba, H., Thorne, S., Mulugetta, Y., Rai, K. and Sokona, Y. (2012) "Financing low carbon energy access in Africa", *Energy Policy*, Vol 1, No. June, pp 71-78.
- Gunawan, J. and Fraser, K. (2016) "Exploring young and green entrepreneurship in Indonesia: An introduction", *Journal of Asian Business Strategy*, Vol 6, No. 9, pp 185-194.
- Gupta, M. and Dharwal, M. (2022) "Green entrepreneurship and sustainable development: A conceptual framework", *Materials Today: Proceedings*, Vol 49, pp 3603-3606.
- Hockerts, K. (2015) "Determinants of social entrepreneurial intentions", *Entrepreneurship Theory and Practice*, Vol 41, No. 1, pp 105-130.
- Hockerts, K. (2017) "Determinants of Social Entrepreneurial Intentions", *Entrepreneurship Theory and Practice*, Vol 41, No. 1, pp 105-130.
- Krueger, R. A. and Casey, M. A. (2014) *Focus groups: A practical guide for applied research*, Sage Publications.
- Lerner, J. (2010) *Innovation, Entrepreneurship and Financial Market Cycle STI Working Paper 2010/3: Industry issues*, OECD.
- Marneros, S., Papageorgiou, G., & Efstathiades, A. (2023) "Evaluating Strategies for Sustainability and Business Performance in the Hotel Industry of Cyprus". In *International Conference on Tourism Research* (Vol. 6, No. 1, pp 177-185).
- Molina-Azorin, J. F. (2012) "Mixed methods research in strategic management: Impact and applications", *Organizational Research Methods*, Vol 15, No. 1, pp 33-56.
- Moon, C., Walmsley, A. and Apostolopoulos, N. (2022) "EntreComp and GreenComp for Entrepreneurship. What is the 'Real' Relationship?", In *European Conference on Innovation and Entrepreneurship*, Vol. 17, No. 1, pp 726-732.
- Mukherjee, A., Onel, N., and Nuñez, R. (2015) "Business strategies for environmental sustainability: An integrated approach", In D. Sarkar, R. Datta, A. Mukherjee, & R. Hannigan (Eds.), *An Integrated Approach to Environmental Management*, John Wiley & Sons, pp. 195-230.
- Muo, I., and Azeez, A. A. (2019) "Green entrepreneurship: Literature review and agenda for future research", *International Journal of Entrepreneurial Knowledge*, Vol 7, No. 2.
- Nasution, H. N., Mavondo, F. T., Matanda, M. J., and Ndubisi, N. O. (2011) "Entrepreneurship: Its relationship with market orientation and learning orientation and as antecedents to innovation and customer value", *Industrial Marketing Management*, Vol 40, pp 336-345.
- OECD (2011) *Measuring green entrepreneurship entrepreneurship at a Glance*, OECD Publishing.
<http://www.oecd.org/science/inno/48350231.pdf>.
- Papageorgiou, G., Mihai-Yiannaki, S., Ioannou, M., Varnava-Marouchou, D., & Marneros, S. (2021a) "Entrepreneurship Education in an Era of Digital Communications. In *Universities and Entrepreneurship: Meeting the Educational and Social Challenges*", Emerald Publishing Limited, pp 65-77.
- Papageorgiou, G., Yiannaki, S. M., & Varnava-Marouchou, D. (2021b) "A Critical Evaluation of Contemporary Tools on Developing Innovative Thinking Competencies for Entrepreneurship", In *European Conference on Innovation and Entrepreneurship*, pp 701-R24, Academic Conferences International Limited.
- Papageorgiou, G., Yiannaki, S. M., Varnava-Marouchou, D., Anastasiades, T., Hadjipapa-Gee, S., & Englezou, D. (2021c) "A System Dynamics Approach to Entrepreneurship Applied to the Case of the Creative Arts Industry", In *European Conference on Innovation and Entrepreneurship* (pp. 707-R24). Academic Conferences International Limited.
- Perri, D. F., and Chu, H. M. (2012) "Entrepreneurs in China and Vietnam: Motivations and Problems", *International Journal of Entrepreneurship*, Vol 16, Special Issue, pp 93-111.
- Schaltegger, S. (2002) "A Framework for Ecopreneurship: Leading Bioneers and Environmental Managers to Ecopreneurship", *Greener Management International*, No. 38, pp 45-58.
- Schaper, M. (2016) "Understanding the green entrepreneur", In *Making ecopreneurs*, Routledge, pp 7-20.
- York, J. G., and Venkataraman, S. (2010) "The entrepreneur-environment nexus: Uncertainty, innovation, and allocation", *Journal of Business Venturing*, Vol 25, No. 5, pp 449-463.

The Ideological Fundamentals of Social Entrepreneurship: the Political Economy Aspect

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Abstract: For many centuries ideology has been playing a major role in the development of societies and economies. It can evolve at the level of the state (the macro-level), as well as at the level of enterprises (the micro-level). At the level of special enterprises, such as social ones, the special ideology that shapes their behavior model, their development strategy and creates the fundamentals of their social mission that make them different from ordinary commercial enterprises, exists. This paper attempts to search for the ideological fundamentals of social entrepreneurship that shape their special way in the socio-economic development of several countries at the modern phase of the formation development. The social and economic missions are assumed to comprise the base of ideology of any social enterprise. The social mission of social enterprises refers to value creation for the “public good”, whereas their economic mission refers to value creation for “private gain”. It is shown that the ideology of social enterprises is reflected in the balance between these two missions during different periods of its development. It is concluded that in the historical perspective the outcome of this balance depends on the institutional pressure in a given country. The modern post-Soviet critical Marxism approach is used as a theoretical and methodological basis of the study. Due to it, the main formations of socio-economic development are derived and the development vector for the long run is specified.

Keywords: Social Entrepreneurship, Ideology, Political Economy, Social Mission, Economic Mission.

1. Introduction

During recent decades in the development of capitalism the trends which can be characterized as the process of capitalism socialization are observed. In most part it is connected with the fact that in the field of entrepreneurial activity new organisms named social enterprises emerged. These enterprises were focused not on profit maximization, but on maximizing the social value. By the kind of their activity these enterprises contradict the ordinary commercial enterprises, because in terms of surplus value, if it is formed, it is reinvested into the further social projects and is not captured by the top management or by the enterprise owners. Besides, these enterprises are actively supported by the state and are not left to fend for themselves in the struggle for surviving at the market. So, for instance, in the UK the government finances the activity of social enterprises by means of social procurement mechanism and in the USA the government supports social enterprises by means of the public programme “Pay for success”, which was launched in the period of B. Obama's presidency, under which a certain sum was returned to the investor in the case if the target of the project he invested in was fulfilled, the sum he invested in was returned to him and he would get a certain premium, if the target of the project was overfulfilled, but he wouldn't get anything, if the target of the project wasn't fulfilled. In the process of financing this project the finances of taxpayers were involved, and that meant that this project was financed at the expense of the state budget. Indeed the government in these countries begins to intervene actively into the development of social enterprises, and that means the active participation of the government in the development of social enterprises.

The fact that these enterprises differ from the ordinary commercial enterprises can't be neglected even by the representatives of neoliberal paradigm of economics from the Higher School of Economics, when they try to present these enterprises as self-sustaining ones that function at the expense of sustainable commercial effect, whose best guarantee is earning the income from products and services sales and not the grants and charities, which are not excluded as the supplementary sources, though (Social entrepreneurship... , 2011). These authors have to admit that this opinion is false, when they argue that these enterprises should be named as not-for-profit. Though, they imply by this sentence that a certain part of profit should be reinvested into the further social projects and not the uncommercial kind of activity of these enterprises, as it is mutually accepted in the world. This fact was stressed by E. Rudyk (2011) in his analysis of current trends of development of social enterprises.

All these facts suggest that social enterprises have their own ideology, which determines the way of behavior of social enterprises, shapes their development strategy for the long-run and creates the fundamentals of their social mission which differ them from ordinary commercial enterprises acting on the basis of profit maximization and assigning the profit by the bourgeois class. It is this reason, due to which a famous foreign researcher C. Leadbeater called social enterprises as the mainstream of dissidents, because it doesn't fit for any pattern which

is provided for it by the representatives of neoliberal economics (Leadbeater, 2007). To express figuratively, we should say that these mainstream concepts are “bursting at the seams” when somebody is trying to pull them on social entrepreneurship to characterize its way of behavior as an ordinary commercial entrepreneurship, that differs from it only by fulfillment of certain social duties.

2. Research hypothesis

The hypothesis stated in this paper is to set a question, whether social enterprises have their own ideology of behavior, and what direction, in terms of the formation development, this ideology indicates. In other words, where this ideology leads and what direction of social development it assumes.

3. The diversity of meanings of social entrepreneurship in the modern world

From addressing marginalized individuals and communities (Haugh & Talwar, 2016; Parthiban et al., 2020; Qureshi et al., 2021) to poverty alleviation (Hackett, 2010; Mair et al., 2012; Sutter et al., 2019) and environmental conservation (Belz & Binder, 2017; Calic & Mosakowski, 2016), social entrepreneurship has existed as a phenomenon since the beginning of entrepreneurial activities (Dacin et al., 2010). The emergence of social entrepreneurship has coincided with the increasing inability of governments and the public sector to meet increasingly complex social welfare needs and challenges (Stephan et al., 2015; World Bank, 2017). Social entrepreneurship signals the need to promote positive change to social problems (Dacin et al., 2011, Deloitte, 2017; European Commission, 2017). It is the social transformations in response to societal problems that distinguish social entrepreneurship from commercial entrepreneurs and the broader for-profit organizations. Social entrepreneurship is thus a separate field of research from entrepreneurship (Mair & Marti, 2006).

Although entrepreneurial ideas and actions to achieve social and economic benefits are not new, academic research on the topic has only recently gained traction in the last decade (Saebi et al., 2019). Existing work on social entrepreneurship presents interesting discussions and contentions. For example, the diversity of actors involved in social entrepreneurship, as well as their broad range of motivations from hybrid missions to not-for-profits, often lead to confusion about the social entrepreneurship concept (Canestrino et al., 2020; Dacin et al., 2010). The term “social entrepreneurship” also has no universally agreed-upon definition, making it a broad term that encompasses a wide range of socially beneficial initiatives and activities. Social entrepreneurship has been defined as an “entrepreneurial activity with an embedded social purpose” (Cherrier et al., 2018). Zahra and colleagues (2009) defined social entrepreneurship as “activities and processes undertaken to discover, define and exploit opportunities to enhance social wealth by creating new ventures or managing existing organizations in an innovative manner” (p. 522). Others have focused on social entrepreneurship as combining the economic mission of entrepreneurship and its social goals (Chell et al., 2016; Saebi et al., 2019). Regardless of differences in definitions, social entrepreneurship literature often highlights the mission of social entrepreneurship as creating both social and economic value (Doherty et al., 2014; Saebi et al., 2019; Santos, 2012; Wu et al., 2020).

One of quite extraordinary forms of social entrepreneurship is the reform which was held in Peru by the deputy of the Greek parliament Elena Panaritis, which improved significantly the lives of the labor migrants in this country. As a result of this reform, the labor migrants have got the opportunity of acquiring the real estate on the legal basis, which was captured by them before on the illegal basis. The main result of this reform was that due to the procedure of the real estate legalization these migrants have got the opportunity of being engaged in the entrepreneurial activity on this area and, as a whole, it contributed much to the economic growth and the growth of GDP at this country. After that E. Panaritis called herself “a social entrepreneur” in her numerous interviews (see, for instance, Panaritis, 2007), and that looks justified in this situation. So, if we allow for this reform, a wider definition of this phenomenon would look as the following: social entrepreneurship is the activity which is designed to solve the social problems which results in the emergence of commercial success, under which the main target group, for which this activity is realized, gets the ability to increase the level of its welfare on the basis of market mechanism, as well as at the expense of involving external sources of financing (for instance, grants, subsidies, micro-loans, investment, public procurements etc.).

For social enterprises the commercial element has a supplementary nature. Basically, they use the external sources of financing, but as they regularly experience the lack of external resources, they have to make ends meet and enter the market to earn a certain profit to realize the social projects. The profit here is the supplementary source of financing, not the main one, because for them the main task is to solve a social problem, not to be a self-sustaining enterprise. And it is their ideology, which is that they act not for profit, but for a certain social effect, that shapes their nature of activity as a non-profit, but in which a commercial activity can be as a

supplementary source of financing. In another definition in the paper of C. Seelos and J. Mair (2005) the social is about efficiently catering to basic human need that existing markets and institutions have failed to satisfy. According to their opinion, social needs are the goal of achieving sustainable development. Similarly, S. Certo and T. Miller (2008) refer to social as the fulfillment of basic and long-standing needs such as providing food, water, shelter, education and medical services to those who are in need. Other specifications are a sustainable method of enabling disadvantaged groups to improve their position (S. Hibbert, G. Hogg & T. Quinn, 2002, p. 299) to alleviate social exclusion and unemployment. In the study of M. Sharir and M. Lerner (2006, p. 7) social is about answers to social problems whether educational, welfare, environmental or health related. Finally, H. Neck and colleagues (2009) see the environment as one of the many social problems the world is facing today. This approach results in very diverse and often narrow interpretations of social value, of who social entrepreneurs are and what they do. Although this approach is relevant in concrete research contexts, this approach is difficult to sustain at the conceptual level when studying a heterogeneous population of social enterprises.

Besides, the researchers that study social value disagree on the meanings of this phenomenon. The term “social value” is considered to be subjective and varies greatly from one context to another, so the term is consequently imprecise and difficult to measure. A. Peredo and M. Mclean (2006, p. 59) broadly suggest that social values contribute to the welfare or well-being in a given human community, whereas P. Murphy and S. Coombes (2009, p. 326) imply an underlying range of basic values that are desirable and important in a civilized society. S. Brickson (2007, p. 866) in turn defines social value as that which enhances well-being for the earth and its living organisms. The common denominator of these definitions is their almost ideological stance toward advancing the well-being of people, communities and societies (the public or common good) built on a set of basic values. As compared with that, economic value creation is not primarily concerned with the public good but with enhancement of economic return and shareholder wealth (see, for instance, J. Austin et al., 2006; J. Dees & B. Anderson, 2002; S. Hibbert et al., 2002).

4. Social and economic missions of social enterprises

Nowadays some researchers, which tried to study the ideological fundamentals of social entrepreneurship, suggest that actually every social enterprise is based on realization of two missions – social and economic ones. In this case the social mission refers to value creation for the public good, whereas their economic mission refers to value creation for the private gain. Whereas commercial enterprises are only focused on their economic mission, a distinctive feature of social enterprises is their social mission in addition to the economic mission, and it is the balance between these two missions that shapes eventually the strategy of social enterprise and its potential for realizing social functions. According to the opinion of R. Stevens, N. Moray and J. Bruneel (2015), these two phenomena may also be subject to boundary conditions of time as the relative balance between social and economic missions may vary over time due to institutional pressures.

The ideology of social enterprise gives us the opportunity to determine, at what extent social enterprise needs state support and involving other external sources of support, because if ideologically the function of social enterprise is to help the people in need and to produce the social value, so that it harms its economic mission, all the aforementioned remarks suggest that this enterprise indeed needs the strong state support and the external sponsorship. In this sense social entrepreneurship in China should be regarded as an illustration of this thesis (see Figure 1, for instance). As we can see, here the share of external sources of financing social entrepreneurship is rather significant, and this fact suggests that ideologically these enterprises are oriented, first of all, to the realization of their social mission, and that makes them rather vulnerable in terms of ability to be self-sustaining.

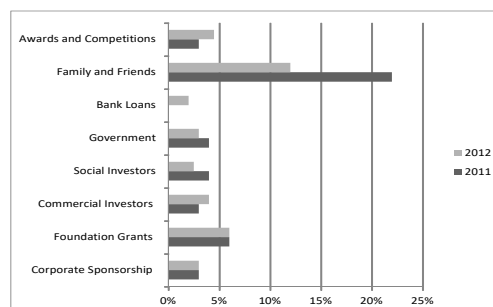


Figure 1: The financial sources of social entrepreneurship in China (2011-2012).

Source: Lane et al. (2012).

According to the opinion of R. Stevens, N. Moray and J. Bruneel (2015), social enterprises begin to act due to the individuals with a prosocial position, which are not guided by the private gain. These social entrepreneurs are altruistic in their activities and they place social values at a higher position than profitability. To fill the social and economic missions with a significant meaning the aforementioned authors conducted the correlation analysis and they concluded that the correlation between the utilitarian identity and relative significance of the sales growth is positive and significant, whereas the correlation between the normative identity and relative significance of the sales growth is negative and significant. So, for instance, such indicators of activity of social enterprises as normative identity, attention to social goals and values oriented to the community development are inherent to the social mission of social enterprises, and utilitarian identity, attention to the economic goals and self-interest values are inherent to the economic mission. For each of these missions, respectively, all these indicators were positively correlated, but between each of these missions the negative correlation was observed, and that is quite understandable, allowing for the conflicting nature between social and economic missions.

5. The place of social entrepreneurship in terms of current trends of the formation development

If we evaluate the place of social entrepreneurship within a context of current transformations of socio-economic development, we can use the periodization of modern history of economic relations provided by D. Laibman (2013). According to this periodization, it turns out that social entrepreneurship should be attributed to the stage that he named socialism-precursor, which is characterized, in particular, by the following peculiarities: the abilities and mind of the masses are historically constrained, because they are infused with an individualistic and possessive ideology and the practices of the society, from which they descended, mitigated by the cooperation experience during the production process, collective struggle and solidarity partially and not entirely. All these features can be found at most social enterprises. Besides, they bring into the economic practice also the elements of a new system of evaluating enterprises. It is well-known that the efficiency of social enterprises is measured not in terms of producing the economic value, but in terms of producing social value. In this sense, this system is a precursor of forming of such mechanism as the Multilevel Democratic Iterative Coordination, MDIC), which comprises the base of the core of mature socialistic society, according to the concept of D. Laibman, which, according to his theory, is the stage following the period of socialism-precursor. Beside other important elements of coordination of socio-economic processes, this system, in particular, includes the criteria that characterize the solving of a series of social tasks: the worker development, overcoming of the expressions of stratification of the rich and poor inherited from the past and the oppression, according to the gender or race features, reaching the planned targets concerning the impact on the environment, the development of relations with local community, other enterprises and so on. All this list is the area of impact of social entrepreneurship, and respectively is the object of evaluation, judging by some publications in this area (see, for instance, Young, 2006). In this sense, being attributed to the socialism-precursor stage, social entrepreneurship brings also the features of genesis of the next stage – mature socialism and because of that it certainly contributes much to its formation. So, we can determine the way of production presented by social entrepreneurship as transitional from the capitalistic structure to the new form of economic relations, in which the values of solidarity and general welfare predominate over other values, and not the individualistic and private property interests. Should we name this period as the mature socialism, the time will show, but today we should argue only one thing: the modern state of capitalism has reached the stage, when the state should bring into this system many elements, which are not inherent to it, to keep this paradigm and eradicate all its contradictions. These elements are: elements of planning, social sector development and decreasing of significant level of social tension predetermined by the social inequality growth (Pavlov, 2018). Though eventually all these quantitative changes will turn into qualitative ones, and all that can lead to the process of forming of a new integral society, in which the solidarity and cooperation values will play a greater role, than the individualistic and competition values (Pavlov, 2018). The features of this technical and economic formation emerging before our eyes are mentioned in the paper of S.D. Bodrunov (2015), who pointed out that the prioritized development of the high-tech production based on socially oriented regulated economic development are inherent to this formation. As an important task for it he points the necessity of borrowing the experience of foreign countries in the area of state regulation and programming the market economy. The active role of the state on supporting the social entrepreneurship development in the UK and the USA suggests that it actually regulated its development, including it, thus, into the common programme of country development. The consequence of that was the high level of development of social entrepreneurship in these countries.

6. The superstructure and the basis of social enterprise

A. Nicholls (2007) wrote that this phenomenon is alien for existing market system, when he told that it challenges the market paradigm at three levels (macro-, meso- and micro-). According to his approach, social enterprises challenge the dominating paradigm at three levels: micro (enterprises), meso (new markets, intermediaries) and macro (socio-economic impact, political implication). It relates to social enterprises that (1) react to the market failure and (or) institutional void by the development of new products and services, (2) contribute to the market reconfiguration to generate a new or increased social value and (3) challenge the institutional systems through the political impact (Nicholls, 2007). Also in the paper of Nicholls the classification of social enterprises depending on each of the presented levels is provided. So, for instance, the institutional social enterprise relates to the first type (enterprises that react to the market failure or institutional void by the development of new products and services). The normative social enterprise relates to the second type (the market reconfiguration to create a new or increased social value). And finally, the transformative social enterprise (challenging the institutional systems through the support and political impact) relates to the third type.

In most part the conflict nature between the existing paradigm of economic development and social entrepreneurship can be explained, if we remember the division of the economy which is well-known from the Soviet period into two parts: the basis and the superstructure, by the fact that social entrepreneurship can be also divided into such categories and show that in terms of the basis social entrepreneurship presents a new ideological system conflicting with the existing economic relations system of modern capitalism. If we apply here the concept of D. Laibman to social entrepreneurship as a transitional phenomenon, we will get the following picture: the base (or the basis) of social entrepreneurship is the socialistic model that can be considered as a precursor of multilevel democratic system comprising the core of mature socialistic society. Its main comprising elements are the cooperation, collective struggle and solidarity. In this case the superstructure presents forms and trends of the capitalistic formation passing to the past, i.e. the presence of individualistic and possessive ideology, from which social entrepreneurship descended, i.e. the structures of doing business, that are inherent to the capitalistic formation, i.e. the presence in the management structure of enterprises such posts as the chief executive officer, the financial director and other posts, which are inherent to the general commercial enterprise comprising the base of the capitalistic structure.

7. In conclusion

The fact that social enterprises have their own ideology is recognized even by the Western scholars. In particular, the study of Foreman and Whetten (2002) covers the beliefs of the leaders concerning the organization identity by means of measuring their views on the basic values and ideology. Though there are no yet any papers, which would be specially focused on this topic, and this paper is the first attempt to look at the development of social entrepreneurship through the perspective of its ideology. As it was shown in the paper, in most part the ideology of social entrepreneurship depends on the balance between its social and economic missions. So, the hypothesis stated in the beginning of the paper is proved. All the social enterprises have a certain ideology. Moreover, the direction that this ideology indicates, suggests that the social entrepreneurship is a transitional phenomenon from the Socialism-precursor stage to the Mature socialism stage. Thus, the social entrepreneurship ideology is the early socialism ideology, expressed in the socialistic basis, but having the superstructure of the capitalistic society, expressed in the elements of the corporate structure inherent to the capitalistic system. One should hope that this study is prospective, as nowadays the attention to ideological aspects of different systems is increasing, because the need in ideology as a spiritual field of society is steadily growing, and thus, in future the growth of attention towards studying the ideological aspect of society as a whole can be observed.

References

- Austin, J., Stevenson, H., & Wei-Skillern J. (2006) Social and commercial entrepreneurship: Same, different, or both? // *Entrepreneurship Theory and Practice*, 30(1), 1-22.
- Belz, F.M., & Binder, J.K. (2017) Sustainable entrepreneurship: A convergent process model. *Business strategy and the Environment*, 26 (1), 1-17. <https://doi.org/10.1002/bse.1887>
- Bodrunov S.D. (2015) Renewal of the Russian economic system: Political Economy aspect. *Problems in Political Economy*, No. 2, 52-57 (in Russ.).
- Brickson, S.L. (2007) Organizational identity orientation: The genesis of the role of the firm and distinct forms of social value. // *Academy of Management Review*, 32(3), 864-888.
- Calic, G., Mosakowski, E. (2016) Kicking off social entrepreneurship: How a sustainability orientation influences crowdfunding success. *Journal of Management Studies*, 53(5), 738-767. <https://doi.org/10.1111/joms.12201>

- Canestrino, R., Ćwiklicki, M., Magliocca, P., & Pawelek, B. (2020). Understanding social entrepreneurship : a cultural perspective in business research. *Journal of Business Research*, 110, 132-143.
<https://doi.org/10.1016/j.jbusres.2020.01.006>
- Certo, S.T. & Miller T. (2008) Social entrepreneurship: Key issues and concepts. // *Business Horizons*, 51(4), 267-271.
- Chell, E., Spense, L.J., Perrini, F., & Harris, J.D. (2016) Social entrepreneurship and business ethics: Does social equal ethical? *Journal of Business Ethics*, 133(4), 619-625. <https://doi.org/10.1007/s10551-014-2439-6>
- Cherrier, H., Goswami, P., & Ray, S. (2018) Social entrepreneurship: Creating value in the context of institutional complexity. *Journal of Business Research*, 86, 245-258. <https://doi.org/10.1016/j.jbusres.2017.10.056>
- Dacin, M.T., Dacin, P.A., & Tracey, P. (2011) Social entrepreneurship: A critique and future directions. *Organization Science*, 22(5), 1203-1213. <https://doi.org/10.1287/orsc.1100.0620>
- Dacin, P.A., Dacin, M.T., & Matear, M. (2010) Social entrepreneurship: Why we don't need a new theory and how we move forward from here. *Academy of Management Perspectives*, 24(3), 35-57.
<https://doi.org/10.5465/AMP.2010.52842950>
- Dees, J.G., & Anderson, B.B. (2002) For-profit social ventures. // *International Journal of Entrepreneurship Education*, 2(1), 12-38.
- Deloitte (2017) The rise of the social enterprise. In *2018 Deloitte global human capital trends* [online],
https://www2.deloitte.com/content/dam/insights/us/articles/HCTrends2018/2018-HCTrends_Rise-of-the-social-enterprise.pdf
- Doherty, B., Haugh, H., & Lyon, F. (2014) Social enterprises as hybrid organizations: A review and research agenda. *International Journal of Management Reviews*, 16(4), 417-436. <https://doi.org/10.1111/ijmr.12028>
- European Commission (2017) *Social entrepreneurship as an alternative for young unemployed* [online],
https://ied.eu/entre_files/outcomes/Social_Entrepreneurship_as_an_alternative_for_Young_Unemployed.pdf
- Foreman, P. & Whetten, D.A. (2002) Members' identification with multiple-identity organizations. // *Organization Science*, 13(6), 618-635.
- Hackett, M.T. (2010) Challenging social enterprise debates in Bangladesh. *Social Enterprise Journal*, 6(3), 210-224.
<https://doi.org/10.1016/j.ijme.2017.05.002>
- Haugh, H.M. & Talwar, A. (2016) Linking social entrepreneurship and social change: The mediating role of empowerment. *Journal of Business Ethics*, 133 (4), 643-658. <https://doi.org/10.007/s10551-014-2449-4>
- Hibbert, S.A., Hogg, G., & Quinn T. (2002) Consumer response to social entrepreneurship: The case of the big issue in Scotland. // *International Journal of Nonprofit and Voluntary Sector Marketing*, 7(3), 288-301.
- Laibman D. (2013) Mature Socialism: the structure, premises, transition periods. *Alternatives*, No. 1. URL:
<http://www.intelros.ru/readroom/alternativi/al-2013/19011-zrelyy-socializm-structurs-predposylki-perehodnye-periody.html>. (in Russ.).
- Lane A., Baral S., Simons K., Lane A., Zhang C. China Social Enterprise Report (2012) [online],
www.bsr.org/reports/FYSE_China_Social_Enterprise_Report_2012.pdf
- Leadbeater C. (2007) Mainstreaming of the Mavericks // *The Observer*. March 25.
- Mair, J., & Marti, I. (2006) Social entrepreneurship research: A source of explanation, prediction and delight. *Journal of World Business*, 41(1), 36-44. <https://doi.org/10.1016/j.jwb.2005.09.002>
- Mair, J., Marti, I., & Ventresca, M.J. (2012) Building inclusive markets in rural Bangladesh: How intermediaries work institutional voids. *Academy of Management Journal*, 55(4), 819-850.
- Murphy, P.J., & Coombes, S.M. (2009) A model of social entrepreneurial discovery. // *Journal of Business Ethics*, 87(3), 325-336.
- Neck H., Brush C., & Ellen, E. (2009) The landscape of social entrepreneurship. // *Business Horizons*, 52, 13-19.
- Nicholls, A. (2007), *What is the Future of Social Enterprise in Ethical Markets?* [online], Office of The Third Sector, London,
www.webarchive.nationalarchives.gov.uk/ukgwa/+http://www.cabinetoffice.gov.uk/media/cabinetoffice/third_sector/assets/future_social_enterprise_ethical_markets.pdf
- Panaritis E. (2007) *Prosperity Unbound. Building Property Markets with Trust*. New York, Palgrave Macmillan, 2007. - 182 p.
- Parthiban, R., Qureshi, I., Bandyopadhyay, S., Bhatt, B., & Jaikumar, S. (2020). Leveraging ICT to overcome complementary institutional voids: Insights from institutional work by a social enterprise to help marginalized. *Information Systems Frontiers*, 22(3), 633-653. <https://doi.org/10.1007/s10796-020-09991-6> Qureshi, I., Pan, S.L., & Zheng, Y. (2021) Digital social innovations: An overview and research framework. *Information Systems Journal*, 31(5), 647-671. <https://doi.org/10.1111/isj.12362>
- Pavlov R.N. (2017) The political economy analysis of current trends of social entrepreneurship development. In *Economics of modern Russia*. № 3. Pp. 113-128.
- Pavlov R.N. (2018) The political economy as a theoretical and methodological basis for deriving the basic trends of social entrepreneurship development. In *Economic and Social Changes: Facts, Trends, Forecast*. Vol. 11. № 4, 235-351.
- Peredo, A.M., & McLean, M. (2006) Social entrepreneurship: A critical review of the concept. *Journal of World Business*. 41(1), 56-65.
- Rudyk E.N. (2011) The Social State and the Social Enterprise In *Man and the economy: justice and basic democracy versus the totalitarianism of market and capital*. Ed. by A.V. Buzgalin and M.I. Voyeykov. M.: The Economics, 263-273. (In Russ.).

- Saebi, T., Foss, N.J., & Linder, S. (2019) Social entrepreneurship research: Past achievements and future promises. *Journal of Management*, 45(1), 70-95. <https://doi.org/10.1177/0149206318793196>
- Santos, F.M. (2012) A positive theory of social entrepreneurship. *Journal of Business Ethics*, 111(3), 335-351. <https://doi.org/10.1007/s10551-012-1413-4>
- Seelos C., & Mair, J. (2005) Social entrepreneurship: Creating new business models to serve the poor. // *Business Horizons*, 48, 241-246.
- Sharir M. & Lerner M. (2006) Gauging the success of social ventures initiated by individual social entrepreneurs. // *Journal of World Business*, 41(1), 6-20.
- Social entrepreneurship: practice and studies* (2011) / ed. by A.A. Moscovskaya. National Research University "Higher School of Economics". M.: Publishing House of Higher School of Economics. - 284 p. (In Russ.).
- Stephan U., Uhlaner, L.M., & Stride C. (2015) Institutions and social entrepreneurship: The role of institutional voids, institutional support, and institutional configurations. *Journal of International Business Studies*, 46(3), 308-331. <https://doi.org/10.1057/jibs.2014.38>
- Stevens R., Moray N., & Bruneel J. (2015) The Social and Economic Mission of Social Enterprises: Dimensions, Measurement, Validation, and Relation. // *Entrepreneurship Theory and Practice*. Vol. 39, Issue 5, 1051-1082. DOI: 10.1111/etap.12091.
- Sutter, C., Bruton, G.D., & Chen J. (2019) Entrepreneurship as a solution to extreme poverty. A review and future research directions. *Journal of Business Venturing*, 34(1), 197-214. <https://doi.org/10.1016/j.jbusvent.2018.06.003>
- World Bank (2017) *Assessing the role of international organizations in the development of the social enterprise sector* (Issue March).
- Wu, Y.J., Wu, T., & Arno Sharpe, J. (2020) Consensus on the definition of social entrepreneurship: A content analysis approach. *Management Decision*, 58(12), 2593-2619. <https://doi.org/10.1108/MD-11-2016-0791>
- Young R. (2006) For what it is worth: Social value and the future of social entrepreneurship. In *Social entrepreneurship: New models of sustainable social change*. Oxford: Oxford University Press, 56-73.
- Zahra, S.A., Gedajlovic, E., Neubaum, D.O., & Shulman J.M. (2009) A typology of social entrepreneurs: Motives, search processes and ethical challenges. *Journal of Business Venturing*, 24(5), 519-532. <https://doi.org/10.1016/j.jbusvent.2008.04.007>

Social Innovation: The Ideas and Contributions of Gabriel Tarde

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Abstract: Social innovation (SI) has received increasing attention from policymakers and researchers. It has become one of the answers to contemporary societal challenges (Grimm et al., 2013), a policy in the European Union (Nicholls and Edmiston 2018), and is still an emerging area of innovation studies (Van der Have and Rubalcaba 2016). Even though the empirical history of SI is becoming well documented, its theoretical history has not received much attention. Exceptions include contributions to SI, where Gabriel Tarde (1843–1904) has been named as a source of a theory about SI. Motivated by these observations, this paper explores, describes, and discusses Tarde’s theoretical ideas about innovation in general and especially the category of SI by asking the following guiding question: What are Tarde’s innovation-related theoretical ideas and what is their relevance to SI research today? This theoretical discussion is based on three areas of literature: (i) a selection of 12 of Tarde’s original publications from 1890 to 1902, (ii) a selection of contemporary publications on SI, and (iii) a diverse selection of literature relevant to the development of innovation studies and SI studies. A central component of this paper is that it is based on original French publications and two early English translations that represent good sources for pinpointing when words and concepts were used in Tarde’s writings. This paper identifies and discusses three connections between Tarde and SI research. The first is the identification of three categories of innovation that cover examples of SI today. The second is his social theory, which emphasizes the role of invention and imitation in social change. The third is that Tarde is an early example of the theoretical idea of a combination of innovation and social change, which can also be identified in current research on SI. These findings could be of interest to those intrigued by how SIs today are the result of the diffusion or combination of earlier ideas with different sources (hybrids).

Keywords: Gabriel Tarde, innovation, invention, imitation, SI, combination perspective

1. Introduction

Social innovation (SI), that is, the development and implementation of new ideas to meet social needs and create new social relationships or collaborators (European Commission 2020, p. 6), has a long empirical (Drucker 1957; Mumford 2002; Godin 2012) and theoretical history. The term or category is not new (Sargant 1858; Ward 1903, p. 243; Thorp 1942, pp. 52, 53; Redlich 1949, p. 235), but it is little theorized. Early on, Ward (1903) mentioned that Tarde saw SI as advantageous to society, and much later, several researchers named Tarde as a possible forerunner of SI theory (Godin 2012; Jessop et al. 2014; Ayob et al. 2016; Howaldt and Schwarz 2017)—along with Schumpeter, the first modern theorist on innovation (Damanpour 2020). However, Tarde is still little explored in relation to innovation (Howaldt et al. 2015), and “the long forgotten early exponent of an integrated sociological theory of innovation” (Howaldt and Schwartz 2017, p. 169). Motivated by a lack of attention to theoretical history, this paper explores, describes, and discusses Tarde’s ideas about innovation, especially the category of SI, by discussing the question presented above: What are Tarde’s innovation-related theoretical ideas and what is their relevance to SI research today? More precisely, the purpose is to extract innovation-related ideas and to discuss and compare them in relation to contemporary SI research. By doing this, the paper contributes to SI research by discussing theoretical roots and history.

Methodologically, this theoretical discussion is based on a selection of Tarde publications and other relevant literature. Today, there are different editions of Tarde publications: Suhrkamp (Frankfurt), Metropolis (Marburg), Seuil (Paris), Synthélabo (Paris), Alcan (Paris), University of Chicago Press (Chicago), and Henry Holt & Company (New York). This paper uses original texts from 1890 to 1902 (two early translations from 1899 and 1903), as they are more readily available in digital formats today. Almost all the Tarde works included here are original Félix Alcan and V. Giard and E. Briere publications, representing good sources for pinpointing when words and concepts were used in Tarde’s writings. The author has translated all quotes from the French texts. The main criterion in the selection of the literature was the presence of exact information about when Tarde put forward certain ideas or showed a major shift in terminology (e.g., innovation). Among the included publications, four (Tarde 1890; 1895; 1898a; 1902) are especially important in their ability to illuminate the ideas that form the focus of this paper, and two are early English translations (Tarde 1890/1903; 1897/1899). Also, a selection of contemporary publications on SI, and a diverse selection of literature on the development of innovation and SI studies history (e.g., Clark 1969; Godin 2012; Pedersen 2021) and literature reviews (e.g., Van der Have and Rubalcaba, 2016) are used. This selection has the possible limitation that Tarde is better covered than contemporary SI studies (though more publications were used to write this paper). Another limitation is the trade-off between the current focus and other interesting aspects of Tarde’s ideas. Finally, since the paper

explores old and new formulations of theoretical ideas, it has followed some of the recommendations from Merton (1967) on this type of discussion. Keywords are, for example, to examine the context, meaning and use of such earlier and contemporary formulations of concepts and ideas.

The remainder of the paper is organized as follows. After briefly presenting SI definitions and recent research, this paper outlines Tarde's ideas on innovation. This is followed by a discussion of the relevance today.

2. Social innovation today

As noted, over several years, SI has received interest from policymakers in different countries as a cross-sectoral, bottom-up solution to social or societal problems and challenges. Although SI has a longer history in the EU, it became a policy there after the 2007–2008 financial crisis, which led to a recession (and structural unemployment and social challenges) in many European economies (Grimm et al. 2013; European Commission 2020; Nicholls and Edmiston 2018). SI is a key element in the European 2020 strategy by the European Commission to facilitate and embed SI across Europe (Grimm et al. 2013; Nicholls and Edmiston 2018).

The term SI is not consistently used in studies of SI or in the literature on innovation (Moulaert et al. 2005; Edwards-Schachter and Wallace 2017; Van der Have and Rubalcaba 2016). In this paper, some definitions can be observed (Mulgan 2006; Mulgan et al. 2007; Phills et al. 2008; Howaldt et al. 2015; Voorberg et al. 2015; Nicholls and Edmiston 2018). Examples of elements in SI definitions are new ideas that create new social relationships (often bottom-up) and collaborators across organizational boundaries and sectors (Mulgan et al. 2007; European Commission 2020; Howaldt et al. 2015; Phills et al. 2008; Voorberg et al. 2015), better and sustainable solutions (Phills et al. 2008; Howaldt et al. 2015), and long-lasting outcomes (Voorberg et al. 2015), replicable models, and programs (Mulgan et al. 2007). Further, it is not restricted to what is called social policy (Mulgan et al. 2007; Phills et al. 2008) but has a broad conception of ideas or SI: products, services, models, technology, concepts, policy instruments, new forms of cooperation and organization, methods, processes, regulations, legislation, interventions, social movements, or a combination of these (EC 2020; Phills et al. 2008; Howaldt et al. 2015; Mulgan et al. 2007). Even though other elements may vary, commonalities in the definitions include social motivation and social purpose, SI as ideas, creative ways or activities to meet social needs or societal challenges (Mulgan 2006; European Commission 2020; Mulgan et al. 2007; Grimm et al. 2013), and social goals rather than profit as motives (Phills et al. 2008).

Further, the selection of literature reviews in this paper (Moulaert et al. 2005; Godin 2012; Phillips et al. 2015; Voorberg et al. 2015; Rana et al. 2014; Edwards-Schachter and Wallace 2017; Van der Have and Rubalcaba 2016; Galego et al. 2022) illustrates interest in identifying influential articles on SI (Ayob et al. 2016) and mapping its different research communities, such as psychology, creativity, social, and societal challenges, and local development (e.g. urban and regional issues) (Van der Have and Rubalcaba 2016). In these reviews, some reports have limited use of systematic methodology and confusion around the characteristics of SI (Edwards-Schachter and Wallace 2017), while others note that over the years, SI has taken on a set of meanings far removed from its sociological roots (Ayob et al. 2016). Tarde represents one such sociological root.

3. Gabriel Tarde and innovation

3.1 Tarde publications and innovation

Tarde uses the term invention in many publications, as is the case with the term innovation (Tarde 1890; 1890/1912; 1890/1903; 1894; 1895; 1897; 1897/1899; 1898a; 1898b; 1899; 1901/1910; 1902a; 1902b). The term innovation appears in Tarde's publications, which are touched on here, for example, Tarde's (1894) discussion of jurisprudence and his work on opposition (1897). In the latter work on his theoretical concept of opposition, he wrote, "When an artistic innovation emerges, in music, in painting, in poetry, the world of artists and amateurs is divided into two parties: those who welcome this novelty and those who reject it" (1897, p. 386). Tarde (1901), in *Opinion and the Crowd*, touched upon issues such as public opinion, the public, the press, and communication media. Tarde's (1899) discussion of the field of government can be seen as his contribution to political theory. Writing on sociology, Tarde (1898b, p. 61) mentioned that the discipline must handle problems such as the causes of invention and the reason why some inventions are imitated while others are not. Finally, in 1902, he wrote a large two-volume work on economic psychology. In this work, he organized economic phenomena into three concepts: economic repetition, economic opposition, and economic adaptation. For example, he used the term "entrepreneur" (1902b, p. 357, 368), a term also appearing in *La logic sociale* (Tarde 1895, p. 372). Even though Sargant (1858) used the term "social innovator," Tarde puts it in a theoretical

framework and contributes to the diffusion of SI as a category of innovation (Godin 2012). The next section focuses on Tarde's publications in relation to SI.

3.2 Tarde and social innovation

Tarde (1890) already uses the term innovation on page 2 in the first French edition of the *Laws of Imitation*. He uses this term several times, along with terms such as invention and discovery, stating, "By these two terms I mean any kind of an innovation throughout the range of social phenomena—language, religion, politics, law, industry, or art" (1890; 1890/1903, p. 2). This concept covers innovation not only as an economic phenomenon, but also as a social phenomenon. Further, he describes his theory of imitation, for example, why some innovations spread while others do not (1890/1903, p. 140), various forms of imitation, such as "counter-imitation" (p. xvii), fashion imitation and custom imitation (p. 14), fashion in all its forms (p. 16), and the role of networks, "occupation and education" in spread (1890/1903, p. 64). He said that "Every heard of wild cattle has its leaders, its influential heads" (1890/1903, p. 4), meaning the role of individual initiatives in new inventions and the role of social status in the spread. He believed that human interaction fostered the appearance of inventions, and he knew that "imitations are modified in passing from one race or nation to another" (p. 22).

Finally, he discusses the emergence of simple and complex combinations: "Several lines of imitation intersected one another in the brilliant eighteenth-century idea of applying steam-engine ... to the satisfaction of desire for ocean travel" (1890/1903, p. 44). Further, he states that "all inventions and discoveries are composed of prior imitations," and "these composites are themselves imitated and are destined to become, in turn, elements of more complex combinations" (p. 45). The result of this process is accumulation, and Tarde mentioned that "it follows that there is a genealogical tree of successful initiatives and that they appear in an *irreversible* ... sequence" (p. 45).

In *La logique sociale*, he included his theory of invention (1895, pp. 153–223). Here, he introduces the term "l'innovation sociale" (p. 129n) but uses it in a way like how he uses the term innovation elsewhere. He also uses phrases such as "a new idea is a combination of old ideas" (Tarde 1895, p. 171), "inventive creation" (p. 173), and "association" (p. 382). For example, he said that any association "is a kind of invention" and that "every invention is an association of previous inventions" (p. 382). The theoretical idea of combination is followed up here (p. 171), and he explains how complex inventions emerge, usually in three phases (1895, p. 192–5).

Tarde (1898a; 1897/1899), in discussing social laws and outlining sociology, dealt with three central concepts: repetition, opposition, and adaptation. Tarde discussed innovation in several places in the texts, and he used the terms "innovation sociale" (1898a, p. 54) and "social innovation" (1897/1899, p. 64). While he discusses the obstacles to the propagation of SI, he adds competition (Tardean competition) with other innovations to factors such as climate and race, stating, "The greatest impediment to the spread of a social innovation and its consolidation into a traditional custom is some other equally expansive innovation which it encounters during its course" (1897/1899, p. 64). "In fact, social innovation as discussed here is not different from innovation as used elsewhere in the text" (Godin 2012, p. 30). Tarde connects innovation to combination, noting that "Innovations are, for the most part, combinations of previous examples" (Tarde 1897/1899, p. 40).

Finally, Tarde (1902a) presented his explanation of social evolution and considered inventions to be an engine of social evolution. He stated that social transformations are explained by the imitation of successful individual initiatives (p. 1). Next, he maintained the use of the idea of combination: "Invention is always, by its very nature, an intersection of imitation rays, an original combination of imitations" (p. 4). "Every machine consists of old tools, old methods, combined in a different way" (p. 5). He maintained a broad conception, mentioning verbal (neologisms), ritual, political, industrial, judiciary, military, artistic, and literary innovations (p. 4). Here, it is noteworthy that he came closer to defining innovation. He made a distinction between theoretical inventions, such as scientific discoveries, and practical inventions, such as industrial innovations (p. 4). Theoretical inventions make their appearance before practical ones. He also distinguished between accumulable inventions and substitutable inventions, saying that, for example, scientific discoveries can accumulate ceaselessly, while industrial inventions often replace each other (p. 4).

4. Discussion: Connections between Tarde and later social innovation

While the previous section extracted some innovation-related ideas from Tarde's publications, the next section focuses on three connections between Tarde and contemporary SI research.

4.1 Three categories covering social innovation

The first connection concerns the categories of innovation. As identified, Tarde uses terms such as “innovations politiques,” “innovations juridiques” (1890; 1902a), and “l’innovation sociale” (1895; 1898a). At first glance, all of these cover how SI has been used over the years. For example, based on the examples Tarde uses in his old writings (e.g., 1890), the following examples from later SI research illustrate the point: innovation in law has its examples of retirement pensions, minimum age laws, working hours, and other rights (McVoy 1940), regulations related to the environment, sustainability, and fair trade (Mulgan et al. 2007; Phills et al. 2008), and patient rights and social laws. Political innovation includes collaboration between public and non-public actors, new governance structures (collaborative governance), grassroots initiatives, and community-based development (Moulaert et al. 2005; Galego et al. 2022). Furthermore, there are similarities to SI today, such as new models of participation and governance, and strategies of innovation (e.g., co-creation). For example, co-creation is connected to SI (Voorberg et al. 2015; Phills et al. 2008; Galego et al. 2022; Moulaert et al. 2007). Even though the labels are different, some of the principles and ideas are the same, including broader participation, collaboration, and the changing role of the public sector actor in the process, which conforms to several contemporary conceptions of SI (e.g., Phills et al. 2008; Moulaert and MacCallum 2019).

As noted, the term SI was indirectly introduced in 1890 and directly in 1895 and is also mentioned in his publication on social laws: “The major step that stops the expansion of a social innovation and its consolidation in traditional custom, is that some other expansive innovation that meets on its path” (Tarde 1898a, p. 54). He uses SI in the same way he uses innovation elsewhere. At second glance, even though the term SI may be interpreted as a category of innovation, it is correct to understand it more broadly to include any type of innovation, something supported by others as well (Godin 2012; Howaldt and Schwarz 2017).

4.2 Theory of social evolution

The second connection is how Tarde conceptualizes invention and innovation through his theories of invention (1895; 1902b, p. 230–253), imitation (1890/1903), and social evolution (1902a). He defined invention and imitation (1895, p. 382; 1890/1903, p. xiv) and claimed that, socially, “everything is either invention or imitation” (1890/1903, p. 3). Invention, innovation, and imitation are elements in Tarde’s theory of social evolution. Changes in societies or cultures depend on the introduction of inventions as infrequent products of genius (Tarde 1890, 1895). Whereas inventions are rare (landmarks) in human conduct, most human action can be explained by the flow of imitation (Kinnunen, 1996). Tarde had ideas about how imitations may be weakened and replaced by new inventions or subsequent imitations (1890/1903, p. 210). As he notes about industrial and other innovations, “it is the caprice of a chosen few before it becomes a public need and forms part of the necessities of life” (1897/1899, p. 194).

As seen, Tarde had a broad conception of innovation covering domains such as economy (industrial), public administration (political, law/judiciary, military), and culture (artistic, language/literary, ritual). His emphasis on social phenomena (1895, p. 193; 1902a, p. 4) was later interpreted as a wide variety of SIs (Godin 2012; Howaldt and Schwarz 2017). This means that the inventions that spread may be material or immaterial objects. This broad conception is, for example, commonly used in public sector innovation studies today (De Vries et al., 2016), and the broad conception of Tarde has been suggested in later literature since it includes a wide variety of SIs (Domanski et al. 2020; Howaldt et al. 2015). Such a wide conception was, as already noted, used by McVoy (1940) to study the pattern of diffusion of different types of innovations, such as governance structures, welfare schemes (e.g., services), and pieces of legislation. McVoy (1940) used the terms political invention, SI, and innovation.

Tarde used the term innovation interchangeably with invention, discoveries, and imitation and did not offer a precise and explicit definition (Godin 2012). Invention and imitation seem to be more important concepts; for example, he is most known for his laws on invention and imitation. However, imitation means dissemination and is central to social reproduction and change (1890/1903, p. 14). He used the term innovation in relation to his theory of imitation. Imitation has aspects of innovation, and innovation has aspects of imitation. Tarde (1902a) also had a distinction between theoretical and practical inventions (e.g., industrial innovations), which comes close to the later invention-innovation distinction in innovation literatures.

4.3 Combination of ideas

A third connection can be found in relation to the theoretical idea (or concept) of combination (Tarde 1890; 1895; 1898a; 1902a). This is a combination-accumulation view on invention and innovation, for example, that inventions such as the telegraph and railroads are the result of a “group of accumulated and yet distinguishable and numerable inventions” (1890/1903, p. 11n). Furthermore, Tarde (1902a) discussed new combinations of already existing resources and concepts. He believed that even the most genius poet or artist does nothing more than combine processes and elements that are already known in a different way (p. 5). This view of inventions is seen as a combination of previous ideas (Tarde 1895, p. 171; 1902a, p. 5; Chapin 1928, p. 340–341; Powell 2017). One early example is the creation of a new local government form: the city manager plan (Chapin 1928). SIs today are “usually new combinations or hybrids of existing elements” (Mulgan et al. 2007, p. 5). Phills et al. (2008), who have ten examples of recent SIs, remarked that “many of the best recognized social innovations, such as microfinance, are combinations” (p. 39). “As a consequence of this cross-pollination, a host of SIs have emerged” (Phills et al., 2008, p. 41) (e.g., responsible investing [SRI]). Further, they discuss cross-sector (nonprofit, government, and business sectors) dynamics and/or cross-pollination (fertilization) through three mechanisms of SI: exchange of ideas and values, a shift in roles and relationships (e.g., state taking more collaborative roles, such as partner and supporter), and the integration of private capital with public and philanthropic support (blending sources of models [business models and delivery]).

5. Conclusion

The centrality of concepts such as invention and imitation (repetition), as well as the lack of an explicit definition of innovation, may have obscured Tarde’s theoretical ideas on innovation. Tarde had ideas, many of which still help us understand changes taking place at the micro (individual initiatives) and meso levels (imitative repetitions). It is important that the categories of political and law innovations covered today are sorted under the SI label. However, Tarde had a broad conception of innovation, covering political (government), cultural (arts, language), and economic (industry) phenomena. He used the terms innovation and SI interchangeably to cover a wide range of “social phenomena” (1890, p. 2). Together, this leads to the conclusion that Tarde offers a theoretical framework for invention, imitation, and social impact and change (as a result of imitation, opposition, and adaptation). This framework is relevant to SI and public sector innovation.

Since Tarde can be seen as an early theoretical father of SI studies, future studies could more generally explore or use his (innovation-related) ideas more deeply and broadly. Keywords and themes to investigate include the role of individual initiatives in invention, the role of social status and fashion, the role of identity, the imitation–innovation process, replacement (or adaptation) of ideas (when two imitations collide), and adaptation. Also, two other areas for future studies could be suggested. Long before others, Tarde put forward the theoretical concept of combination (e.g. Schumpeter, Nelson and Winter). Today, this term covers what is called hybrids (see Mulgan et al. 2007; Phills et al. 2008) and recombination (Padgett and Powell 2012). Further, the term is relevant to understanding new technology (e.g., iPhones), new governance and organizational structures (the city manager form of local government, crowd-based organizing), new forms of finance, and so on. For example, crowd-funding is a kind of mashup of charitable fundraising with a venture capital mindset (Powell 2017). More exploration of the theoretical concept of combination could be conducted. Finally, Tarde focused to a limited extent on implementation. This theoretical discussion has focused little on his theoretical ideas of opposition (1897; 1897/1899) and adaptation (1897/1899). These concepts may be relevant in relation to implementation. Tarde, at least, touched upon the outcome of imitation when he talked about “perfect adaptation and perfect opposition (...) between which are countless intermediary positions” (1897/1899, p. 195).

Acknowledgments

The author thanks Inland Business School for financial support, Tore Bakken, Maria Røhnebak and the anonymous reviewer for comments on the paper.

References

- Ayob, N., Teasdale, S. and Fagan, K. (2016). How social innovation “came to be”: Tracing the evolution of a contested concept. *Journal of Social Policy*, 45(4), 635–653.
- Chapin, F.S. (1928). *Cultural Change*. New York: Century.
- Clark, T.N. (1969). Introduction. In: Clark, T.N. ed. *Gabriel Tarde on Communication and Social Influence*. Chicago, IL: University of Chicago Press, pp. 1–72.

- Damanpour, F. (2020). *Organizational Innovation: Theory, Research, and Direction*. Cheltenham, UK: Edward Elgar.
- De Vries, H., Bekkers, V.J.J.M. and Tummers, L. (2016). Innovation in the public sector: A systematic review and future research agenda. *Public Administration*, 94(1), 146–166.
- Domanski, D., Howaldt, J. and Kaletka, C. (2020). A comprehensive concept of social innovation and its implications for the local context – on the growing importance of social innovation ecosystems and infrastructures. *European Planning Studies*, 28(3), 454–474.
- Drucker, P.F. (1957). *Landmarks of Tomorrow*. New York: Harper and Row.
- Edwards-Schachter, M. and Wallace, M.L. (2017). “Shaken, but not stirred”: Sixty years of defining social innovation. *Technological Forecasting & Social Change*, 119, 64–79.
- European Commission (2020). *Social innovation: Inspirational practices supporting people throughout their lives*. Luxembourg: Publications Office of the European Union.
- Galego, D., Moulaert, F., Brans, M. and Santinha, G. (2022). Social innovation & governance: A scoping review. *Innovation: The European Journal of Social Science Research*, 35(2), 265–290.
- Grimm, R., Fox, C., Baines, S. and Albertson, K. (2013). Social innovation, an answer to contemporary societal challenges? Locating the concept in theory and practice. *Innovation: The European Journal of Social Science Research*, 26(4), 436–455.
- Godin, B. (2012). *Social innovation: Utopias of innovation from ca-1830 to the present*. Working Paper No. 11. Montréal: INRS.
- Godin, B. (2015). *Innovation contested. The Idea Innovation over the Centuries*. New York & Abingdon, UK: Routledge.
- Howaldt, J. and Schwarz, M. (2017). Social innovation and human development – how the capabilities approach and social innovation theory mutually support each other. *Journal of Human Development and Capabilities*, 18(2), 163–180.
- Howaldt, J., Kopp, R. and Schwarz, M. (2015). Social innovations as drivers of social change – Exploring Tarde’s contribution to social innovation theory building. In: Nicholls, A., Simon, J. and Gabriel, M. eds. *New Frontiers in Social Innovation Research*. London: Palgrave Macmillan, pp. 29–51.
- Jessop, B., Moulaert, F., Hulgård, L. and Hamdouch, A. (2014). Social innovation research: A new stage in innovation analysis. In: Moulaert, F. et al. eds. *The International Handbook on Social Innovation*. Cheltenham, UK: Edward Elgar, pp. 110–130.
- Kinnunen, J. (1996). Gabriel Tarde as founding father of innovation diffusion research. *Acta Sociologica*, 39(4), 431–442.
- McVoy, E.C. (1940). Patterns of Diffusion in the United States. *American Sociological Review*, 5(2), 219–27.
- Merton, R.K. (1967). On the history and systematics of sociological theory. In: Merton, R.K. ed. *On Theoretical Sociology: Five Essays, old and new*. New York: The Free Press, pp 1–37.
- Moulaert, F., Martinelli, F., Swyngedouw, E. and Gonzales, S. (2005). Towards alternative model(s) of local innovation. *Urban Studies*, 42(11), 1969–1990.
- Moulaert, F., Martinelli, F. and Gonzalez, S. (2007). Introduction: Social innovation and governance in European cities: Urban development between path dependence and radical innovation. *European Urban and Regional Studies*, 14(3), 195–209.
- Moulaert, F. and MacCallum, D. (2019). *Advanced Introduction to Social Innovation*. Cheltenham, UK: Edward Elgar.
- Mulgan, G. (2006). The process of social innovation. *Innovations: Technology, Governance, Globalization*, 1(2), 145–162.
- Mulgan, G., Tucker, S., Ali, R. and Sanders, B. (2007). *Social Innovation*. Oxford: Skoll Center of Social Entrepreneurship.
- Mumford, M. (2002). Social innovation: Ten cases from Benjamin Franklin. *Creativity Research Journal*, 14(2), 253–256.
- Nicholls, A. and Edmiston, D. (2018). Social Innovation policy in the European Union. In: Heiskala, R. and Aro, J. eds. *Policy Design in the European Union*. London: Palgrave Macmillan, pp. 161–190.
- Padgett, J.F. and Powell, W.W. (2012). *The Emergence of Organizations and Markets*. Princeton: Princeton University Press.
- Pedersen, T.H. (2021). Innovation and dynamic evolution: The ideas of Gabriel Tarde. Paper NEON Conference, Lillehammer, 25.-26.11.2021.
- Phillips, W., Lee, H., James, P., Ghorbadian, A. and O’Regan, N. (2015). Social innovation and social entrepreneurship: A systematic review. *Group & Organization Management*, 40(3), 428–461.
- Phills Jr., J., Deigmeier, K. and Miller, D. (2008). Rediscovering social innovation. *Stanford Social Innovation Review*, 6(3), 33–43.
- Powell, W.W. (2017). A sociologist looks at crowds: Innovation or invention? *Strategic Organization*, 15(2), 289–297.
- Rana, N.P., Weerakkody, V., Dwivedi, Y.K. and Piercy, N.C. (2014). Profiling existing research on social innovation in the public sector. *Information Systems Management*, 31, 259–273.
- Redlich, F. (1949). The business leader in theory and reality. *American Journal of Economics and Sociology*, 8(3), 223–237.
- Rogers, E.M. (2003). *The Diffusion of Innovations* (5th ed.). New York: The Free Press.
- Sargent, W.L. (1858). *Social Innovators and Their Schemes*. London: Smith, Elder & Co.
- Tarde, G. (1890). *Les Lois de l’imitation*. Paris: Felix Alcan.
- Tarde, G. (1897/1899). *Social Laws: An Outline of Sociology*. New York: The Macmillan Company.
- Tarde, G. (1890/1903). *The Laws of Imitation*. New York: Henry Holt and Company.
- Tarde, G. (1890/1912). *Penal Philosophy*. Boston: Little, Brown, and Company.
- Tarde, G. (1893). *Transformations du droit etude sociologique*. Deuxième édition revue. Paris: Félix Alcan.
- Tarde, G. (1898a). *Les lois sociales: Esquisse d’une sociologie*. Paris: Felix Alcan.
- Tarde, G. (1898b). *Etudes de psychologie sociale*. Paris: V. Giard and E. Briere.
- Tarde, G. (1895). *La logique sociale*. Paris: Felix Alcan.

- Tarde, G. (1897). *L'opposition universelle: Essai d'une theorie des contraires*, Félix Alcan, Paris.
- Tarde, G. (1899). *Les transformations du pouvoir*, Félix Alcan, Paris.
- Tarde, G. (1901/1910). *L'opinion et la foule*. Troisieme Edition, Felix Alcan, Paris.
- Tarde, G. (1902a). L'invention considerée comme moteur de l'évolution sociale, Extrait de La Revue Internationale de Sociologie, V. Giard & E. Briere, Paris.
- Tarde, G. (1902b). *La psychologie économique*, 2 vols. Paris: Felix Alcan.
- Thorp, W.L. (1942). The role of management as an innovator. *Studies of Business Administration*, 12(1), 42–61.
- Van der Have, R.P. and Rubalcaba, L. (2016). Social innovation research: An emerging area of innovation studies. *Research Policy*, 45(9), 1923–1935.
- Voorberg, W.H., Bekkers, V.J.J.M. and Tummers, L.G. (2015). A systematic review of co-creation and co-production: Embarking on the social innovation journey. *Public Management Review*, 17(9), 1333–1357.
- Ward, L.F. (1903). *Pure Sociology: A Treatise on the Origin and Spontaneous Development of Society*. New York: The Macmillan Company.

NEXTCOA: How an Entrepreneurial University can Transform the Cocoa Industry Towards Circularity

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Abstract: As the economy has evolved from being driven by physical capital to knowledge and entrepreneurship, the role of the university has also evolved over time; besides its responsibility to generate technology transfer and knowledge-based startups, universities have broadened to focus on enhancing entrepreneurship capital and facilitating behavior to prosper in an entrepreneurial society (Audretsch, 2014). This article talks about Nextcoa, an academic spin-off initiative which wants to revolutionize the cocoa industry by modernizing the production and transformation of the fruit to obtain the traditional chocolate, but also using the current waste to produce new goods and services. The research question is focus on how challenging is for a Colombian entrepreneurial university to contribute to circularity, trying to produce sweeteners and biopolymers obtained from cocoa mucilage that can be used to produce and package chocolates, replacing sugar cane and plastic bags, while gives use to a residue that is currently wasted. First, it is explained the development process of new products from Nextcoa since its conception. Then, an analysis of external conditions for the cocoa sweetener and biopolymer is done, using the Porter diamond model. In third place, it is presented an internal capabilities profile of Nextcoa. Finally, the challenges for the new products to be successful in the market are synthesized, thus contributing to the circularity of the cocoa industry. As main results, it is obtained that there is an important technological limitation in obtaining the cocoa mucilage to produce the sweetener and biopolymer as well as in the little knowledge and management of biotechnological processes of those involved in the cocoa value chain. On the other hand, there is a significant demand for plastics and sweeteners for chocolate production and packaging, and a prevailing need to reduce related contamination and consumption of sugar cane for health issues. Also, being produced by an academic spin-off gives good-will to Nextcoa products but, given the bureaucracy typical of a public university in Colombia, it can mean complications for doing business. Finally, cocoa biopolymer and sweetener would have an interesting market, especially if they can be produced at a competitive cost.

Keywords: entrepreneurial university, spin-off, cocoa

1. Introduction

Cocoa is one of the main products consumed worldwide that is similar to coffee; a primary difference between coffee and cocoa is that cocoa is produced in developing countries and is consumed mainly in industrialized countries (Duana-Ávila et al. 2023). As Suuh & Molua (2022) cited, worldwide, about 95% of cocoa is grown on smallholder farms ranging from 2-5 hectares (Anga, 2016), and employing about 5–6 million cocoa farmers from Asia, Africa, Oceania, and Latin America (Kozicka et al, 2018). Currently, the top 10 cocoa producing countries in the world, in the ranking order, are Cote Ghana, Indonesia, Nigeria, Cameroon, Brazil, Ecuador, Peru, Dominican Republic and Colombia (Aremu-Dele et al, 2022). They jointly produced 91.5% (5,268,666 tonnes) of the global annual production of (5,756,953 tonnes) according to FAOSTAT (2020).

As Savitri et al (2022) says, based on Voora et al. (2019) and Yolanda et al. (2022), “cocoa has been widely marketed worldwide for its importance and popularity as raw material for food industries, cosmetics, and pharmaceuticals”. Roasted cocoa beans are processed into cocoa liquor, cocoa butter, cocoa powder, and final cocoa products such as chocolate bars, chocolate drinks, etc. (Hartatri et al., 2021). However, only 10% of the annual production of cocoa corresponds to the cocoa bean and the remaining value corresponds to a high number of residues, cocoa bean shell, pulp and husk (Soares and Oliveira, 2022). In this context, “more than 550,000 m³ of juice from mucilage of cocoa beans are produced and abandoned in farms each year. This cloudy substance is composed of 85.3% of moisture” (Anvoh, et al., 2009).

Trying to contribute to cocoa industry circularity in a producer country as Colombia, *Nextcoa* has been working in developing new cocoa derivatives from residues. Between them, a sweetener and a biopolymer have been created, made of cocoa mucilage that is currently wasted. As they can be used in chocolate production and packaging, their development contributes doubly to the sustainability of the cocoa industry; first, they use a waste that is currently thrown away but, additionally, they help to reduce the use of cane sugar and plastic packaging in chocolate production. The consumption of chocolate is expected to grow by 4.78% by 2025 reaching

sales of more than 180 billion dollars (Gil et al., 2022), so these sweetener and bioplastic could be highly demanded and therefore contributing to cocoa industry competitiveness.

Nextcoa is a spin-off initiative from *Universidad Industrial de Santander*, a Colombian public university that is highly recognized for its research contributions as these ones related to cocoa derivatives. As the economy has evolved from being driven by physical capital to knowledge and entrepreneurship, the role of the university has also evolved over time; besides its responsibility to generate technology transfer and knowledge-based startups, universities have broadened to focus on enhancing entrepreneurship capital and facilitating behavior to prosper in an entrepreneurial society (Audretsch, 2014). However, as Fernández-Alles et al. (2015) says about the development of an academic spin-off (ASO), it "is challenging for academics, who face important obstacles that can reduce an ASO's chance of survival and success, particularly because growth implies that ASOs must compete in a commercial environment that is very different from the university context in which they are created (Vanaelst et al. 2006; Vohora et al. 2004)".

This article presents a research about *Nextcoa*, whose question is focus on how challenging is for an entrepreneurial university to contribute to circularity, trying to produce sweeteners and biopolymers obtained from cocoa mucilage that can be used to produce and package chocolates.

After literature review and methodology chapters, this document presents findings and discussion, starting with an abbreviated report of the development process of new products from *Nextcoa* since its conception, followed by an analysis of competitive conditions for the cocoa sweetener and biopolymer using the Porter diamond model and an internal capabilities profile. Finally, as conclusions, the challenges for the new products to be successful in the market are synthesized, thus contributing to the circularity of the cocoa industry.

2. Literature review

University technology transfer refers to the process by which intellectual property, innovations, and knowledge generated within universities and research institutions are transferred and commercialized for practical applications and societal impact. According to Rasmussen et al. (2020), university technology transfer involves translating academic research findings into tangible products, services, or processes that can be utilized by industry, entrepreneurs, and society at large; this process typically involves activities such as intellectual property protection, licensing agreements, forming spin-off companies, seeking funding, and establishing collaborative partnerships between academia and industry.

That concept is closely with entrepreneurial universities because they actively promote and foster entrepreneurship, innovation, and knowledge exchange within its academic community, while university technology transfer involves the process of translating academic research and innovations into practical applications for commercialization and societal impact (Link & Scott, 2005).

In this context, one of the common ways of transferring technology in the case of entrepreneurial universities is the creation of academic spin-off companies. They refer to a new venture that is established based on intellectual property, technology, or research outcomes developed within an academic institution; it is formed by faculty members, researchers, or students who aim to commercialize their innovative ideas or technologies and bring them to the market (Shane, 2004). In that sense, academic spin-off companies serve as a bridge between academia and industry, translating scientific knowledge into practical applications and products.

Just like any business, according to Clarysse et al. (2005) and Colombo & Grilli (2005), it is important for an academic spin-off company to be competitive for several reasons, between them: i. Market Success: Being competitive allows the spin-off to effectively position itself against existing competitors and seize opportunities in the market. ii. Sustainable Growth: By offering innovative products or services that address market needs and surpass competitors' offerings, a spin-off can achieve sustained revenue growth and this growth is essential for the spin-off's survival, expansion, and long-term viability. iii. Attracting Investors and Funding: A spin-off that demonstrates competitiveness through a solid business model, market understanding, and differentiation is more likely to gain the confidence and financial support of investors. iv. Recruitment and Retention of Talent: In a highly competitive landscape, skilled individuals are drawn to companies that offer challenging and rewarding opportunities. v. Industry Partnerships and Collaborations: Established companies are more inclined to collaborate with spin-offs that demonstrate competitive advantages, as such partnerships can lead to mutual benefits, such as accessing new markets, leveraging complementary expertise, and enhancing technological capabilities. vi. Technology Differentiation: By continuously improving and innovating their technology, spin-offs can maintain a competitive edge, protect intellectual property, and prevent rivals from easily replicating their

offerings. vii. Economic Impact: By successfully competing in the market, the spin-off can create jobs, contribute to economic growth, attract investments to the region, and foster innovation and entrepreneurship within the academic ecosystem.

3. Methodology

This research adopts an interpretive, exploratory, and inductive approach, in which data are taken at a single moment in time. A qualitative methodology of case study was followed, using what was previously found in the literature to categorize and compare analytical units. This methodology is relevant to this research because a contemporary phenomenon is analyzed within its real context, where the limits between the phenomenon and the context are not clearly evident (Yin, 2014). As methodological steps, in the first place, the data collection instruments were designed for both secondary and primary sources. Then, an analysis of web content about Nextcoa was done, as well as a review of available documents about the process of creation of the academic spin-off company. Subsequently, semi-structured interviews were conducted with the entrepreneurial scientists. The data obtained were then analyzed based on the established research question.

4. Findings and discussion

4.1 The magic of Nextcoa

The origin of Nextcoa initiated around 2017, when professors Cristian Blanco Tirado and Marianny Yajaira Combariza, from the Industrial University of Santander UIS, started to research about cocoa, seeking to make the most of these fruits. Until now, Nextcoa helps to promote the cocoa business; using mucilage, shells and others cocoa residues that are considered waste, they develop biomaterials and food products. Its developments include premium chocolate bars and bonbons, produced with high-class manufacturing standards, and a technology to remove cadmium from cocoa beans. Also, they produce sweeteners and biopolymers from fermentable sugars and bacterial cellulose obtained from biotechnological processes using cocoa mucilage (Blanco Tirado, 2019).

4.2 Producing cocoa sweeteners and biopolymers in a rough environment

As it was mentioned before, Nextcoa is a Colombian academic entrepreneurship. Its competitiveness depends on its own capabilities but also in the opportunities and threats that its context offers. That is why, to analyze the challenges that this ASO faces, in first place an analysis was done through the porter's diamond model.

Porters diamond model helps to assess the sources of competitive advantages of an industry in a particular country and consists of four determinants of competitive advantage: factor conditions, demand conditions, related and supporting industries, and firm strategy, structure, and rivalry (Bakan and Doğan, 2012).

4.2.1 Factor conditions.

According to Porter, these can be of two types of factor conditions: basic and advanced. Basic resources include land, natural resources, and unskilled labor, while advanced resources involve capital, infrastructure, skilled labor, and cutting-edge technology. In this case, producing cocoa sweetener and biopolymer need capabilities for develop biotechnological processes. Finding cocoa and even native bacteria as raw material won't be a problem; however, in a developing country as Colombia it is a challenge to find skilled labor, infrastructure and technology for managing bioindustries. As Buitrago (2012) says, "In Colombia, developments in biotechnology have been around three decades and show significant growth in terms of the formation and consolidation of communities dedicated to research, for which universities and some research centers undertook actions within the framework of strategic plans to train at the postgraduate level in foreign schools ... in contrast, the emergence of companies that are supported by biotechnologies or traditional companies that are recognized as such, has been limited compared to the previous community".

4.2.2 Demand conditions.

The main clients of the packages and sweeteners manufactured from residual cocoa biomass are the companies dedicated to the production of chocolates. In 2021 the value of this market was approximately 304 billion pesos, and it is expected that by 2026 this figure will increase to 362.5 billion pesos, with big actors as *Compañía Nacional de Chocolates*, *Comestibles Ítalo*, among others (Euromonitor International, 2022). However, as the

use of these new cocoa products could increase the price of chocolates, it can be assumed that buyers would be those manufacturing premium chocolates.

In the last decade, a series of local brands specializing in premium chocolates have emerged in the country; *Cacao Hunters Food*, *Sagu Co*, *Chocolate Santander*, *Chuculat* are examples of this type of brand which offer dark chocolate with more than 70% cocoa content (Euromonitor International, 2022). For this kind of chocolates, cocoa content increases while the sugar content decreases; as they are promoted as healthier, their makers try to replace caloric sweeteners for non-caloric ones.

On the other hand, in premium chocolates the packaging has two purposes: preservation and to improve visualization. This must keep the perishable chocolate fresh and protecting it against environmental risks, temperature fluctuations, moisture absorption or loss, being a barrier to foreign odors; for this reason, the packaging must be hermetic and impermeable. Likewise, the packaging must highlight the beauty of the product, therefore, elegant packaging with beautiful graphics adds value for consumers (Bertrand, 2003).

This means, cocoa biopolymer and sweetener would have an interesting demand as soon as they reach market conditions.

4.2.3 *Related and supporting industries*

For the preparation of sweetener and biopolymer from Nextcoa, the necessary raw material is the cocoa mucilage. Cocoa production in Colombia has experienced growth of 6.1% and 8.9% for the year 2020 and 2021 respectively, which demonstrates an excellent performance of this sector in recent years (National Cocoa Growers Federation of Colombia, 2022). In addition to this, it must be considered that the commercialization of this fruit both nationally and internationally is carried out only from the dry grain, wasting the rest of the harvest. However, as the mucilage is not valuable right now for farmers, they are not used to picking it up or giving it a hygienic and proper handling; this could represent a supply problem.

4.2.4 *Firm strategy, structure, and rivalry*

European company SMW developed in 2016 a unique cocoa fiber, called Cocoa Paper, which has patented technology that increases the value of waste of cocoa shells by transforming them into creative packaging materials; this fiber can be used for the manufacture of paper and cardboard to create customized solutions applicable to industries such as confectionery, bakery, decoration, among others (SWM, s.f.). At the national level, no companies producing or marketing cocoa packaging were found. However, aluminum foil wrappings and transparent cellophane pouches are currently very attractive to customers (Bertrand, 2003).

Something similar happens with cocoa sweeteners. There is no evidence that it is being produced in Colombia. There is an Equatorian one, produced by Mindo Chocolate Makers, that can be considered a substitute, but it is still in development and is not well distributed. On the other hand, KOA Concentrated Juice, Valrhona Oabika, Honey, Corn and Date Syrup, Monk Fruit Extract, Coconut Sugar and Stevia Powder, are some of natural sweeteners that are used in chocolate premium production.

4.3 From an entrepreneurial University to the market

Nextcoa is a new competitor in the market. As it is still an spin-off initiative, it has produced and commercialized its goods and technologies only on a pilot scale. However, to evaluate its current competitiveness, an internal capabilities profile was done, assessing Nextcoa's buildings, equipment and inventory, employees' skills and knowledge, and organizational structures and processes.

4.3.1 *Buildings, equipment, and inventory.*

As it was mentioned before, Nextcoa is an ASO initiative from UIS. Nowadays, it is located in Guatiguará Technology Park, in Bucaramanga-Colombia. Its buildings, equipment and inventory are mainly from university, and they have efficient and state-of-the-art technology, included biotech for production of cocoa derivatives as sweeteners and biopolymers. However, its productive capacity is small size and that represents a high cost of production and low economy of scale. On the other hand, it has a strength based on intellectual property assets; for example, its researchers have recently made a patent application for a technology to reduce cadmium from cocoa.

4.3.2 *Employees' skills and knowledge.*

Being part of a well-known research university, Nextcoa has talented employees, especially for I+D+i. They help to produce with excellent standards and to develop new products and processes.

4.3.3 Organizational structures and processes.

Nextcoa has developed high-tech processes for producing sweeteners and biopolymers based on cocoa mucilage, that are innovative and demanded products for chocolate makers. Although their technology readiness level TRL could be 6, they have only been produced on a pilot scale, so their manufacturing readiness level MRL is still in pre-production level.

On the other hand, talking about organizational processes, being an ASO of a public university could not be the best scenario for making business in Colombia given the bureaucracy that is managed specially to sell and buy goods and services.

5. Conclusion

Nextcoa is definitely promoting cocoa industry circularity. Producing a sweetener and a biopolymer, made of cocoa mucilage, it contributes doubly to the sustainability of the cocoa industry; first, they use a waste that is currently thrown away but, additionally, they help to reduce the use of cane sugar and plastic packaging in chocolate production.

As an advantage for Nextcoa, there is a significant demand for plastics and sweeteners for chocolate production and packaging, and a prevailing need to reduce related contamination and consumption of sugar cane for health issues. However, there is an important technological limitation for being competitive, in obtaining the cocoa mucilage to produce the sweetener and biopolymer as well as in the little knowledge and management of biotechnological processes of those involved in the cocoa value chain.

Additionally, being an academic spin-off, Nextcoa has the advantage of being backed by a recognized university, that provide excellent infrastructure and skilled employees. However, it could also be problematic given the bureaucracy typical of a public university in Colombia, that mean complications for doing business.

As a conclusion, cocoa biopolymer and sweetener may have an interesting market and can turn Nextcoa into a great player in the cocoa industry, especially if they can be produced at a competitive cost. This could mean that the company becomes independent from the university but also that it makes productive alliances to guarantee the availability of cocoa mucilage in excellent conditions.

References

- Anga, J.M. (2016). "Injecting Innovation to Sustain the Future Supply of Cocoa". Presentation at the World Cocoa Conference 2016, Punta Cana, Dominic Republic, May.
- Anvoh, K.Y.B., Bi, A.Z. and Gnagri, D. (2009). "Production and characterization of juice from mucilage of cocoa beans and its transformation into marmalade", *Pakistan Journal of Nutrition*, Vol 8, No. 2, pp.129-133.
- Aremu-Dele, O., Sobowale, I.O., Nduka, B.A., Adesanya, K.A. and Solomon, O. (2022). "Cocoa production improvement in some major producing countries of the world". Presentation at the Conference Natural Ecosystem Sustainability in the 21st Century, Ibadan, Nigeria, July.
- Audretsch, D.B. (2014). "From the entrepreneurial university to the university for the entrepreneurial society", *The Journal of Technology Transfer*, Vol 39, pp.313-321.
- Bakan, I. and Doğan, İ.F. (2012). "Competitiveness of the industries based on the Porter's diamond model: An empirical study", *International Journal of Research and Reviews in Applied Sciences*, Vol 11, No. 3, pp.441-455.
- Blanco Tirado, C., Combariza Montañez, M., and Barbosa Basto, L. A. (2019). "NEXTCOA: Desarrollo de nuevos procesos y productos para la valorización de mucílago y granos de cacao en el Departamento de Santander", *Memorias Institucionales UIS*, Vol 1, No. 1.
- Bertrand, K. (2003). "Packaging Sweetens Brand Image of Premium Chocolates", *Packaging Strategies 2003*, pp. 36-40.
- Clarysse, B., Wright, M., Lockett, A., Van de Velde, E., & Vohora, A. (2005). Spinning out new ventures: A typology of incubation strategies from European research institutions. *Journal of Business Venturing*, 20(2), 183-216.
- Colombo, M. G., & Grilli, L. (2005). Founders' human capital and the growth of new technology-based firms: A competence-based view. *Research Policy*, 34(6), 795-816.
- Duana-Ávila, D., Hernández-Gracia, T.J., Martínez-Muñoz, E., García-Velázquez, M.D.R. and Román-Gutiérrez, A.D. (2023). "Study of the Mexican Cocoa Market: An Analysis of Its Competitiveness (2010–2021)", *Agronomy*, 13(2), p.378.
- Euromonitor International (2022). "Chocolate Confectionery in Colombia", [online], Euromonitor, <https://www.euromonitor.com/chocolate-confectionery-in-colombia/report>
- FAOSTAT. (2020). "Food and Agriculture Organization of the United Nations FAO Database", [online], FAO, <https://www.fao.org/faostat/en/#data/QC> L. Accessed 02/03/2022.

- Fernández-Alles, M., Camelo-Ordaz, C. and Franco-Leal, N. (2015). "Key resources and actors for the evolution of academic spin-offs", *The Journal of Technology Transfer*, Vol 40, pp.976-1002.
- Gil, M., Gallego, V., Jaramillo, Y., Gil, M. and Uribe, D. (2022). "Advances on acrylamide in cocoa and its derivatives: a challenge to control from postharvest to the industrialization", *Current Opinion in Food Science*, Vol 47, October 2022, p.100903.
- Kozicka, M., Tacconi, F., Horna, D. and Gotor, E. (2018). *Forecasting Cocoa Yields for 2050*, Bioversity International, Rome.
- Link, A. N., & Scott, J. T. (2005). Opening the Black Box of University-Industry Technology Transfer. *Journal of Technology Transfer*, 30(1-2), 35-49.
- National Cocoa Growers Federation of Colombia (2022). Fedecacao. "La producción cacaotera nacional sigue creciendo: en 2021 logra un nuevo récord histórico", [online], Fedecacao, <https://www.fedecacao.com.co/post/la-produccion-cacaotera-nacional-sigue-creciendo-en-2021-logra-un-nuevo-r%C3%A9cord-hist%C3%B3rico>
- Rasmussen, E., & Rice, M. P. (2012). A framework for government support mechanisms aimed at enhancing university technology transfer: the Norwegian case. *International Journal of Technology Transfer and Commercialisation*, 11(1-2), 1-25.
- Savitri, D. A., Setiyono, Subroto, G., Suud, H. M., Haliza, N., & Novijanto, N. (2022). "Cocoa and Chocolate Products: The Sensory Characteristics That Affect Consumers' Acceptance", *Journal La Lifesci*, Vol 3, No. 3, pp. 119-127.
- Shane, S. (2004). *Academic Entrepreneurship: University Spinoffs and Wealth Creation*. Edward Elgar Publishing.
- Soares, T.F. and Oliveira, M.B.P. (2022). "Cocoa By-Products: Characterization of Bioactive Compounds and Beneficial Health Effects", *Molecules*, Vol 27, No. 5, p.1625.
- Suh, N.N. and Molua, E.L. (2022). "Cocoa production under climate variability and farm management challenges: Some farmers' perspective", *Journal of Agriculture and Food Research*, Vol 8, June 2022 p.100282.
- Vanaelst, I., Clarysse, B., Wright, M., Lockett, A., Moray, N. and S'Jegers, R. (2006). "Entrepreneurial team development in academic spinouts: An examination of team heterogeneity", *Entrepreneurship Theory and Practice*, Vol 30, No. 2, pp.249-271.
- Vohora, A., Wright, M. and Lockett, A. (2004). "Critical junctures in the development of university high-tech spinout companies", *Research policy*, Vol 33, No. 1, pp.147-175.
- Yin, R. K. (2014). *Case Study Research Design and Methods* (5th ed.). Thousand Oaks, CA: Sage.

Effectuation and Lean Startup in Swiss Start-ups: An Integrative Analysis

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Abstract: Founding a start-up entails numerous risks and uncertainties. To minimise these risks and to deal with uncertainties, the popular concepts of Effectuation and Lean Startup, among others, are discussed in entrepreneurship research. Although both concepts are not new, they have gained importance in recent years. Effectuation focuses on dealing with uncertainty and contrasts with causation, which focuses on planning. The starting point for Effectuation is the resources available to the founders, which leads to different business ideas. The core of Effectuation includes four key dimensions: available means, affordable losses, exploiting contingencies and building partnerships. Lean Startup can be understood as a framework for decision-making in which direct interaction takes priority over extensive planning. The approach is based on three fundamental principles: experimentation rather than planning, focus on customer feedback and iterative learning. The core elements include a clear entrepreneurial vision, close contact with the customer, the Build-Measure-Learn feedback loop and the Minimum Viable Product. The key dimensions of Effectuation and the core elements of Lean Startup also form the frame of reference for the empirical investigation. The article examines the extent to which these concepts are applied by Swiss entrepreneurs and whether a combination of the two takes place. The data comes from the business plans of 25 finalists of a Swiss innovation competition from 2022. The business plans are evaluated and analysed in a multi-stage process. The study provides insight into the behaviour of Swiss start-ups, whether they proceed according to Effectuation and apply the Lean Startup principles. Surprisingly, the study reveals that many start-ups proceed according to Effectuation, while relatively few start-ups apply the Lean Startup principles. We were able to show the extent to which the two approaches are used and how they relate to each other. We also found that the origin of the start-up (research-based or industry experience-based) plays a significant role.

Keywords: Effectuation, Lean Startup, relationships between entrepreneurial approaches, entrepreneurial behaviour, Swiss start-ups.

1. Introduction

Starting a new business, especially a start-up, involves considerable risks and uncertainties (Bortolini et al., 2021). The survival rate of young companies in Switzerland after five years is only around 50% (Baldegger et al., 2022; Swiss Federal Statistical Office, 2022; Kyora and Rockinger, 2023). This is not surprising, as start-ups often face significant obstacles as they operate in an environment of great uncertainty (Blank, 2013; Ries, 2011) and strive for a scalable business model (Blank, 2013). In this context, a pertinent question arises: How can risks be minimised and uncertainties managed more effectively?. Two potential approaches that address this question are Effectuation and Lean Startup (LS). Effectuation is a concept from entrepreneurship research that has been the subject of lively discussion for more than two decades and has attracted great attention (Alzamora-Ruiz et al., 2021; Reh, 2020). Similarly, the concept of the LS also continues to grow in popularity (Allen, 2022; Bocken and Snihur, 2020; Contigiani, 2023), both in research and in practical application in start-ups (Konietzko et al, 2020) and in the curriculum of entrepreneurship courses (Mansoori and Lackéus, 2020; Raneri et al., 2022; Sarasvathy, 2021).

This study aims to examine (1) the extent to which entrepreneurs in Switzerland apply the concepts of Effectuation and LS, and (2) whether they use a combination of the two. The data is based on the business concepts of the 25 top competitors in a Swiss innovation competition. The paper is structured as follows: In a first step, the relevant literature on Effectuation and LS is reviewed, and a link is established between these two concepts. Subsequently, the methodological approach is outlined, followed by a discussion of results and the research question's resolution. Finally, the study highlights the limitations of the chosen approach and potential directions for further research.

2. Theoretical framework

2.1 Effectuation

Based on empirical research in the field of entrepreneurship (Richter and Schildhauer, 2018), Effectuation explains how start-ups deal with uncertainty (Read et al., 2009; Sarasvathy, 2001; Solaimani et al., 2022). Effectuation, developed by Sarasvathy, defines Effectuation as “processes that take a set of means as given and focus on selecting between various possible effects that can be created with that set of means” (Sarasvathy, 2001, p. 245), as opposed to causation, which emphasises planning. Entrepreneurial behaviour is thus divided into two opposing logics (Raneri et al., 2022; Sarasvathy, 2008, 2001). Effectuation emphasises the importance of uncertainty, which limits the validity of prediction and planning (Ortega et al., 2017), and therefore relies on experimentation to develop the business model (Hinz, 2017; Xu et al., 2022). Instead of following a clearly defined plan, making assumptions about the future, and focusing on desired goals (Sarasvathy, 2001; Welter et al., 2021), entrepreneurs examine what resources they have at their disposal in order to use them flexibly (Hinz and Eisenbart, 2019; Sarasvathy, 2001). The core of Effectuation originally encompassed five key dimensions (Solaimani et al., 2022), which were reduced to four in later work (Alzamora-Ruiz et al., 2021; Ortega et al., 2017):

- *Available means*: Entrepreneurs start with the means available (Fueglistaller et al., 2019). Which goals can be realised with the available competences and skills, resources, networks and specific experiences (Grichnik et al., 2018; Sarasvathy, 2001). When it comes to concrete implementation, the goals that best match your own preferences are considered. (Grichnik et al., 2018).
- *Affordable loss*: Entrepreneurs determine what the worst possible consequences of their actions could be and clarify how much loss they are willing to accept (Fueglistaller et al., 2019; Kalinic et al., 2014). This affordable loss can be described as opportunity cost, loss of time, attention, commitment or of capital (Grichnik et al., 2018). Founders therefore try not to invest more resources than they can afford (Brenk et al., 2019).
- *Exploiting contingencies*: Entrepreneurs take chances (Faschingbauer, 2017) and are open to contingencies, using them as opportunities (Hinz, 2017; Yang et al., 2019). This includes chance encounters (Faschingbauer, 2017) and interaction with other people (Kalinic et al., 2014). Interaction with others facilitates co-creation, which in turn leads to creativity (Brenk et al., 2019; Sarasvathy, 2001). Interaction is therefore a key aspect of contingency generation.
- *Form partnerships*: Entrepreneurs enter into agreements and form partnerships rather than pursuing individual paths (Grichnik et al., 2018; Hinz, 2017). Collaborations result in the broadening of resources (partners contribute their resources), clarity of goals (partners contribute their goals, leading to trade-offs) and shared entrepreneurial risks (Chandler et al., 2011; Eberz, 2018). When entrepreneurs act according to Effectuation, they tend to proactively seek partners (Yang et al., 2019), which may include suppliers, (potential) customers (Eberz, 2018; Yang et al., 2019) or by involving other organisations in their own venture (Chandler et al., 2011).

2.2 Lean Startup

LS is a decision-making framework that prioritises immediate customer engagement and rapid prototyping over accurate preparation (Blank and Eckhardt, 2023; Hinz and Eisenbart, 2019). Its origins lie in the manufacturing world (Ghezzi and Cavallo, 2020). Blank (Blank, 2005, 2013), with the ‘customer development’ approach, and Ries (2011), with the ‘lean startup’, applied these concepts to the development of a start-up (Ghezzi, 2019; Ghezzi and Cavallo, 2020). Blank combined the concepts of the business model canvas, customer development methods and agile methods (Blank, 2005, 2013, 2013; Blank and Dorf, 2012) and Ries (2011) extended the concept by the minimal viable product (MVP) (Chengbin et al., 2022; Ghezzi, 2019) and the pivot (Ghezzi, 2019). The approach presented by Ries is widely used in the start-up scene (Bortolini et al., 2021) and can almost be considered a standard procedure when founding (Bortolini et al., 2021). LS is considered one of the most pragmatic ways to develop a start-up (Chengbin et al., 2022; Frederiksen and Brem, 2017). Especially in situations of high uncertainty and complexity, combined with a fast pace of change, success is often determined by how quickly an organisation can test, experiment and learn (Bortolini et al., 2021; Osterwalder and Pigneur, 2011), thereby minimising the risk of failure (Eckert, 2017). With “LS”, Ries tries to make the creation of a start-up a systematic and reproducible process to minimise the time and resources needed to validate a business model. Failing quickly and learning from it prevents persisting with a wrong idea, which would waste valuable resources (Eisenmann et al., 2013; Silva et al., 2020). The approach presented by Ries (2011) is based on three key principles: 1) experimenting rather than sophisticated planning, 2) focusing on customer feedback and 3)

incremental development (Nörr, 2016). The focus is on validated learning using the so-called Build-Measure-Learn (BML) feedback loop (Bortolini et al., 2021; Silva et al., 2020).

The following core elements should be highlighted:

- *Vision – Strategy – Product*: The starting point is a clear entrepreneurial vision (Bortolini et al., 2021; Ries, 2011; York, 2021), from which the strategy and the product are derived. The vision itself is rarely touched, while the product is adjusted more often in the fine-tuning process (iterative learning). The strategy is adjusted when a product adjustment no longer leads to the desired goal (Ries, 2011). The pivot is a possible path based on the results of validated learning (BML) (York, 2021).
- *Close customer contact*: Customers should be involved in the development process as early as possible. Customer feedback plays an important role (Bortolini et al., 2021) as it helps to improve the existing solution (Hinz and Eisenbart, 2019; Ries, 2011). Constantly formulating new hypotheses, which are then tested in direct interaction with customers, increases knowledge about customers (Mansoori and Lackeus, 2020) and their needs.
- *Build-Measure-Learn feedback loop*: LS focuses on rapidly subjecting the entrepreneurial concept to rigorous validation of certain product characteristics. (Hinz and Eisenbart, 2019; Rasmussen and Tanev, 2015). Validated learning is based on hypotheses (Eisenmann et al., 2013), which are validated as part of the BML feedback loop. A lean approach ensures that the start-up delivers value and achieves growth (Allen, 2022; Ries, 2011), as it minimises the chance of developing a product that customers are not interested in (Hinz and Eisenbart, 2019).
- *Minimum viable product (MVP)*: An MVP is a product with the smallest possible feature set (Ripsas et al., 2018), which enables the completion of one pass in the BML cycle with minimal effort and development time (Ries, 2011; Shepherd and Patzelt, 2021). The MVP allows the product to be quickly adapted based on feedback from real users, making it a cost-effective way to test hypotheses (Balocco et al., 2019). The aim is to find out what customers want as quickly as possible. (Hinz and Eisenbart, 2019).

2.3 Effectuation and the Lean Startup

The roots of LS lie, among others, in Effectuation theory (Frederiksen and Brem, 2017; Ghezzi, 2019; York, 2021). It is therefore not surprising that there are parallels between the two approaches. LS, together with Effectuation, is seen as the antithesis of causation with the creation of business plans (Bortolini et al., 2021; Ripsas et al., 2018). Parallels also exist in the iterative process, which plays a role in both Effectuation and LS (Mansoori et al., 2019; York, 2021). While Effectuation is about iterative cycles (Mansoori et al., 2019; Sarasvathy and Dew, 2005), LS postulates a BML feedback loop (Hinz and Eisenbart, 2019; Ries, 2011). Another parallel is stakeholder involvement. According to Effectuation, stakeholders are actively sought, and partnerships and alliances are formed with them (Mansoori and Lackeus, 2020; Sarasvathy and Dew, 2005). LS is also about actively interacting with stakeholders by trying to interact with as many people as possible and getting their feedback (Eisenmann et al., 2013; Mansoori and Lackeus, 2020). Although parallels between the two approaches are evident (Frederiksen and Brem, 2017), it is not clear whether Effectuation supports the application of LS (Welter et al., 2021). However, the application of LS practices seems to indicate working with Effectuation (Ghezzi, 2019; Solaimani et al., 2022), and LS is sometimes even seen as a way to put Effectuation into practice (Raneri et al., 2022).

But there are also differences between the two approaches. If we look at the starting point, Effectuation starts with the available resources and the possibilities for action arise from them (Blank and Eckhardt, 2023). LS, on the other hand, tries to gain as much knowledge as possible about customers in a first step by formulating a hypothesis and then testing it (Mansoori and Lackeus, 2020). In building knowledge, Effectuation starts with what the founders already know, who they are and who they know (Sarasvathy and Dew, 2005; York, 2021). In contrast, LS is about learning more about customers through hypothesis testing (Eisenmann et al., 2013; Ries, 2011). The use of resources also differs between the two approaches. Effectuation refers to the expansion of the resource pool through the creative use of scope through interaction with stakeholders (Sarasvathy, 2008), whereas LS focuses on conserving resources by adopting an iterative process (Blank, 2013).

3. Methodological approach

The study is based on the analysis of 25 business plans from Swiss start-ups that participated in the Swiss Innovation Challenge (SIC) 2022. The SIC is an annual innovation competition with an accelerator component.

As part of the programme, 25 out of an initial 100 participants reach the final round through a three-stage selection process. All participants are required to submit a business plan, a unique database for this study. It is acknowledged that the business plan may not necessarily follow the logic of Effectuation or LS (Blank and Eckhardt, 2023; Welter et al., 2021). However, as the submission of such a document is mandatory for participation in the SIC, start-ups are forced by external pressure to produce a business plan, regardless of their internal business logic. In this study, a multiple case study approach will be used to increase the credibility of the results and to provide a more comprehensive understanding of how Swiss start-ups deal with Effectuation and use LS. To improve the quality of the analysis, the data sets were analysed independently by the three researchers and then consolidated. This reduced individual interpretations and increased overall objectivity. First, the sample was checked for indications of the four key dimensions of Effectuation (available means, affordable loss, interaction and forming partnerships). Second, the data was then evaluated for evidence of the use of the four core elements of LS (strategy-product-vision, close customer contact, use of a MVP and use of the BML cycle). Additionally, other parameters were also collected (see empirical results). The final step was to clarify whether both approaches are combined with each other.

4. Empirical results

Based on the key elements mentioned above, the research sample was examined to assess the extent to which there was evidence that a start-up followed the Effectuation logic. Evidence was present if three of the four key dimensions mentioned were met. First, if there was evidence of working with the available means (skills, resources, networks and specific experience). Second, if there is evidence that an affordable loss has been incurred. Third, if there was evidence of an open approach to contingencies, for example through deliberate interaction with the ecosystem (e.g. co-working space, competitions, coaching, external support). Fourth, whether there was evidence of a cooperative strategy for forming partnerships with stakeholders (such as clients, suppliers and other businesses in the entrepreneur's network).

The expectation was that some companies would operate according to Effectuation, consciously or unconsciously. However, the data showed that 96% of all the start-ups studied operated according to Effectuation. In other words, they started with available means, interacted with other people or start-ups and made commitments through partnerships and alliances. The application of Effectuation is therefore evident. As can be seen in Figure 1, there was remarkable consistency across the four dimensions examined, except for the dimension of 'affordable loss'. Too little evidence was found for this key element. Nevertheless, 20% of the business plans examined contained evidence that an affordable loss had been defined. However, due to the low level of evidence, this dimension is not considered in the following.

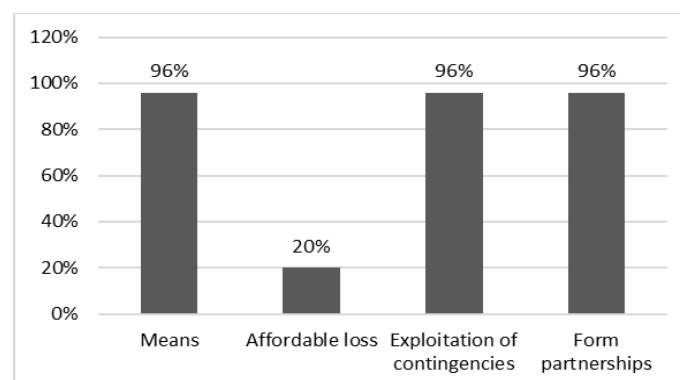


Figure 1: Key dimensions of Effectuation and their use in the sample studied (own representation).

At first glance, this observation may seem surprising, but on closer inspection it is less so. As shown in Figure 2, 84% of the start-ups are based either on research (56%) or on several years of experience of the founders (28%), which was the basis for the development of the start-up. Since the SIC is aimed at innovative companies, it is understandable that through the selection process it is mainly highly innovative start-ups that reach the final round. Highly innovative start-ups often have their origins in university research and are often founded as spin-offs from a university. More than half (56%) of the start-ups in this study that operate according to Effectuation have their starting point in research. It was also noticeable that a smaller proportion were developed because of experience gained within a sector. For the remaining 16%, we could not identify either of these two options, but concluded that they started with existing resources, such as a specific network, or pre-existing skills.

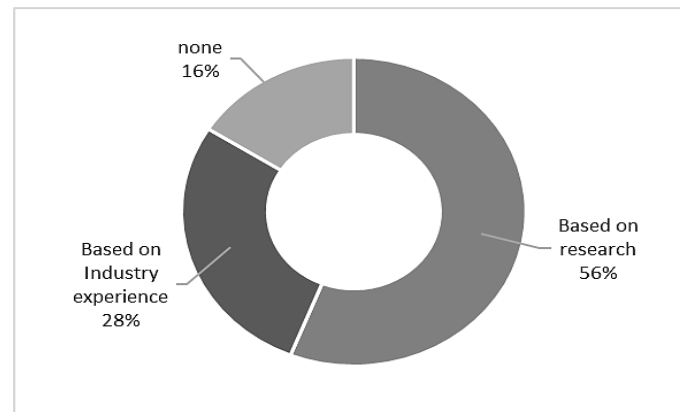


Figure 2: Starting point of the start-up (research, industry experience), (own presentation).

Not surprisingly, there is also a high score for the ‘opportunity as possibility’ dimension. Interaction is an essential element in creating opportunities. By interacting with others, new ideas are generated, the field is broadened, and this opens the door to new opportunities. 79% of the companies surveyed are either affiliated with various start-up support programmes (e.g. incubators), work in a co-working space – of which there are over 185 different offerings in Switzerland (Hediger, 2019) – or are supported by various support agencies. As Figure 3 shows, many of them work with coaches or mentors or participate in start-up competitions (except SIC), most even use both options (54%).

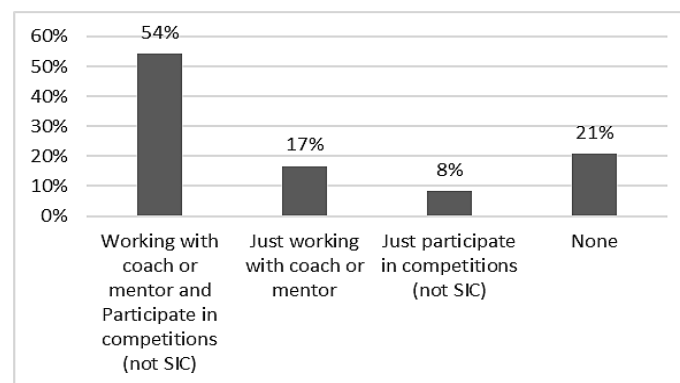


Figure 3: Interaction through support and competitions (own presentation).

Concerning “form partnerships”, it was noticeable that the start-ups actively sought to establish partnerships and alliances, be it with producers, distribution partners, other start-ups or with (future) customers. Notably, the analysed start-ups usually already had existing partnerships in place. Future customers support product development and often offer the possibility to test the initial MVP. Manufacturers, among others, are involved in the development process and thus make an important contribution to the realisation of a product vision.

In relation to LS, the available data sources were reviewed to see if there was evidence that a start-up was working with LS. Again, we considered this to be evident if three of the four core elements were being used. Firstly, if there was evidence of close contact and involvement in the development process. Second, if there was evidence that a BML feedback loop was used. Third, if there is evidence that an MVP is used to get customer feedback. Fourth, if an overarching strategy could be found that allowed pivoting while still pursuing the strategy.

While most start-ups studied followed Effectuation, LS presents a different picture. As can be seen in Figure 4, 60% of the companies implemented at least three of the four core elements mentioned, indicating partial adoption of LS. In contrast, 40% did not apply LS at all. This result can be explained by the fact that LS is a process that needs to be worked through and is rarely applied intuitively (unlike Effectuation). Although most of the surveyed start-ups have taken part in one or another entrepreneurship training course, it can be assumed that LS is not universally included in the curriculum. For example, in the programmes offered by Innosuisse, the Swiss state funding agency, do not explicitly refer to LS as part of their offerings (Innosuisse, 2023).

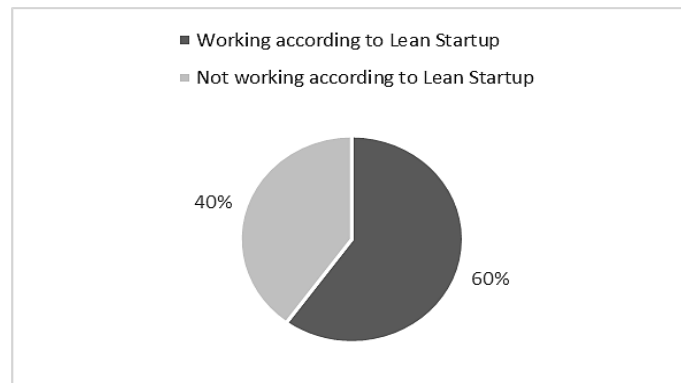


Figure 4: Using of LS (own presentation)

Looking at the four core elements (see Figure 5), it was observed that 80% of the surveyed start-ups implemented close customer contact. The “vision-strategy-product” dimension is somewhat less prevalent at 68%. In the analysis, particular attention was paid to presenting a clear overarching vision in the business plan. The MVP was also used relatively frequently (60%). The least commonly used element was a clear build-measure-learn feedback loop. This is certainly one of the clearest indications of whether LS is being applied. The MVP is clearly defined according to Ries (2011), but it cannot be ruled out here that the now very well-known term was simply used instead of the prototype.

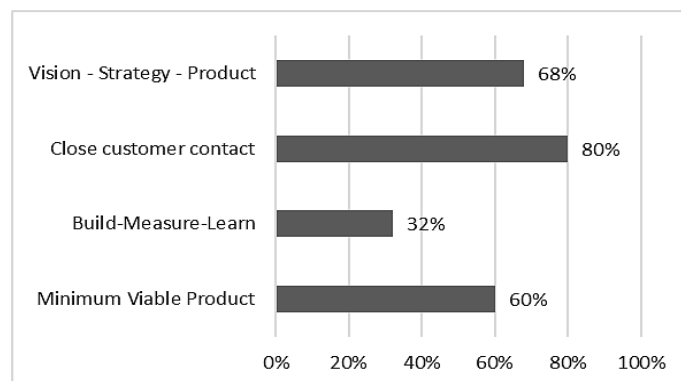


Figure 5: Frequency of use of the four core elements (own presentation)

Since almost all the start-ups surveyed follow Effectuation, it is not surprising that some of them also embrace LS principles. Of the 96% that use Effectuation, 42% work according to the LS methodology (see Figure 7). The only start-up that could not be assigned to Effectuation had no evidence of following LS.

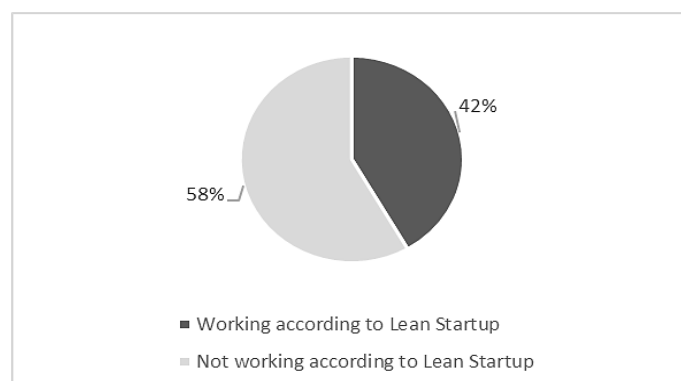


Figure 6: Number of core elements implemented (own representation).

Finally, we looked at whether there were differences in application depending on whether a start-up had its roots in research or was founded based on industrial experience. Figure 8 clearly shows that it is mainly research-

based start-ups that use LS. This is not surprising as Ries (2011) strongly emphasises that LS is a scientific approach, making it a natural fit for research-oriented ventures.



Figure 7: Connection between LS and the starting point of the company's creation (own representation).

5. Discussion and conclusion

The aim of the study was to find out to what extent Swiss entrepreneurs apply the concepts of Effectuation and LS. Several main conclusions can be drawn. Regarding the application of Effectuation, it was found that it is applied in 96% of the Swiss start-ups studied, that entrepreneurs act with the resources available to them, interact with their environment and work together to build partnerships and alliances. Limited resources and the ability to manage them efficiently were the reasons for its application (Reymen et al., 2017). 56% of start-ups using Effectuation had their starting point in research, while 28% were founded based on extensive industry experience; in addition, 79% of start-ups actively sought exchange with others (e.g. mentors or coaches). LS, on the other hand, was used much less, with 60% of start-ups adopting it as a decision-making framework (Blank and Eckhardt, 2023). Most start-ups (80%) practice close customer contact and involve the customer in the development process at an early stage, as postulated by Ries (2011). Through this interaction they increase their knowledge about their customers and their needs (Mansoori and Lackéus, 2020). The least used loop was BML-Feedback (32%), suggesting that many start-ups refrained from validating hypotheses in an iterative process (Hinz and Eisenbart, 2019; Rasmussen and Tanev, 2015). Furthermore, we found that 42% of the start-ups that could be assigned to Effectuation also considered adopting LS. This is certainly also because there are clear parallels between the two approaches (Ghezzi, 2019; Mansoori and Lackéus, 2020; York, 2021).

The present study was able to clarify the extent to which Effectuation and LS are used by Swiss start-ups. It should be noted, however, that on the one hand, only the business plans of 25 finalists of the SIC were analysed, a competition that is specifically aimed at innovative start-ups, thereby representing only a limited range of young companies. Secondly, a small subset of start-ups is not sufficient to make reliable statements about the application of Effectuation and LS in the Swiss start-up scene. Further research is therefore needed to confirm the results with a larger sample. The data from the annual SIC, which is already available and will be updated in the future, offers the opportunity to shed more light on this field using quantitative, content-analytical, and qualitative approaches. Qualitative approaches can be helpful in clarifying the extent to which Effectuation plays a role in actions taken by start-ups and how exactly LS is dealt with. In particular, the level of action, which is only inadequately covered in the business plan, should be considered in future research projects.

References

- Allen, G.J. (2022), "Concepturealize™: a new contribution to generate real-needs-focussed, user-centred, lean business models", *Journal of Innovation and Entrepreneurship*, Vol. 11 No. 1, pp. 6.
- Alzamora-Ruiz, J., del Mar Fuentes-Fuentes, M. and Martinez-Fiestas, M. (2021), "Together or separately? Direct and synergistic effects of Effectuation and Causation on innovation in technology-based SMEs", *International Entrepreneurship and Management Journal*, Vol. 17 No. 4, pp. 1917–1943.
- Baldegger, R., Gaudart, R. and Wild, P. (2022), *Global Entrepreneurship Monitor (GEM) 2021/2022: Report on Switzerland.*, Fribourg.
- Balocco, R., Cavallo, A., Ghezzi, A. and Berbegal-Mirabent, J. (2019), "Lean business models change process in digital entrepreneurship", *Business Process Management Journal*, Vol. 25 No. 7, pp. 1520–1542.
- Blank, S. (2005), *The Four Steps to the Epiphany: Successful Strategies for Products That Win*, Wiley, Hoboken, New Jersey.
- Blank, S. (2013), "Why the lean start-up changes everything", Vol. 91 No. 5, pp. 63–72.

- Blank, S. and Eckhardt, J.T. (2023), "The Lean Startup as an Actionable Theory of Entrepreneurship", *Journal of Management*, pp. 1–23.
- Blank, S.G. and Dorf, B. (2012), *The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company*, K & S Ranch, Pescadero, California.
- Bocken, N. and Snihur, Y. (2020), "Lean Startup and the business model: Experimenting for novelty and impact", *Long Range Planning*, Vol. 53 No. 4, p. 101953.
- Bortolini, R.F., Nogueira Cortimiglia, M., Danilevicz, A. de M.F. and Ghezzi, A. (2021), "Lean Startup: a comprehensive historical review", *Management Decision*, Vol. 59 No. 8, pp. 1765–1783.
- Brenk, S., Lüttgens, D., Diener, K. and Piller, F. (2019), "Learning from failures in business model innovation: solving decision-making logic conflicts through intrapreneurial effectuation", *Journal of Business Economics*, Vol. 89 No. 8–9, pp. 1097–1147.
- Bundesamt für Statistik (Ed.). (2022), *Unternehmensdemografie (UDEMO)*, Bundesamt für Statistik (BFS), Neuchâtel.
- Chandler, G.N., DeTienne, D.R., McKelvie, A. and Mumford, T.V. (2011), "Causation and effectuation processes: A validation study", *Journal of Business Venturing*, Vol. 26 No. 3, pp. 375–390.
- Chengbin, W., Hongbin, W., Min, D. and Yongyan, F. (2022), "Lean Startup Approaches (LSAs): Convergence, Integration and Improvement", *Technological Forecasting and Social Change*, Vol. 179, p. 121640.
- Contigiani, A. (2023), "Experimentation and appropriability in early-stage ventures: Evidence from the US software industry", *Strategic Management Journal*, John Wiley & Sons, Ltd, pp. 1–47.
- Eberz, S. (2018), *Effectuation oder Causation?*, Springer Fachmedien Wiesbaden, Wiesbaden.
- Eckert, R. (2017), *Lean Startup in Konzernen und Mittelstandsunternehmen: Ergebnisse einer Expertenbefragung und Handlungsempfehlungen*, Springer Fachmedien Wiesbaden, Wiesbaden.
- Eisenmann, T., Ries, E. and Dillard, S. (2013), "Hypothesis-Driven Entrepreneurship: The Lean Startup", *Harvard Business School Background Note*, No. 812–095.
- Faschingbauer, M. (2017), *Effectuation: Wie erfolgreiche Unternehmer denken, entscheiden und handeln*, Schäffer-Poeschel.
- Frederiksen, D.L. and Brem, A. (2017), "How do entrepreneurs think they create value? A scientific reflection of Eric Ries' Lean Startup approach", *International Entrepreneurship and Management Journal*, Vol. 13 No. 1, pp. 169–189.
- Fueglistaller, U., Fust, A., Müller, C., Müller, S. and Zellweger, T. (2019), "Strategie und Geschäftsmodell", in Fueglistaller, U., Fust, A., Müller, C., Müller, S. and Zellweger, T. (Eds.), *Entrepreneurship: Modelle – Umsetzung – Perspektiven Mit Fallbeispielen Aus Deutschland, Österreich Und Der Schweiz*, Springer Fachmedien Wiesbaden, Wiesbaden, pp. 139–182.
- Ghezzi, A. (2019), "Digital startups and the adoption and implementation of Lean Startup Approaches: Effectuation, Bricolage and Opportunity Creation in practice", *Technological Forecasting and Social Change*, Vol. 146, pp. 945–960.
- Ghezzi, A. and Cavallo, A. (2020), "Agile Business Model Innovation in Digital Entrepreneurship: Lean Startup Approaches", *Journal of Business Research*, Vol. 110, pp. 519–537.
- Grichnik, D., Baierl, R. and Faschingbauer, M. (2018), "Effectuation", in Faltin, G. (Ed.), *Handbuch Entrepreneurship*, Springer Fachmedien Wiesbaden, Wiesbaden, pp. 91–107.
- Hediger, D. (2019), *Shared Office Monitor 2019*, immodea Coworking Solutions, Aarau.
- Hinz, A. (2017), "Entrepreneurial behaviour revisited: Linking self-efficacy with effectuation", *International Journal of Business and Society*, Vol. 18 No. S2, pp. 245–260.
- Hinz, A. and Eisenbart, B. (2019), "Connecting the Dots: Effectuation and Lean Startup", *Proceeding Book of The 4th ICMEM 2019 and The 11th IICIES 2019*, presented at the ICMEM 2019 and IICIES 2019, Bali, Indonesia.
- Innosuisse. (2023), "Get the tools you need to set up your company", *Innosuisse - Swiss Innovation Agency*, available at: <https://www.innosuisse.ch/inno/en/home/start-and-grow-your-business/start-up-training.html> (accessed 30 April 2023).
- Kalinic, I., Sarasvathy, S.D. and Forza, C. (2014), "'Expect the unexpected': Implications of effectual logic on the internationalization process", *International Business Review*, Vol. 23 No. 3, pp. 635–647.
- Konietzko, J., Baldassarre, B., Brown, P., Bocken, N. and Hultink, E.J. (2020), "Circular business model experimentation: Demystifying assumptions", *Journal of Cleaner Production*, Vol. 277, pp. 122596.
- Kyora, S. and Rockinger, M. (2023), *Swiss Startup Radar 2022/2023*, Luzern.
- Mansoori, Y., Karlsson, T. and Lundqvist, M. (2019), "The influence of the lean startup methodology on entrepreneur-coach relationships in the context of a startup accelerator", *Technovation*, Vol. 84–85, pp. 37–47.
- Mansoori, Y. and Lackéus, M. (2020), "Comparing effectuation to discovery-driven planning, prescriptive entrepreneurship, business planning, lean startup, and design thinking", *Small Business Economics*, Vol. 54 No. 3, pp. 791–818.
- Nörr, M. (2016), *Key Learnings aus dem Serial Entrepreneurship*, Springer Fachmedien Wiesbaden, Wiesbaden.
- Ortega, A.M., García, M.T. and Santos, M.V. (2017), "Effectuation-causation: what happens in new product development?", *Management Decision*, Vol. 55 No. 8, pp. 1717–1735.
- Osterwalder, A. and Pigneur, Y. (2011), *Business Model Generation: ein Handbuch für Visionäre, Spielveränderer und Herausforderer*, translated by Wegberg, J.T.A., Campus Verlag, Frankfurt New York.
- Raneri, S., Lecron, F., Hermans, J. and Fouss, F. (2022), "Predictions through Lean startup? Harnessing AI-based predictions under uncertainty", *International Journal of Entrepreneurial Behavior & Research*.
- Rasmussen, E.S. and Tanev, S. (2015), "The Emergence of the Lean Global Startup as a New Type of Firm", *Technology Innovation Management Review*, Vol. 5 No. 11, pp. 12–19.

- Read, S., Song, M. and Smit, W. (2009), "A meta-analytic review of effectuation and venture performance", *Journal of Business Venturing*, Vol. 24 No. 6, pp. 573–587.
- Reh, S. (2020), *Effectuation als Startup-Entscheidungslogik: Einflussfaktoren auf die Entscheidungsfindung in jungen Unternehmen*, Springer Fachmedien Wiesbaden, Wiesbaden.
- Richter, N. and Schildhauer, T. (2018), "Startup Clinics: Applied Research and 'First Aid' for Early Stage Startups", in Richter, N., Jackson, P. and Schildhauer, T. (Eds.), *Entrepreneurial Innovation and Leadership: Preparing for a Digital Future*, Springer International Publishing, Cham, pp. 29–40.
- Ries, E. (2011), *The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses*, Crown Business, New York.
- Ripsas, S., Schaper, B. and Tröger, S. (2018), "A Startup Cockpit for the Proof-of-Concept", in Faltin, G. (Ed.), *Handbuch Entrepreneurship*, Springer Fachmedien Wiesbaden, Wiesbaden, pp. 1–17.
- Sarasvathy, S.D. (2008), "Effectuation: Elements of Entrepreneurial Expertise", *Effectuation: Elements of Entrepreneurial Expertise*, Vol. 243.
- Sarasvathy, S.D. (2001), "Causation and Effectuation: Toward a Theoretical Shift from Economic Inevitability to Entrepreneurial Contingency", *Academy of Management Review*, Vol. 26 No. 2, pp. 243–263.
- Sarasvathy, S.D. (2021), "The Middle Class of Business: Endurance as a Dependent Variable in Entrepreneurship", *Entrepreneurship Theory and Practice*, Vol. 45 No. 5, pp. 1054–1082.
- Sarasvathy, S.D. and Dew, N. (2005), "New market creation through transformation", *Journal of Evolutionary Economics*, Vol. 15 No. 5, pp. 533–565.
- Shepherd, D.A. and Patzelt, H. (2021), *Entrepreneurial Strategy: Starting, Managing, and Scaling New Ventures*, Springer International Publishing, Cham.
- Silva, D.S., Ghezzi, A., Aguiar, R.B. de, Cortimiglia, M.N. and ten Caten, C.S. (2020), "Lean Startup, Agile Methodologies and Customer Development for business model innovation: A systematic review and research agenda", *International Journal of Entrepreneurial Behavior & Research*, Vol. 26 No. 4, pp. 595–628.
- Solaimani, S., van Eck, T., Kievit, H. and Koelemeijer, K. (2022), "An exploration of the applicability of Lean Startup in small non-digital firms: an effectuation perspective", *International Journal of Entrepreneurial Behavior & Research*, Vol. 28 No. 9, pp. 198–218.
- Welter, C., Scrimshire, A., Tolonen, D. and O'Brien, E. (2021), "The road to entrepreneurial success: business plans, lean startup, or both?", *New England Journal of Entrepreneurship*, Vol. 24 No. 1, pp. 21–42.
- Xu, S., He, J., Morrison, A.M., de Domenici, M. and Wang, Y. (2022), "Entrepreneurial networks, effectuation and business model innovation of startups: The moderating role of environmental dynamism", *Creativity and Innovation Management*, Vol. 31 No. 3, pp. 460–478.
- Yang, X., Sun, S.L. and Zhao, X. (2019), "Search and execution: examining the entrepreneurial cognitions behind the lean startup model", *Small Business Economics*, Vol. 52 No. 3, pp. 667–679.
- Practice Experience and Current Academic Discussions", *Journal of Entrepreneurship & Organization Management*, Vol. 10 No. 8, pp. 1–22.
- York, J.M. (2021), "Status of the Lean Startup Methodology: From Theoretical Foundations to Practice Experience and Current Academic Discussions", *Journal of Entrepreneurship & Organization Management*, Vol. 10 No. 8, pp. 1–22.

Model for Digital Skills Training for SMEs

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Abstract: Concerning the level of digitalisation, SMEs are not as well positioned as large companies. Lack of affordable training and ability to obtain needed competences form significant obstacles for the digitalisation of SMEs. The present study discusses these challenges and proposes an experimental model developed in a project implemented in cooperation with a university of applied sciences and regional business development organisations. The project provides the tools necessary for SMEs to develop their digital skills in the South Savo region, Finland. Our research question is: How can SMEs be best supported to develop and grow their digital skills and business models? Earlier research shows that employees working in SMEs need a set of competences enabling them to work and prosper in the ever-changing digital environment. For SMEs, the question is, which set of employee competences is the most relevant for the company's commercial success, because digital competences play a vital role in most SMEs' future success. The training model presented in the paper is based, firstly, on defining the relevant areas of digital competences and the most significant skills gaps for each SME and, secondly, on tailoring a company-specific syllabus for closing these gaps. There are over 180 SMEs participating in the project. The practical work with each SME starts with digital competence mapping in a meeting between a business advisor and a representative of the SME. Based on the competence mapping, the SME then receives a company-specific action plan, and a syllabus. The project provides participating SMEs with clear learning paths at both basic and advanced levels, longer training paths and coaching. By doing so, the model ensures that participating SMEs only concentrate on relevant issues and get appropriate particular support for their businesses. The contribution of the study is the development of an efficient training model and testing it with 180 SMEs. Based on our results, the most important digital competences for each SME in developing and growing its business must be defined based on each SME's specific business needs, grounded in its business model and context, and skills gaps related to these competences.

Keywords: Digital skills; Skills gaps; SMEs; Training model; Finland

1. Introduction

In the European Union (EU), 98.9% of all companies are small enterprises, and just 0.2% are classified as large enterprises with 250 or more persons employed (Eurostat 2020). Consequently, as SMEs play a vital role in the economy, it is central that SMEs are offered the necessary support and training to become competitive. Concerning the level of digitalisation, large companies are far better positioned than SMEs. Due to the rapid changes in business life and digital tools, the need to train digital competences in SMEs is continuous. Digital competences play a central role in most SMEs' future success (Vieru et al., 2015; Hubschmid-Vierheilg et al., 2019).

The European Commission's (EC) annual Digital Economy and Society Index (DESI) report 2022 detected that although the COVID-19 pandemic accelerated existing digital trends, the digital divide has not diminished. At the level of workers, telework was skewed towards white-collar employment. At the level of companies, even though businesses now provide more digitised products and services or buy more cloud computing services, significant differences persist between large enterprises and SMEs. The report (p. 7) summarises that also among those countries that are EU frontrunners, the adoption of key digital technologies by businesses remains low. Inadequate levels of digital skills complicate the prospects of future growth.

The present study discusses these challenges and proposes an experimental model developed in a project that aimed to increase the digital skills of SMEs in the South Savo region, Finland. Our research question is: How can SMEs be best supported to develop and grow their digital skills and business models?

The paper proceeds as follows: first, we review previous literature on digital competences, how digital competences have been defined, and how their role in SMEs has been described. We discuss the project implemented with SMEs in South Savo, Finland. Next, we discuss the training model developed in the project, the experiences gained and project team roles and process. Finally, we present concluding remarks.

2. Background

Competence is a widely used and broad concept; as such, the meaning and usage varies (Vieru et al., 2015). The European Union (2019) defines competence as knowledge combined with skills and attitudes. Knowledge means established concepts, facts and figures, ideas, and theories. Skills denote the ability to use knowledge to achieve results. Attitudes refer to mindsets to act or react to ideas, persons, or situations. Furthermore, digital competence is mentioned as one of the eight key competences.

Currently, there is yet to be a widely accepted definition of the concept of digital competence (Hubschmid-Vierheilig et al., 2019). Recently, one of the most widely used categorization of digital competences is the European Digital Competence (DigComp) Framework for Citizens, developed in 2013 by the EC. DigComp 2.2 defines digital competence as *“the confident, critical, and responsible use of, and engagement with, digital technologies for learning, at work, and participation in society”*. Digital competence areas have been defined in the DigComp framework as 1) Information and data literacy: searching, evaluating, and managing data, information, and content; 2) Communication and collaboration: interacting, sharing, engaging, and collaborating through digital technologies, netiquette, digital identity; 3) Digital content creation: developing and elaborating digital content, IPR, programming, 4) Safety: protecting of devices, identity, health, environment; and 5) Problem-solving: solving technical problems, creativity, identifying needs, resources and competence gaps. Since 2015, the EC has followed the development of EU citizens' digital skills using the Digital Skills Index (DSI) based on DigiComp indicators. (Vuorikari et al., 2022.)

In the literature, there are a diverse range of categorisations used to understand digital competences in SMEs. For example, Vieru et al. (2015) propose a typology of three digital competence archetypes of SME employees, namely a technical expert, organizer, and campaigner, to provide complementarity aspects to implement recent technologies in SMEs successfully. They (p. 4683) suggest the following conceptualization of digital competence: *“Digital competence is an individual capacity to use and combine one’s knowledge (i.e., know-what), skill (i.e., know-how), and attitude (i.e., know-why) associated with three related competence areas, technological, cognitive and social,..., in order to investigate and solve work-related problems and develop a collaborative knowledge base while engaging in organizational practices within a specific organizational context.”* The main idea is that digital competences, besides technical competences, must include contextual and social aspects, skills, and attitudes. SMEs' employees have diverse roles with broad responsibilities, meaning that every employee should become an active change agent of digitalisation. (Vieru et al., 2015.)

Employees working in SMEs need a set of competences enabling them to work and prosper in the ever-changing digital environment. It is also true that digital competences are transversal, enabling the acquisition of other competences. At the SME level, if they wish to succeed in the digital business environment, they need to have digitally competent employees. (Hubschmid-Vierheilig et al., 2019.) For SMEs, the question is, which set of employee competences is the most important and relevant for the company's commercial success, which is the best combination of employees and competences that the SME should have inhouse and which competences can be outsourced. It is crucial for the company to reflect on how digital competences relate to competitiveness and performance because digital competences play a vital role in most SMEs' future success (Vieru et al., 2015; Hubschmid-Vierheilig et al., 2019).

Digital competences – like any other competences – are built step by step, so the ability to adopt recent technologies builds upon existing competences. Further, one must consider each organisation's business context and model, creating specific requirements for competences. (Vieru et al., 2015; Hubschmid-Vierheilig et al., 2019). An important concept to mention in this context is the absorptive capacity, in other words, the ability of a company to recognize the value of the latest information and to apply it for commercial purposes (Thorpe et al., 2006; Cohen and Levinthal, 1990). A lack of training and the ability to obtain competences are significant obstacles to the digitalisation of SMEs. SMEs that have employees with better digital competences are more likely to adopt digital innovations due to their increased understanding of the advances these innovations bring. (Vieru et al., 2015.) In other words, these SMEs have a better absorptive capacity.

Furthermore, we can refer to the theory of technology domestication, which describes how new technologies are 'tamed' by the users to better fit into their lives and contexts (Silverstone et al., 1992; Deidre, 2007; Rajahonka and Villman, 2019), and conclude that the domestication processes in SMEs are rather complex, because learning has to be enfolded in the otherwise busy days and this leads to recurrent interruptions in learning processes (Harwood, 2011; Rajahonka and Villman, 2019).

In recent decades, there have been attempts in the literature to develop maturity or stage models describing the process of SME digitalisation. However, some of them have been criticized for being too technocentric, incapable of taking into account the variety of SMEs and the expected business value of adopting technologies, or these models have even been claimed to be an oxymoron as there are no typical paths for SMEs' digitalisation at all. (Alonso-Mendo et al., 2009; Depaoli et al., 2020.) It has been emphasised that for SMEs, instead of the search for technologies to adopt, a far more critical question is to define the requirements to build a more effective and efficient relationship with customers and suppliers (Depaoli et al., 2020).

3. The Digital Steps 2.0 project

'Digital Steps 2.0 – Paths for business growth' (2021-2023) project provides the tools necessary for SMEs to develop their digital skills. The project aims to improve SMEs' digital skills in the South Savo region, Finland, and to help participating SMEs achieve business growth. The project provides participating SMEs with clear learning paths at both basic and advanced levels. Further, it executes focused development programs built around the needs of SMEs. The project tasks are organized as separate steps, with the first step welcoming companies to the project and analysing their current situation, and the following providing digital training paths and coaching. The higher steps provide more advanced content, in the form of, for example, digital marketing and eCommerce development programs.

The project reaches hundreds of SMEs in the region. There are over 180 SMEs participating in the project. A company and its employees typically participate in several training sessions. Around 150 training sessions will be organized, reaching hundreds of individual participants. In addition, the project offers an online learning environment with a broad range of content. In the project, SMEs gain new competences to operate in a digital business environment and renew their business.

4. The training model

The practical work with each SME participating in the Digital Steps 2.0 project starts with digital competence mapping in a meeting between a business advisor and a representative of the SME – typically the managing director. In this meeting, a company-specific initial survey is conducted for the SME, the company's business model is discussed, and the training needs are defined. Based on the competence mapping, the SME receives a company-specific development program, an action plan, and a syllabus. In other words, the training model is based, firstly, on defining for each SME and its business the relevant areas of digital competences along with the level of current competences in these areas, revealing the skills gaps related to the appropriate areas and, secondly, on tailoring a syllabus for each SME to overcome these gaps.

The areas of digital competences discussed are presented in Table 1. Each competence area is evaluated against the business model, business context, and the SME's needs.

Table 1: Competence areas evaluated in the interviews.

Competence area	Possible competence gaps
1. Basic competences, making work efficient with digitalisation	Using office software, video conferencing tools, project management, effective use of smartphones, teamwork, and internal communication
2. Digital information management and information security	GDPR, Data Protection Statement, digital information management, cloud services, information security (passwords, virus protection)
3. Producing online content	Online writing, graphic content production, photography/mobile photography, image editing, video shooting, video editing, streaming
4. Online visibility	Search engine optimization level I and II, Google My Business, WordPress level I and II
5. Digital advertising	Sales ad, Google Ads level I and II, Google Shopping, Facebook Business Manager level I and II, e-mail marketing, influencer marketing
6. Social media	Social media basics, Facebook for business use, Instagram for business use, YouTube for business use, LinkedIn for business use
7. Online shopping and digital sales	Electronic appointment booking, chat, customer journey, online store conversion optimization, online shopping platforms, online course platforms, Amazon, Etsy, etc.
8. Internal production management of the company	Enterprise resource planning, customer relationship management, financial management

Competence area	Possible competence gaps
9. Data collection, analysis and utilization	Farm data collection, Google Analytics, customer data, customer feedback
10. Other training needs	(Specified in more detail)

Source: Digital Steps 2.0 project.

From the perspective of the project's personnel, competence mapping functions as a training needs survey and produces information, with the help of which it is possible to plan the training best suited to the participating SMEs' needs. After the competence mapping, the personnel participating in the training are invited to conduct a self-assessment of their digital skills. The self-assessment questionnaire, containing the same competence areas as the competence mapping interview, is sent to be answered several times during the project, allowing the respondents to monitor the development of their competences. Through self-assessments, the project's personnel receive information about the development of the participants' competences, i.e., the project's results and impact.

The training is organized in small groups, emphasizing practical digital skills and hands-on support for the participants. SMEs have opportunities for peer learning and sharing of their experiences. Moreover, an online learning environment, guides, other publications, and video materials are available to support the learning and application of the new skills in practice. In addition, company-specific coaching is provided, as well as more advanced content, such as digital marketing and online store development programs.

The SMEs can receive the necessary support to meet the challenges from the COVID-19 pandemic, while the effects of the crisis may be channelled into strengths in learning new competences and skills.

The training model of the project is described in Figure 1 below.

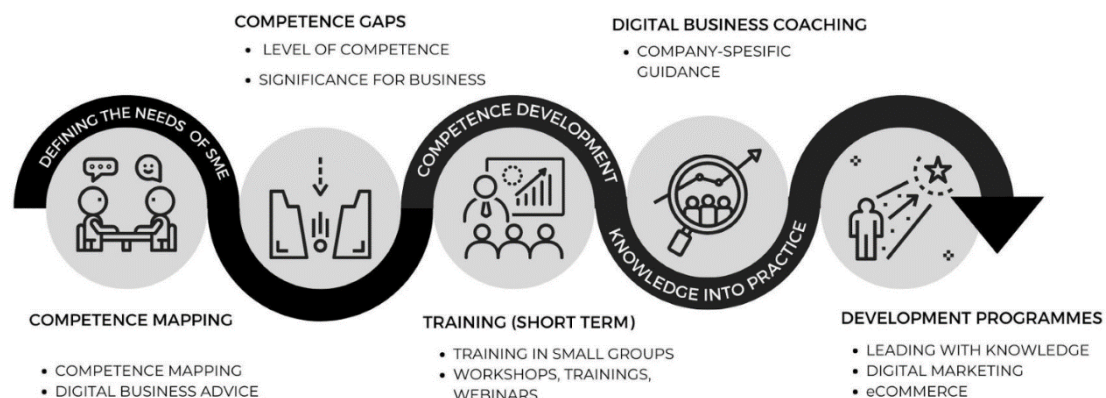


Figure 1. The training model in Digital Steps 2.0 project. Source: www.digiportaati.fi (2023).

5. Project team roles and the process

The project team is a combination of different professionals from four different public organizations: business advisory companies of two municipalities, a higher educational institute (HEI) and a regional rural advisory organization. Each project participant has their own role. The HEI is leading the project and has the main responsibility of the success of the project. This does not reduce the importance of participating project members; they are responsible for the customer interface, the SMEs.

In the beginning of the project, the HEI's project manager's role is to tender out the best possible digital business trainers. In addition to costs, the quality of the course contents and the trainer's experience and references are considered. The HEI's role is to maintain the training calendar and project website. When a company enters the project, by filling in an application online or by meeting project personnel, they are invited to a competence mapping session which is held by a business advisor. In this meeting, a company-specific initial survey is conducted for the SME, the company's business model is discussed, and the training needs are defined. The business advisor is SME's primary contact person during the whole project.

Training needs and self-assessment of digital skills are collected with Hyviö tool which was developed in the HEI in a previous project. It is a tool that helps businesses and institutions improve their service effectiveness by

tracking real-time data (Hyviö 2023). The company coordinator follows the competence mapping data collected into the tool and reports the SME's needs for training. The project group compiles the training calendar based on SME's needs. After the training calendar is published, e.g., for six months period, the SMEs are informed about the training possibilities, and they can enrol to the short courses.

The training coordinator is responsible for the organisation of the courses. There have been two to three training coordinators in the project in different areas of the South Savo region. Concerning the courses, the coordinators are the primary contact to the trainer and the participant SMEs. Most of the courses are online-based and about 10% are held at the HEI campus. The training coordinator participates the courses together with SME representatives and that way can assess the quality of the teaching methods and the content. The training coordinator can also observe new needs and ideas for trainings. After the training the coordinator delivers the course materials and collects feedback. The course feedback is discussed and further processed in the weekly meetings.

To serve a large number of companies, the application process to enter the project is continuous. The idea was to invite companies to join the project activities not only in the beginning, but also during the project. That way the business advisors could divide their workload for a longer period and the course offering can be divided evenly throughout the project. The selection of short courses is modified continuously according to the SME's needs. Therefore, the project team must be up to date concerning the new competence needs and tailor the selection of trainings continuously.

The idea behind the project is to act like we teach. Therefore, the course calendar on the website is visible online for anyone interested. In addition, the webpages of the project have been built to serve all interested such as companies, organisations, students, and business developers who are interested in digital business development of small companies. Moreover, the project uses the same tools and methods as SMEs e.g., in social media campaigns and content, newsletters and e-mail advertising. The Google environment is advanced in the project administration and sharing course and support materials and to collect feedback. All the processes are built as clear as possible and all the materials, application forms, website, and course materials are available for the whole project team. In a case of absence, anyone in the project team can overtake colleagues' duties.

6. Discussion and conclusion

This paper discussed the concepts and training models of SMEs' digital competences based on the current literature and the experiences gained in the Digital Steps 2.0 project in South Savo, Finland. The research question of the paper was: How can SMEs be best supported to develop and grow their digital skills and business models?

Based on the earlier literature (Alonso-Mendo et al., 2009, Depaoli et al., 2020), there have been attempts to develop models describing the process of SME digitalisation. Nonetheless, some of the models have been criticized for a lack of focus in the variety of SMEs and the expected business value of adopting technologies. The training model of the Digital Steps 2.0 project has been built up to offer a variety of SMEs with different kinds of business needs and level of digital competences the necessary support and training to enable business growth and competitiveness. The main contribution of the study is the development of an efficient training model and testing it with SMEs. The training model of project has proven to be effective and popular among the SMEs in the region. The project has reached over 180 SMEs in the region. These have been mostly sole entrepreneurs and microenterprises, employing less than 10 people. A company and its employees typically participate in several training sessions. The implementation of the model has enabled mapping and focusing on the skills gaps of participating SMEs, among other things, by providing training. As a result, the participating SMEs have gained new competences to operate in a digital business environment and renew their business.

Based on the model and results of the project, there are no general solutions. Still, the most important digital competences for each SME in developing and growing its business must be defined exclusively based on each SME's specific business needs, grounded in its business model and context, and skills gaps related to these competences. By doing so, no busy entrepreneur or employee of an SME is obliged to study things that are not relevant to the success of their business. According to the experiences of the project, SMEs can be more agile in adapting new digital business models, tools, and social media than their larger peers. However, it can also be claimed that each SME adapts or 'tames' the digital technology so that it is a better fit for its purposes and best captures the value of the technology.

Concerning the training offered in the project, development targets have also been obtained and tackled with the help of systematic feedback. Based on the entrepreneurs' feedback, some found it challenging to adapt the information gained from the training, and they need more hands-on support. Some entrepreneurs also had technical difficulties that they needed help to overcome. To answer this call, business advisors and HEI's experts coached these entrepreneurs and offered this service to all participating SMEs. Because each SME has a different level of digital business competences, providing short courses and longer study paths at different levels is important. Also, communicating the course contents and guiding the entrepreneurs to the right level is vital for success.

Often cooperation in a such complex project team can be challenging. The management and organisation model of this project has been successful for many reasons. Recruitment of project team members has been one of the key factors: the project team is motivated to help SMEs in their digital business and is committed to project aims. They also have excellent understanding of digital business. Team members have versatile and complementary expertise, clear roles and tasks, and all the work and discussions are visible on the project digital platform. Joint tools and a shared digital platform make work efficient and enable serving of numerous companies without lowering the quality. During the project work the working methods and processes have been continuously monitored and developed and become more efficient.

This study corroborates the observations presented in the previous research that digital competences are built step by step, and SMEs whose employees have increased digital competences and understanding will be better able to adopt digital innovations, as absorptive capacity of these SMEs increase, and their employees become active change agents. Further, based on the observations of the study it is crucial to consider each SME's business model and context, and how it can build a better relationship with customers with the help of digitalisation. Nevertheless, more research will be needed to better understand the links between business success and increased digital competences in SMEs.

Acknowledgments

'Digital Steps 2.0 - Paths for business growth' is funded by the South Savo Centre for Economic Development, Transport, and the Environment, and the European Social Fund, React EU Funds. The project partners are South-Eastern Finland University of Applied Sciences (Xamk), Mikkeli Development Miksei Ltd, Savonlinna Development Services Ltd, and ProAgria Southern Savonia.

References

- Alonso-Mendo, F., Fitzgerald, G., & Frias-Martinez, E. (2009) "Understanding web site redesigns in small- and medium-sized enterprises (SMEs): a U.K.-based study on the applicability of e-commerce Stage Models", *European Journal of Information Systems*, Vol. 18, No. 3, pp 264-279.
- Cohen, W., & Levinthal, D. (1990) "Absorptive capacity: a new perspective on learning and innovation", *Administrative Science Quarterly*, No. 35, pp 128-152.
- Deidre, H. (2007) "Applying Domestication: How the Internet Found Its Place in the Home. Managing Worldwide Operations & Communications with Information Technology", IN: *Proceedings of the 2007 Information Resources Management Association (IRMA) International Conference. May 19-23, Vancouver, Canada*, pp 799-801.
- Depaoli, P., Za, S., & Scornavacca, E. (2020) "A model for digital development of SMEs: an interaction-based approach." *Journal of Small Business and Enterprise Development*, Vol. 27, No. 7, pp 1049-1068. doi.org/10.1108/JSBED-06-2020-0219.
- European Commission (2022) *Digital Economy and Society Index. Thematic chapters*. <https://digital-strategy.ec.europa.eu/en/policies/desi>.
- European Union (2019) *Key competences for lifelong learning*. ISBN 978-92-76-00476-9.
- Eurostat (2020) *Small and medium-sized enterprises: an overview*. <https://ec.europa.eu/eurostat/web/products-eurostat-news/-/ddn-20200514-1>.
- Harwood, S. A. (2011) "The Domestication of Online Technologies by Smaller Businesses and the 'Busy Day'". *Information and Organization*, Vol. 21, No. 2, pp 84-106.
- Hubschmid-Vierheilg, E., Rohrer, M., & Mitsakis, F. (2019) *Digital competence and SMEs: Review of the relevant literature*. In: *20th International Conference on Human Resource Development Research and Practice across Europe (UFHRD)*, Nottingham Business School, Nottingham Trent University, Nottingham. <https://irep.ntu.ac.uk/id/eprint/37009>.
- Hyviö. What is Hyviö? <https://hyvio.fi/what-is-hyvio-effectiveness/>.
- Rajahonka, M. and Villman, K. (2019) "Women Managers and Entrepreneurs and Digitalisation: On the Verge of a New Era or a Nervous Breakdown?", *Technology Innovation Management Review*, Vol. 9, No. 6, pp 14-24.

- Silverstone, R., Hirsch, E. and Morley, D. (1992) "Information and Communication Technologies and the Moral Economy of the Household", IN: R. Silverstone and E. Hirsch (Eds.), *Consuming Technologies: Media and Information in Domestic Spaces*, Routledge, London and New York.
- Thorpe, R., Holt, R., Macpherson, A., & Pittaway, L. (2006) "Using knowledge within small and medium-sized firms: A systematic review of the evidence", *International Journal of Management Reviews*, Vol. 7 No. 4, pp 257–281.
- Vieru, D., Bourdeau, S., Bernier, A., & Yapo, S. (2015) "Digital Competence: A Multi-dimensional Conceptualization and a Typology in an SME Context", *48th Hawaii International Conference on System Sciences*, pp 4681-4690. doi:10.1109/HICSS.2015.557.
- 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, ISBN 978-92-76-48882-8, doi:10.2760/115376, JRC128415.

Perception of Social Entrepreneurship Competence in University Business Students

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Abstract: The ability to transform social and environmental problems into strategic actions to face the challenges of a changing environment in a creative and innovative way drives the need to train social entrepreneurs who anticipate new scenarios. Society needs social entrepreneurs who create business opportunities by bringing resources to impoverished places and using technology to generate social inclusion for people with disabilities; These ventures apply innovation to improve people's standard of living. The objective of this research was to determine the level of perception of the social entrepreneurship competence in business students of a private university in Lima, capital of Peru. The methodology used was quantitative, with a transactional approach, the sample was random considering 185 business students, the data collected was analyzed using the statistical program SPSS. The results show that 94.1% have a high level of perception of competence in social entrepreneurship; in social and personal traits they present 91.4% and 96.2% respectively; however, a lower level in innovative traits with 76.2%. The investigation concluded in the determination of a high level of competence in social entrepreneurship, however, the innovative traits must be reinforced and for this the innovation component can be included in the courses, to generate viable products and services that contribute to the creation of sustainable organizations improving their value proposition, competitiveness and economic growth. Likewise, it is advisable to reinforce personal and social traits in the training of professionals to face an environment of high uncertainty. This work will contribute to other scientific research to compare the level of competence in social entrepreneurship in other national and international contexts.

Keywords: Competition, Entrepreneurship, Innovation, Personal, Social.

1. Introduction

Social entrepreneurship is a transversal competence that refers to the ability to identify and solve social problems in an innovative, sustainable and ethical way (García-González et al., 2020). This competence has become an objective of higher education, both in Europe and in Latin America and Peru, since it contributes to human development and social well-being (Sáenz and López, 2015). However, there are various challenges to teach and evaluate social entrepreneurship, such as the lack of a common frame of reference, the diversity of contexts and actors involved, and the scarcity of resources and institutional support (García-González et al., 2020; Cordova-Buiza et al., 2022a).

According to the study carried out by Sáenz and López (2015), university training programs in social entrepreneurship in Latin America focus on developing five dimensions of competence: knowledge, skills, attitudes, values, and emotions. These dimensions are related to aspects such as critical thinking, creativity, communication, collaboration, leadership, social responsibility and self-efficacy. However, the authors point out that it is necessary to improve the articulation between theory and practice, as well as the promotion of social commitment in students, the identity mark of the future social entrepreneur. In the case of Peru, social entrepreneurship has gained relevance in recent years, due to the need to face the social and environmental problems that affect the country. According to the 2019/2020 Global Entrepreneurship Monitor (GEM) report, Peru ranks 11th out of 54 countries in terms of the rate of social entrepreneurship activity (TEA-S), with 3.8% of the adult population involved in these kinds of initiatives. In addition, 63.6% of Peruvian social entrepreneurs are between 18 and 34 years old, which reflects the potential of young people to generate positive changes in their environment (GEM Peru, 2020). However, there are also some challenges for the development of social entrepreneurship in Peru, such as the lack of financing, training, advice and support networks (GEM Peru, 2020).

In this sense, higher education has a key role in promoting social entrepreneurship as a competence for business and social sustainability. I consider that social entrepreneurship is a fundamental competence for the 21st century, since it implies a comprehensive and transformative vision of reality (Saldarriaga Salazar & Guzmán González, 2018). Universities must take on the challenge of training their students not only as competent professionals, but also as citizens committed to the common good. For this, it is necessary to design and implement training programs in social entrepreneurship that respond to the needs and demands of each context, that integrate theoretical and practical knowledge, and that stimulate the personal and social development of students (Nsereko et al., 2018).

Entrepreneurship is a dynamic concept that adapts and innovates based on the needs and opportunities of the market, as well as the recipients to whom the product or service is directed (Villa et al., 2021). Likewise, it is an activity that is conceived as an opportunity that contributes to the socioeconomic development of the countries, where the social entrepreneur becomes a transforming agent of the communities with ideas that help to solve their needs (Paz-Marcano et al., 2019).

Entrepreneurship not only refers to the creation of new companies and/or businesses, today it is also understood as a competence that encompasses a set of abilities and skills such as creativity, leadership, teamwork, innovation, decision making; all of them demanded in the personal, social and professional field (Paños, 2017).

Social entrepreneurship has become a key intellectual structure within entrepreneurship (Ferreira et al., 2019; Cordova-Buiza et al., 2022b). Also, social entrepreneurship as a concept is interpreted as a combination of social and business factors (Capella-Peris et al., 2020; Barro-Chale et al., 2023). Likewise, it is considered as an activity that explores opportunities to create, sustain, distribute and disseminate social and/or environmental value through social innovation (Alegre et al., 2017). In the same way, it can be defined as the act of recognizing and pursuing opportunities to solve social problems through the creativity of the typical entrepreneurial process of society (Corner and Ho, 2010).

An entrepreneurial society stands out because in it entrepreneurship and knowledge are considered driving forces for economic growth, job creation and market competitiveness (Machuca-Vílchez et al., 2023). In this context, within the strengths are the values that are practiced in organizations such as: solidarity, ethics, service, responsibility, mutual aid, the experiences that have been generated in each of the organizations, the capacity they have had to solve problems despite adversities (Corzo-Gutiérrez et al., 2020).

Studies have shown that social entrepreneurship activities have a far-reaching socioeconomic impact, especially in solving societal challenges (Nsereko et al., 2018). The entrepreneur must aspire to create private benefit, but also to generate social value. The model shows how the use of innovative practices manages to break with the existing paradigms so far (Alonso-Martínez et al., 2018; Olavarria-Benavides et al., 2021).

Entrepreneurship also requires certain personal, interpersonal and technical skills, as well as training that at least offers a greater probability of success and maintenance over time (Villa et al., 2021). On the other hand, factors such as endogenous barriers, the exogenous environment, the university environment, and support for entrepreneurial intention among management students are key to implementation. In addition, the topic of Social Entrepreneurship is of great importance due to the various problems that society faces, which require the development of effective projects with a social conscience that is oriented to contribute to community well-being (Trivedi, 2017).

1.1 Objectives

The objective of this study was to determine the level of perception of the social entrepreneurship competence in business students of a private university, in Lima, the capital of Peru, with this investigation the main personality traits, social skills and innovation that characterizes, and will serve to develop support strategies for the development of future social enterprises that contribute to economic, social and environmental development, likewise the results presented will serve for future research that seeks to create business models that generate value and social impact.

2. Literature Review

Social entrepreneurship is not a specific phenomenon, but rather suggests a global restructuring of work (of individuals lacking institutional support), based on the logic of entrepreneurship and the growing outsourcing of

State functions (Valenzuela-García et al., 2019). Likewise, the commitment to incorporate entrepreneurship, as part of its activities, not only academically with the training of people, but also from the creation of an entrepreneurial spirit with extension activity, which contributes to the well-being and quality of life in the communities, with the ability to determine the presence of entrepreneurial characteristics (Cantillo et al., 2021).

Current education requires training in skills to adapt to change, make decisions, solve problems, manage failure, develop creative thinking and entrepreneurship (Hamizan Roslan et al., 2019). In this sense, social entrepreneurship in students is achieved through the development of competencies that must be worked on within and by universities (Vázquez-burgete et al., 2012).

The development of the social entrepreneurship competence demonstrates the commitment that educational institutions have with leadership-with-a-cause or leadership-with-value, training their students to become true agents of change (Vázquez-Parra et al., 2020). Naturally, more training is needed in entrepreneurship in general and social entrepreneurship in particular, in the necessary skills to, in addition to achieving a sustainable and effective project, do so by solving or helping to solve a social problem to which the particular venture is directed (Villa et al., 2021).

The empowerment of social entrepreneurship in social work is a student demand and, therefore, a competence to work within future study plans (Recover and Gómez, 2019). In this sense, a greater commitment of educational institutions is required to promote this competence. For Díez et al. (2023) Social entrepreneurship is the set of strategic actions that a group carries out to improve its socioeconomic situation, where it seeks to provide social goods and services, thus avoiding dependence on its benefactors and thus achieving financial sustainability; social entrepreneurship and innovation are the main drivers of sustainable competitiveness.

The education of the future human capital within higher education highlights the need to train agents of change, with a series of skills that allow them to identify problems, propose and execute sustainable solutions and under ethical principles. In this context, social entrepreneurship stands out as a strategic competence that educational institutions are beginning to incorporate into their curriculum (García-González et al., 2020). In this context, it stands out that the measurement of entrepreneurship focuses on students, the social focus and the specific characteristics that favor entrepreneurship. Few studies consider the measurement of entrepreneurship from the perspective of the teacher (Rojas et al., 2019).

Entrepreneurship is a powerful tool to address the employment difficulties faced by youth in multiple societies globally, as well as being a source of creativity and innovation that contributes significantly to the development of societies (Sanchez et al., 2017). Furthermore, the mission of social entrepreneurship is the creation of social value for society as a whole (Murphy and Coombes, 2009). Therefore, it is necessary to support and empower family members to develop defined and functional roles through the development of skills that promote social entrepreneurship (Delfín-Ruiz et al., 2020).

Similarly, a social entrepreneur may be a businessperson capable of establishing solutions to an organization's problems, strengthening business opportunities (Roy et al., 2017). In this context, impact investors pursue both financial and social objectives and have become an important source of finance for social enterprises (Block et al., 2021). Well, social entrepreneurs like salespeople possess three proven components of entrepreneurial passion. On the other hand, another study did not demonstrate a statistically significant difference between these two groups of respondents (Balgishvili, 2017).

The business or social profile of entrepreneurs affects the challenges they face at various stages of the organization's life cycle and the strategies that help them further their unique mission (Yaari et al., 2020). Social entrepreneurship has a highly differentiated profile and is articulated with the objectives of sustainable development, which causes the majority of students to become involved in social activities through Social Responsibility policies. This is how it is evident that it is not about fighting poverty, but about working on productivity as a solution (Melian et al., 2011). Obviously, social entrepreneurs are often at the forefront of solving complex social problems in society by linking the entrepreneurial mindset with approaches to solving these systemic problems in society. Regarding the field of social entrepreneurship and the existing forms, it is a necessity to understand the various roles that social entrepreneurs must embody on a daily basis (Davis et al., 2021). Also, it is considered a main sphere of social activity that allows to solve important social problems, decrease the burden of the state regarding the solution of pressing social problems (Ignatjeva and Pletnev, 2021). In this context, investors make their financing decisions and provide a nuanced view in this new market oriented to social enterprises.

In relation to innovation, it is considered as: the need to generate results in an environment of such high uncertainty and has put extraordinary pressure on the people responsible for decision making, the confinements and the decrease in the number of operational activities have freed them time and allowed to reflect at a strategic level and, in particular, to analyze how innovation, in its different expressions, can contribute to the sustainable future of their organizations (García-Madurga et al., 2021) innovation is a fundamental piece in the development of issues economic, fulfilling a significant role in social issues such as education and environmental issues (García et al., 2020) and it seeks to anticipate the constant changes in the market, identifying potential customers to meet the needs (Son et al., 2017) .

Similarly, individual traits play an important role in entrepreneurship. In this regard, the author points out that: entrepreneurial education involves understanding the important challenges it poses, one of which is a conceptual change in the notion of entrepreneurship, assuming the comprehensive perspective of a set of valid competencies for all aspects of life, both personal, citizen or labor (Rojas et al., 2019b). Likewise, in the results they recognize that the relationship between entrepreneurial personality traits and entrepreneurial intention is fully mediated by perceived self-efficacy (Roy et al., 2017).

Research reveals six groups of underlying business theories: (1) knowledge spillover theory of entrepreneurship, (2) creation and network theory, (3) decision-making theory, (4) the specialization of (5) the theory of social entrepreneurship and (6) entrepreneurship in the informal sector (Ferreira et al., 2019).

On the other hand, looking at the aspect of entrepreneurship, the interest of micro-investors towards projects that create jobs or help preserve existing ones has been reinforced; on the other hand, as an element that helps to trace the associations between investors and entrepreneurs, a variable that we call mediation was identified; Based on the above, a list of criteria was defined that could help design a collective financing platform with a decentralized and supportive network approach (Segura Mojica, 2021). To clarify the changes that this new phenomenon brings, it is important to know what is the level of perception of social entrepreneurship competence in university students? Therefore, this research seeks to determine the level of perception of social entrepreneurship competence in business students from a private university in Peru.

3. Methodology

The present investigation was worked under the quantitative approach that is circumscribed within the positivist paradigm. The type of research is basic and descriptive design. The purpose of this descriptive study is to specify properties and characteristics of concepts, phenomena, variables or facts in a given context. In this case of the investigation, we worked on the level of perception of the social entrepreneurship competence in business students. The sample consisted of 185 students from the Business School of a private university in Lima. Of which 117 were women and 68 men. Sampling was random probabilistic. These samples are essential in cross-sectional, descriptive research designs, where it is intended to make estimates of variables in the population. These variables are measured and analyzed with statistical tests in a sample, where it is assumed that this is probabilistic and all the elements of the population have the same probability of being chosen (Hernandez et al., 2014).

The instrument used is called the Scale to Assess Social Entrepreneurship Competency in Higher Education and was applied in March and April 2021. This instrument measures personal traits, social characteristics and innovative characteristics, contains 30 items on a Likert scale, the score was: strongly disagree (1), disagree (2), midpoint (3), agree (4), strongly agree (5) (Capella-Peris et al., 2020). The reliability of 0.820 in Cronbach's Alpha, this score demonstrates a strong level of reliability of the instrument. These collected data were analyzed using the statistical program SPSS.

4. Results and Discussion

Of the results obtained by the respondents, 63% were female students and 37% male students who expressed the perception of competition as evidenced in Table 1, of 185 students representing 100%, 1.6% have a low level of the perception of competition, at a medium level 4.3%, and 94.1% represents a high level, which shows that there is a good scenario to promote social entrepreneurship in various academic activities with the purpose of contribute to business sustainability.

Table 1. Competition in Social Entrepreneurship

		Frequency	Percent	Percent Valid	Percent Accumulated
Valid	Low	3	1,6	1,6	1,6
	Half	8	4,3	4,3	5,9
	High	174	94,1	94,1	100,0
	Total	185	100,0	100,0	

Regarding Table 2, the personal trait dimension shows that 2.2% of the respondents are at the low level, followed by 6.5% who are at a medium level, and more than 90% are at a high level, which represents a positive disposition of the students to develop the competence of social entrepreneurship.

Table 2. Personal Trait

		Frequency	Percent	Percent Valid	Percent Accumulated
Valid	Low	4	2,2	2,2	2,2
	Half	12	6,5	6,5	8,6
	High	169	91,4	91,4	100,0
	Total	185	100,0	100,0	

On the other hand, in Table 3, the perception of the social trait of the social entrepreneurship competence, of 100% of respondents, it is evident that 1.6% are at the low level, 2.2% at a medium level, and 178 students representing 96.2% are at a high level.; therefore, students gather capacities to interrelate and may be able to create collaborative networks, promote teamwork and face problems together.

Table 3. Social Trait

		Frequency	Percent	Percent Valid	Percent Accumulated
Valid	Low	3	1,6	1,6	1,6
	Half	4	2,2	2,2	3,8
	High	178	96,2	96,2	100,0
	Total	185	100,0	100,0	

Finally, the dimension of the innovative trait is presented, where it is evident that 2.2% of the respondents are at the low level, while 21.6% are at a medium level, and 76% of the respondents are at a medium level. high level. In other words, students have capacities for the creation and transformation of new processes, products and/or services and based on the new organizational context, strategies must be promoted to increase innovation, given that it is a key factor for business management, making them more competitive and sustainable.

Table 4. Innovative Trait

		Frequency	Percent	Percent Valid	Percent Accumulated
Valid	Low	4	2,2	2,2	2,2
	Half	40	21,6	21,6	23,8
	High	141	76,2	76,2	100,0
	Total	185	100,0	100,0	

5. Discussion

The results obtained show a high level of perception of competence in social entrepreneurship in business students, similar to the research by Sainz-Barajas et al. (2020) which concludes that undergraduate students assigned to the Faculty of Administrative Sciences have solid attitudes of social entrepreneurship. On the other hand, in the study by Vera-Sagredo et al. (2019) indicates that teachers recognize the priority of developing skills in entrepreneurship and innovation in the training process. In the same position, Anica et al. (2020) show that the field of social entrepreneurship is known by about 56% of the respondents, and they have identified knowing the social problems that can be solved by initiatives and are willing to get involved in social activities. Likewise, the results coincide with those of Monzón and Torres-Ortega (2021) whose empirical results show that there is great interest on the part of students in business initiatives for social purposes, this is evident since most of the companies created for the Ikaenpresa entrepreneurship contest were of a social nature.

On the other hand, 82% of the students consider that the degree has allowed them to identify social entrepreneurship opportunities and 74% affirmed that the university has motivated them to think about starting a social entrepreneurship, on the other hand, 54% consider that the university does not have enough resources to develop new innovative projects and 48% of the students consider it necessary to create incentives to train new entrepreneurs (Gómez, 2021), results that coincide with the study that shows a high level of competition in higher education students. Unlike the results of the following study, which determines that 119 (59.6%) of the students had a low level of entrepreneurial attitude and only 24 (12.1%) of the students had a high level of entrepreneurship (Rivera et al., 2018).

In the present study, personal traits predominate, showing a high level of perception with 91.4%; A similar result is shown in the following study of personal experience with social entrepreneurship, which presents a medium to high level and mentions that previous experience supports improving entrepreneurial performance (García-González et al., 2020), the characteristics being key. such as trust, good communication, proactivity, optimism and decision-making.

Likewise, the innovative feature of it is evident that the majority with 76.2% have a high level of perception in this dimension. Then, 21.6% are at a medium level and 2.2% at a low level. A similar result was demonstrated in the following study. In which, they indicate that personal initiative in terms of proactivity and innovation is positively and significantly associated with the creation of social enterprises (Nsereko et al., 2018). Likewise, it has been shown that social entrepreneurs with a higher degree of entrepreneurial orientation apply product innovation and accumulate and use social capital more actively (Son et al., 2017). Also, 26% prefer proposals that generate innovation and 17% focus on altruistic causes (Segura-Mojica, 2021).

6. Conclusions

In conclusion, social entrepreneurship skills need to be included in the training programs of universities to deal with social problems and create sustainable businesses. However, in most of these institutions it is not carried out.

Regarding dimensions such as personal, social and innovative traits, they are considered basic for the development of entrepreneurship competence; which will empower university students by improving their quality of life and their environment, generating innovative projects with a value proposition that guarantee sustainability, beings capable of overcoming adversities that respond to difficult situations with a new responsible approach to constant changes. environment in the social, economic and environmental fields.

Currently, education requires developing the social entrepreneurship competence for the formation of beings capable of adapting to social, economic and environmental changes, and this competence must be worked within university classrooms with specialized teachers trained in the subject.

References

- Alegre, I., Kislenko, S., & Berbegal-Mirabent, J. (2017). Organized Chaos: Mapping the Definitions of Social Entrepreneurship. *Journal of Social Entrepreneurship*, 8(2), 248–264. <https://doi.org/10.1080/19420676.2017.1371631>
- Alegre, I., Kislenko, S., & Berbegal-Mirabent, J. (2017). Organized Chaos: Mapping the Definitions of Social Entrepreneurship. *Journal of Social Entrepreneurship*, 8(2), 248–264. <https://doi.org/10.1080/19420676.2017.1371631>
- Alonso-Martínez, D., González-Álvarez, N., & Nieto, M. (2018). Social entrepreneurship vs social innovation. *Cuadernos Aragoneses de Economía*, 24(1–2), 119–140. https://doi.org/10.26754/ojs_cae/cae.20141-22640
- Anica, I. ., Popescu, L., & Popescu, V. (2020). Factors influencing social entrepreneurship intentions in Romania. *Economic Research-Ekonomska Istrazivanja*, 0(0), 1–12. <https://doi.org/10.1080/1331677X.2020.1820358>
- Barro-Chale, A., Rivera-Castañeda, P., Ramos-Cavero, M. J., & Cordova-Buiza, F. (2023). Agricultural associations and fair trade in the peruvian rainforest: A socioeconomic and ecological analysis. *Environmental Economics*, 14(1), 24–35. [https://doi.org/10.21511/ee.14\(1\).2023.03](https://doi.org/10.21511/ee.14(1).2023.03)
- Balgiashvili, T. (2017). Comparing entrepreneurial passion of social and commercial entrepreneurs in the Czech Republic. *Central European Business Review*, 6(4), 45–61. <https://doi.org/10.18267/J.CEBR.190>
- Block, J. H., Hirschmann, M., y Fisch, C. (2021). Which criteria matter when impact investors screen social enterprises? *Journal of Corporate Finance*, 66(February 2020), 101813. <https://doi.org/10.1016/j.jcorpfin.2020.101813>
- Cantillo, N., Pedraza, C., & Suarez, H. (2021). Training view of social entrepreneurship: Commitment of the University of La Guajira in Colombia. *Revista de Ciencias Sociales (Ve)*, XXVI(1), 216–229. <https://www.produccioncientificaluz.org/index.php/rccs/article/view/35308/37384>

- Capella-Peris, C., Gil-Gómez, J., Martí-Puig, M., & Ruíz-Bernardo, P. (2020). Development and Validation of a Scale to Assess Social Entrepreneurship Competency in Higher Education. *Journal of Social Entrepreneurship*, 11(1), 23–39. <https://doi.org/10.1080/19420676.2018.1545686>
- Cordova-Buiza, F., Tapara-Sinti, J., Gallardo-Tello, N. E., & Robles-Fabian, D. A. (2022a). Level of financial education among university students of business: A study in the peruvian scenario. *IBIMA Business Review*, 2022. <https://doi.org/10.5171/2022.275437>
- Cordova-Buiza, F., Tapara-Sinti, J., Gallardo-Tello, N. E., & Robles-Fabian, D. A. (2022). Level of financial education among university students of business: A study in the peruvian scenario. *IBIMA Business Review*, 2022. <https://doi.org/10.5171/2022.275437>
- Corner, P. D., & Ho, M. (2010). How opportunities develop in social entrepreneurship. *Entrepreneurship: Theory and Practice*, 34(4), 635–659. <https://doi.org/10.1111/j.1540-6520.2010.00382.x>
- Corzo-Gutiérrez, N., Sarmiento-blanco, U., & Fajardo, M. A. (2020). A look at the Solidarity Organizations active in the Province of Guantán Department of Santander Colombia. 1–29.
- Davis, P. E., Bendickson, J. S., Muldoon, J., & McDowell, W. C. (2021). Agency theory utility and social entrepreneurship: issues of identity and role conflict. *Review of Managerial Science*, 0123456789. <https://doi.org/10.1007/s11846-020-00423-y>
- Delfín-Ruiz, C., Cano-Guzmán, R., & Peña-Valencia, E. (2020). Family functionality as a strategy for the generation of social entrepreneurship in Mexico. *Revista Venezolana de Gerencia*, 89(89). <https://doi.org/10.37960/revista.v25i89.31387>
- Díez, D., Flórez, L., & Arboleda, C. (2023). Social innovation from social entrepreneurship: Panorama of the global and Colombian bibliography. *Revista de Ciencias Sociales [RCS]*, XXIX (2), 277–296. <https://doi.org/10.31876/rcs.v29i2.39976>
- Ferreira, J. J. M., Fernandes, C. I., & Kraus, S. (2019). Entrepreneurship research: mapping intellectual structures and research trends. *Review of Managerial Science*, 13(1), 181–205. <https://doi.org/10.1007/s11846-017-0242-3>
- García-González, A., Ramírez-Montoya, M. S., De León, G., & Aragón, S. (2020). Social entrepreneurship as a transversal competence: construction and validation of an assessment instrument in the university context. *REVESCO. Revista de Estudios Cooperativos*, 136(136), e71862. <https://doi.org/10.5209/reve.71862>
- García-Madurga, M.-Á., Grilló-Méndez, A. J., & Morte-Nadal, T. (2021). The adaptation of companies to the COVID reality: a systematic review. *Retos*, 11(21), 55–70. <https://doi.org/10.17163/ret.n21.2021.04>
- García, A., Roberto, Thoene, U., Figueroa, A. M., & Murillo Amaris, E. (2020). Social Entrepreneurship within the framework of the Pacific Alliance. *REVESCO. Revista de Estudios Cooperativos*, 133(133), 1–12. <https://doi.org/10.5209/reve.67341>
- GEM Perú. (2020). National report of the Global Entrepreneurship Monitor (GEM) Perú 2019/2020. <https://gemperu.pe/wp-content/uploads/2021/02/GEM-Peru-2019-2020.pdf>
- Gómez, E. (2021). Factors that promote interest in social entrepreneurship in special education students VIII semester of UDELAS Panama campus. *Revista Redes*, 1(13), 125–138. <https://revistas.um.es/analesps/article/view/analesps.32.1.186681>
- Hamizan Roslan, M., Hamid, S., Taha Ijab, M., & Bukhari, S. (2019). Social Entrepreneurship Learning Model in Higher Education using Social Network Analysis. *Journal of Physics: Conference Series*, 1339(1). <https://doi.org/10.1088/1742-6596/1339/1/012029>
- Hernández, R., Fernández, C., & Baptista, M. (2014). Definition of the scope of the research to be carried out: exploratory, descriptive, correlational or explanatory. *Investigation methodology*. <http://www.casadellibro.com/libro-metodologia-de-la-investigacion-5-ed-incluye-cd-rom/9786071502919/1960006>
- Ignatjeva, O., & Pletnev, A. (2021). Social entrepreneurship in Saint-Petersburg as green economy aspect. *E3S Web of Conferences*, 244, 1–13. <https://doi.org/10.1051/e3sconf/202124410041>
- Machuca-Vílchez, J. A., Ramos-Cavero, M. J., & Cordova-Buiza, F. (2023). Knowledge management in financial education in peruvian government programs focused on women: Progress and challenges. *Knowledge and Performance Management*, 7(1), 1-14. [https://doi.org/10.21511/kpm.07\(1\).2023.01](https://doi.org/10.21511/kpm.07(1).2023.01)
- Melian, A., Campos, V., & Sanchis, J. (2011). Study on the efficacy of the Portuguese cooperative taxation. *REVESCO Revista de Estudios Cooperativos*, 121, 7–32. <https://doi.org/10.5209/rev>
- Monzón, J., & Torres-Ortega, J. (2021). Social entrepreneurship in vocational training: the case of País Vasco. 137, 1–18.
- Murphy, P. J., & Coombes, S. M. (2009). A model of social entrepreneurial discovery. *Journal of Business Ethics*, 87(3), 325–336. <https://doi.org/10.1007/s10551-008-9921-y>
- Nsereko, I., Balunywa, W., Munene, J., Orobia, L., & Muhammed, N. (2018). Personal initiative: Its power in social entrepreneurial venture creation. *Cogent Business and Management*, 5(1). <https://doi.org/10.1080/23311975.2018.1443686>
- Olavarria-Benavides, H. L., Carassa, A. G. C., & Cordova-Buiza, F. (2021). Travel influencers as a factor in choosing a tourist destination post covid-19: Analysis of the national tourist. Paper presented at the Proceedings of the 2021 IEEE Sciences and Humanities International Research Conference, SHIRCON 2021, <https://doi.org/10.1109/SHIRCON53068.2021.9652385>
- Paños, J. (2017). Entrepreneurial education and active methodologies for its promotion. *Revista Electrónica Interuniversitaria de Formación Del Profesorado*, 20(3), 33. <https://doi.org/10.6018/reifop.20.3.272221>

- Paz-Marcano, A. I., Castro-Alfaro, A., & Palacios-Rozo, J. J. (2019). Competences of the Social Entrepreneur Ally of the Communities of the Venezuelan Oil Business Environment. *Saber, Ciencia y Libertad*, 14(2), 163–177. <https://doi.org/10.18041/2382-3240/saber.2019v14n2.5883>
- Recover, M. Á. M., & Gómez, P. M. (2019). Empowerment from social entrepreneurship: The case of Social Work students. *Revista Lasallista de Investigación*, 16(2), 67–76. <https://doi.org/10.22507/rli.v16n2a6>
- Rivera, O., Rivera, I., & Bonilla, C. (2018). Entrepreneurial attitude and social skills in students of a Peruvian Educational Institution. *Ucv-Scientia*, 10(2), 131–135. <https://doi.org/10.18050/revucv-scientia.v10n2a6>
- Rojas, G. Y., Pertuz, V., Navarro, A., & Quintero, L. T. (2019a). Instrument to Identify Personal Characteristics and Didactics Used by Teachers in the Training of Entrepreneurs. *Formación Universitaria*, 12(2), 29–40. <https://doi.org/10.4067/s0718-50062019000200029>
- Rojas, G. Y., Pertuz, V., Navarro, A., & Quintero, L. T. (2019b). Instrument to Identify Personal Characteristics and Didactics Used by Teachers in the Training of Entrepreneurs. *Formación Universitaria*, 12(2), 29–40. <https://doi.org/10.4067/s0718-50062019000200029>
- Roy, R., Akhtar, F., & Das, N. (2017). Entrepreneurial intention among science y technology students in India: extending the theory of planned behavior. *International Entrepreneurship and Management Journal*, 13(4), 1013–1041. <https://doi.org/10.1007/s11365-017-0434-y>
- Sáenz Bilbao, N., & López Vélez, A. L. (2015). Social entrepreneurship competencies: approach through university training programs in Latin America. *REVESCO Revista de Estudios Cooperativos* (119), 159–182. <https://www.redalyc.org/pdf/367/36741404007.pdf>
- Sainz-Barajas, M., Clara-Zafra, M., & Aguirre-Alemán, M. (2020). Times New Roman Title 14 in Social Entrepreneurship Traits of Students Times New Roman Title 14 in Social Entrepreneurship Traits of Students of a IES. October.
- Saldarriaga Salazar, M. E., & Guzmán González, M. F. (2018). Teaching entrepreneurship in higher education: Methodology or model? *School of Business Administration [EAN]* (85), 125–142. Obtenido de <https://doi.org/10.21158/01208160.n85.2018.2054>
- Sanchez, C., Brizeida, A., & Flores, L. (2017). entrepreneurial education: State of the art. 5, 401–437.
- Segura-Mojica, F. J. (2021). Crowdfunding for the rescue of micro-enterprises. Factors and perceptions of potential investors in Mexico. *Retos*, 11(21), 71–91. <https://doi.org/10.17163/ret.n21.2021.05>
- Son, H., Lee, J., & Chung, Y. (2017). Value creation mechanism of social enterprises in manufacturing industry: Empirical evidence from Korea. *Sustainability (Switzerland)*, 10(1). <https://doi.org/10.3390/su10010046>
- Trivedi, R. H. (2017). Entrepreneurial-intention constraint model: A comparative analysis among post-graduate management students in India, Singapore and Malaysia. *International Entrepreneurship and Management Journal*, 13(4), 1239–1261. <https://doi.org/10.1007/s11365-017-0449-4>
- Valenzuela-García, H., Molina, J. L., Lubbers, M. J., Escibano, P., & Fuentes, S. (2019). Social Entrepreneurship. Self-employment and extraction of value in the post-crisis. *Revista de Antropología Social*, 28(2), 371–390. <https://doi.org/10.5209/raso.65619>
- Vázquez-burgete, J. L., Lanero, A., Raisiene, A. G., García, M. P., Vázquez-burgete, J. L., Lanero, A., Raišienė, A. G., & García, M. P. (2012). Entrepreneurship education in Humanities and Social Sciences: are students qualified to start a business? 13(1), 27–35. <https://doi.org/10.3846/btp.2012.03>
- Vázquez-Parra, J. C., García-González, A., & Ramírez-Montoya, M. S. (2020). Social entrepreneurship competency: an approach by discipline and gender. *Journal of Applied Research in Higher Education*. <https://doi.org/10.1108/JARHE-09-2020-0317>
- Vera-Sagredo, A. J., Constenla-Núñez, J., Jara-Coatt, P., & Lassalle-Cordero, A. (2019). Entrepreneurship and innovation in professional technical education: perception from teachers and managers. *Revista Colombiana de Educación*, 1(79), 85–107. <https://doi.org/10.17227/rce.num79-8605>
- Villa, A., Arias, M., & Peña-Lang, M. (2021). A training model to develop social entrepreneurship. *Educación*, 57(1), 97–116. <https://doi.org/https://doi.org/10.5565/rev/educar.1153>
- Yaari, M., Blit-Cohen, E., & Savaya, R. (2020). Management in social enterprises—Management style, challenges, and strategies. *Journal of General Management*, 46(1), 36–46. <https://doi.org/10.1177/0306307020919529>

Understanding SMEs Digitalization: A Literature Review of Maturity Models

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Abstract: In recent years, digital technologies have transformed the way large firms conduct their business, from strategies and processes to products and services. However, small and medium-sized enterprises (SMEs) have faced difficulties in fully embracing these technologies due to resource constraints and a lack of expertise. The COVID-19 pandemic has highlighted the potential and versatility of digital technologies, potentially increasing SME entrepreneurs' awareness of digital topics. SMEs represent the beating heart of the European economy; therefore, it is essential to find tools to support their digital transformation. To guide SMEs in their digital roadmap, readiness or maturity models could be useful. However, existing research often lacks the proper perspective on SMEs. To address this issue, authors aim to illustrate the state-of-the-art digital maturity models for SMEs, through a review of existing academic knowledge. A systematic search, followed by a bibliometric review and conceptual review has been carried out to highlight and compare previous contribution to the topic. Since maturity models are multi-dimensional, major themes addressed in defining a maturity model or readiness model from both quantitative and qualitative models have been identified. The relevant dimensions were, then, reclassified and summarized into eight clusters. Digital strategy roadmap, employee skill and culture, organizational flexibility and adaptability, information technology, integration, customers, external environment, and, performance and benefits, are the major dimension identified in the review. A prominent attention of scholars and practitioners toward manufacturing and industry 4.0, is reflected in the existing model. It also emerges a focus internal dimension, that neglects external elements. Digital maturity models often take a vertical approach focused on manufacturing, hindering the development of comprehensive models to study digital maturity. Consequently, a future research agenda is also presented, highlighting the importance for future studies to build digital maturity model, analysing the specific context in which both manufacturing and service SMEs operate, and considering their peculiarities.

Keywords: Digital Maturity, Digital Transformation, Maturity Models, Literature Review, SMEs

1. Introduction

In recent years, significant shifts have been observed among large corporations, as they've embarked on a journey to reshape their business strategies, processes, capabilities, products, services, and interfirm associations by seamlessly integrating digital technologies into their operations (Bharadwaj, El Sawy, Pavlou & Venkatraman, 2013). Some of these enterprises have nearly reached the culmination of their strategic endeavors, leading to a noteworthy ability to deliver specialized, high-quality products and services at a reduced cost, consequently driving down prices (Trstenjak, Cajner & Opetuk, 2019). Conversely, small and medium-sized enterprises (SMEs), hindered by limited resources and expertise, encounter greater obstacles in harnessing the full potential of emerging technologies (Amaral & Peças, 2021). Despite this, the vulnerability of SMEs to various risks becomes apparent, spanning economic, social, human, and organizational domains. These vulnerabilities have been glaringly exposed through their arduous responses to the challenges precipitated by the pandemic (Mandviwalla & Flanagan, 2021).

The pandemic has, in fact, unveiled the vast capabilities and adaptability of digital technologies, potentially fostering heightened awareness among SME entrepreneurs concerning digital domains. However, the journey of transformational change brings about substantial hurdles, primarily stemming from the necessity to cultivate novel competencies within the organization (Soluk & Kammerlander, 2021). One conceivable approach to guide SMEs through their digital transformation involves leveraging tools such as readiness or maturity models. Regrettably, the existing body of research frequently lacks the requisite SME-centric perspective (Mittal, Khan, Romero & Wuest, 2018), often neglecting crucial considerations such as firm boundaries, industry dynamics, market competitiveness, and the broader operational network of SMEs.

This study seeks to address the pivotal research question: What is the contemporary landscape of digital maturity models tailored for SMEs? The overarching aim of this investigation is to provide an insightful response to this inquiry, achieved through a systematic review encompassing the existing academic knowledge.

2. Literature Screening

The examination of scholarly literature pertaining to the assessment of digitalization in SMEs was conducted through a systematic approach using the Scopus database. Initially, a search query was devised based on the research scope, meticulously selecting keywords with the aid of relevant papers to ensure comprehensive coverage of the existing literature on the subject.

Phenomenon	(TITLE-ABS-KEY ("digital maturity" OR "digital readiness" OR "digital transformation" OR "digitalization" OR "digitization"))
Purpose	AND TITLE-ABS-KEY ("measur*" OR "assess*" OR "defin*" OR "framework*" OR "model*" OR "evaluat*" OR "index*" OR "level*" OR "stage*" OR "phase*" OR "survey*" OR "case stud*" OR "journey*")
Subject of interest	AND TITLE-ABS-KEY ("sme*" OR "smb*" OR "small enterprise*" OR "medium enterprise*" OR "small business*" OR "medium business*" OR "small firm*" OR "medium firm*" OR "small and medium-sized enterprise*" OR "small and medium-sized business*" OR "small and medium-sized firm*" OR "small-medium enterprise*" OR "small-medium business*" OR "small-medium firm*" OR "small and medium enterprise*" OR "small and medium business*" OR "small and medium firm*")

Figure 1: Research strategy

The query was designed to retrieve articles and conference papers in English, structured according to the principal themes encompassing the research area. Notably, the keyword search encompassed titles, abstracts, and keywords, categorized into three primary clusters:

- Phenomenon under Study: Digitalization process.
- Objective/Purpose of the Study: Establishing a structured approach to measure the phenomenon.
- Subject of Interest: Small and medium-sized enterprises (SMEs).

The phenomenon outlined in Table 1 was elucidated using five distinct yet complementary keywords, identified through an initial review. Concerning the first two keywords, digital maturity and digital readiness, the terms "readiness" and "maturity" are frequently interchanged to denote the same set of concepts (Pirola, Cimini & Pinto, 2019). However, readiness is defined as "the state of being both psychologically and behaviorally prepared to take action (i.e., willing and able)" (Weiner, 2009), while maturity pertains to "the state of being complete, perfect, or ready" (Soanes & Stevenson, 2006). Consequently, these two definitions are synonymous. Alternatively, Mettler (2011) introduces the concept of evolution, asserting that maturity necessitates progressive evolution in demonstrating a specific ability or accomplishing a target, transitioning from an initial to a desired state. Singh, Kaur, Kaur, and College (2015) introduce another perspective, contending that maturity pertains to "the degree of formality and optimization of processes, from ad-hoc practices to formally defined steps, to managed result metrics, to active optimization of the processes."

Convergence among authors is evident when discussing readiness assessment and maturity assessment. Benedict et al. (2017) define readiness assessments as "evaluation tools to analyze and determine the level of preparedness of conditions, attitudes, and resources at all system levels necessary for goal achievement." Using Holt, Armenakis, Field, and Harris (2007), readiness assessment aims to identify potential risks, opportunities, and challenges arising during the implementation of change processes within an organizational context. Moreover, readiness assessment allows addressing gaps in the existing organization either beforehand or during the planned changes (Holt et al., 2007). Mettler (2011) asserts that maturity models for maturity assessment are "models that facilitate individuals or entities in achieving a higher maturity level (i.e., ability) in people/culture, processes/structures, and/or objects/technologies through a step-by-step continuous improvement process."

Hence, maturity models, akin to readiness assessment models, aid in objectively and impartially evaluating a company's position, addressing queries about measurement requirements and assigning specific maturity stages or degrees (Becker, Knackstedt & Pöppelbuß, 2009). Consequently, this study considered both digital readiness and digital maturity models. Regarding the second set of terms-digitization, digitalization, and digital transformation-literature portrays them as describing distinct facets/phases of the same phenomenon. Despite their frequent interchangeability, these terms encapsulate interrelated yet distinct phenomena.

Digitization. According to Legner, Eymann, Hess, Matt, Böhm, Drews, Mädche, Urbach & Ahlmann (2017), digitization refers to "the transformation of information into a digital representation." It is also described as "the

technical process of converting analogue data into digital ones, creating data for information system and processing" (Autio, Nambisan, Thomas & Wright, 2018; Tilson, Lyytinen, & Sørensen, 2010; Verhoef, Broekhuizen, Bart, Bhattacharya, Dong, Fabian & Haenlein, 2021). Park, Pavlou, and Saraf (2020) offer a slightly different yet coherent definition, portraying digitization as the "firm's effort and process to digitize its business processes by implementing, assimilating, and using information systems."

Digitalization. Described as a paradigm that heightens the pivotal role of information technology (IT) in competitiveness and customer satisfaction (Mithas, Ali & Will, 2013), digitalization is characterized by Fischer, Imgrund, Janiesch, and Winkelmann (2020), Autio et al. (2018), and Tilson et al. (2010) as a "socio-technical process." This process involves the incorporation of information and communication technology (ICT) alongside knowledge-based assets, such as organizational and human capital, to foster enhanced outcomes (OECD, 2017).

Digital transformation. As articulated by Legner et al. (2017), digital transformation ensues as digital technologies facilitate connections between people, things, and locations, generating and analyzing vast quantities of data. This fusion of digitization and digitalization results in digital transformation, which, as asserted by Hansen & Sia (2015) and Holotiuk & Beimbom (2017), "alters communication and interactions between all stakeholders and reshapes the current economic, social, and political landscape." Acknowledged by Verhoef et al. (2021) as the most intricate and far-reaching phase, digital transformation encompasses changes in strategy, organization, information technology, supply chains, and marketing. Rogers (2016) underscores that it is fundamentally strategic rather than merely technological. In synthesis, digital transformation can be defined as "the process of reshaping the business model of a company through the adoption and use of digital technologies, enabling new possibilities and value creation" (Jeansson & Bredmar, 2019).

After the extraction, the compiled list underwent a meticulous screening process (Figure 1), with the primary aim of accumulating articles strictly relevant to the designated topic. This selection procedure unfolded across three distinct steps. Firstly, a title screening was executed to eliminate outcomes that clearly deviated from the research objective, resulting in the exclusion of 359 records. Illustrative instances of papers excluded encompassed titles such as "The Quality of Infectious Disease Hospital Websites in Poland in Light of the COVID-19 Pandemic" (Król & Zdonek, 2021), with a pronounced connection to health management, and "The Implications of Social Media on Local Media Business: Case Studies in Palembang, Manado, and Bandung" (Maryani, Rahmawan & Karlinah, 2020), prominently linked to marketing and communications.

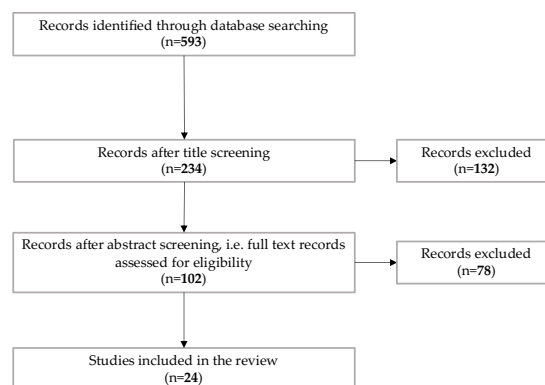


Figure 2: PRISMA Flow Chart

The ensuing step involved filtering the records through abstract reading, whereby 132 records were eliminated due to their misalignment with the research objective. The remaining documents underwent a comprehensive scrutiny during the final phase, involving a thorough examination of full-text content to assess their eligibility.

3. Bibliometric review

To better describe the composition of our data sample and to identify the trends and the most trending issues in scientific research, we have conducted also a bibliometric analysis. Bibliometric was first used by Paul Otlet in 1934 and it is defined as "the measurement of all aspects related to the publication and reading of books and documents" (Chonsawat & Sopadang, 2020). The interest in bibliometric research is growing thanks to ICTs, since it allows analyses based on large amount of data with distance-based approaches (Durana et al., 2020).

The following bibliographic analysis is based on the visualization of similarities techniques, using VoS Viewer™ to reconstruct scientific networks. Items in these networks are linked by co-authorship, co-occurrence, citation,

bibliographic coupling, or co-citation links (van Eck & Waltman, 2009). Van Eck et al. (2010) claim that the VoS Viewer is especially useful for displaying large bibliometric maps, but a minimum number of 100 fields is required for a meaningful analysis.

Items analyzed with VoS Viewer are characterized by attributes (e.g., number of citations received by a document). When working with keywords, as in our case, the key attribute is occurrences, i.e., the number of documents in which a keyword occurs (van Eck & Waltman, 2009). Occurrences are used as *weight* attributes: items with a higher weight (a wider circle) are more predominant in the network map than items with a lower weight (van Eck & Waltman, 2009). There are also two standard weight attributes, referred to as *links* and *total link strength*, represented with lines in the graphical representation. For a given item, the links and total link strength attributes indicate, respectively, the number of links of an item with other items and the total strength of the links of an item with other items (van Eck & Waltman, 2009). Lastly, colors are used to identify clusters—the same color means that terms within the cluster are more closely, and therefore more similar, more closely related than terms in different clusters (van Eck & Waltman, 2009).

The data sample analyzed is the result of the eligibility phase of the literature review. We decided to focus our analysis only on papers that are in line with the research topic and that can be recognized as influential publications. The map creation is based on bibliographic data, focused on Index keyword co-occurrences. To avoid noise, a minimum threshold of occurrences of a keyword has been set to 10. Of the 1485 keywords, only 25 meet the threshold. A normalization technique was applied on co-occurrence frequencies that observed the number of co-occurrences of node i (aspects) and node j called association strength. This improved the readability and the interpretation of the map. Moreover, a minimum number of 6 items was set to create a single cluster.

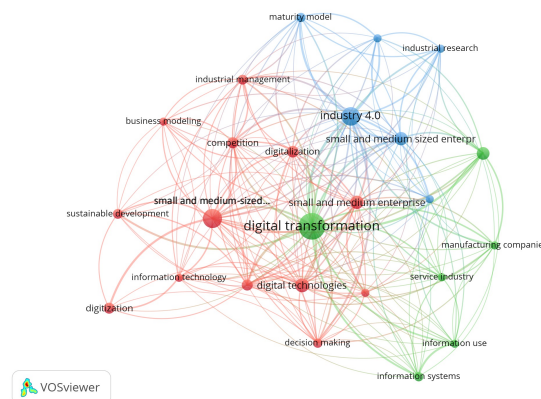


Figure 1: VoS Viewer representation

From Figure 1 it is noticeable that Industry 4.0, digital transformation, and SMEs are the main labels on which clusters are defined. This points to the conclusion that researchers that are focused on SMEs and digital transformation usually address the research topic from an Industry 4.0 perspective. Müller et al. (2018) have collected the definitions of Industry 4.0 in the extant literature and define Industry 4.0 as “a new paradigm which leads to swifter and more accurate decision making and to a completely new approach to production”. It is crucial to point out that many of the listed definitions take into consideration the convergence of production and ICT evidencing the strong focus on the manufacturing sector. Digital transformation, instead, has a different level of detail, it has a wider perspective: “Digital transformation is to be understood as the process of reshaping the business model of a company due to, and through, the adoption and use of digital technologies, in order to create a setting where new possibilities are enabled and value created” (Jeansson & Bredmar, 2019). Hence, the Industry 4.0 paradigm involves digital transformation, however a focus on digital transformation does not always imply focusing on Industry 4.0. In light of this analysis, it is necessary to deepen the knowledge of “non-manufacturing” SMEs, in order to understand how they address their digital transformation.

4. Systematic review

Maturity models, as highlighted by Wendler (2012), often exhibit multidimensional characteristics. Through a qualitative examination of the literature, specific academic papers with significant influence in this domain were identified. These foundational papers enabled the extraction of key themes addressed by researchers in the formulation of both quantitative and qualitative maturity or readiness models. Consequently, the pertinent dimensions were reclassified and synthesized into eight distinct clusters.

Each theme represents a collection of relationships between two dimensions, endorsed by researchers' studies. Drawing insights from the works of Eller et al. (2020), Jeansson & Bredmar (2019), Pirola et al. (2019), Zangiacomi, Pessot, Fornasiero, Bertetti, and Sacco (2020), Del Giudice, Scuotto, Papa, Tarba, Bresciani & Warkentint (2021), and Park et al. (2020), the intention is to offer a more comprehensive elucidation of established dimensions. This research aims to expand the existing knowledge landscape, fostering a more profound understanding of digitalization in SMEs.

4.1 Strategic Approach and Digital Roadmap

Within the digital strategy/roadmap cluster, we amalgamate connections between digitalization and other dimensions associated with a SME's strategy. A consensus exists among Jeansson and Bredmar (2019), Pirola et al. (2019), Eller et al. (2020), and Zangiacomi et al. (2020) that a positive correlation exists between digital strategy and digitalization. Conversely, the inverse holds true as well: a lack of alignment between digital and business strategies adversely affects digitalization and transformation (Jeansson & Bredmar, 2019), underscoring the pivotal role of a well-defined strategy for a successful digital roadmap. The studies also reveal that the ability to discern which technologies best align with business needs significantly bolsters digitalization (Zangiacomi et al., 2020). Identifying optimal solutions hinges on an understanding of the SME's objectives, thus tethering this subtheme to the former. A robust roadmap necessitates adept management, as underscored by Zangiacomi et al. (2020), who highlight the favorable impact on digitalization of pilot projects. This approach, according to Zangiacomi et al. (2020), proves highly advantageous for company digitalization, offering room for experimentation. A test-by-doing approach is deemed a best practice in charting SME digital trajectories within the dynamic digital landscape.

4.2 Employee Competencies and Organizational Culture

This theme likewise permeates the discourse: four of the six seminal papers (Jeansson & Bredmar, 2019; Pirola et al., 2019; Eller et al., 2020; Zangiacomi et al., 2020) scrutinize the interplay among employee skills, corporate culture, and digitalization. Analogous to the previous theme, authors concur that deficient management and knowledge, coupled with an absence of shared organizational identity and culture, exert detrimental effects on SME digitalization (Eller et al., 2020; Jeansson & Bredmar, 2019), underscoring the pivotal roles of information and know-how for firms. The human element, manifest through employee skills, emerges as a priority for SMEs as organizations; human resources play a pivotal role in fostering implementation and attainment of elevated digitalization levels (Eller et al., 2020). Digital maturity hinges on employee skills and competencies (Pirola et al., 2019), and firms can enhance digitalization by investing in people and culture, facilitating knowledge sharing and best practices within the organization (Zangiacomi et al., 2020). Individuals constitute the foremost users of new technologies, thus becoming the primary source of feedback for SMEs. Hence, nurturing employees' critical approach becomes imperative for effective digital project implementation and consequent improvements in digital maturity (Pirola et al., 2019).

4.3 Agility and Adaptability of Organizations

The third thematic area in the literature pertains to an organization's capacity for adaptation. Multinational enterprises have traditionally held an advantage over SMEs due to their greater resource allocation for introducing enabling digital technologies (Del Giudice et al., 2021). Nevertheless, the growing prevalence of software-as-a-service allows firms to seamlessly transition between technologies while remaining within reasonable resource and time limits (OECD, 2017). This novel avenue empowers SMEs to catalyze digitalization by constructing scalable, high-quality IT infrastructures (Eller et al., 2020). However, effective organizational adaptability is indispensable for harnessing cost-effective digital implementation (Del Giudice et al., 2021). It significantly influences the learning curve of the company (Del Giudice et al., 2021), prompting the need for an ever-evolving set of dynamic capabilities to ensure alignment between business and IT, while rapidly sensing and reacting to shifting contexts (Eller et al., 2020; Park et al., 2020). In tandem with the prior section, this process should unfold through progressive proactive engagement of human resources, aimed at gathering diverse perspectives and fostering an integrated approach (Zangiacomi et al., 2020). In essence, SMEs (and companies at large) must cultivate ambidexterity, characterized as "the ability to simultaneously pursue efficiency and flexibility while balancing exploitation and exploration" (Park et al., 2020). Indeed, Del Giudice et al. (2021) consider it a "measure of organizational agility and adaptability."

The relatively modest size and flexible structure of SMEs can facilitate the establishment of shared codes of positive values and norms conducive to digitalization (Eller et al., 2020). In contrast, large enterprises grapple with structural complexity, inertia of existing processes, and bureaucratic formalities (Del Giudice et al., 2021).

This bidirectional relationship can generate virtuous cycles, as emphasized by Park et al. (2020), where IT systems facilitate seamless knowledge flow by fostering active participation and collaboration among employees, thereby enhancing enterprise flexibility and adaptability in volatile, ever-changing environments (Del Giudice et al., 2021). As businesses continuously adapt to dynamic market demands, the evaluation models must also evolve accordingly. In fact, modularity, interpreted as the capacity to tailor to the company's needs and context, emerges as a pivotal aspect in assessing SMEs' digitalization, according to Pirola et al. (2019).

4.4 Role of Information Technology

Although only a few authors (Eller et al., 2020; Jeansson & Bredmar, 2019; Pirola et al., 2019) delve into the implications of IT within SMEs, it remains fundamental to underscore that digitalization is set in motion by specific technologies. As posited by Pirola et al. (2019), IT holds substantial significance in digital transformation, and a discerning analysis of an SME's current IT infrastructure should form the bedrock of a digitalization roadmap. "IT encapsulates technological devices endowed with computing capabilities that support decision-making and organizational information processing" (Eller et al., 2020). This underscores that Information Technology serves as the core of digitalization—an essential resource and enabler that small and medium-sized enterprises should harness to enhance communication, collaboration, and the development of digital infrastructure (Eller et al., 2020). Hence, both authors concur in affirming that IT wields a positive influence on digitalization.

4.5 Process Integration

This cluster endows digitalization with a pronounced processes-oriented perspective. Within the Integration theme, Pirola et al. (2019) and Jeansson & Bredmar (2019) delineate the nexus between digital maturity and process integration. These researchers extend the discourse beyond a simple positive correlation between these two dimensions, asserting that process integration is an imperative of digital maturity (Pirola et al., 2019). As such, implementing new technologies or software within a company cannot be reduced to a solitary objective for improving digital readiness. SMEs must consider the horizontal implications across all processes affected by new technology, striving to harness the benefits that integration affords (Jeansson & Bredmar, 2019; Pirola et al., 2019). Digitalization, synonymous with technology integration, favorably impacts information exchange and communication across various organizational realms and within the supply chain (Pirola et al., 2019). Hence, sharing information and data amid processes assumes paramount importance for bolstering SMEs' digital readiness and affording companies advantages in future digital undertakings.

4.6 Customers

This thematic cluster encapsulates evidence related to the advantageous impact of digitalization on customers. SMEs recognize the increasing digital orientation of their customer base, as customers embrace digital systems and tools. Consequently, customer orientation becomes a prerequisite for digital maturity (Pirola et al., 2019). Digital tools introduce new avenues for customer communication, prompting SMEs to embark on digital projects to enhance their value proposition communication (Jeansson & Bredmar, 2019). Furthermore, digitalization elevates competition, heightening customer demands. This dynamic landscape compels SMEs to refine their processes and capabilities, positively influencing the implementation of digital projects (Jeansson & Bredmar, 2019). A customer-oriented approach is pivotal for SMEs to achieve digital maturity (Pirola et al., 2019), enhancing communication downstream within the supply chain of companies (Eller et al., 2020).

4.7 External Environment

Firms operating in highly competitive landscapes strive to leverage all available resources. Jeansson & Bredmar (2019) assert that an unstable market and external pressures correlate positively with the development of digital projects. Digitalization, in turn, correlates positively with enhanced market competitiveness, strategic advantages, market positioning, and the innovation of products and services (Jeansson & Bredmar, 2019). Exogenous events, such as the COVID-19 pandemic, serve as catalysts for SMEs' digitalization roadmap (Pirola et al., 2019). This external environment theme encompasses dimensions closely tied to digital maturity. Networking emerges as crucial for SMEs to address internal gaps and knowledge deficits (Del Giudice et al.,

2021). SMEs equipped with robust networks are better poised to adopt new technologies than isolated counterparts, as effective networking can help surmount constraints and propel competitiveness (Mittal et al., 2018; Zangiacomi, 2020).

4.8 Performance and Gains

The final thematic area derived from our review pertains to performance and benefits. This category potentially encapsulates the drivers that SMEs primarily consider when assessing the adoption of new technologies. Authors unanimously underscore the impact on cost efficiency as one of the foremost benefits SMEs can reap from digitalization (Eller et al., 2020; Jeansson & Bredmar, 2019). Yet, digitalization bears numerous other improvements, including the enhancement of a company's measurement system. Eller (2020) observes that digitalization allows real-time data collection, fostering superior process optimization and financial analysis. Data collection emerges as a pivotal driver in the digitalized landscape (Pirola et al., 2019).

5. Conclusions and Future Research Directions

Our review reveals that most of the analysis and studies conducted in past years in connection to digitalization and digital transformation were focused on Industry 4.0 (Klohs & Sandkuhl, 2020). However, Industry 4.0, is a particular shape of digital transformation, which is mainly focused on production technologies such as AR/VR, IoT/IIoT/IoS, smart sensors, data visualization and many others (Mittal et al., 2019). Instead, digital transformation changes are associated with the application of digital technology in all aspects of human society (Kääriäinen et al., 2020). Furthermore, as reported by Frank et al. (2019), servitization is currently the second trend that is shaping businesses, in parallel with Industry 4.0. The authors underline the internal nature of Industry 4.0, due to its focus on improving production-related technologies, while they attribute a more external perspective to servitization, seen as a way of generating value for customers.

Therefore, deepdiving into the service domain can contribute to this research by two means: on the one hand, it allows bridging the literature gap by understanding the dynamics that govern the digitalization process of a service SME, on the other hand, since companies are no longer polarized but they are increasingly product-service oriented, it also provides the opportunity to enlarge the current theoretical basis related to manufacturing SMEs digitalization.

The consequences of the preponderance of Industry 4.0 is reflected in the models extant in the literature. In fact, most of the existing Industry 4.0 and Smart manufacturing models focus on internal dimensions while keeping less attention on external dimensions. Moreover, this excessive attention to the digitization of the production process has led the scientific literature to focus almost exclusively on manufacturing companies, leaving aside the sphere of service SMEs. Therefore, it is interesting to investigate service SMEs' strategic decisions, needs, and the obstacles they encounter while conducting a digitalization project.

Also, the ramifications of the Industry 4.0 era are palpably reflected in existing models. Many Industry 4.0 and Smart manufacturing models predominantly focus on internal dimensions, potentially neglecting external aspects. Additionally, a prevalent vertical orientation in digital maturity models is often observed in the literature, limiting the development of all-encompassing models for studying digital maturity. Building on the findings presented herein, future research endeavors should validate the employment of comprehensive digital maturity models through empirical methods. Furthermore, the creation of tailor-made digital maturity models for SMEs necessitates the analysis of the unique internal and external contexts in which manufacturing and service SMEs operate. Finally, this study acknowledges limitations—it is based solely on extraction from the Scopus database, and only English-language conference and newspaper articles were analyzed.

References

- Amaral, A., & Peças, P. (2021). SMEs and Industry 4.0: Two case studies of digitalization for a smoother integration. *Computers in Industry*, 125.
- Autio, E., Nambisan, S., Thomas, L. D. W., & Wright, M. (2018). Digital affordances, spatial affordances, and the genesis of entrepreneurial ecosystems. *Strategic Entrepreneurship Journal*, 12(1), 72–95.
- Bharadwaj, A., El Sawy, O. A., Pavlou, P. A., & Venkatraman, N. v. (2013). Digital business strategy: toward a next generation of insights. *MIS Quarterly*, 471–482.
- Becker, J., Knackstedt, R., & Pöppelbuß, J. (2009). Developing maturity models for IT management. *Business & Information Systems Engineering*, 1(3), 213–222.

- Benedict, N., Smithburger, P., Donihi, A. C., Empey, P., Kobulinsky, L., Seybert, A., Waters, T., Drab, S., Lutz, J., Farkas, D., & Meyer, S. (2017). Blended Simulation Progress Testing for Assessment of Practice Readiness. *American Journal of Pharmaceutical Education*, 81(1), 14.
- Chonsawat, N., & Sopadang, A. (2020). Defining SMEs' 4.0 readiness indicators. *Applied sciences*, 10(24), 8998.
- Del Giudice, M., Scuto, V., Papa, A., Tarba, S. Y., Bresciani, S., & Warkentin, M. (2021). A Self-Tuning Model for Smart Manufacturing SMEs: Effects on Digital Innovation. *Journal of Product Innovation Management*, 38(1), 68–89.
- Eller, R., Alford, P., Kallmünzer, A., & Peters, M. (2020). Antecedents, consequences, and challenges of small and medium-sized enterprise digitalization. *Journal of Business Research*, 112(March), 119–127.
- European Union Commission. (2014). Official Journal. *Official Journal of the European Union*, 57(467), 216.
- Fischer, M., Imgrund, F., Janiesch, C., & Winkelmann, A. (2020). Strategy archetypes for digital transformation: Defining meta objectives using business process management. *Information and Management*, 57(5), 103262.
- Frank, Alejandro G., et al. "Servitization and Industry 4.0 convergence in the digital transformation of product firms: A business model innovation perspective." *Technological Forecasting and Social Change* 141 (2019): 341-351.
- Gavrila Gavrilă, S., & de Lucas Ancillo, A. (2021). Spanish SMEs' digitalization enablers: E-Receipt applications to the offline retail market. *Technological Forecasting and Social Change*, 162(October 2020), 120381.
- Ghezzi, A., Renga, F., & Cortimiglia, M. (2009). Value networks: scenarios on the mobile content market configurations. In 2009 Eighth International Conference on Mobile Business (pp. 35-40). IEEE.
- Ghezzi, A. (2012). Emerging business models and strategies for mobile platform providers: a reference framework, *info*, 14(5), 36-56.
- Ghezzi, A., Georgiades, M., Reichl, P., Le-Sauze, N., Di Cairano-Gilfedder, C., & Mangiaracina, R. (2013). Generating innovative interconnection business models for the future internet. *info*, 15(4), 43-68.
- Ghezzi, A., Rangone, A., & Balocco, R. (2013). Technology diffusion theory revisited: a regulation, environment, strategy, technology model for technology activation analysis of mobile ICT. *Technology Analysis & Strategic Management*, 25(10), 1223-1249.
- Ghezzi, A. (2020). How Entrepreneurs make sense of Lean Startup Approaches: Business Models as cognitive lenses to generate fast and frugal Heuristics. *Technological Forecasting and Social Change*, 161, 120324.
- Hansen, R., & Sia, S. K. (2015). Hummel's digital transformation toward omnichannel retailing key lessons learned. *MIS Quarterly Executive*, 14(2).
- Higgins, J. P., Thomas, J., Chandler, J., Cumpston, M., Li, T., Page, M. J., & Welch, V. A. (2019). *Cochrane handbook for systematic reviews of interventions*. John Wiley & Sons.
- Holotiuk, F., & Beimborn, D. (2017). Critical success factors of digital business strategy.
- Holt, D. T., Armenakis, A. A., Feild, H. S., & Harris, S. G. (2007). Readiness for organizational change: The systematic development of a scale. *The Journal of Applied Behavioral Science*, 43(2), 232–255.
- Jeansson, J., & Bredmar, K. (2019). Digital transformation of SMEs: Capturing complexity. 32nd Bled EConference: Humanizing Technology for a Sustainable Society, Bled, Slovenia, June 16-19, 2019, 523–541.
- Jocevski, M., Arvidsson, N., & Ghezzi, A. (2020). Interconnected business models: present debates and future agenda, *Journal of Business & Industrial Marketing*, 35(6), 1051-1067.
- Kääriäinen, J., Kuusisto, O., Pussinen, P., Saarela, M., Saari, L., & Hänninen, K. (2020). Applying the positioning phase of the digital transformation model in practice for smes: Toward systematic development of digitalization. *International Journal of Information Systems and Project Management*, 8(4), 24–43.
- Klohs, K., & Sandkuhl, K. (2020). Digitalization of Small and Medium-Sized Enterprises: An Analysis of the State of Research. In *Lecture Notes in Business Information Processing* (Vol. 394). Springer International Publishing.
- Król, K., & Zdonek, D. (2021). The quality of infectious disease hospital websites in Poland in light of the COVID-19 pandemic. *International Journal of Environmental Research and Public Health*, 18(2), 642.
- Legner, C., Eymann, T., Hess, T., Matt, C., Böhm, T., Drews, P., Mädche, A., Urbach, N., & Ahlemann, F. (2017). Digitalization: opportunity and challenge for the business and information systems engineering community. *Business & Information Systems Engineering*, 59(4), 301–308.
- Mandviwalla, M., & Flanagan, R. (2021). Small business digital transformation in the context of the pandemic. *European Journal of Information Systems*, 30(4), 359–375.
- Maryani, E., Rahmawan, D. E. T. T. A., & Karlinah, S. I. T. I. (2020). The implications of social media on local media business: Case studies in Palembang, Manado and Bandung. *Jurnal Komunikasi: Malaysian Journal of Communication*, 36(1), 317-333.
- Mettler, T. (2011). Maturity assessment models: a design science research approach. *International Journal of Society Systems Science*, 3(1–2), 81–98.
- Mithas, S., Ali, T., & Will, M. (2013). How a Firm's Competitive Environment and Digital Strategy Posture Influence Digital Business Strategy. *Management Information Systems Quarterly*, 37(2), 511–536.
- Mittal, S., Khan, M. A., Romero, D., & Wuest, T. (2018). A critical review of smart manufacturing & Industry 4.0 maturity models: Implications for small and medium-sized enterprises (SMEs). *Journal of Manufacturing Systems*, 49(June), 194–214.
- Mittal, S., Khan, M. A., Romero, D., & Wuest, T. (2019). Smart manufacturing: Characteristics, technologies and enabling factors. *Proceedings of the Institution of Mechanical Engineers, Part B: Journal of Engineering Manufacture*, 233(5), 1342–1361.

- Mittal, S., Romero, D., & Wuest, T. (2018). Towards a smart manufacturing maturity model for SMEs (SM3E). In IFIP Advances in Information and Communication Technology (Vol. 536). Springer International Publishing.
- OECD (2020), "Coronavirus (COVID-19): SME policy responses", OECD Policy Responses to Coronavirus (COVID-19), OECD Publishing, Paris.
- Müller, J. M., Buliga, O., & Voigt, K. I. (2018). Fortune favors the prepared: How SMEs approach business model innovations in Industry 4.0. *Technological Forecasting and Social Change*, 132(September 2017), 2–17.
- Park, Y. K., Pavlou, P. A., & Saraf, N. (2020). Configurations for achieving organizational ambidexterity with digitization. *Information Systems Research*, 31(4), 1376–1397.
- Peters, E., Klietk, T., Musa, H., & Durana, P. (2020). Product decision-making information systems, real-time big data analytics, and deep learning-enabled smart process planning in sustainable industry 4.0. *Journal of Self-Governance and Management Economics*, 8(3), 16–22.
- Pirola, F., Cimini, C., & Pinto, R. (2019). Digital readiness assessment of Italian SMEs: a case-study research. *Journal of Manufacturing Technology Management*, 31(5), 1045–1083.
- Rogers, D. (2016). *The digital transformation playbook*. Columbia University Press.
- Sanasi, S., & Ghezzi, A. (2022). Pivots as strategic re-sponses to crises: Evidence from Italian companies navigating Covid-19. *Strategic Organization*, 14761270221122933.
- Sanasi, S., Manotti, J., & Ghezzi, A. (2021). Achieving agility in high-reputation firms: Agile experimentation revisited. *IEEE Transactions on Engineering Management*, 69(6), 3529–3545.
- Singh, S., Kaur, G., Kaur, P., & College, D. A. V. (2015). Importance of Testing Maturity Model.
- Soanes, C., & Stevenson, A. (2006). *Concise oxford English dictionary* (Vol. 11). Oxford University Press Oxford.
- 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.
- Tilson, D., Lyytinen, K., & Sørensen, C. (2010). Research Commentary—Digital Infrastructures: The Missing IS Research Agenda. *Information Systems Research*, 21(4), 748–759.
- Trstenjak, M., Cajner, H., & Opetuk, T. (2019). Industry 4.0 readiness factor calculation: Criteria evaluation framework. *FME Transactions*, 47(4), 841–845.
- Van Eck, N. J., & Waltman, L. (2009). VOSviewer: A Computer Program for Bibliometric Mapping. In *ERIM report series research in management Erasmus Research Institute of Management (Issue ERS-2009-005-LIS)*. Erasmus Research Institute of Management.
- Van Eck, N. J., Waltman, L., Dekker, R., & Van Den Berg, J. (2010). A comparison of two techniques for bibliometric mapping: Multidimensional scaling and VOS. *Journal of the American Society for Information Science and Technology*, 61(12), 2405–2416.
- Verhoef, P. C., Broekhuizen, T., Bart, Y., Bhattacharya, A., Dong, J. Q., Fabian, N., & Haenlein, M. (2021). Digital transformation: A multidisciplinary reflection and research agenda. *Journal of Business Research*, 122, 889–901.
- Weiner, B. J. (2009). A theory of organizational readiness for change. *Implementation Science*, 4(1), 67.
- Wendler, R. (2012). The maturity of maturity model research: A systematic mapping study. *Information and Software Technology*, 54(12), 1317–1339.
- Wendler, R. (2012). The maturity of maturity model research: A systematic mapping study. *Information and Software Technology*, 54(12), 1317–1339.
- Wyckoff, A., & Pilat, D. (2017). *Key issues for digital transformation in the G20*. Berlin: OECD.
- Zangiacomì, A., Pessot, E., Fornasiero, R., Bertetti, M., & Sacco, M. (2020). Moving towards digitalization: a multiple case study in manufacturing. *Production Planning and Control*, 31(2–3), 143–157.

Supporting The Digitalization of SMEs Through Maturity Models

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Abstract: over the past two years, small and medium-sized enterprises (SMEs) have faced a crisis due to the Coronavirus pandemic. The use of digital tools has been crucial for SMEs to mitigate the negative impacts of Covid-19, but they still face challenges in their digitalization path due to limited resources, skills, and know-how. To address this, policymakers and practitioner in the SME ecosystem need to understand SMEs' level of digitalization and develop strategies for their digital transformation: digital maturity models can help entrepreneurs and consultants to develop a structured digital roadmap that considers SMEs' resources and constraints. However, even if maturity models and readiness model are effective tools, existing models may not account for SMEs' unique characteristics being either developed for large firm or Industry 4.0 enterprises. Thus, researchers need a better theoretical understanding of the various stages of the digitalization process to account for the heterogeneity among firms' current digital states. Therefore, this research, building on pre-existent literature, aims to identify the elements necessary for developing a digital maturity framework specifically for SMEs. This qualitative research study uses a multiple case study approach, identifying 18 cases of Italian SMEs. The selection of the sample was carried out to consider the industry (manufacturing or services), the size (small or medium) and the geographical location (Northern Italy, Central Italy, Southern Italy), to grant a higher heterogeneity and to allow a better understanding of SMEs approach to digitalization. By departing from existing models exclusively designed for large or manufacturing companies, this research enriches our understanding of digital maturity models for SMEs. Based on the research carried out, a three-layer framework is proposed to illustrate the elements to be considered in the construction of a framework and their connections. The proposed model considers dimensions and elements related to SMEs integrated processes, relationship between SMEs and external actors, and the context in which they operate.

Keywords: Case Study, Digital Maturity, Digital Transformation, Maturity Models, SMEs

1. Introduction

As underscored by the OECD (2020), the COVID-19 pandemic has acted as a destabilizing force for SMEs in the past two years. The utilization of digital tools among SMEs emerged as a contributing factor in mitigating the adverse consequences of Covid-19 (OECD 2020). For numerous instances, these tools were the "lifeline" that enabled their survival (Mandviwalla & Flanagan, 2021). Nonetheless, SMEs are currently confronted with various obstacles along their digitization journey. These challenges are rooted in a scarcity of resources, skills, and expertise, hindering their ability to fully harness the benefits presented by digital technologies (Amaral & Peças, 2021; Soluk & Kammerlander, 2021). Consequently, the development of digital maturity models becomes of paramount importance. These models must serve as tools that empower policymakers and stakeholders embedded within the SME ecosystem. This empowers them to comprehend the true extent of digitization within small and medium-sized enterprises and to devise optimal strategies that foster the digital transformation of such entities.

However, as articulated by Mittal, Khan, Romero, and Wuest (2018), digital maturity models, primarily crafted for larger corporations, are unlikely to capture the intricacies inherent in the economic and relational ecosystem of SMEs. This research seeks to bridge this gap in the literature by addressing the following research question: How should a digital maturity framework be devised to suit the distinct context of SMEs? Subsequent sections encompass the following subjects: a) providing a theoretical contextualization concerning the significance of SMEs and the role of digital maturity models; b) elucidating the research methodology applied; c) presenting the findings derived from interviews conducted with SMEs; and d) engaging in deliberations while presenting a proposed framework. Ultimately, the study concludes by offering insights into its constraints and suggesting avenues for future research.

2. Literature review

2.1 The relevance of SMEs digital maturity

Digitalization constitutes a fundamental imperative for companies seeking to engage with the emerging industrial revolution (Amaral & Peças, 2021). Nonetheless, the process of digitalization, which seeks to "enhance an entity through substantial alterations to its attributes using a blend of information, computation, communication, and connectivity technologies" (Mandviwalla & Flanagan, 2021), is relatively less advanced within SMEs. This disparity stems from various constraints that render SMEs more encumbered in adopting novel technologies (Amaral & Peças, 2021). Simultaneously, the landscape of digital transformation is engendering swift shifts within industry and society, extending opportunities in terms of scale, scope, and velocity (Mandviwalla & Flanagan, 2021). SMEs, in particular, find themselves propelled towards intricate trajectories of growth (Denicolai, Zucchella & Magnani, 2021).

By employing readiness models and digital maturity models, entrepreneurs and consultants can lay out a methodical digital roadmap that takes into account the resources and limitations characteristic of SMEs. On the other hand, researchers stand to gain from a more comprehensive theoretical framework encompassing the distinct phases of the digitalization journey. This would enable them to recognize the diversity existing among firms regarding their current degree of digital integration (Soluk & Kammerlander, 2021).

2.2 Maturity and Readiness model

Given the challenges confronting SMEs, the process of digitization is often approached incrementally (Depaoli, Za & Scornavacca, 2020). Consequently, significant efforts have been directed towards enhancing the qualification of this phenomenon through readiness assessments in order to gradually navigate the intricacies of digitization (Li, Su, Zhang & Mao, 2018). The pioneering role of consultancy firms in introducing the concept of maturity models is underscored by Trotta & Garengo (2019), who term them as the "first movers" of this strategy. These firms recognized the need for a comprehensive tool that not only aids in project governance but also simplifies communication about the intricate subject of Digitalization (Trotta & Garengo, 2019). However, the scales used by practitioners are often ill-suited for SMEs, as they are predominantly tailored towards larger enterprises (North et al., 2020). Furthermore, these scales typically lack the necessary attributes of replicability, generalizability, and transparency that are expected of scientific publications (North et al., 2020; Trotta & Garengo, 2019). Additionally, a considerable number of recently developed maturity models have a primary focus on Industry 4.0 transformations (Klohs & Sandkuhl, 2020).

It is widely recognized that SMEs often struggle to grasp the true essence of digitalization or digital transformation (Pirola, Cimini, Pinto, 2019), leading to potential misinformed decisions by managers and entrepreneurs. Maturity models offer the potential to elucidate their digital roadmap (Zapata, Berrah & Tabourot, 2020), unlocking the actual potential of their technologies (Kääriäinen, Kuusisto, Pussinen, Saarela, Saari & Hänninen, 2020). These models allow for a multidimensional analysis that bridges organizational needs with operational insights (Trotta & Garengo, 2019), enabling SMEs to enhance their business performance through a systematic approach to digitalization (Depaoli et al., 2020).

According to certain authors like Wendler (2012), maturity models are commonly conceptualized as multi-dimensional frameworks. Some researchers have integrated evaluations of factors that influence a company's digital maturity into their models, such as leadership, ambidexterity, or technology integration (González-Varona, Acebes, Poza & López-Paredes, 2020; Pirola et al., 2019). Others adopt a business process management approach, focusing on the six core elements of BPM – strategic alignment, governance, method, information technology, people and culture – which are considered prerequisites for digital transformation, as they underpin the restructuring of business models (Fischer et al., 2020). Alternatively, some scholars deviate from traditional perspectives, delving into the correlation between competences and a company's level of digitalization, resulting in maturity models based on the theory of Digital Maturity Competences (DMC; Li et al., 2018).

Upon meticulous scrutiny of the literature, eight distinct dimensions emerge as commonly considered when devising assessment models for digital maturity: digital strategy and roadmap (Pirola et al., 2019; Eller et al. 2020; Zangiacomi et al., 2020), employee skill and culture (Jeansson & Bredmar, 2019; Pirola et al., 2019; Eller et al. 2020; Zangiacomi et al., 2020), organizational flexibility and adaptability (Pirola et al., 2019; Eller et al., 2020; Del Giudice et al., 2021; Park et al., 2020; Zangiacomi et al., 2020), information technology (Pirola et al., 2019; Eller et al., 2020), integration (Jeansson & Bredmar, 2019; Pirola et al., 2019), customers (Jeansson &

Bredmar, 2019; Pirola et al., 2019; Eller et al., 2020), external environment (Jeansson & Bredmar, 2019; Pirola et al., 2019; Del Giudice et al., 2021; Zangiacomi et al., 2020), and performance and benefits (Jeansson & Bredmar, 2019; Pirola et al., 2019; Eller et al., 2020; Zangiacomi et al., 2020).

3. Methodology

The present study has been conceived as a descriptive multiple case study, aligning with the works of Eisenhardt (1989), Eisenhardt & Graebner (2007), and Yin (2014). The case study methodology is particularly fitting when research inquiries are open-ended and aim to dissect intricate phenomena (Yin, 2014), such as the digitalization processes within SMEs. The overarching objective of this investigation is to unravel the underlying mechanisms and dynamics that govern the digitalization processes in SMEs. Given the nature of the research questions and its objectives, the most appropriate approach is to adopt the individual SME as the unit of analysis.

The European Union Commission (2014) defines micro, small, and medium-sized enterprises (SMEs) as entities employing fewer than 250 individuals, with an annual turnover not surpassing EUR 50 million, and/or an annual balance sheet total not exceeding EUR 43 million. Nonetheless, for the purposes of this study, only the small and medium-sized category was considered. Comparing with micro enterprises would introduce complexities due to substantial structural and financial differences. Additionally, for a more accurate comprehension of the digitalization potential, autonomous SMEs as classified by the European Union Commission (2014) were chosen as the research's unit of analysis.

The case selection process stands as a pivotal aspect in the construction of theory from cases (Eisenhardt, 1989). To bolster the external validity of this research, the adoption of multiple case studies is preferred over single case studies (Yin, 2014), since the intent to generalize findings necessitates the examination of a broader spectrum of cases. To maximize insights, a methodical approach to the sampling process was employed, yielding three primary dimensions: Industry (manufacturing vs. services); size (small $10 < AWU < 50$ vs. medium $50 < AWU < 250$); geographical location (Northern Italy, Central Italy, Southern Italy). In order to provide an overview as comprehensive as possible of the SME category, we have also mapped the economic sector of activity (Ateco 2007 classification), regrouped in order to narrow down the sectors to the only ones deemed suitable for carrying out the research. In particular: the "Agriculture, forestry and fishing" division was excluded because of the choice of focusing on manufacturing and services; "Public administration and defense; compulsory social insurance" and "Extraterritorial organizations and bodies" were considered out of scope; "Arts, sports, entertainment and recreation activities" and "Activities of families and cohabitation as employers for domestic staff, production of undifferentiated goods and services, for their own use by families and cohabitation" were evaluated as too specific and not strictly related to the industries under exam; the "Other service activities" group was deemed too broad and generic. Once the criteria for ensuring heterogeneity within the sample were settled, the actual search for cases was performed. This activity was carried out through the support of Bureau Van Dijk's AIDA database of Italian firms (*Analisi Informatizzata delle Aziende Italiane*), then contacted by phone calls, e-mails, or official websites. To understand whether the selected SMEs could be included in the research scope defined above, we verified through the websites: the accuracy of the information provided by AIDA; whether the firm was actually part of a larger group; whether the firm had access to significant external financial resources through other means. In some cases, the "staff headcount" required to be adjusted according to the number declared by the company. This meticulous selection process resulted in the assembly of a diverse sample comprising 18 cases, thoughtfully anonymized to ensure the confidentiality of the SMEs involved. Respondents were told at the beginning of the interview how the collected data would be used. Each interviewee was assigned an alphanumeric code, with which to report the citations in the paper.

After having transcribed verbatim each interview, a coding procedure was initiated, following the Gioia Methodology (Gioia et al., 2012). According to Strauss & Corbin (1998) coding is defined as "the analytical process of examining data line by line or paragraph by paragraph looking for significant events, experiences, feelings, and so on, that are then denoted as concepts". The first critical step is the definition of the coding strategy. Consistently with the design and purpose of the research described so far, a mix of deductive and inductive approaches was deemed the most appropriate solution. The procedure started with a within-case analysis and then moved to a cross-case synthesis to aggregate the findings and build a more robust basis for the development of a theoretical framework. In the first-order analysis, the attempt was to remain as faithful as possible to the words of the interviewees. In this perspective, both in-vivo and constructed codes have been adopted to label salient points of the collected empirical evidence. Despite the large number of labels generated, in this first phase little effort was made to distill categories. This was done on purpose following Gioia et al. (2012) advice of "getting lost before you can get found". Then, in the second-order analysis labels were grouped

together and categorized according to the corresponding sphere of pertinence. In this phase a process of triangulation between the evidence collected in the field and the theoretical realms related to SMEs digitalization was carried out, questioning each time whether the concepts developed were both consistent with the literature and able to explain the phenomena observed in reality (Gioia et al., 2012). Once the categories were formed, the process of abstraction went on with their further aggregation into themes. In this phase the focus was on two fronts: on one side themes validating extant theories and propositions emerged, while on the other side novel concepts for enriching the scientific framework “leaped out”. This process made it possible to break down the data collected by organizing them in a well-defined structure that lays the foundations and facilitates the presentation of the results and the discussion of the findings presented in the following chapters.

4. Findings

ID	Industry	Ateco code 2007	Geographic location	Staff headcount (adjusted)	Revenue	Balance sheet total	Interviewee role
M1	Manufacturing	255000 Forging, pressing, stamping and roll forming of metal; powder metallurgy	Puglia	241	34.916 k€	50.596 k€	General Manager
M2	Manufacturing	131000 Preparation and spinning of textile fibers	Piedmont	150	20.595 k€	32.526 k€	Marketing and communication manager + CEO
M3	Manufacturing	281200 Manufacture of fluid dynamic equipment	Lombardy	128	25.990 k€	37.812 k€	CEO
M4	Manufacturing	412000 Construction of residential and non-residential buildings	Lazio	84	24.943 k€	23.172 k€	Administrative manager
M5	Manufacturing	233200 Manufacture of bricks, tiles and other building products in terracotta	Lombardy	35	5.612 k€	10.161 k€	CEO + General manager
M6	Manufacturing	267011 Manufacture of optical elements and precision optical instruments	Veneto	31	7.858 k€	9.194 k€	CEO
M7	Manufacturing	110210 Production of table wines and v.p.q.r.d	Calabria	25	7.095 k€	15.890 k€	Marketing and sales manager
M8	Manufacturing	107120 Production of fresh pastry	Tuscany	14	1.023 k€	1.048 k€	CEO
S1	Services	370000 Collection and purification of waste water	Lazio	150	12.772 k€	9.020 k€	Safety, quality and environment manager
S2	Services	620100 Production of software not related to the edition	Emilia Romagna	112	22.282 k€	22.574 k€	CEO
S3	Services	494100 Transport of goods by road	Campania	87	15.386 k€	10.875 k€	CEO
S4	Services	467410 Wholesale of articles of iron and other metals (hardware store)	Lombardy	85	27.846 k€	32.620 k€	CEO
S5	Services	620100 Production of software not related to the edition	Lombardy	71	7.558 k€	8.730 k€	Governance and privacy manager
S6	Services	479130 Retail trade of any type of product by correspondence, radio, telephone	Emilia Romagna	65	2.722 k€	2.562 k€	Warehouse manager
S7	Services	869021 Physiotherapy	Molise	45	955 k€	7.808 k€	Managing director
S8	Services	551000 Hotels	Lombardy	42	1.300 k€	1.765 k€	CEO
S9	Services	662202 Insurance agents	Tuscany	40	2.815 k€	2.828 k€	CEO
S10	Services	782000 Activities of temporary work supply agencies (interim)	Lombardy	16	4.784 k€	2.163 k€	CEO + Service center manager

Figure 1: List of interviews

4.1 Internal Layer

Based on our interview findings, it is evident that skills, culture, adaptability, flexibility, and shared best practices are closely correlated with digital maturity and hold a pivotal role within SMEs. However, it is crucial to acknowledge that these dimensions are interconnected due to the pervasive nature of digitalization. In fact, a robust commitment and a mindset that prioritizes people facilitate the implementation of the digital roadmap with reduced effort. As emphasized by a participant, *"The most critical and most important asset is the people, because they are the ones who create the most value for any company. So, this is the first step, that is, having a team, having a company focused on the same goal and convinced to do so"* (S5, Governance and Privacy Manager). Technologies further enable enhanced information sharing and significantly influence organizational work methods, subsequently affecting the People & Culture dimension. This sentiment is echoed by another participant, *"We must, so to speak, facilitate integration between people. So, if this integration already exists within the supplier, that's fine, otherwise if this technology or need is not inherent to the suppliers we have, we try to find market-wide solutions that allow us to provide a solution to this thing, compatibly with what are the investments"* (M6, CEO).

4.2 External Layer

Now shifting to an external perspective, we delve into the environment within which SMEs operate. Our empirical evidence underscores that the roles of customers and suppliers in shaping digital maturity are inherently similar. Consequently, it can be confirmed that the behavior of both customers and suppliers positively influences technology adoption (Jeansson & Bredmar, 2019). However, some interviews also reveal the potential negative impact that these external actors might exert on digital maturity. In these scenarios, the mediating role of company size comes to light: when an SME is smaller than its customer base or its suppliers, the implementation or hindrance of digital initiatives by these external actors tends to be simpler. Conversely, when SMEs surpass their customers and suppliers in size, they can stimulate technology adoption throughout the supply chain. This factor substantially influences the evaluation of digital maturity, as certain companies, constrained by external factors, might struggle to digitalize processes and enhance their digital maturity.

A broader array of stakeholders, including competitors, consultants, universities, research entities, and public agencies, also contribute to the improvement of digital maturity. However, SMEs express that some stakeholders, such as consultants and universities, could enhance their contribution to digitalization efforts. As articulated by a participant, *"The facilitators of this, including the universities, competence centers, the digital innovation hubs, all these people here, including you, it's a bit of a mess"* (M3, CEO). Competitors wield a distinct influence, often driving companies to adopt projects due to market competitiveness. *"Sometimes we thought this was a waste of money, always like I told you from our parents. However, we gradually led them, through competitors, to change their mindset by telling them things like, 'Did you see? They did this, they have the website, they have...'. Let's say that we pushed them and this desire to excel led them to listen to us allowing us to catch up with the times"* (S3, CEO). The competitive market environment gives rise to several initiatives. The influence of competitors is pertinent across all scales of SMEs. Lastly, Digital Service Providers (DSPs) stand as the central reference point for all digital projects within SMEs. Their contribution extends beyond technology provision, as they also act as guides throughout the digital journey.

4.3 Relationship between Internal and External Layer

The factor that significantly contributes to defining digital maturity is the Applicability dimension. Positioned as an intermediary layer between SMEs and external actors, this dimension, despite its background role, exercises substantial influence over all other dimensions within the framework. On occasion, internal processes remain nondigitalized due to the analog version's superior effectiveness. As expressed by a CEO (M3), *"I don't know, the kanban with tags, maybe tomorrow we will also do the digital kanban, it already exists, and we can do it, but if the green, yellow and red card works perfectly, as has been done for thirty years in Toyota and twenty in Italy, it works well and its point of strength is also this stuff, why digitalize it?"* This phenomenon extends to the external perspective as well. The Applicability dimension shapes the dynamic between SMEs and their customers and suppliers, it molds the influence of Digital Service Providers (DSPs) on digitalization, and it sculpts the interactions between exogenous factors, other stakeholders, and SMEs.

4.4 The Environment

Throughout our interviews, the impact of the Covid-19 pandemic frequently emerged, underscoring it as an exogenous factor influencing digital transformation. This reinforces the notion that socio-economic conditions significantly mold organizational methods and practices, thereby affecting SMEs' digital maturity (Mandviwalla & Flanagan, 2021). For instance, a participant noted, *"In the period of Covid we could not go around and since we had to present the new collection...we created a virtual showroom to present the collection made using CAD...useful or not useful? At that moment it was required...However, at that moment, during the three-and-a-half-month lockdown, we created a virtual showroom"* (M2, Marketing and Communication Manager).

The overall technological know-how within the economy and the availability of required competencies to integrate these technologies hold a significant influence on digital maturity. This assessment pertains to the advancement of technologies within a specific context. While a technology might be immature and not implemented during a certain period, it may enable new processes and innovations over time. A participant aptly stated, *"In my opinion sooner or later we will also think of the metaverse, perhaps better sooner than later because maybe after it's late...Now the technology has a short life cycle"* (S5, Governance and Privacy Manager). This dynamic necessitates frequent recalibration of maturity models to ensure accurate assessment of SMEs, offering the potential for an innovative evolution in readiness models by accommodating varying time periods for assessments.

Furthermore, the Legal Framework significantly influences technology adoption. As several authors highlight, public institutions indeed impact SMEs' digitalization efforts, as echoed by our interviews. *"These are years of exceptional investments for us, because the various opportunities and tax advantages linked to 4.0 combined with Sabatini have given us crazy leverage"* (M5, CEO). Lastly, the geographical and socio-economic context should not be disregarded. In some instances, this external factor assumes the role of the primary catalyst for digitalization. *"The digitalization comes from, I would say 70 (external factor) and 30 (internal factor)"* (S9, CEO). Nevertheless, context-specific challenges can impede growth, as reflected in the sentiment, *"In Italy, personnel management is enough...we don't focus so much on people, that is, in Italy there are the lowest salaries in Europe"* (S9, CEO). Accounting for these dimensions in digital maturity evaluations is paramount, facilitating benchmarking among companies operating within diverse environments.

5. Findings and framework

5.1 An introduction to the framework

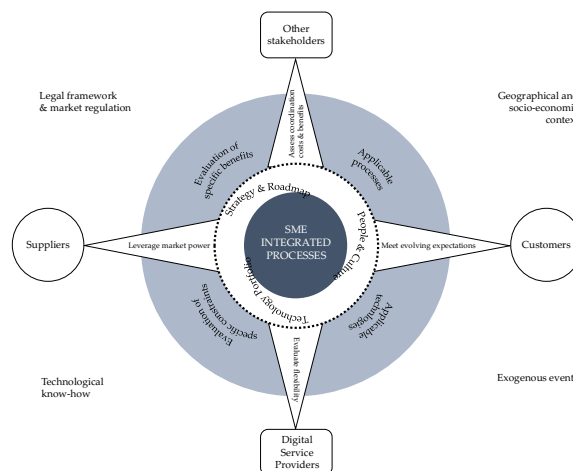


Figure 2: SMEs Digital Maturity Framework.

5.2 An introduction to the framework

The primary objective of this framework is to furnish a comprehensive guideline for the equitable evaluation of digital maturity, encompassing diverse perspectives for assessing small and medium enterprises. Consequently, Figure 1 illustrates the framework as a compass, signifying the principal dimensions that drive SMEs' digitalization endeavors while acknowledging the inherent nature of these enterprises. Our research involves refining the comprehension of the primary dimensions identified in existing research, with the aim of encompassing all SMEs, along with their unique characteristics and distinctions. The eight fundamental dimensions serve as the cornerstone for the proposed model, anchoring our research from a theoretical standpoint.

However, the framework's dimensions do not align exactly with those enumerated in the literature review; instead, certain dimensions are consolidated within a common theme. This is evident for the People & Culture dimension, which amalgamates Employee Skill and Culture alongside Organizational Flexibility and Adaptability. A similar grouping occurs in the Technology Portfolio dimension, which converges Integration and Information Technology.

5.3 Nucleus

Central to our framework, People & Culture, Technology Portfolio, and Strategy & Roadmap form the essence of SMEs, collectively converging into the Integrated Processes dimension that functions as a crucial connector. Our interviews emphasize the pivotal role of People & Culture as a catalyst for digitalization, thereby validating contributions from various seminal studies (Eller et al., 2020; Jeansson & Bredmar, 2019; Pirola et al., 2019; Zangiacomi et al., 2020). The Technology Portfolio dimension directly contributes to digital maturity, considering that digital technologies constitute the tools that facilitate transformation. Earlier research underscores the necessity of technology integration for digital maturity. The Strategy & Roadmap dimension, as the third dimension, is considered pivotal for digital maturity by a majority of authors (Eller et al., 2020; Jeansson &

Bredmar, 2019; Pirola et al., 2019; Zangiacomi et al., 2020). It is widely acknowledged that Strategy & Roadmap reflects a company's capability to implement, evaluate, and define digital objectives. However, further emphasis on this dimension is necessary, as existing literature scarcely addresses Strategy & Roadmap from the perspective of service-oriented SMEs. By considering Strategy & Roadmap, the framework accommodates the diverse nature of SMEs, whether they are engaged in manufacturing or services, enabling a tailored assessment approach. These dimensions substantially influence the Integrated Processes dimension. Nonetheless, when authors develop models and assessment tools focusing on production processes, the categories often pertain strictly to manufacturing machinery, sensors, and products.

5.4 Relationships

Processes transcend SME boundaries, establishing connections with other entities in the framework. Within the SME network, four pivotal relationships warrant attention, represented as the cardinal points: Customers, Suppliers, Digital Service Providers (DSPs), and Other Stakeholders. Customers' significance is echoed in other studies (Eller et al., 2020; Jeansson & Bredmar, 2019; Pirola et al., 2019), while the role of suppliers garners less mention. Our findings, however, indicate that the roles of customers and suppliers in shaping digital maturity are fundamentally akin. Thus, it can be confirmed that the behavior of both customers and suppliers positively influences technology adoption (Jeansson & Bredmar, 2019). While seminal studies acknowledge DSPs' role in digital transformation, none highlight their substantial contribution to SMEs. In our research, DSPs are shown to exert a positive impact on digitalization, particularly in the context of Strategy & Roadmap, People & Culture, and the Technology Portfolio. Applicability influences interactions between SMEs, customers, suppliers, DSPs, external factors, and other stakeholders. Consequently, Applicability serves as a filter that guides interactions among framework entities, aligning with SMEs' pursuit of benefits.

5.5 Context

Lastly, informed by interview insights, the context should be assessed based on technological know-how, exogenous events, the legal framework, and geographical and socioeconomic conditions. Our interviews reveal that assessing digital maturity warrants an evolving approach; this accommodates instances where an SME might be deemed digitally mature within a specific context, only to transition to digital immaturity as the context evolves. This feature endows our model with the capacity to reflect potential demotion to lower digital maturity levels. Furthermore, the four elements comprising the external layer of our framework should be viewed as interconnected components.

6. Managerial and policy implication

This framework presents significant opportunities for small and medium-sized enterprises and policymakers. The use of digitalization level assessments – which consider only the elements present in the core of the model (People & Culture, Strategy & Roadmap, Technology Portfolio) – can undoubtedly enable individual SMEs to develop a digital transformation strategy. This approach is appropriate and effective in formulating transformation strategies at the level of individual companies, and it is well-suited for consulting firms and technology transfer centers that support small and medium-sized enterprises. Furthermore, this approach could be well-suited for companies that are at the beginning of their digital transformation journey. However, the utilization of a comprehensive digital maturity model can serve in developing the awareness that a digital transformation process shouldn't be merely seen as the digitization of processes or the organization, but as a growth journey in which the stakeholders with whom the company interacts and the technical, socio-economic, and regulatory context in which the small to medium-sized enterprise operates are also involved. The development of this awareness is important, as it can lead the entrepreneur to view digital transformation not only as a tactical response to opportunities or challenges that may arise, but also as a strategic response that could potentially lead to a reconsideration of their own business model.

Developing a comprehensive model that maps the digital transformation of small and medium-sized enterprises presents significant advantages for policymakers. Firstly, it can enable them to devise effective public policies to support digitalization that can assist SMEs considering the economic and technological landscape within which businesses operate. Secondly, it can allow them to pursue a dynamic analysis of digital maturity within a country,

considering not only the socio-economic context and external events but also the legal framework and regulations. This approach might also demonstrate greater efficacy in countries where the digital transformation process is already underway and widespread. Thirdly, the development of a comprehensive model can facilitate comparative analyses among different countries, thanks to the emphasis placed on the "relationships" layer and the context.

The development of a comprehensive digital maturity model should not be seen as an alternative tool to the individual assessment, but rather should be used as a complementary tool. These approaches should be used jointly to both navigate SMEs' digital journeys but also to enable policymakers to craft informed and effective policies that foster digitalization across diverse business landscapes.

7. Concluding Remarks, Limitations, and Future Directions

This research attains a dual objective: it both confirms dimensions underscored by previous researchers, enhancing them with finer details, and diverges from contributions exclusively tailored for large or manufacturing companies, offering a distinct digital maturity model tailored for SMEs. Yet, limitations persist. Firstly, this study offers a "high-level" perspective, with interviews solely involving C-level managers and executives. Future research could incorporate a broader array of informants from varying hierarchical levels. Secondly, a scarcity of diverse viewpoints from other ecosystem actors represents another limitation. Exploring the phenomenon from different vantage points, such as vendors, could complement and refine our understanding of SMEs' digitalization processes. Thirdly, the effective application of the model to assess SMEs' digital maturity merits attention. Future research should focus on identifying scales and evaluation criteria for the framework's constituent variables. Lastly, the qualitative nature of our methodology restricts the generalizability of findings in terms of numerosity and heterogeneity. This limitation aligns with our research purpose, which necessitated an in-depth investigation to establish a theoretical foundation for comprehending SMEs' digitalization rationale. Nonetheless, future research could enhance generalizability by addressing "idiosyncratic phenomena" (Eisenhardt, 1989) through two pathways:

- Quantitative-research approach: Complement the interpretive-oriented interview approach with more statistical-oriented research.
- Enhanced Heterogeneity: Expand geographical scope or include additional sectors to introduce more diversity within the sample.

Given these limitations, the presented framework is not an end in itself; rather, it marks a preliminary starting point that paves the way for new research avenues.

References

- Amaral, A., & Peças, P. (2021). SMEs and Industry 4.0: Two case studies of digitalization for a smoother integration. *Computers in Industry*, 125.
- Cavallo, A., Ghezzi, A., & Ruales Guzman, B. V. (2020). Driving internationalization through business model innovation: Evidences from an AgTech company. *Multi-national Business Review*, 28(2), 201-220.
- Denicolai, S., Zucchella, A., & Magnani, G. (2021). Internationalization, digitalization, and sustainability: Are SMEs ready? A survey on synergies and substituting effects among growth paths. *Technological Forecasting and Social Change*, 166(December 2020).
- Del Giudice, M., Scuotto, V., Papa, A., Tarba, S. Y., Bresciani, S., & Warkentin, M. (2021). A Self-Tuning Model for Smart Manufacturing SMEs: Effects on Digital Innovation. *Journal of Product Innovation Management*, 38(1), 68-89.
- Depaoli, P., Za, S., & Scornavacca, E. (2020). A model for digital development of SMEs: an interaction-based approach. *Journal of Small Business and Enterprise Development*, 27(7), 1049-1068.
- Eisenhardt, K. M. (1989). Building Theories from Case Study Research. *Academy of Management Review*, 14(4), 532-550.
- Eisenhardt, K. M., & Graebner, M. E. (2007). Theory building from cases: Opportunities and challenges. *Academy of Management Journal*, 50(1), 25-32.
- Eller, R., Alford, P., Kallmünzer, A., & Peters, M. (2020). Antecedents, consequences, and challenges of small and medium-sized enterprise digitalization. *Journal of Business Research*, 112(March), 119-127.
- European Union Commission. (2014). Official Journal. *Official Journal of the European Union*, 57(467), 216.
- Ghezzi, A., Georgiades, M., Reichl, P., Le - Sauze, N., Di Cairano - Giffedder, C., & Managiaracina, R. (2013). Generating innovative interconnection business models for the future internet. *info*, 15(4), 43-68.
- Ghezzi, A., Rangone, A., & Balocco, R. (2013). Technology diffusion theory revisited: a regulation, environment, strategy, technology model for technology activation analysis of mobile ICT. *Technology Analysis & Strategic Management*, 25(10), 1223-1249.

- Gioia, D. A., Corley, K. G., & Hamilton, A. L. (2012). Seeking Qualitative Rigor in Inductive Research: Notes on the Gioia Methodology. *Organizational Research Methods*, 16(1), 15–31.
- González-Varona, J. M., Acebes, F., Poza, D., & López-Paredes, A. (2020). Fostering Digital Growth in SMEs: Organizational Competence for Digital Transformation. *Working Conference on Virtual Enterprises*, 237–248.
- Jansson, J., & Bredmar, K. (2019). Digital transformation of SMEs: Capturing complexity. *32nd Bled EConference: Humanizing Technology for a Sustainable Society, Bled, Slovenia, June 16-19, 2019*, 523–541.
- Jocevski, M., Arvidsson, N., & Ghezzi, A. (2020). Inter-connected business models: present debates and future agenda. *Journal of Business & Industrial Marketing*, 35(6), 1051–1067.
- Kääriäinen, J., Kuusisto, O., Pussinen, P., Saarela, M., Saari, L., & Hänninen, K. (2020). Applying the positioning phase of the digital transformation model in practice for smes: Toward systematic development of digitalization. *International Journal of Information Systems and Project Management*, 8(4), 24–43.
- Klohs, K., & Sandkuhl, K. (2020). Digitalization of Small and Medium-Sized Enterprises: An Analysis of the State of Research. In *Lecture Notes in Business Information Processing* (Vol. 394). Springer International Publishing.
- Li, L., Su, F., Zhang, W., & Mao, J. Y. (2018). Digital transformation by SME entrepreneurs: A capability perspective. *Information Systems Journal*, 28(6), 1129–1157.
- Mandviwalla, M., & Flanagan, R. (2021). Small business digital transformation in the context of the pandemic. *European Journal of Information Systems*, 30(4), 359–375.
- Mittal, S., Khan, M. A., Romero, D., & Wuest, T. (2018). A critical review of smart manufacturing & Industry 4.0 maturity models: Implications for small and medium-sized enterprises (SMEs). *Journal of Manufacturing Systems*, 49(June), 194–214.
- Mittal, S., Romero, D., & Wuest, T. (2018). Towards a smart manufacturing maturity model for SMEs (SM3E). In *IFIP Advances in Information and Communication Technology* (Vol. 536). Springer International Publishing.
- OECD (2020), "Coronavirus (COVID-19): SME policy responses", *OECD Policy Responses to Coronavirus (COVID-19)*, OECD Publishing, Paris.
- Park, Y. K., Pavlou, P. A., & Saraf, N. (2020). Configurations for achieving organizational ambidexterity with digitization. *Information Systems Research*, 31(4), 1376–1397.
- Pirola, F., Cimini, C., & Pinto, R. (2019). Digital readiness assessment of Italian SMEs: a case-study research. *Journal of Manufacturing Technology Management*, 31(5), 1045–1083.
- 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.
- Trotta, D., & Garengo, P. (2019). Assessing Industry 4.0 Maturity: An Essential Scale for SMEs. *Proceedings of 2019 8th International Conference on Industrial Technology and Management, ICITM 2019*, 69–74.
- Wendler, R. (2012). The maturity of maturity model research: A systematic mapping study. *Information and Software Technology*, 54(12), 1317–1339.
- Yin, R. K. (2014). Case Study Research: Design and Methods 5th edition. *S.l.: SAGE Publications*.
- Zangiacomi, A., Pessot, E., Fornasiero, R., Bertetti, M., & Sacco, M. (2020). Moving towards digitalization: a multiple case study in manufacturing. *Production Planning and Control*, 31(2–3), 143–157.
- Zapata, M. L., Berrah, L., & Tabourot, L. (2020a). Is a digital transformation framework enough for manufacturing smart products? The case of Small and Medium Enterprises. *Procedia Manufacturing*, 42, 70–75.

The Impact of Prototyping on the Survival Chances of Digital Early-Stage Startups: Findings and Insights from Explorative Expert Interviews

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Abstract: The products of digital entrepreneurs are highly innovative, and their business models contribute to the prosperity and further development of the economy and society. However, studies indicate that most of all startups fail, particularly during the early stages of their business journey. Prototyping as part of Lean Startup or Business Model Testing approaches, can assist digital early-stage startups in navigating uncertainty and achieving successful product launches. However, these methods are applied very individually and there is little empirical research on best practices. We therefore conducted 65 explorative expert interviews and asked successful startups about their prototyping practices. Our results include learnings on the prototyping process and the testing format, the role of the founding team during prototyping practices, the customer focus and the role of networks. Our study adds important details to theory and practice of the innovation and prototyping processes of digital early-stage startups. Our results offer actionable advice and guidance to any current and potential entrepreneur, but especially to first-time founders and less experienced executives in early stage-startups. Additionally, our contribution enhances the theoretical understanding of the Lean Startup approach and prototyping practices.

Keywords: business model, prototyping, Lean Startup, expert interviews, digital entrepreneurs

1. Introduction

‘A startup is a human institution designed to create a new product or service under conditions of extreme uncertainty.’ (Ries, 2011) The products of startups stand for innovation and technological progress, and their business models are often highly digital. Startups are innovation drivers for economic and social progress, are hopefuls for the creation of new jobs, are growth-oriented and their product or business model is highly innovative (Blank & Dorf, 2014; Kollmann et al., 2017). However, many of them fail especially in the early stages (CB Insights, 2021; Lai & Lin, 2015). The early stage is divided into the seed phase and the startup phase. The seed phase is the pre-founding phase. In the seed phase, there is only an idea for a product, a service or a prototype that has not yet been fully developed. The startup phase comprises the steps from founding the company to market launch. An advanced prototype exists, or the product is largely fully developed and must be prepared for market launch. (Deutsche Startups, n.d.). The primary factors contributing to the uncertainty of early-stage startup processes are the highly volatile and unpredictable conditions in which startups operate.

There are different theoretical approaches that discuss early-stage entrepreneurial innovation processes like the Lean Startup (Ries, 2011), Effectuation (Sarasvathy, 2001) or Business Model Testing (Bland & Osterwalder, 2019). Prototyping is an essential aspect of the early-stage innovation process of startups. Prototypes are ‘working models’ and function like a steppingstone on the journey towards a new product, service or Business Model (Tidd & Bessant, 2019). The principle of creating a minimum viable product (MVP) (Ries, 2011) is a certain kind of prototype. According to Ries (2009), ‘the minimum viable product is that version of a new product which allows a team to collect the maximum amount of validated learning about customers with the least effort.’ This kind of prototype is used by many successful startups nowadays. However, in practice the innovation process and the implementation of prototyping is still done in a very individual way. Important learning only crystallizes over time without being systematically recorded. Therefore, our research focusses on best practices and learnings of successful digital entrepreneurs. The main research questions are: How did digital entrepreneurs in their early stages effectively transform their innovative business ideas into tangible, market-ready products? How did they validate their ideas? What role did prototyping play in their innovation process? What can we learn from their successes? There is little empirical data on the role of prototyping in the innovation process of startups (Shepherd & Gruber, 2021; Dahle & Steinert, 2016; Gutbrod & Tichy, 2017). We therefore conducted 65 explorative expert interviews with founders of successful digital startups to discuss their experiences. We only talked to founders or core team members of startups with digital products and business models whose context is shaped by a high level of uncertainty and who are situated in Germany. Further, we focused on startup companies that are already successful in the market for a couple of years.

2. Theoretical background

Entrepreneurial processes, especially in the early stages of business development, are extremely uncertain. At the beginning, entrepreneurs almost never know what the final product, business model or service will look like. Often their approaches are very different from the patterns of established firms (Richter et al., 2018). Entrepreneurs navigate through an environment of constant uncertainty. In addition to external uncertainty, there is the liability of newness (resource poverty, lack of legitimacy, weak ties and weakness in competition) faced by innovation driven digital startups. Digital startups are often also referred to as technology startups and defined as follows: "Companies whose purpose is to bring technology products or services to market. These companies deliver new technology products or services or deliver existing technology products or services in new ways." (Funderclub, n.d.). Only 40% of the companies survive the first years of their existence (Lai & Lin, 2015). For digital startups, the survival rate is often even lower than that of traditional small or medium-sized companies because the degree of uncertainty is higher. Digital and innovative startups are not only new to the market but also differ from existing companies in terms of their product, business model, and the market they serve (Amason et al., 2006). The aim is therefore to find out what role prototyping plays in the innovation process for the survival chances of digital startups. Most of the time, the reasons lie with the founders or employees or their attitude. Founders education, industry experience and team composition are found to have a high impact on startup survival (Eliakis et al., 2020; Song et al., 2008; Richter, 2018). In part, the reasons for the success or failure of startups are also seen in the existing networks and the extent to which strong and weak ties influence important founding processes such as discovering opportunities, securing resources, and obtaining legitimacy (Elfring & Hulsink, 2003; Eliakis et al., 2020; Welter, 2011). From our literature review we observed that various parameters such as team, context or product influence a successful entrepreneurial process. But the process itself also plays an important role. While founders may be well-educated and possess relevant industry experience, without a viable business idea or opportunity, a successful market launch becomes unattainable.

The business idea can be the result of a discovery or creation process (Alvarez & Barney, 2007). In the Discovery School principles are based on systematic analysis and evidence ("thinking first"). The reduction of uncertainty is done through extensive research and planning. Goals and strategies are initially set and actions are guided by plans. An example in startup practice is the business plan. In the Creation School approaches and, principles are based on pragmatic action ("doing first"). The focus lies on the reduction of uncertainty through early interaction with customers and learning effects. Goals and strategies are readjusted or emerge during the process. An example in startup practice is the Lean Startup method. Research shows that both approaches are important, but that especially in the early stages, the Creation School such as the Lean Startup method, that focuses on prototyping, are more likely to lead to success than the Discovery School (Brinkmann, 2010; Grichnik et al., 2017).

The starting point of the Lean Startup methodology is a high level of uncertainty, which is why only a few entrepreneurial ideas are successfully implemented (Blank, 2013). Following the Lean Startup approach uncertainty can be diminished by continuously formulating working hypothesis related to business ideas, testing the validity of them and thereby quickly expanding the knowledge base (Mansoori & Lackeus, 2019; Murray & Tripsas, 2004). The build-measure-feedback loop is a model which shows how to build the future through testing thoroughly designed hypothesis. Tactics are targeted experiments, interviews with customers, physical prototypes, A/B Tests, concierge MVPs, or fake door tests (Mansoori & Lackeus, 2019). The Lean Startup approach has its origins in the entrepreneurial practice. The basic idea is to turn away from traditional planning and move towards fast action and fast failure. The maxims are, therefore, to experiment instead of planning in detail, to develop iteratively instead of making high investments in advance, and to seek customer interaction and feedback instead of relying solely on the intuition of the founder (Grichnik et al., 2017). There is already some research on the survival and growth of digital startups (Eliakis et al., 2020; Song et al., 2008; Richter et al., 2018) but none with a focus on the role of prototyping processes for digital early-stage startups. Our research fills this gap and asks for the most important factors that can positively influence the prototyping of startups in the innovation process.

3. Methodology and data collection: Explorative expert interviews

Explorative expert interviews were conducted to investigate the research field. The focus of the interviews was on collecting information on a relatively unexplored subject. Up to now, there have been only a few qualitative empirical studies on prototyping processes of early-stage digital startups (Shepherd & Gruber, 2021; Dahle & Steinert, 2016; Gutbrod & Tichy, 2017). Therefore, new scientific hypotheses and theories need to be developed. This will provide a basis for further research on the topic. The expert interview is a special method of the

explorative interview. In an expert interview, the focus is on gaining knowledge from people who have special and retrievable knowledge in their field through their function or profession (Mayer, 2013). Nevertheless, the personal perspective of the interviewee usually influences the statements obtained in the interview. For this reason, information on a subject should be gathered from several interviewees. In our case, we interviewed only successful entrepreneurs who have already founded one or more companies, and whose companies have been successful in the market for several years. A total of 65 entrepreneurs were interviewed to provide at statements that go beyond purely personal perspectives. Each interview lasted about 40 minutes. 'Expert interviews were conducted for as long and as many times as necessary until all the information needed to answer the research question had been collected and repetitive statements were made on specific topics' (Gläser & Laudel, 2010, p. 117f). The transcripts were read and text sections of interest were marked and given headings (Meuser & Nagel, 2002). After reviewing all the interviews, topics were grouped together and marked with codes. The codes were formed only for topics that appeared repeatedly in different interviews (Meuser & Nagel, 2002). Finally, correlations between the codes were examined and interpretations formulated. This interpretation is presented below.

4. Results

A total of 65 founders from Germany were interviewed. All of the companies surveyed are still active in the market. The average age of the founders at the time of the survey was 38 years. The average age at the time of founding was 31 years. A majority of the founding teams consist of 2 or more founders (90.4% in total). A quarter of the respondents are female (26%). Despite this low proportion, women are slightly overrepresented in this survey compared to the total of German startups (according to the German Startup Monitor, the proportion of women in startups is 20.3%). The startups are predominantly in the digital sector (e. g. FoodTech, FinTech, RetailTech, GreenTech, HRTech, MarTech, Travel-Tech, IoT, MedTech, InsuranceTech, AI, HealthTech, 3D Printing, BioTech, VR/AR). Out of all the founders, 52.1% are focused on B2B (business-to-business), 15.1% on B2C (business-to-consumer), and 32.9% on both B2B and B2C. A clear majority of the founders rate the innovation and complexity of their own products as high or very high (Likert scale: low, rather low, medium, rather high, high). None of the founders estimate the degree of innovation of their own products as low. With regard to the novelty of the market, over 60% of the founders rate the degree of novelty as high. Only a few of the respondents rate the degree of market novelty as rather low. The customer pain point is rated as high. The intensity of competition is rated as high or very high. Accordingly, the interviewees are primarily startups that operate in a highly uncertain environment. Based on our explorative expert interviews we identified four different themes and associated sub-themes (see table 1).

Table 1: Findings from explorative expert interviews with 65 startup founders

1 The Founding Team	
code 1.1	Team composition
code 1.1.1	Idea phase and development phase often start with the participation of at least 2 persons.
code 1.1.2	Having a diverse team for prototyping, including technical experts (like computer scientists or engineers), can be advantageous, but it is not necessarily essential for testing ideas via prototyping.
code 1.2	Knowledge Acquisition
code 1.2.1	Testing becomes crucial when there is insufficient market knowledge.
code 1.2.2	Testing is conducted not only in situations where there is limited market knowledge, but also when there is a need for qualitative product improvement.
code 1.2.3	Industry experience is not a prerequisite but helpful to shorten the process of experimentation.
code 1.3	Attitudes and behaviour of the founding team
code 1.5	Testing requires an experimental behaviour and attitude on the part of the founding team.
code 1.6	The founder knows whether to stick to an idea or abandon it (pivot or persevere).
code 1.7	The founder is aware of the open-endedness of the innovation process and acts pro-actively to achieve results.
code 1.8	Founders should personally conduct experiments and gain experience to optimize their own learning curve and learn from mistakes.
code 1.9	Conducting experiments is open, playful and yet rigorous in evaluation.
code 1.10	Testing requires courage and stepping out of the comfort zone.
code 1.11	Intrinsic motivation supports perseverance in the experimentation process.
2 Prototyping Process and MVP	
code 2.1	Timing, speed, frequency and type of testing are important factors for successfully dealing with uncertainty in the innovation process of early-stage entrepreneurs.
code 2.1.1	Prototyping is carried out until a product-market fit has been achieved. When a scalable Business Model is found, prototyping ends for the time being. Some entrepreneurs warn against ending prototyping too early.
code 2.1.2	Testing of the idea should start very early. The aim is to make sure that a market exists before market entry.

code 2.1.3	It does not remain with one test, but the potential product is continuously tested in the different development stages with a certain, increasingly specific customer base.
code 2.1.4	Prototyping increases the speed of the innovation process for startups. The time used plays a significant role due to the limited resources available.
code 2.1.5	At the heart of prototyping is the learning process. This involves learning from customer feedback and founder's mistakes.
code 2.2	The prototype (MVP) must have certain characteristics so that it can be successfully used in the innovation process of startups
code 2.2.1	Tests are deliberately open in nature and quickly prepared and executed. They invite collaboration.
code 2.2.2	Focus on necessary product components is crucial. Often the application is thought too complex at the beginning.
code 2.2.3	Testing can be done very cheaply with the help of digital tools and programmes. Therefore, prototyping is especially but not only suitable for startups in the digital sector.
code 2.2.4	At the beginning of prototyping, products and designs from competitors serve as inspiration for the creation of an MVP.
code 2.2.5	(Mega-)trends such as sustainability or health are reflected by founders and consciously used in the creation of MVPs.
code 2.2.6	In prototyping, not only the product but the entire Business Model is usually tested (customer relations, channels, revenue generation, ...).
code 2.2.7	Founders know different types of prototypes and use them consciously (the following prototypes are most commonly used: A/B tests, interviews, concierge test, storytelling, pop-up stores, mailings, flyers, posters, surveys, 3D prints, Power Point presentations, events).
code 2.2.8	Storytelling accompanies the use of prototyping. Clear, structured and open communication is essential.
code 2.2.9	When using prototypes, the measurability of the pre-defined hypotheses must be ensured.
code 2.2.10	Fake it until you make it! The prototype is representative of the final product or service. The customer usually does not know that the final product does not yet exist.
3 Customer Focus	
code 3.1	Nature of relationship with the customer
code 3.1.1	The potential customer is at the centre of prototyping in the innovation process of startups as a partner and target group.
code 3.1.2	During the initial stages of the innovation process, prioritizing customer interaction and feedback is more crucial than achieving technical perfection of the prototype.
code 3.1.3	Prototyping is about a deep engagement with customer needs, not about scaling (Do things that don't scale!).
code 3.1.4	Startups often commence with close collaboration with a small, typically homogeneous customer group, gradually expanding the customer base as they progress.
code 3.1.5	Where the customer pain is high, customers have a high willingness to participate in the product development or prototyping process. (e.g., in the construction industry or in the recruitment sector).
code 3.1.6	For ideas/opportunities that are complex in nature, cooperation with customers is even more central for a startup.
code 3.1.7	Customer feedback should always be questioned and critically reflected upon by the founder. Often it serves to give food for thought. Sometimes customer feedback is misleading and should therefore not be implemented by the founder.
code 3.1.8	Test customers are often converted to permanent customers. Therefore, prototyping can also be seen as a form of customer acquisition especially for B2B startups.
code 3.1.9	Prototyping serves to build up or increase trust and legitimacy on the customer side.
code 3.2	Goals of customer interaction
code 3.2.1	Testing aims to identify the right customers and to understand and satisfy the real customer needs.
code 3.2.2	Testing is used to evaluate the willingness to pay and the pricing level with the help of potential customers.
code 3.2.3	The level of payment for an unfinished product is not the focus of testing. Rather, it is about checking the existing commitment of potential customers and thus their feedback quality.
code 3.2.4	Testing helps to define the target markets (regional/national/international).
4 Networks	
code 4.1	Characteristics of networks
code 4.1.1	Networks are of high relevance for the prototyping process.
code 4.1.2	Network building should be very specific to the individual product and market.
code 4.1.3	Networks influence the final characteristics of the product and Business Model.
code 4.1.4	Coincidence often plays an important role in the creation of suitable networks. It is therefore important for a startup to get the idea out and tell the public about it.
code 4.1.5	Founders talk openly about their ideas in relevant networks. The fear of idea theft can be assessed as rather low.
code 4.2	Network partners
code 4.2.1	Testing involves the use of existing networks including friends and family as well as their targeted extension.
code 4.2.2	Social media networks are important for reducing uncertainty in the startup process as well as for customer acquisition. LinkedIn is the most relevant B2B social network, especially if there are no relevant industry contacts.
code 4.2.3	Networks to traditional media are relevant. Coverage in traditional media (PR) increases credibility and trust in startup projects and has a high impact on success during and after the prototyping process.
code 4.2.4	Crowdfunding, accelerator programmes, startup competitions and events are significant networking activities in the context of prototyping.

5. Discussion

The majority of the entrepreneurs interviewed acknowledged consciously adopting the Lean Startup approach for their prototyping process, even if they were not explicitly asked about it. However, the question arises as to how exactly the methodology was applied and what learnings result from it.

5.1 The founding team

Following our study, startup ideas are almost exclusively developed by teams (more than 90 %) (code: 1.1.1). In the Lean Startup approach (Ries, 2011), the founder is usually supported by a team. Depending on the characteristics, these people can also be replaced by others. Our research shows, that teams are not dependent on technical expertise when prototyping (code: 1.1.2). An experimental attitude holds greater significance than technical know-how (codes: 1.5, 1.1.2). Founders conduct experiments themselves (code: 1.8). Delegation of this critical task to others is discouraged. Our study further demonstrates that founders rely on intuition or draw from their experience to determine whether to persevere with an idea or to pivot (code: 1.6). Not all teams have previous experience in founding (code: 1.2.3). The teams interviewed confirmed that prototyping supports the development of knowledge about the market and the improvement of the product quality (codes: 1.2.1, 1.2.2).

Following the methodology, the acquisition of knowledge plays a pivotal role in the entrepreneurial process. It is expanded through the entrepreneur's information gathering activities, where they explicitly embrace contingencies and surprises (Mansoori & Lackéus, 2019). According to our expert entrepreneurs prototyping is seen as a playful process, but the focus is on rigorously measuring hypotheses (code: 1.9). Founders frequently step out of their comfort zone while testing business ideas, driven by their intrinsic motivation to persist until the product-market fit is achieved (codes: 1.10, 1.11). The Lean Startup (Ries, 2011) underlines that redirections happen any time, when new information is discovered. Almost all experts interviewed follow this logic.

5.2 Prototyping process and MVP

Our research shows that the process of prototyping is preferably carried out until a product-market fit is achieved and should not end earlier (code: 2.1.1). Further, the experimental prototyping process should begin as early as possible (code: 2.1.2). The process does not stop at one test, but is repeated and carried out with an increasingly specific customer base (code: 2.1.3). Prototyping accelerates the early-stage innovation process, which is why prototyping helps to save resources (code: 2.1.4). The focus is on the learning process, which is primarily fed by customer feedback and the founder's reflection on his or her mistakes (code: 2.1.5). The Lean Startup approach puts iterative processes that are triggered by feedback and learning opportunities at center stage. Feedback from the external environment is the source of continuous learning. Continuous learning shapes the path of the innovation process (Mansoori & Lackéus, 2019; Minniti & Bygrave, 2001). Our findings are in line with the Lean Startup methodology. We add further details and found out that timing, speed, frequency and the testing format are important for successful prototyping experiments (code: 2.1). Prototyping typically centers around the product or service, but it encompasses the entire business model as well. Founders rigorously test hypotheses that result from the initial design of the business model. Business models are often designed by drawing inspiration from competitors, which serves as a starting point (code: 2.2.4). Existing social trends such as sustainability also influence the early prototyping phase (code: 2.2.5). Founders should make sure that the first product draft is not too complex and contains only the most necessary features to test the customer benefits.

The prototype must have certain characteristics in order to be used successfully in the prototyping process. First of all, it must be openly designed and quickly prepared. It serves the purpose of social cooperation (code: 2.2.1). Test formats are inexpensive to produce (code: 2.2.3). The prototype must fit the product or business model and should be designed to allow hypothesis testing (code: 2.2.6). Most commonly used are A/B tests, interviews, concierge tests, storytelling, pop-up stores, mailings, flyers, posters, surveys, 3D prints, power point presentations and events (code: 2.2.7). The prototype is embedded in a clearly structured and open storytelling or narrative (code: 2.2.8). Although the prototype represents the final product or business model, the customer is usually not aware that it is only a prototype he or she is using/testing (code: 2.2.10). In the Lean Startup methodology (Ries, 2011) instead of a comprehensive business plan, founders use a business model approach such as the Business Model Canvas framework (Osterwalder & Peigneur, 2010). Using the nine building blocks of the canvas framework, they summarize their hypotheses. A network of users or partners acts as a feedback provider to test hypotheses. Value is created not only for the customers but also for entrepreneurs and their collaborators. In both cases value creation is the goal of the entire entrepreneurial process (Mansoori & Lackéus, 2019).

5.3 Customer focus

Customer focus is the most frequently mentioned topic by the entrepreneurs interviewed. The customer is a partner at eye level and a target group in equal measure (code: 3.1.1). Founders therefore emphasize the importance of direct customer contact and interaction (code: 3.1.2). The founder should proactively engage with potential customers by being present in places where they are likely to be found. Close cooperation with the customer is more important than the technically perfect implementation of the prototype and deep engagement is more important in the prototyping phase than scaling activities (codes: 3.1.2; 3.1.3), which is in line with the Lean Startup methodology (Ries, 2011). The primary objective of prototyping is to identify the ideal customers and gain a deep understanding of their needs in order to tailor the product accordingly. Identifying willingness to pay and pricing are further goals of prototyping (code: 3.2.2). This is not primarily about the amount of payment, but also about determining the sincerity of the customer's interest in order to be able to assess the respective value of the customer feedback (code: 3.2.3). The greater the need and the customer pain, the more potential customers are willing to cooperate with founders (code: 3.1.5). During the prototyping process, a relationship of trust develops between founders and clients (code: 3.1.9). Frequently, test customers become the founders' initial paying customers (code: 3.1.8). In the early stages, the customer base is typically small and relatively homogeneous, gradually expanding over time as the process unfolds (code: 3.1.4). The founder must be able to critically reflect on customer feedback. Not every hint mentioned by the customer should be taken into account by the founder (code: 3.1.7). Therefore, customer interaction is a permanent process of negotiation.

Some aspects of the Lean Startup approach (Ries, 2011) could be confirmed by this empirical study. For example, the founder should distance himself from customers and critically reflect customer feedback. Nevertheless, the customer is more than just a feedback provider. Moreover, our study identifies significant characteristics of customer interaction, which yield insights that are subsequently utilized for further refinement of the business model or product idea (Ries, 2011).

5.4 Networks

Existing and emerging networks are indispensable prerequisites for the prototyping process (code: 4.1.1). Networks are continuously expanded at the beginning of prototyping. In particular, close connections to a specific network of potential customers are established. The interaction with the existing network significantly impacts the ongoing evolution of the business model (code: 4.1.3). Social media networks such as LinkedIn are of very high relevance, especially in the B2B sector (code: 4.2.2). But also, connections to traditional media have an impact, as they increase the trust in the team and their product, which in turn has a positive effect on the interaction with potential customers (code: 4.2.3). Important networking activities during prototyping are also participation in crowdfunding campaigns, accelerator programs and startup competitions (code: 4.2.4). Founders talk proactively and frequently about their ideas and thus increase the likelihood of finding the right partners.

The fear of idea theft is typically not a significant concern for most founders (code: 4.1.5). Existing research underlines that interactions with others are crucial for entrepreneurs (Sarasvathy & Venkataraman, 2011). They interact with stakeholders who are involved in the innovation process and stakeholders who only indirectly influence the trajectory of the value creation (Mansoori & Lackeus, 2019). The network concept of the Lean Startup approach, however, is not sufficient to represent the presented importance of different stakeholder groups. In a large part of the interviews, network partners such as family, friends, other founders, as well as acquaintances, play an important role. Here, the network concept of the Effectuation approach (Sarasvathy, 2001) seems more suitable as a basis for explanation. In Effectuation the management of social networks is an important aspect of integrating customers, suppliers or users into the innovation process. The concept of the team is broader and the boundaries are fluid and permeable.

6. Conclusion

Our findings revealed four main topics and related sub-themes (see table 1) that illustrate how digital entrepreneurs employ experimentation to convert business ideas into viable products. The main themes include networks, customer focus, prototyping process and MVP, as well as core team attitudes. These topics were derived inductively and exclusively from the transcribed interviews. They emerged after interviewing founders about prototyping and its role in the innovation process. It can therefore be assumed that these four topics have an important influence on successful prototyping. Prototyping helps in particular to gain relevant market knowledge, to improve the quality of products and business models before market entry, to ensure success in the early startup phase even without technical co-founders, to increase the speed of the innovation process and

thus save resources, to successfully develop products and business models that are urgently needed in the market, to win the first real customers, to build trust and legitimacy for startup, product and business model and to facilitate identifying appropriate pricing strategies. Prototyping was central to the early founding process for all the startups interviewed. Almost all respondents based the practices of prototyping on the Lean Startup approach, although the method was interpreted freely. The focal point was not always on building a classic MVP, i.e., a prototype that contains all the essential features of the final product or business model. Further, our sample shows that the customer has an active role and partly becomes a co-creator during the innovation process. This is in contrast to the Lean Startup approach, where customers are known to take on a rather passive role (Ries, 2011). Additionally, networks play an exceptionally important part in the success of prototyping.

However, the network approach of the interviewed founders is more similar to the network approach as it became known from Effectuation research (Sarasvathy, 2001). The integration of network partners as active idea providers and creators, is more prominent in our research than the Lean Startup approach proposes. This shows that the influence of networks, customers and MVP formats on the decision-making processes of early-stage startups are of high importance and require further research. The adaptation of product and business model is crucial for the success of startups and the customer plays the most important role in this. Successful interaction with potential customers can massively shorten the time between idea and market entry if it is done correctly (Zalewska-Kurek et al. 2016). This saves startups resources and enables them to reach the market fit faster and grow successfully. Our article provides important clues on how successful customer interaction takes place. For the practical implementation of startup support programs this means to focus more on the prototyping process and provide the corresponding resources and knowledge. Prototyping could also play a greater role in the educational context, e.g., in universities and research institutes, but also in incubators, accelerators, startup competitions, investor pitches, investment forums, trade fairs, exhibitions and events. In theoretical terms our research has contributed valuable insights to the existing knowledge about the Lean Startup method und prototyping in the context of the Creation School in general. Future studies could compare these findings with other methods that belong to the Creation School such as Design Thinking (Brown, 2008), Effectuation (Sarasvathy, 2001), or Business Model Testing (Osterwalder & Pigneur, 2010; Bland & Osterwalder, 2019). The study has some limitations. For example, the hypotheses were generated but not tested in a quantitative study or mixed methods analysis. The statements are also limited to the geographical area of Germany and in particular Berlin, the startup capital. International studies can test the validity of the statements for other cultural contexts, more rural regions or other National Innovation Systems.

References

- Alvarez, S. A., & J. B. Barney. (2007) Discovery and creation: Alternative theories of entrepreneurial action, *Strategic Entrepreneurship Journal* 1: 11–26.
- Amason, A. C., R. C. Shrader & G. H. Tompson (2006) Newness and novelty: Relating top management team composition to new venture performance, *Journal of Business Venturing* 21: 125–48.
- Bland, D. J., & Osterwalder, A. (2019) *Testing business ideas: A field guide for rapid experimentation*, John Wiley & Sons.
- Blank, S. (2013) Harvard business review, *Why the Lean Startup changes everything*, Online: <https://hbr.org/2013/05/why-the-lean-startup-changes-everything>.
- Blank, S. & Dorf, B. (2014) *Das Handbuch für Startups*, O'Reilly Verlag, Köln.
- Blank, S., & Dorf, B. (2020) *The startup owner's manual: The step-by-step guide for building a great company*, John Wiley & Sons.
- Brown, T. (2008) Design thinking, *Harvard business review*, 86(6), 84.
- CB Insights (2021) The Top 12 Reasons Startups Fail, online: [cbinsights.com/research/report/startup-failure-reasons-top](https://www.cbinsights.com/research/report/startup-failure-reasons-top).
- Dahle, Y., & Steinert, M. (2016, June) Does Lean Startup really work? Foundation for an empirical study, in *2016 International Conference on Engineering, Technology and Innovation/IEEE International Technology Management Conference (ICE/ITMC)* (pp. 1-5), IEEE.
- Deutsche Startups (n.d.) online: deutsche-startups.de/lexikon/investitionsphasen.
- Elfring, T. & Hulsink, W. (2003). Networks in entrepreneurship: The case of high-technology firms, *Small business economics*, 21, 409-422.
- Eliakis, S., Kotsopoulos, D., Karagiannaki, A. & Pramataris, K. (2020) Survival and growth in innovative technology entrepreneurship: a mixed-methods investigation, *Administrative Sciences*, 10(3), 39.
- Funderclub (n.d.) online: funderclub.com.
- Gläser, J., & Laudel, G. (2010) *Experteninterviews und qualitative Inhaltsanalyse*, Springer-Verlag.
- Grichnik, D., Brettel, M., Koropp, C. & Mauer, R. (2017) *Entrepreneurship: unternehmerisches Denken, Entscheiden und Handeln in innovativen und technologieorientierten Unternehmen*, Schäffer-Poeschel.
- Gutbrod, M., Münch, J. & Tichy, M. (2017) How do software startups approach experimentation? Empirical results from a qualitative interview study, in *Product-Focused Software Process Improvement: 18th International Conference*,

- PROFES 2017, Innsbruck, Austria, November 29–December 1, 2017, *Proceedings 18* (pp. 297-304), Springer International Publishing.
- Kollmann, T., Stöckmann, C., Hensellek, S. & Kensbock, J. (2017) Deutscher Startup Monitor 2017: Mut und Macher, Universität Duisburg Essen.
- Lai, W.H. & Lin, C.C. (2015) Constructing business incubation service capabilities for tenants at post-entrepreneurial phase, *Journal of Business Research*, 68: 2285–89.
- Mansoori, Y., & Lackeus, M. (2020) Comparing Effectuation to discovery-driven planning, prescriptive entrepreneurship, business planning, Lean Startup, and design thinking, *Small Business Economics*, 54, 791-818.
- Mayer, H. O. (2013) *Interview und Schriftliche Befragung 6. A, Grundlagen und Methoden Empirischer Sozialforschung*, Oldenbourg Wissenschaftsverlag Verlag.
- Meuser, M., & Nagel, U. (2002) ExpertInneninterviews—vielfach erprobt, wenig bedacht: Ein Beitrag zur qualitativen Methodendiskussion, *Das Experteninterview: Theorie, Methode, Anwendung*, 71-93.
- Minniti, M., & Bygrave, W. (2001) A dynamic model of entrepreneurial learning, *Entrepreneurship theory and practice*, 25(3), 5-16.
- Murray, F., & Tripsas, M. (2004) The exploratory processes of entrepreneurial firms: The role of purposeful experimentation, in *Business strategy over the industry lifecycle*, Emerald Group Publishing Limited.
- Osterwalder, A., & Pigneur, Y. (2010) *Business Model generation: a handbook for visionaries, game changers, and challengers* (Vol. 1), John Wiley & Sons.
- Richter, N., Jackson, P., & Schildhauer, T. (Eds.) (2018) *Entrepreneurial innovation and leadership: preparing for a digital future*, Springer.
- Ries, E. (2009) Minimum viable product, a guide, online: <http://www.startuplessonslearned.com/2009/08/minimum-viable-product-guide.html>.
- Ries, E. (2011) *The Lean Startup: How today's entrepreneurs use continuous innovation to create radically successful businesses*, Currency.
- Sarasvathy, S. D. (2001) Causation and Effectuation: Toward a theoretical shift from economic inevitability to entrepreneurial contingency, *Academy of management Review*, 26(2), 243-263.
- Sarasvathy, S. D. & Venkataraman, S. (2011) Entrepreneurship as method: Open questions for an entrepreneurial future, *Entrepreneurship theory and practice*, 35(1), 113-135.
- Shepherd, D. A. & Gruber, M. (2021) The Lean Startup framework: Closing the academic–practitioner divide, *Entrepreneurship Theory and Practice*, 45(5), 967-998.
- Song, M., Podoynitsyna, K., Van Der Bij, H. & Halman, J. I. (2008) Success factors in new ventures: A meta-analysis, *Journal of product innovation management*, 25(1), 7-27.
- Tidd, J. & Bessant, J. R. (2020) *Managing innovation: integrating technological, market and organizational change*, John Wiley & Sons.
- Welter, F. (2011) Contextualizing Entrepreneurship—Conceptual Challenges and Ways Forward, *Entrepreneurship: Theory and Practice* 35: 165–84.

Representations of Entrepreneurship in Local Media: A Comparative Analysis

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Abstract: Entrepreneurial culture is a key element of the success of entrepreneurial ecosystems. Previous studies have shown that regional levels of entrepreneurial activity tend to remain persistent over long periods of time and that cultural attitudes in favour of entrepreneurship and rooted in the history of the region can influence innovation activity and new business formation today. Prior research has studied the entrepreneurial culture investigating individuals' perceptions, attitudes, values, and entrepreneurial personality fit. However, such approaches fail to address the importance of social representations of entrepreneurship as a part of entrepreneurial culture. The aim of this study is to increase understanding about the local entrepreneurial culture within entrepreneurial ecosystems by analysing local media representations of entrepreneurship as indications of local entrepreneurial cultures in the entrepreneurial ecosystem context. The research was carried out as a comparative study of two Finnish regions: Päijät-Häme and South Karelia. The primary research data consists of 120 newspaper articles from regional daily newspapers. The results suggest that in the studied regions local media particularly helps transmit entrepreneurial success stories as an ecosystem service. Also, narratives of entrepreneurial ambition, innovativeness and risk acceptance were transmitted to the local audiences. Some regional differences were also detected, which might reflect the different historical backgrounds and regional levels of entrepreneurial activity. This paper presents the preliminary results of the study which are of value for both ecosystem actors and policymakers designing initiatives to strengthen the local entrepreneurial culture and public discourse promoting entrepreneurship.

Keywords: Entrepreneurship, Entrepreneurial Ecosystem, Entrepreneurial Culture

1. Introduction

Over the last decade, the phenomena of entrepreneurship have been increasingly studied in the context of regional entrepreneurial ecosystems (Malecki, 2018). Many ecosystem-specific factors, actors, and processes influence entrepreneurship that creates both economic and social value to the region (Spiegel and Harrison, 2018). Culture is recognized as one of the core elements of entrepreneurial ecosystems (Audretsch and Belitski, 2017; Stam, 2015). Culture embedded in the ecosystem includes the norms, institutions and beliefs associated with entrepreneurship (Stuetzer et al., 2018). However, entrepreneurial culture has not been studied much in the entrepreneurial ecosystem context.

The aim of this study is to increase understanding about the local entrepreneurial culture within entrepreneurial ecosystems by analysing local media representations of entrepreneurship as the indications of local entrepreneurial culture. Media expressions of entrepreneurial culture have not been studied much although media helps transmit the accepted norms and values in society and hence also contributes to the social construction of cultural attitudes. For the study of entrepreneurial culture, instead of a static view on culture the entrepreneurial ecosystem concept provides a context that is dynamic and process-oriented. The dataset of this study consists of newspaper articles published in regional daily newspapers in three separate one-week periods between July 2022 and February 2023. The analysis of the newspaper articles was guided by the cultural entrepreneurial ecosystem services framework (Donaldson, 2021), and the data were analysed using software assisted qualitative content analysis. This paper presents the preliminary results of the study based on the first-round analysis.

New perspectives for the much-studied topic of entrepreneurial culture are provided here. Our study extends beyond the perceptions of individuals and investigates entrepreneurial culture through regional media representations, responding to the need to study entrepreneurial culture in the entrepreneurial ecosystem context, also including the ecosystem services view. The findings of this study increase our understanding about the cultural narratives and contents associated with entrepreneurship, that the local media helps to transmit within ecosystems.

2. Entrepreneurial Ecosystems and Entrepreneurial Culture

Since the 2010s the concept of entrepreneurial ecosystems has become one of the most popular entrepreneurial research contexts (Malecki, 2018). As with many other more recently developed ecosystem concepts, the

definitions of entrepreneurial ecosystems vary. According to a widely applicable and often used definition presented by Stam (2015: 1765) entrepreneurial ecosystem is *“a set of interdependent actors and factors coordinated in such a way that they enable productive entrepreneurship”*. Malecki (2018: 1) further strengthens the dynamic and process view on entrepreneurial ecosystems by defining them as *“dynamic local social, institutional and cultural processes and actors that encourage and enhance new firm formation and growth”*. Adopting the ecosystem view on entrepreneurship means focusing on the individual entrepreneurs as well as on the role of the context allowing and supporting entrepreneurship or restricting it (Stam, 2015). Entrepreneurial ecosystems thus provide the framework conditions (formal institutions, culture, physical infrastructure, demand) and systemic conditions (networks, leadership, finance, talent, knowledge, support services/intermediaries) for entrepreneurship (Stam, 2015).

Regional entrepreneurial ecosystems literature shows that when it comes to entrepreneurial activities, local context matters (Audretsch and Belitski, 2017). Regional level is a suitable level of study in entrepreneurial ecosystem research, as resources, support structures, culture and social networks are often regionally or locally bound (Spiegel and Harrison, 2018). However, it should be noted that entrepreneurial ecosystems are open systems that need connections also outside their geographical boundaries. Entrepreneurial culture is a regional characteristic and its impact on entrepreneurship is studied to some extent (Stuetzer et al., 2018). According to Spiegel (2013: 805) entrepreneurial culture *“refers to the collective worldviews common to a place that affects how the act of entrepreneurship is understood and experienced”*. Cultural characteristics concern norms, institutions, and beliefs, including how the general, local population perceives entrepreneurship and risks, business failures or success related to entrepreneurship (Stuetzer et al., 2018). Shared narratives of entrepreneurial success, experiences, risk taking and innovation support entrepreneurial activities and help to bring ecosystem members closer together (Spiegel, 2017). Local entrepreneurial culture is not an exogenous phenomenon but socially constructed informal institutions including role model entrepreneurs, the examples of success and failure, and important knowledge about entrepreneurial practices (Malecki, 2018).

Prior research has concentrated on entrepreneurial culture from the viewpoint of individuals' perceptions, attitudes, values, and entrepreneurial personality fit (e.g., Davidsson 1995; Thomas and Mueller, 2000; Urban, 2006; Autio et al., 2001). However, studies focusing on individuals fail to recognize the importance of social representations of entrepreneurship. While a number of studies investigated entrepreneurial culture and its role at national levels (e.g., Sipola, 2022; Dheer, 2017; Hayton & Cacciotti, 2013; Radu and Redien-Collo, 2008; Hayton et al., 2002), much less attention has been paid to the regional or local level although it is recognized that cultural attitudes rooted in the history of a region can influence innovation and entrepreneurial activity today (Stuetzer et al. 2018; 2014; Aoyama, 2009). Several studies have recognized culture being a core element of entrepreneurial ecosystems (Audretsch and Belitski, 2017; Stam, 2015; Mack and Mayer, 2016; Spiegel, 2017). Studying entrepreneurial culture in the (regional) entrepreneurial ecosystems increases our understanding about different subcultures and their impact on regional economies (Hayton & Cacciotti, 2013; Donaldson, 2021). Regional cultures have been shown to shape what are acceptable entrepreneurial norms and practices and hence influence entrepreneurial activities and their regional levels over time (Aoyama, 2009; Fritsch et al. 2019).

Entrepreneurial ecosystems consist of a variety of systems within and between which resources flow and fuel innovation and new venture creation (Spiegel and Harrison, 2018). Entrepreneurial ecosystems are viewed as dynamic entities rather than static constructions of factors, actors, and institutions. Ecosystems produce outcomes that – proven relevant and beneficial – can be considered useful entrepreneurial ecosystem services (Donaldson, 2021). This service view brings dynamism to the study of entrepreneurial ecosystems also by considering the interrelatedness of different service types and their impact on entrepreneurial activities. Based on existing ecosystem models Donaldson (2021) presents an assembly of different ecosystem service types consisting of regulating services, provisioning services and cultural entrepreneurial ecosystem services (CEES). CEESs include the tolerance of failure, success stories, risk acceptance, ambition, the high social status of entrepreneurs, as well as innovation, curiosity, and experimentation (Donaldson, 2021). From the viewpoint of entrepreneurial communities and entrepreneurial cultural identities, CEESs are fundamental to both their birth and long-term survival (Spiegel, 2017).

In the field of entrepreneurship research newspaper articles have been used to study for example entrepreneurial identity (Anderson and Warren, 2011) and representations of female entrepreneurship (Achtenhagen and Welter, 2011; Bobrowska and Conrad, 2017; Eikhof et al., 2013; Nadin et al., 2020) but not to investigate the cultural aspects and the representations of entrepreneurship in an ecosystem context. Regional entrepreneurial culture and CEES can be difficult to capture empirically (Donaldson, 2021). Local media and the

local press are an important channel to transmit cultural values, norms, and ideas (Achtenhagen and Welter, 2003). Study of the content and the representations of entrepreneurship that newspaper articles share especially to local audiences gives us an opportunity to empirically reach entrepreneurial culture in an ecosystem context. The aim of this study is to empirically examine the entrepreneurial ecosystem culture and how entrepreneurship is represented in local media.

3. Data and Methods

3.1 Data Collection and Analysis

The dataset of this study consists of newspaper articles collected from two regional daily newspapers representing the local media of each case region. Short descriptions of the case regions are presented in the following sub-section. The articles were retrieved from the newspapers' online archives. The data covers articles published in three separate one-week periods between July 2022 and February 2023. These periods of analysis were chosen based on even distribution between the six-month period, and daily publication of the newspaper, excluding time periods that included national holidays that influenced publication times. Also, each period of analysis covers one calendar week from Monday to Sunday.

In the beginning of data collection, selection criteria were established. The dataset comprised articles that included mentions of, or the content of which was related to an entrepreneur, entrepreneurship, starting a new business, business development, business opportunities or entrepreneurial process. The final dataset consisted of altogether 120 articles (Table 1). The data were analysed using software assisted qualitative content analysis (Kaefer et al., 2015). The first level coding phase was guided by the CEES framework and the data were coded following the elements of the framework (Donaldson, 2021). The coded chunks of data were further coded based on the sentiment tone related to entrepreneurship in each coded text. The used sentiment tones were positive, negative, neutral, and mixed. The sentiment tone was related to the content of the article, not to the tone of the text, as most of the articles were news articles or other articles written by newspaper journalists, the tone of which is primarily neutral.

Table 1: The number of articles in the dataset

Region	4 – 10 July /2022	24 – 30 Oct /2022	30 Jan – 5 Feb /2023	Total
Päijät-Häme	22	20	26	68
South Karelia	10	17	25	52
				120

3.2 Case regions

3.2.1 Päijät-Häme

Päijät-Häme region is in Southern Finland, approximately 100 kilometres North from Helsinki, the capital of Finland. Population is app. 200 000 inhabitants dispersed in ten municipalities. City of Lahti is the centre of the region. The region has a relatively diverse industrial structure, characterized by a substantial number of SMEs. Industry and construction are the biggest sectors, and the region is known for its wood, plastic, food, and mechatronics industries. Here, family firms are more common than anywhere in Finland. According to statistics, app. 1100 new companies are established every year (Nieminen and Repo, 2022). Several universities have had their regional units here, until in 2018 LUT University established a campus in the city of Lahti. Therefore, Lahti is now the youngest university city in Finland. Etelä-Suomen Sanomat is the biggest newspaper in the region.

3.2.2 South Karelia

South Karelia region in South-East Finland consists of nine municipalities and has around 129,000 inhabitants. The centre is the city of Lappeenranta. The industrial structure is dominated by large forest industry companies and the region is one of the most significant forest industry concentrations in Europe. Therefore, the region is dependent on the renewal of forest industry. Other important sectors are tourism, commerce, and logistics. The number of new companies established is around 600 (Nieminen and Repo, 2022). In addition, there is a technical university and university of applied sciences, and some of the large forest companies have their R&D operations in the region. The regional newspaper is called Etelä-Saimaa.

4. Results

Altogether 60.3% of the articles included in the dataset were news articles. The share of news articles was bigger in Päijät-Häme (68.1%) than in South Karelia (50%). The rest represented other article types such as more “lifestyle-oriented” articles with a local angle. Another distinctive article type was portrait and interview articles of local entrepreneurs. The dataset also included editorial and opinion articles, but their share of the dataset was very low (3.3%). Categorization of the articles after the first level coding is presented in Table 2. Most of the articles contained elements related to only one of the codes. However, there were also articles that related to more than one code and therefore the total number of articles per code does not match the number of articles in the dataset.

Table 2: Number of articles coded under each code

Code	Päijät-Häme	South Karelia	Total
Ambition	12	10	22
Innovation, curiosity and experimentation	7	14	21
Success stories	18	14	32
Risk acceptance	14	9	23
Tolerance of failure	6	4	10
High social status of entrepreneurs	1	0	1
Other	30	15	45

References to entrepreneurship in the article contents were very often related to entrepreneurial success stories. References related to ambition, innovativeness and future opportunities, and risk acceptance were also common within the dataset. However, the high social status of entrepreneurs was explicitly recognizable only in one article. A significant part of the articles’ content linked to entrepreneurship was related to something else than to the elements of the CEES framework, which was an interesting finding. The more detailed tabular data related to the studied articles is presented in Appendix 1, and the more detailed findings are opened in the following sub sections.

4.1 Ambition

In both newspapers most references related to entrepreneurial ambition had a positive or mixed tone. Also, in both newspapers references to entrepreneurial ambition were detected mostly from articles portraying local entrepreneurs or articles about running a certain business in the region. References to entrepreneurial ambition paint a picture of entrepreneurs who have passion and internal motivation for a specific topic, and a strong drive to implement their ideas and make their dreams come true through entrepreneurship. Entrepreneurs are described to have solid faith in their own goals, persistence, and desire to learn new things. Although entrepreneurial ambition was presented in a very positive light, many articles bring out notions of mixed sentiment tones next to the positive ones. These notions and comments from entrepreneurs spanned from work being in the center of their lives and not having time for holidays, but yet enjoying entrepreneurship as a way of life. Despite the struggles with bureaucracy and finances at the beginning of one’s entrepreneurship journey, they saw that after being persistent and receiving help from others, they were happy with choosing to start a business.

There weren’t significant regional differences in how ambition was presented in the articles, although in Päijät-Häme the content related to ambition was more diverse, whereas in South Karelia the emphasis was on the long working days and work being in the center of entrepreneurs’ lives. What was interesting is that neither of the newspapers’ articles had references related to ambitions of growing one’s business or strong ambitions towards economic success.

4.2 Innovation, curiosity, and experimentation

Articles in South Karelia had more references to innovation, curiosity, and experimentation than those in Päijät-Häme (table 2). In most cases the tone of the content was positive or neutral. In Päijät-Häme the references were related to business opportunities in increasing diversity and inclusiveness in games, in the growing demand for non-alcoholic brewery products, and in post-war reconstruction in Ukraine. In a portrait article one

entrepreneur told how she actively thinks about and explores future opportunities regarding her own business. The few references related to technological innovations dealt with renewable energy production and the construction of wooden apartment houses.

In South Karelia several references were linked to technological innovations, for instance, new technologies implemented in a local firm, plans for a solar power production project and other possibilities for renewable energy production in the region. It was noteworthy, that articles describing energy production opportunities included references to university collaboration. Mixed-tone notions were related to articles on solar power production project plans (citizens' concerns about the impacts on their living environment) and mining companies' possibilities of prospects for ore in the region. Besides references linked to new technologies, another clear theme was entrepreneurial opportunities and examples of new businesses in specific spaces that were or had become vacant in the region. The dataset also included articles telling the story of a new business based on a current trend (recycling) perceived by the entrepreneur, and a new business idea developed within a local development project. South Karelian newspaper also published the same article dealing with business opportunities in increasing diversity and inclusiveness in games as the newspaper in Päijät-Häme.

4.3 Success stories

Altogether 18 articles published in Päijät-Häme included references to entrepreneurial success stories. Many of the references were related to the success of individual entrepreneurs. Some articles also included references to a company achieving short term success by, for example, winning a prize or a tendering competition. Other positive success references related to a good annual result and a current trend having a positive impact on a company's business. The only reference with a negative tone was about a machine contractor with their services less and less in demand. The two mixed-tone success-related references told the stories of two entrepreneurs who had faced personal disappointments but found purpose and success through their new entrepreneurial endeavors.

South Karelian articles had fewer references to entrepreneurial success stories than in Päijät-Häme, furthermore, four of the references had a negative tone opposed to only one with a negative sentiment tone in Päijät-Häme. These negative references related to the financial difficulties of certain businesses or the ending of a business. The positive references included varying types of success stories: the good annual results of companies, growth targets, a large new order for a B2B company, and the success of individual entrepreneurs. The mixed-toned articles told about entrepreneurs facing a high business demand from the markets but having delivery problems or work overload.

4.4 Risk acceptance

In Päijät-Häme references to risk acceptance were more common than in South Karelia. During the study period, there were several national strikes which was also reflected in the content of the articles. Strikes and their impact on local companies were seen to reflect the risks associated with the operational environment, as were also other types of risks (increase in energy prices, inflation, access to labour etc.) and their impact on companies. The attitude of entrepreneurs towards risk acceptance was also present in articles where a new entrepreneur brought out the uncertainty related to entrepreneurship but also assured to have confidence in the future. Strikes and their impacts as well as the other risks related to the operational environment were also present in articles published in South Karelia. As in Päijät-Häme, the articles also included entrepreneurs' thoughts about the uncertain nature of entrepreneurship and accepting it.

4.5 Tolerance of failure

Articles referring to the tolerance of failure in entrepreneurial activities related mostly to the financial difficulties of certain local companies, and therefore had a quite negative, mixed or a neutral tone. One company and its financial situation was in the headlines several times in Päijät-Häme and once also in South Karelia. South Karelia also had one positive reference to the ability to cope with failure in an article mentioning a restaurant that had to close in one location but has had a good start in another location. From a methodological point of view, it is noteworthy that during the data coding phase it was quite difficult to decide which references in the text related to the tolerance of failure and which to success stories with a negative tone.

4.6 High social status of entrepreneurs

Overall, references to the high social status of entrepreneurs were almost absent, as only one article published in Päijät-Häme region included a reference to this CEES element. This reference related to an (non-Finnish) entrepreneur who had started modestly but become very wealthy and a part of the national elite. One reason why the data included so few references related to this element might be the “vagueness” of the element. How is high social status defined and what are its characteristics? Conceptual clarification is needed to make better use of this element in the analysis of this type of data.

4.7 Other

The dataset included several references to entrepreneurs or entrepreneurship that could not be categorized following under the list of elements in the CEES framework. In Päijät-Häme, the number of these references was higher than in South Karelia. In Päijät-Häme many of the references were related to infrastructure or land use and planning, and its impact on businesses. Another group of references was related to trends or market environments and their impact. Besides these, the articles included references to collaboration between entrepreneurs, suspected crimes related to businesses and several short mentions about an entrepreneur's business and how it started.

Contrary to Päijät-Häme, in South Karelia the references to infrastructure and land use were almost absent. In South Karelia the references addressing other than CEES elements related topics mostly related to trends and market environments and their impact on businesses and prices, and short mentions or descriptions about the current state of an entrepreneur's business or how it started.

5. Conclusions

The preliminary findings of this study contribute to the research on entrepreneurial culture within entrepreneurial ecosystems by presenting the representations of entrepreneurship transmitted in the region by the local media, and by highlighting the role of transmitting success stories to local audience as an ecosystem service. References addressing entrepreneurial ambition, innovativeness and risk acceptance were also strongly present in the articles, although their share of the data varied between the two study regions. Based on previous literature, these types of shared narratives of ambition, success, risk-taking and innovation can help bring ecosystem members closer together and support entrepreneurial activities (Spiegel, 2017; Stuetzer et al., 2018; Aoyama, 2009). The number of references addressing the ability to cope with failure was much smaller, and the high social status of entrepreneurs was almost absent in the data.

Based on prior literature (e.g., Donaldson, 2021; Radu and Redien-Collot, 2008), the assumption of departure was that as a mediator of values and attitudes connected to entrepreneurial culture, the local newspapers could convey the image of entrepreneurship reflecting the different CEES. However, the findings suggest that the media's references to entrepreneurship reflect also other types of ecosystem service components than just the cultural ones (such as legislation and infrastructure) which in the CEES framework are positioned within regulating services or provisioning services (Donaldson, 2021).

When comparing the two regions, some elements were more visible in Päijät-Häme and some in South Karelia. In Päijät-Häme, the number of positive entrepreneurial success stories was higher, and ability to accept (or tolerate) risk was more often referred to whereas in South Karelia, the rather mixed notions related to the impact of entrepreneurship on the entrepreneur's personal time use and personal life were more common. Also, references related to innovativeness, particularly to technological innovations, were more common in South Karelia. This could be partly related to the longer history of university collaboration in South Karelia. These preliminary results suggest that regional differences in the entrepreneurial ecosystem cultures might be detectable by using newspaper article data. However, more data and a deeper analysis is needed to validate these results.

The most important limitations of this study are related to the used data and its coverage. It is noteworthy that as a concept “local media” covers more than the articles in printed daily newspapers. To obtain a comprehensive picture of the phenomena, research should also consider for example online media content which was not included in this study. As stated before, this paper presents the preliminary results based on two study regions and three one-week study periods. Each regional entrepreneurial ecosystem has its unique characteristics, which limits the generalizability of these results. In future research, to refine and deepen the comparative analysis, the dataset will be supplemented by extending the study periods and by deepening the analysis.

References

- Achtenhagen, L., and Welter, F. (2003) "Female entrepreneurship in Germany", *New Perspectives on Women Entrepreneurs*; Butler, JE, Ed.; Information Age Publishing: Greenwich, CT, USA, 71-100.
- Achtenhagen, L. and Welter, F. (2011) "Surfing on the ironing board" – the representation of women's entrepreneurship in German newspapers", *Entrepreneurship & Regional Development*, Vol. 23, Nos. 9-10, pp. 763–786.
- Anderson, A.R. and Warren, L. (2011) "The entrepreneur as hero and jester: enacting the entrepreneurial discourse", *International Small Business Journal*, Vol. 29, No. 6, pp. 589–609.
- Aoyama, Y. (2009) "Entrepreneurship and Regional Culture: The Case of Hamamatsu and Kyoto, Japan", *Regional Studies*, Vol. 43, No. 3, pp. 495–512.
- Audretsch, D. B., and Belitski, M. (2017) "Entrepreneurial ecosystems in cities: establishing the framework conditions", *The Journal of Technology Transfer*, Vol. 42, pp. 1030-1051.
- Autio, E., H. Keeley, R., Klofsten, M., GC Parker, G., and Hay, M. (2001) "Entrepreneurial intent among students in Scandinavia and in the USA", *Enterprise and Innovation Management Studies*, Vol. 2, No. 2, pp. 145-160.
- Bobrowska, S. and Conrad, H. (2017) "Discourses of Female Entrepreneurship in the Japanese Business Press – 25 Years and Little Progress", *Japanese Studies*, Vol. 37, No. 1, pp. 1–22.
- Davidsson, P. (1995) "Culture, structure and regional levels of entrepreneurship", *Entrepreneurship & Regional Development*, Vol. 7, No. 1, pp. 41-62.
- Dheer, R.J.S. (2017) "Cross-national differences in entrepreneurial activity: role of culture and institutional factors", *Small Business Economics*, Vol. 48, No. 8, pp. 813–842.
- Donaldson, C. (2021) "Culture in the entrepreneurial ecosystem: A conceptual framing", *International Entrepreneurship and Management Journal*, Vol. 17, No. 1, pp. 289-319.
- Eikhof, D.R., Summers, J., and Carter, S. (2013) "Women doing their own thing": media representations of female entrepreneurship", *International Journal of Entrepreneurial Behaviour & Research*, Vol. 19, No. 5, pp. 547–564.
- Fritsch, M., Obschonka, M., and Wyrwich, M. (2019) "Historical roots of entrepreneurship-facilitating culture and innovation activity: An analysis for German regions", *Regional Studies*, Vol. 53, No. 9, pp. 1296–1307.
- Hayton, J.C. and Cacciotti, G. (2013) "Is there an entrepreneurial culture? A review of empirical research", *Entrepreneurship and Regional Development*, Vol. 25, Nos. 9-10, pp. 708–731.
- Hayton, J.C., George, G. and Zahra, S. A. (2002) "National culture and entrepreneurship: A review of behavioral research", *Entrepreneurship Theory and Practice*, Vol. 26, No. 4, pp. 33–52.
- Kaefer, F., Roper, J., and Sinha, P. N. (2015) "A software-assisted qualitative content analysis of news articles: Examples and reflections", *Forum: Qualitative Social Research*, Vol. 16, No. 2.
- Mack, E. and Mayer, H. (2016) "The evolutionary dynamics of entrepreneurial ecosystems", *Urban Studies*, Vol. 53, No. 10, pp. 2118–2133.
- Malecki, E. J. (2018) "Entrepreneurship and entrepreneurial ecosystems", *Geography compass*, Vol. 12, No. 3, e12359.
- Nadin, S., Smith, R. and Jones, S. (2020) "Heroines of enterprise: Post-recession media representations of women and entrepreneurship in a UK newspaper 2008–2016", *International Small Business Journal: Researching Entrepreneurship*, Vol. 38, No. 6, pp. 557–577.
- Nieminen, J. and Repo, J. (ed) (2022) "Alueelliset kehitysnäkymät syksyllä 2022", *Työ- ja elinkeinoministeriön julkaisuja* 2022:59. Available (https://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/164395/TEM_2022_59.pdf) Cited: 6.4.2023
- Radu, M., and Redien-Collot, R. (2008) "The social representation of entrepreneurs in the French press: Desirable and feasible models?", *International Small Business Journal*, Vol. 26, No. 3, pp. 259–298.
- Sipola, S. (2022) "Another Silicon Valley? Tracking the role of entrepreneurship culture in start-up and venture capital co-evolution in Finland's entrepreneurial ecosystem 1980–1997", *Journal of Entrepreneurship in Emerging Economies*, Vol. 14, No. 3, pp. 469–494.
- Spigel, B. (2017) "The relational organization of entrepreneurial ecosystems", *Entrepreneurship Theory and Practice*, Vol. 41, No. 1, pp. 49–72.
- Spigel, B. (2013) "Bourdieuian approaches to the geography of entrepreneurial cultures", *Entrepreneurship & Regional Development*, Vol. 25, Nos. 9-10, pp. 804–818.
- Spigel, B. and Harrison, R. (2018) "Toward a process theory of entrepreneurial ecosystems", *Strategic Entrepreneurship Journal*, Vol. 12, No. 1, pp. 151–168.
- Stam, E. (2015) "Entrepreneurial ecosystems and regional policy: A sympathetic critique", *European Planning Studies*, Vol. 23, No. 9, pp. 1759–1769.
- Stuetzer, M., Audretsch, D.B., Obschonka, M., Gosling, S.D., Rentfrow, J.P. and Potter, J. (2018) "Entrepreneurship Culture, Knowledge Spillovers, and the Growth of Regions", *Regional Studies*, Vol. 52, No. 5, pp. 603–618.
- Thomas, A. S., and Mueller, S. L. (2000) "A case for comparative entrepreneurship: Assessing the relevance of culture", *Journal of international business studies*, Vol. 31, pp. 287–301.
- Urban, B. (2006) "Entrepreneurship in the rainbow nation: Effect of cultural values and ESE on intentions", *Journal of Developmental Entrepreneurship*, Vol. 11, No. 3, pp. 171–186.

Appendix 1: Number of coded articles under each code

Code	Päijät-Häme	South Karelia	Total
Ambition	12	10	22
<i>Mixed</i>	4	5	9
<i>Negative</i>	0	1	1
<i>Neutral</i>	3	2	5
<i>Positive</i>	7	5	12
Innovation, curiosity, and experimentation	7	14	21
<i>Mixed</i>	1	2	3
<i>Negative</i>	0	1	1
<i>Neutral</i>	5	6	11
<i>Positive</i>	1	9	10
Success stories	18	14	32
<i>Mixed</i>	2	2	4
<i>Negative</i>	1	4	5
<i>Neutral</i>	1	0	1
<i>Positive</i>	14	8	22
Risk acceptance	14	9	23
<i>Mixed</i>	1	3	4
<i>Negative</i>	5	0	5
<i>Neutral</i>	7	4	11
<i>Positive</i>	1	2	3
Tolerance of failure	6	4	10
<i>Mixed</i>	4	2	6
<i>Negative</i>	2	0	2
<i>Neutral</i>	0	1	1
<i>Positive</i>	0	1	1
High social status of entrepreneurs	1	0	1
<i>Mixed</i>	1	0	1
<i>Negative</i>	0	0	0
<i>Neutral</i>	0	0	0
<i>Positive</i>	0	0	0
Other	30	15	45
<i>Mixed</i>	6	2	8
<i>Negative</i>	5	1	6
<i>Neutral</i>	15	10	25
<i>Positive</i>	5	3	8

Working from Home: Creativity and Innovation in the High-Tech Industry in Israel

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Abstract: Creativity is a crucial aspect of tech management, as it allows hi-tech workers to identify and solve problems, generate new ideas, and create innovative solutions that meet the needs and desires of consumers. The COVID-19 pandemic has had a significant impact on the way that people work, with many companies shifting to remote work as a means of maintaining business continuity. This shift has led to a debate about the impact of remote work on creativity, with some arguing that working from home increases creativity since it allows for more flexibility and autonomy. In contrast, others say it decreases it since it can lead to isolation and a lack of collaboration. While some evidence suggests that working from home may positively impact creativity, there is also evidence to suggest that it may have a negative impact. The main objective of this study is to investigate differences, if any, in the perceived creativity among hi-tech workers working from home or the office. The study provides a more nuanced understanding of hi-tech workers' attitudes toward creativity, innovation, and related risk-related issues. We used a validated questionnaire about the extent of innovation and creativity of people in general. Then we investigated these characteristics with the extent of working from home or the office. We statistically compared the means of variables of interest for categories of interest of respondents. We found no significant difference between high-tech workers working from home or the office. Yet, we discovered that hi-tech workers working from home reveal more resilience toward creative ways to solve problems even though these ways are associated with more risk. They are willing to take more risks to accomplish assignments innovatively and creatively. We also found that managers and development hi-tech workers tend to work from home.

Keywords: perceived creativity, working from home, creativity to handle risk, creativity for better quality

1. Introduction

1.1 Rationale

The Corona epidemic (Covid-19) has significantly impacted how people work, with many companies moving to a remote work model to maintain business continuity (Community & England, 2020). If so, a fundamental issue arises as to what is the effect of working from home on the degree of creativity and innovation among employees in general and managers and whether there are differences in the degree of creativity and innovation at work between workers from home and employees who are in organizations. Few studies have dealt with the relationship between the degree of creativity and innovation and the workplace - from home to the organization.

Organizations must respond quickly and flexibly to the changes and opportunities that the environment creates among them. Organizational innovation and creativity have become a tool in the hands of organizations to preserve and nurture the organization's ability to deal with its competitors in a changing environment. This confrontation creates an existential need among organizations to expand organization's activities and ensure renewal (Singh et al., 2021).

The present study examines the differences between high-tech managers who work from home and those who work in the office in their level of creativity and innovation. It will also examine the relationship between working hours from home and creativity and innovation among high-tech managers.

Our research question is to what extent there are relationships between working from home or the office and hi-tech workers' perceived level of creativity and innovation. The research confronts an interesting and vital issue about the pros and cons of working from home versus the office, as working from home has become essential for many workers in high-tech organizations worldwide.

1.2 Literature review

The rapid spread of COVID-19 exposed us to the alternative of working from home. Studies show that the corona crisis has economic, psychological, and mental consequences (Sahu, 2020). As part of the quarantine policy, work and employment were affected when employees were required to work from home and not come to their organization. Some organizations choose to continue with this format even after the spread of the virus has been fully or partially stopped (Condon, 2021). The work-from-home model has many advantages and disadvantages

for both the employer and the employee, which need to be recognized to deal with them most efficiently and correctly for the benefit of both parties (Condon, 2021).

Accordingly, the research of Hayes and others (Hayes et al., 2020) indicates that following the Corona crisis, organizations have internalized that the world of work has changed and will not return to its previous format and, therefore, many organizations have adopted work models that incorporate work from home and constitute the norm the new. However, the transition to a different work model requires planning, change management and even adjustment of processes, metrics, and systems.

Creativity describes a process of generating ideas, uses, and original ways of solving problems by an individual or group working together. Creativity was related to several organizational factors and several cognitive and psychological structures. Psychological and cognitive factors related to creativity are flexibility, persistence, adaptability, enthusiasm, and motivation (Comunian & England, 2020).

Concerning the effect of working from home on the degree of creativity of employees, the studies indicate mixed findings; for example, the study by Zhou and George (2021), which examined the degree of creativity of workers from China and Germany following the spread of the Coronavirus (Covid-19) - before and after the quarantine policy. The study was conducted using the quantitative method and included 754 employees. The study's findings showed an increase in day-to-day creativity among workers from China and Germany - after the transition to working from home and the entrenchment of the lockdown created by the spread of the coronavirus.

In the article by Füzi and others (Füzi et al., 2022), the researchers explain how innovation and creativity are the key elements in the conduct of organizations in the 21st century. The researchers claim that creating collaborative, flexible, open, and comfortable workspaces contribute to an increase in the level of creativity and innovation of employees. As part of the article, the researchers review studies that lead to the claim that employees staying in open spaces at work contributes to the level of creativity and innovation among them.

1.3 Research Hypothesis

Compared to creativity, innovation is the application of ideas relating to products, processes, and ways of working that will contribute to the success of the organization, the team, and the individual. Innovation changes the organization as a response to changes in the external environment or as a proactive action to influence the environment. Therefore, innovation is the adoption of ideas or behavior in various fields that relate to a system, policy, program, product, or service that is new to the organization (Singh et al., 2021). The role of risk attitude and innovations has also been explored. Sadeh et al. (2022) show how risk mitigation helps confront innovative uncertainty to get better performance. These have led us to our first research hypothesis.

RH1: People that work from the office have more perceived creativity.

Creativity describes a process of generating ideas, uses, and original ways of solving problems by an individual or group working together. Creativity was related to several organizational factors and several cognitive and psychological structures. Thus, organizational factors found to be related to the invention are: (i) Expressing appreciation for innovation, (ii) Encouragement for taking risks and creating ideas. (iii) The reward for creative thinking. (iv) Heterogeneous group work and commitment to the project.

Psychological and cognitive factors related to creativity are flexibility, persistence, adaptability, enthusiasm, and motivation (Comunian & England, 2020). So we define our second research hypothesis.

RH2: People that work from the office are ready to take more risks to accomplish their assignments.

Many studies discussed the quality issues of the jobs done by high-tech workers and managers, e.g., Sadeh and Feniser (2021). They related it to communication among the workers. Therefore, we raise the third research hypothesis about the concern of quality.

RH3: People that work from the office are more creative about the quality of their tasks.

2. Methodology

The research approach is quantitative and based on a questionnaire distributed among hi-tech workers in Israel. There are three major categories of questions. The first part contains questions about the background of the responders, their gender, education, their jobs, marital status, age, and tasks. The second part deals with the intensity of working hours from home and from the office in 2022. While the impact of COVID-19 sharply decreased. Most, if only some, of the working places, were not regulated to work from home. The third part

includes six questions about perceived innovation and creativity. The questions are based on a literature review and were adopted from a published and validated questionnaire (Zhou & George, 2001).

We used descriptive statistics to define the most important issues from the data. This part of the research is correlational (descriptive) to describe a phenomenon and examine relationships between variables. We represent and summarize hereafter. Then we used statistical inference to test the research hypotheses. We based our methodology on comparing means of variables of interest according to the research hypotheses by categories of respondents by their profiles. The differences between high-tech workers who work from home and those who work in their offices will be examined in terms of their level of creativity and innovation.

2.1 Sample

The research population is managers, mainly from the high-tech industry in Israel. Our sample includes 192 respondents that thoroughly answered our questions. There are 148 males and 44 females. The portion of Their age varies from 20 to 50, averaging 33.1 years. The Kolmogorov-Smirnov test for normality of the age distribution is accepted with $p < 0.001$.

The respondents ranked their tasks for management as management positions (18.2%), medium level (58.9%), and lower level (22.9). Thirty-two respondents (16.6%) have no academic education, but 69.3% have more than two years of academic studies. Considering the marital status of the responders, 45% are married, but 71% have no kids, and 25% have one or two kids.

About 78% of the respondents work from the office, and 22 % work from home. This empirical distribution fits the situation in the population of Israel in 2022. The numbers are relevant to 2022 when no forced regulation existed to work from home.

3. Findings

We conducted a descriptive statistical analysis followed by statistical inference. The portion of females working from the office is much larger than males; the significant level of the Chi-square test is 0.038. The finding raise much interest and there is an impact on whether the respondent is married or single.

There is no correlation between the hierarchical position of a worker in an organization and office work. Nevertheless, the finding is that management people tend to work more at home, with a significant level of $p = 0.015$.

When checking for the task area of respondents, we found that hi-tech workers in development departments tend to work more at home than in the office. While in our sample, 23% work from home, 34% of development department workers work from home. This difference is statistically significant and elaborates on the aims of this study. Development workers in the hi-tech industry are expected to have more innovative and creative characteristics.

We asked the respondents to mark between 1 and 5 the extent of six statements, as 1 is the lowest extent and five is the highest. The six variables are taken from a verified questionnaire Zhou and George (2001) reported. We provide the study variables in Table 1, their means, and standard deviations.

Table 1: Descriptive statistics of the study's variables.

		Mean	S.D.
1	I will come up with new and practical ideas to improve the execution of the task.	4.29	.799
2	I will look for innovative technologies, processes, techniques, and ideas to accomplish the task.	4.26	.886
3	I will suggest new ways to ensure quality in the execution of the task	4.33	.751
4	I will be a good source of creative ideas for how to accomplish the task	4.09	.839
5	I will be riskless in carrying out the task.	3.82	1.034
6	I will come up with creative solutions to the problems that will arise during the execution of the task.	4.30	.750

Besides variable five about the risk, the other variables have relatively averaged high scores ranging from 4.09 to 4.33. Also, their standard deviations range from .75 to 0.839.

The correlations between the two variables were measured by Spearman correlation and provided in Table 2. While all variables are significantly correlated, the correlations of variables five and 3 with the other variables are smaller.

Table 2: Spearman correlations of the six variables

	1	2	3	4	5	6
1	1.000	.620**	.485**	.618**	.350**	.677**
2	.620**	1.000	.404**	.541**	.382**	.570**
3	.485**	.404**	1.000	.455**	.258**	.378**
4	.618**	.541**	.455**	1.000	.302**	.609**
5	.350**	.382**	.258**	.302**	1.000	.468**
6	.677**	.570**	.378**	.609**	.468**	1.000

The number of each variable corresponds to the number in Table 1.

**) Correlations are significant at 0.01 level.

The alpha Cronbach is 0.847, so the six variables are relevant. This finding led to dimension reduction using factor analysis to define the relevant factors.

We ran a principal component-based factor analysis with rotation on these six variables, which gave us three constructs. The first construct contains variables 1,2,4, and 6, with high, almost equal loadings. We named it Perceived Creativity Construct. Variable 5, which reflects the extent of overcoming risk to achieve better performance, is with high loadings and named Risk Construct. We constructed the third factor by variable 3, Creativity for Quality Construct. The level of variance explained is 82%.

We computed the mean difference of each construct concerning working from home or office. We provide the findings in Table 3.

Table 3: Comparing means by working from office and working from home.

		Mean		P-value (One side)
		Office	Home	
1	Perceived Creativity Construct	4.25	4.28	0.387
2	Risk Construct	3.75	4.17	0.060
3	Creativity for quality Construct	4.30	4.52	0.035

We can test our first research hypothesis using the Perceived Creativity Construct. We conclude that working either from home or from the office ($p=0.387$) has no impact on the perceived creativity of people. Therefore, we rejected our hypothesis 1.

We ran t-tests on the risk construct. The finding about risk is interesting. People that work from home are ready to take more risks to accomplish their assignments (mean=4.17). They use more creative ways, according to their perceived attitude, and confront problems. People who are more risk averse prefer to work from the office (mean=3.75) and not look after risky creative approaches to solve problems. We accept our second hypothesis ($p=0.06$).

Our third hypothesis deals with creativity for better quality. From the finding, people that work from the office use less effort to find ways to ensure better quality (mean=4.30). We interpreted that these employees rely on cooperation with others in their working places. We accept our third hypothesis ($p=0.035$) that people working from home seek creative ways (mean=4.52, $p=0.035$) to ensure better quality.

4. Discussion

The findings of this study lead us to interesting findings that should be treated carefully. The revealed preference of people that work from their home rather than from the office may have managerial considerations about what type of assignments should be assigned to workers from home or in the office. The portfolio of people in the office should be related to the capabilities of workers to work in teams to share ideas and to encourage each other to explore more creative ways to get better performance.

The study gives some light on the attitude of females and males regarding working from home. We show that women in the hi-tech industry tend to work from the office. We found no significant impact of the task and the position of women on their workplace place preferences.

While the hierarchical position in a hi-tech organization has no impact or correlation with working from home, still, managers prefer to work from home. This statistically significant finding relies on a small sample.

The hi-tech development workers tend to work from home. This finding is relevant to the aim of this study, as development workers, especially in the hi-tech industry, are expected to be more innovative and creative. This finding agrees with our hypotheses 2 and 3.

The perceived creativity of hi-tech workers working from home or the office is the same. Workers that work from their home state are willing to take more risks to solve problems. We interpret that they use more innovative and creative acts that may require more risk-taking.

We can draw some managerial rules from the study about what assignments we assign to high-tech workers from home or in the office. These recommendations are also crucial in recruiting human resources. When posting teams of workers, we recommend exploring their attitude toward risk while looking for better innovative working processes.

We interpret the third hypothesis as hi-tech workers from home ready to take more creative and innovative ways to ensure quality. The third hypothesis was accepted, and it reflected that. The second and third hypotheses encourage more research on these specific issues of creativity for quality and success for working from home.

5. Conclusions

The study gives some highlights after years of experiencing working from home and working from the office. We conclude that, generally, perceived creativity is the same for those ways of work. Nevertheless, some personality traits might be expected for those working from home.

Organizations that are willing to increase the level of creativity in general and for purposes are encouraged to view the preferences of their employees concerning working from the office or home.

We show that the people working from the office are looking for creative ways to confront risk and increase quality. They are more independent workers that may need less support from others to reveal more creativity.

We recommend studying hybrid working methods from home and office for further research. This research treats perceived creativity, yet it is suggested to use objective mechanisms to test the creativity level of workers.

The results are based on an adequate number of respondents, but it would be better to expand the research population. The study deals with perceived aspects of creativity and innovation personality traits. We recommend searching for objective elements and, if possible, measurable.

Acknowledgement

We want to thank Mr. Steve Katz, M.Sc. from HIT, for his data collection and lit review input.

Reference

- Comunian, R., & England, L. (2020). Creative and cultural work without filters: Covid-19 and exposed precarity in the creative economy. *Cultural Trends*, 29(2), 112-128.
- Condon, E. (2021). *A quantitative study on the effects of Covid-19 related remote working upon Department of Social Protection staff with particular regard to well-being, work/life balance, and motivation* (Doctoral dissertation). National College of Ireland.
- Füzi, A., Clifton, N., & Loudon, G. (2022). New in-house organizational spaces that support creativity and innovation: the co-working space. *R & D Management Conference*, 3-6, 1-8.

- Hayes, S.; W., Priestley, J., L., Ishmakhametov, N., & Ray, H., E. (2020). *"I'm not Working from Home, I'm Living at Work": Perceived Stress and Work-Related Burnout before and during COVID-19*. Kennesaw State University.
- Sadeh, A., & Feniser, C. (2021). Uncertainty and Managers' skills in Industrial Innovation Processes. In *MATEC Web of Conferences* (Vol. 343). EDP Sciences.
- Sadeh, A., Zwikael, O., & Meredith, J. (2022). Organizational support as an effective risk mitigation approach. *International Journal of Managing Projects in Business*, 15(7), 1123-1143.
- Sahu P. (2020). Closure of Universities Due to Coronavirus Disease 2019 (COVID-19): Impact on Education and Mental Health of Students and Academic Staff. *Cureus*, 12(4), e7541.
- Singh, S. K., Gupta, S., Busso, D., & Kamboj, S. (2021). Top management knowledge value, knowledge sharing practices, open innovation and organizational performance. *Journal of Business Research*, 128, 788-798.
- Zhou, J., & George, J. M. (2001). When job dissatisfaction leads to creativity: Encouraging the expression of voice. *Academy of Management journal*, 44(4), 682-696.

Innovation in Hotel Enterprises During the Covid-19 Pandemic and the Ukraine Conflict. Poland: Case Study

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Abstract: Entrepreneurship is one of the most important components of the modern market economy. Important features of entrepreneurship include expansiveness, innovation and the ability for companies to adapt to changing environmental conditions. These elements are also noticeable in the case of hotel companies, which are among the oldest types of business entities operating in the world. Innovation in hospitality contributes to the improvement of competitive market positioning, as well as effects on the interest of customers. The aim of the publication is to discuss current examples of innovative activities of hotel companies. The article takes into account the significant impact of the Covid-19 pandemic and the war in Ukraine on innovations within these enterprises. For the purpose of achieving the objectives of the publication, the Polish hotel market was taken into account. The subject of the publication concerns an important issue of innovation in the hotel industry. The hotel sector has been particularly affected by unexpected changes in the economic environment. However, despite the difficult situation and uncertain future, the Polish hospitality still provides the examples of innovative activities worth discussing. The motives for choosing the subject of the publication are also the author's personal scientific interests, as well as a limited number of the references on this subject, especially from the most recent period. The paper describes and discusses the concept of innovation, especially in the hotel sector. The examples of the innovative activities in the Polish and foreign hotel companies are described. The most important achievements and successes in this field are presented. The article poses the following research thesis: The Covid-19 pandemic and the war crisis have not significantly affected innovation in the hotel companies in Poland. The article was created using book materials, journals, and netographic information. The research method used in the publication is the analysis of the existing data and literary criticism. The results of the research positively verify the thesis.

Keywords: Global pandemic, hospitality, creativity, ingenuity, war in Ukraine.

1. Introduction

Entrepreneurship is an important pillar of the market economy. Its important features, such as innovation, contribute to the creation and implementation of modern solutions in organisations. As in other branches of the economy, innovation is also a characteristic of hotel companies. Many of them are distinguished by rich traditions and achievements in the field of inventiveness.

The aim of the publication is to discuss current examples of innovative activities of these hotel companies. The article ponders over the significant impact of the Covid-19 pandemic and the war in Ukraine on the innovative activities these enterprises. For the purpose of achieving the objectives of the publication, the Polish hotel market was taken into account.

The subject of the publication focused on the concept of innovation in these Polish hotel companies. The hotel sector in Poland has been strongly influenced by the global pandemic since its outbreak in 2020, and later by the war in Ukraine. However, it is worth analysing the latest achievements of the national hospitality in the field of innovation despite the uncertain situation. The paper describes and discusses the concept of innovation, especially the progress in the hotel sector. The examples of innovation in the Polish and foreign hotel companies are described. The most important achievements and successes in this field are presented.

The article poses the following research thesis: The epidemic and the war have not significantly affected innovation in the hotel industry in Poland. The article was created using book materials, journals, and netographic information. The research method used in the publication is the analysis of the existing data and literary criticism. The results of the research positively verify the thesis.

2. The concept of innovation and innovativeness in hotel industry

Innovation is an important element determining the level of development of each country's economy. Innovations and their implementation provide progress and also provide an opportunity for entrepreneurs from various industries to realise bold and ambitious dreams and ideas. Innovations allow for competition in the market, achieving positive financial results and building growth of the company's value in the long term. The terms innovation and innovativeness are understood differently in the literature. When defining innovation, both narrow and broad approaches are presented (Weresa 2022). Nevertheless, the latter, inspired by J.

Schumpeter, is dominant. The narrow approach refers to the changes based on the new or previously not used knowledge and the commercialisation of a product or process. The broad approach emphasises, inter alia, the use of knowledge to create new knowledge, the introduction of new elements, new means of satisfying human needs, or beneficial changes resulting from the environmental needs and observations (Schumpeter 1960).

The definition of innovation also clearly highlights two trends. The first, in which the emphasis is placed on the process (innovation as a process, sequence of activities); and the second, in which the result is highlighted, namely new solutions. Many scientists perceive innovation as the implementation of certain ideas, actions, systems, strategies, programs, devices, processes, products or services that are new to the organisation (Sołtysik 2021). Innovation is defined as the process of the creative use of knowledge, the transformation of the knowledge possessed by an organisation or acquired from external sources - into new products, services or processes (Cavagnoli 2011).

Innovation has long been part of the European Union policy. In 1986 the Single European Act was adopted, which identified the problem of competitiveness of European goods as one of the priorities of the Community's policy. The subsequent treaties expanded the list of domains to be covered by these pro-innovation policies. The latest treaty, the so-called Lisbon Treaty, solidified the problem of innovation as one of the most important directions of the EU policy (Sozanski 2010).

The level of innovativeness in the economies of European countries is subject to regular analyses. The Innovation Indices of the selected European Union countries in 2022 are presented in Figure 1.

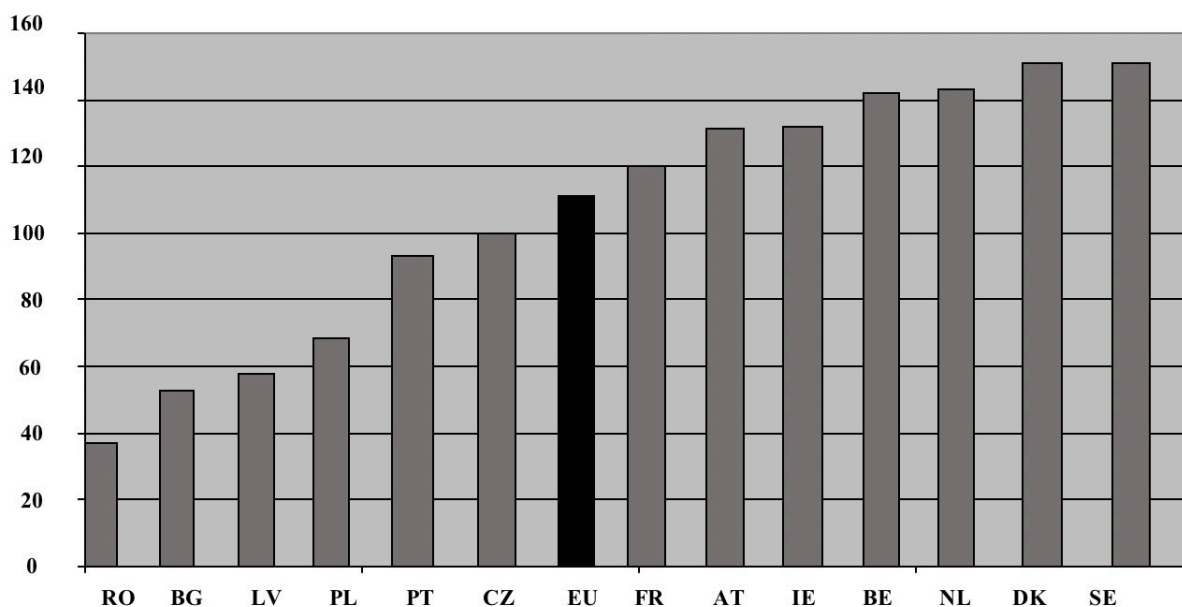


Figure 1: Innovation index of selected EU countries

Source: Self-study based on <https://research-and-innovation.ec.europa.eu/>.

The analysis of the data in Figure 1 indicates that Sweden and Denmark are among the leading innovators in the European Union. Poland's position is below the EU average in this respect. According to many experts, the level of innovativeness of a given economy has a direct impact on the effectiveness of work and the level of income achieved.

The introduction of innovation in enterprises can be an important means to rationalise and save money, as well as to activate the market forces that promote the development of the economy and improve the quality of life, society or the region. In addition, it creates a completely new picture of the market orientation, in which innovation, not prices and costs, will become the main element of competition and strengthening the economic condition of the company. For the purposes of research and comparative analyses, the classification of innovations proposed by the OECD specialists is recommended, included in the so-called Oslo Manual. The Oslo Manual distinguishes the following innovations (<https://www.oecd.org/>):

- Product,
- Procedural,

- Organisational,
- Marketing.

Product innovations are the launch of a new or improved material good (product) or service. In addition, they also include the improvement of some product parameters including the terms of their functionality. The examples include adding additional elements to a regular sales offer (e.g., sports equipment rental) or combining services and products that together will create an inviting tourism package.

Process innovations are mostly related to the modern ICT technologies. They are implemented in order to increase the productivity of the company and to facilitate reaching customers. The examples of this type of innovation include modern booking systems or hotel check-in systems or scanners that allow passengers to be identified based on their irises.

Organisational innovations generally refer to the principles of business operation and internal and external relations. In the service sphere, this type refers to the organisation of the workplace and the introduction of management and control techniques.

Marketing innovations include the introduction of a new marketing method combined with significant changes in the product design, positioning, promotion, pricing and distribution. An example is the implementation of loyalty programs. Popular communication channels in this case are the social media (e.g., Facebook) or the Internet (Walenciuk, Dłużewska 2018). In addition, the literature also includes social innovations, in addition to those mentioned above. These involve changes in the incentive techniques for employees. An example is paying on a piecework basis instead of per hour worked (Taylor 1997).

As in other branches of the economy, innovation has been operating in the hotel industry (Dominik 2013) or catering industry (Sarker 2012) for years. New solutions are an element of marketing and strategic management of hotel companies. The implementation of innovations also builds the brand and recognition of a particular hotel company among other competing facilities in the market (Sztorc 2015). The offers of the most modern hotels are increasingly delighting not only with the fervent fans of technology, but above all the tourists and professionals travelling on business. Innovation in the hotel industry can take various forms (Jędrasiak 2013). Most often, it is commonly associated with the process of implementing new smart solutions, including the introduction of robots replacing traditional operations, artificial intelligence, as well as modern applications controlling residence functions. Nowadays, fashionable boutique and historic hotels often apply technology more typical of spaceships. It is also relatively common to notice the cooperation between facilities in spreading innovation (Najda-Janoszka 2012). The examples of the most innovative hotels in the world are presented in table 1. Innovation is also identified with the process of implementing new solutions and upgrades in the architecture of the construction, of the facilities themselves and the arrangement of the residence spaces (Puciato 2013). Another area of innovation implementation is the production of goods and the provision of accommodation and catering services. Innovation also increasingly involves the process of introducing modern hotel facilities

Table 1: Examples of the most innovative hotels in the world in 2023

Hotel name	Location	Innovation characteristics
Fly Zoo Hotel	Hangzhou, China	Services based on the use of artificial intelligence
Hen na Ha Hotel	Tokyo, Japan	The use of artificial intelligence and robots in guest service
The Yotel	New York, USA	Cabins to replace rooms, robots to serve guests
Aloft Cupertino	California, USA	Boutique hotel stylistically referring to Apple, robots to serve guests
The Ling	Las Vegas, USA	The object is fully controlled by WeChat application
Eccleston Square Pimlico	London, UK	Boutique facility using modern technology and iPod
The Code Hotel	Rome, Italy	Boutique facility with modern solutions and chromotherapy
City Hub	Amsterdam, The Netherlands	Capsule hotel with virtual tourist guide
Smart Hotel	Rome, Italy	Historic boutique hotel using smart technology

Source: Own elaboration based on: <https://apagroup.pl/>.

The data in Table 1 indicate a geographical diversity in hotel innovation and the frequent use of modern applications in the control of guest residence functions. The global pandemic and the conflict in Ukraine have not limited the development of innovation in global hospitality.

3. Evolution and current situation of the hotel industry in Poland

The beginnings of hotel development in Poland were in the early Middle Ages. The first lodging facility to survive to modern times was the Hospice of the Joanite order, founded in 1187 in Poznań. In the following years, inns and taverns were created throughout the country. In 1693, the first hotel complex called Marywil (from the French language "Marie-Ville") was created, which existed until 1825. The mid-19th century brought further development of the Polish hospitality industry. More and more hotels were built. In Poznań, the Bazar Hotel was opened, in Warsaw, the Vienna Hotel (Hotel Wiedeński) and the European Hotel (Hotel Europejski), in Kraków, the French Hotel (Hotel Francuski) and many other facilities of this type (Błądek, Tulibacki 2003) were built. From the very beginning, the Polish hospitality industry has tried to draw examples from the most modern European solutions.

In Poland, the first buildings that were built from the beginning where purposed for use as hotels and today are called historic hotels and these began to appear at the turn of the 20th century. They were mainly established in Poland's largest cities (Liszewski 2008). Among the oldest historical hotels in Poland, which operate to this day, is considered the Pod Różą Hotel in Kraków, which was established in the early 19th century in a historic tenement house from the 14th century. One of the oldest city hotels in Poland is the Bazar Hotel in Poznań dating from 1841, which is currently undergoing a renovation process and does not provide hotel services (Bombicki 1995). In the 19th century, old castles were also adapted for the hotel business. One of the earliest was Chojnik Castle near Jelenia Góra (Chorowska, Dudziak, Jaworski, Kwaśniewski, 2009). However, most historical hotels began to appear at the beginning of the 20th century. These were mainly city hotels, located in large cities (Table 2).

Table 2: Examples of the first hotels in Poland, the highest categories operating in 2023

Hotel name	Categorisation	Number of rooms	Year of creation	Location
Pod Różą Hotel	*****	56	Ca. 1800	Kraków
Europejski Hotel	*****	106	1877	Warsaw
Grand Hotel	*****	64	1887	Kraków
Monopol Hotel	*****	121	1892	Wrocław
Pod Orłem Hotel	****	75	1896	Bydgoszcz
Bristol Hotel	*****	205	1901	Warsaw
Monopol Hotel	*****	108	1903	Katowice
Francuski Hotel	****	42	1912	Kraków
Polonia Palace Hotel	****	206	1913	Warsaw

Source: Own elaboration.

The real flourishing of the Polish hotel industry in quantitative and qualitative terms, and a significant advance in innovation, has occurred since the 1990s. The new political conditions attracted foreign investors and many domestic entrepreneurs. At the same time, the market demand for high-quality hotel services from domestic and foreign guests increased. These factors positively influenced the situation of the Polish hospitality industry. In 1990, there were 499 hotels and 57 396 hotel beds in Poland. Only in the period from 1990 to 2010, more than 1.2 thousand hotels and almost 100 thousand hotel beds (<https://stat.gov.pl/>) appeared in Poland.

Among the private Polish investors, the Likus family (the Likus Hotele&Restauracje) invested the most in the hotel market, with more than PLN 360 million, Tadeusz Gołębiowski (the Gołębiowski Hotels) with about PLN 350 million, Małgorzata Chechlińska (Trip Group) with about PLN 250 million and Andrzej Dowgiałło (Anders Group) with about PLN 150 million. Among hotel chains, investors contributed the most (over PLN 900 million) to the facilities operating under the Starwood chain brands (Sheraton, Westin, Le Meridien). The Orbis/Accor chain spent more than PLN 700 million on investments, while Norway's Qubus spent approximately PLN 300 million. These entities were also the first innovators in the domestic hotel industry (Levansky 2023).

In Poland, in 2021, there were 2521 facilities classified as hotels with almost 297 thousand hotel beds. This means that compared to 2020, there was a slight increase in the number of facilities of 0.9%, while in hotel beds of 7.4%. The number of hotels, hotel rooms and hotel investments in Poland in the years 2011-2021 is presented in Table 3.

Table 3: Number of hotels, hotel rooms and hotel investments in Poland in the 2011-2021

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Number of hotels	1877	2014	2107	2250	2316	2465	2540	2592	2635	2498	2521
Numer of hotels rooms increased in thousands	93 141	100 100	105 783	113 965	117 448	126 165	130 081	136 080	141 383	135 995	144 549
Value of investment hotel (in mln PLN)	2489	3820	2368	3110	1860	2769	1885	1993	2635	1216	3383

Source: Own elaboration based on <https://issuu.com/>.

The data in Table 2 show a noticeable slump in trends in the Polish hotel market in 2020, and a return to a positive trend in 2021. There have been increasingly active hotel chains in Poland since the 1970s, especially from France and the USA. A summary of the results of the largest hotel chains operating in Poland in 2019-2022 is presented in Table 4.

Table 4: The largest hotel chains in Poland in the 2019-2022s.

Name	Location	Established in	Number of hotels/ rooms in 2019	Number of hotels/ rooms in 2020	Number of hotels/ rooms in 2021	Number of hotels/ rooms in 2022
Accor	Paris, France	1967	75/12773	80/13305	82/13489	84/13980
PHH	Warsaw, Poland	2018	-	25/2638	26/2856	54/5851
Hilton Worldwide Holdings	McLean, Virginia, USA	1919	20/3452	22/3739	23/3906	26/4276
Marriott International	Bethesda, Maryland, USA	1927	15/3335	17/3645	17/3645	20/4200
Radisson	Minneapolis, USA, Brussels, Belgium	1960	11/2504	13/3018	15/3551	15/3551

Source: Own elaboration based on: <https://www.e-hotelarz.pl/>.

The analysis of the data in Table 4 leads to the conclusion that in Poland, the French conglomerate Accor plays the biggest role in the chain hotel industry. Currently, chain hotels in Poland account for 25% of the total supply of rooms in Poland. Despite the global pandemic and the conflict in Ukraine, the development of the domestic hotel industry has not stopped. Newly built facilities often astonish with their size, architecture or original solutions. A list of the most spectacular hotel facilities in Poland opened in 2021 and 2022 is presented in Table 5.

Table 5: The largest and most spectacular hotel facilities in Poland, opened in 2021 and 2022

Name	Location	Categorization	Number of rooms
Cristal Resort	Wisła	*****	491
Olimp IV	Kołobrzeg	****	350
NYX Hotel	Warsaw	****	331
AC by Marriott	Kraków	****	300
Mercure	Katowice	****	268
Uphagen Manor House	Gdańsk	****	256
Arche Hotel Poloneza II	Warsaw	***	250
Focus Premium	Warsaw	****	234
Radisson	Kołobrzeg	****	209
Wyndham	Wrocław	*****	205
Mercure	Kraków	****	195

Source: own eleboartion based on: <https://www.e-hotelarz.pl/>.

4. Innovation in Polish hospitality in the Covid – 19 pandemic and the war in Ukraine

With the popularization of the hotel industry in Poland, there have been trends indicating the increasing level of innovation of many facilities. Innovation, on the one hand, is supposed to be a way to stand out in the tourism market; and on the other hand, a magnet for customers longing for novelty. The Polish hospitality industry is trying to respond with its creative ideas to the global trends in this area. In Polish hotels, as in the rest of the

world, it is possible to notice the examples of product innovation, process innovation, organisational innovation, marketing innovation, as well as social innovation. As in other countries, the highest category hotels and network hotels, which can count on substantive support from their corporate headquarters, lead in the implementation of innovation (Tesone 2009). The Covid-19 pandemic and the war in Ukraine has not stopped these innovative trends observed before 2019.

One of the examples of innovations used in the Polish hotels is the increasing use of robots in guest service. BellaBot is an innovative waiter robot used since the end of 2021, serving in the hotel restaurants (Figure 2). The interactive machine delivers products, receives dishes and reacts emotionally to the interest of the guests. Its innovative character also evoked considerable interest from the customers themselves, especially children, and can also be considered from a marketing approach. Currently, the robot is used in catering departments of approximately 10 domestic hotels, among others the Marriott Hotel, the 03 Hotel (Warsaw), the Metropolo Hotel (Kraków), the Cristal Hotel (Białystok), the Miodowy Hotel (Dzierżonów), the Green Mountain Hotel (Karpacz), the Bacówka Hotel (Radawa), the Fox Hotel (Wolborz). Apart from hotels, robots are used in numerous independent restaurants, retail outlets and entertainment zones (<https://puduroboty.pl/>).



Figure 2: BellaBot Robot

Source: https://d-art.ppstatic.pl/kadry/k/r/1/67/61/62a88e58c7608_o_large.jpg.

Another example of innovation in the Polish hotel industry is the bolder architecture of newly built facilities. Some hotels impress with the grandeur of their spaces and the number of hotel rooms, while others prefer intimacy and unusual arrangements. New hotels often exploit former industrial spaces of closed industrial buildings. All of these activities increase the interest of hotel guests.

In the middle of 2020, a large facility was opened, which is part of the Sugar Factory Żnin Conference and Leisure Centre (the Cukrownia Żnin). The 310-room loft-style hotel was built in a 19th-century sugar factory operating until the 1990s. The hotel is part of a large 35-hectare complex with an area of 40 thousand square meters. The facility's innovation consists of direct access to a huge conference space (2300 m²), a cinema room for 100 people, a spa centre with aquapark, a museum of sugar and optimism, a rehabilitation centre with a medical clinic and a commercial park. In addition, the guests have at their disposal a bowling club, own brewery, restaurants, pitches, auditorium, and also the beach on the lake with a beach bar and a kitesurfing school. Also innovative is the integration of holiday homes and a newly built residential development into the complex (<https://arche.pl/>).

At the end of 2021, Uphagen Manor House in Gdańsk was opened. The facility was built in the buildings of the former municipal hospital, which is rather an uncommon phenomenon in Poland. The industrial decor exposes relics of a bygone era. Original bricks, cradle vaults and high, raw concrete ceilings supported by original structural beams are on display. The interiors are illuminated by colourful neon signs creating a unique atmosphere. In addition to the main building housing the hotel, the complex includes an annex and a factory with additional rooms. In the building of the former boiler room there are two conference rooms with an area of 234 m², and in the building of the tenement there is a foundation, whose beneficiaries run their own cafe. Additionally, the hotel offers its customers the opportunity to purchase rooms under the condo system (<https://arche.pl/>).

Another outstanding property is the LALALA Arthotel in Sopot. This is a concept reaching beyond a typical hotel. Each of the rooms is individually designed. Seven rooms, with strange numbers, which are an interesting composition of paintings in contrasting colours, and for their decor use furs, crystals, wood, and metal in various combinations. The door of one room is knocked on by a knocker, in another one, there are curtains with giraffes prancing about, and in room number 100, there is a surreal paradise of surprises. The hotel operates a self-service reception desk (<https://www.lalala.lu/>).

The most spectacular hotel investments in Poland are undoubtedly the first, located fully on the water the Feel Harmony Hotel (Figure 3). This boutique facility with 72 rooms in a modular structure is under construction and is to be opened in the summer of 2023 in Gdańsk at the Motława River near Ołowianka Island, in the vicinity of the Baltic Philharmonic and the AmberSky observation wheel. The hotel, which belongs to the category of floating hotels, will consist of three connected and permanently moored houseboats at a specially prepared wharf. It will offer, inter alia, a sauna and a restaurant with a terrace, where it will be possible to pull up and moor a kayak or motorboat, as formally the Feel Harmony will be a marina with a hotel function. The hotel is supposed to be a connection between nature and the bustling city (<https://www.e-hotelarz.pl/>).



Figure 3: The Feel Harmony Hotel in Gdańsk

Source: <https://bi.im-g.pl/im/da/45/1a/z27547610AMP,W-Gdansk-powstanie-pierwszy-w-Polsce-hotel-na-wod.jpg>.

In mid-2023, the largest and one of the most modern hotels in Poland, the Gołębiowski Pobierowo Hotel, will also be opened after several years of construction. The hotel is built on the premises of a former military unit. The facility will ultimately offer 1200 rooms and 2200 beds, 16 conference rooms for 4 thousand people, a sports centre with halls and pitches and two cinemas (<https://nto.pl/hotel-golebiowski-w-pobierowie-wyglada-naprawie-gotowy-mowia-o-nim-dubaj-nad-baltykiem-ma-byc-otwarty-w-pierwszym-kwartale-roku/ar/c3-17176581>).

Another element of innovation in domestic hotels can be modern solutions in the field of residence organisation and guest service. The pioneers and leaders of innovation in this area include the Blow Up Hall 50/50 Hotel in Poznań. Its name was inspired by the film *Blow-up* by an Italian director Michelangelo Antonioni. The title is also the name of Rafael Lozano-Hemmer's electronic installation project, around which the hotel was arranged. The name of the hotel and the numbers 50/50 means the proportion of pleasure to art. The hotel does not have a reception. Instead of a key, the guests receive an iPhone, which allows them to find and open the door to a particular room using interactive screens. The iPhones are also equipped with the information enabling free use of 24-hour concierge services – booking a table, ordering a taxi and obtaining information about cultural events in Poznań and its surroundings. Due to the ownership changes in 2023, further modern modifications of the facility (<https://www.capitalapart.pl/hotel-blow-hall-5050-noclegi-w-poznaniu-dla-koneser%C3%B3w>) are expected.

In February 2023, the Alto Hotel in Żory joined the group of the most modern hotels in Poland. There is no traditional reception in the hotel. Neither are there keys to the rooms. The guests receive a room code via SMS after they book and pay for their stay at a special touch-screen desk with a check-in system located on the first

floor. Everything was designed in an intuitive and simple way. This innovative solution enables checking in quickly and easily at the hotel. Upon check-in, the system additionally prints the code, which is also the key to the room, to the hotel entrances at night and to the lift. The advantage of this "Self Check-in" system is also that the guests do not need to check out. The system itself will automatically lock the code (<https://www.zory24.pl/>) when the hotel day ends.

5. Conclusions

The global pandemic and the conflict in Ukraine have not significantly affected the development of innovation within the Polish hospitality industry. Despite temporary perturbations, the closedown of some facilities, ownership changes and the overall increase in operating costs, innovation in the domestic hotel industry has not disappeared. In Poland, there are still impressive and bold hotels being built that stand out with their modernity in the market. In the country since the late 1990s, there has been an expansion of boutique hospitality, which amazes with its originality of design solutions. This includes modernist buildings with their futuristic solutions. In many cases, innovation in hotels cannot only increase the interest of guests, but also reduce the cost of operations. Robotisation, the replacement of reception desks with the iPhones for guest services can improve a facility's economic situation and increase its competitiveness in the market. Indeed, receptionists and waiters are among the most frequently rotating jobs in the hotel industry. Another important conclusion is the fact of the wide scope of innovations introduced, which can be observed in product, organisational, but also marketing or process aspects.

References

- Błądek, Z., Tulibacki, T. (2003) *Dzieje krajowego hotelarstwa od zajazdu do współczesności. Fakty, obiekty, ludzie.* Wydawnictwo Albus, Wrocław.
- Bombicki, M. R. (1995) *Bazar poznański: lata świetności*, Poznań.
- Cavagnoli, D. (2011) A Conceptual Framework For Innovation: An Application to Human Resource Management Policies in Australia. „Innovation: Management, Policy & Practice” Vol. 13, April, pp 111.
- Chorowska, M., Dudziak, T., Jaworski, K., Kwaśniewski, A. (2009). *Zamki i dwory obronne w Sudetach*, t.2, Księstwo Jaworskie, Wrocław, pp 41.
- Dominik, P. (2013) Innowacyjne rozwiązania we współczesnym hotelarstwie, Wydział Turystyki i Rekreacji AlmaMer Szkoła Wyższa, Warszawa, pp 55–65.
- Jędrasiak, M. (2013) Innowacyjność w hotelarstwie na przykładzie wybranych hoteli Dolnego Śląska. *Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu*, Wrocław, pp. 140–149.
- Levansky, K. (2023) <https://www.hotelnews.pl/rynek-hotelarski-w-polsce-1990-2010/>.
- Liszewski, S. (2008) Miasto jako przedmiot badań geografii turystyki w Polsce, „Turystyka”, 18 (1).
- Najda-Janoszka, M. (2012) Współdziałanie przedsiębiorstw turystycznych w ramach działalności innowacyjnej, *Przegląd Organizacji*, 12, pp. 20–23.
- OECD (2008) *Podręcznik Oslo. Zasady gromadzenia i interpretacji danych dotyczących innowacji*, Organizacja Współpracy Gospodarczej i Rozwoju, Departament Strategii i Rozwoju Nauki, Warszawa.
- Puciato, D. (2013) Wybrane aspekty innowacyjności przedsiębiorstw hotelowych z Beskidu Śląskiego, *International Journal of Contemporary Management*, 1 (12), pp 106–114.
- Sarker, R. (2012) *Entrepreneurship in Restaurant Business*, KS OmniScriptum Publishing.
- Schumpeter, J. (1960) *Teoria rozwoju gospodarczego*, Państwowe Wydawnictwo Naukowe, Warszawa.
- Sołtysik, M. (2021) *Projektowanie strategii innowacji*, Polskie Wydawnictwo Ekonomiczne, Warszawa.
- Sozański, J. (2010) *Traktat Lizboński*, Polskie Wydawnictwo Prawnicze, Warszawa-Poznań, pp 15.
- Sztorc, M. (2015) Wpływ innowacyjności na konkurencyjność przedsiębiorstw usługowych hoteli, *Zeszyty Naukowe Firma i Rynek*, 1 (48), pp 117–143.
- Taylor, F.W. (1997) *The principles of scientific management*, Dover Publications Inc, Dover.
- Tesone, D. (2009) *Principles of Management for the Hospitality Industry*, Taylor & Francis Ltd, Abingdon on Thames.
- Walenciuk, J., Dłużewska, A. (2018) Innowacje w usługach hotelarskich – analiza porównawcza rozwiązań innowacyjnych wdrażanych w wybranych hotelach województwa lubelskiego i małopolskiego, [http://file:///C:/Users/krzys/Downloads/15_walenciuk.j-dluzewska.a%20\(2\).pdf](http://file:///C:/Users/krzys/Downloads/15_walenciuk.j-dluzewska.a%20(2).pdf).
- <https://research-and-innovation.ec.europa.eu/>
- <https://www.oecd.org/>
- <https://apagroup.pl/>
- <https://stat.gov.pl/>
- <https://issuu.com/>
- <https://www.e-hotelarz.pl>
- <https://puduroboty.pl/>

https://d-art.ppstatic.pl/kadry/k/r/1/67/61/62a88e58c7608_o_large.jpg.
<https://arche.pl/>
<https://www.lalala.lu/>
<https://bi.im-g.pl/im/da/45/1a/z27547610AMP,W-Gdansk-powstanie-pierwszy-w-Polsce-hotel-na-wod.jpg>.
<https://www.e-hotelarz.pl/>
<https://www.capitalapart.pl/hotel-blow-hall-5050-noclegi-w-poznaniu-dla-koneser%C3%B3w>.
<https://nto.pl/hotel-golebiewski-w-pobierowie-wyglada-na-prawie-gotowy-mowia-o-nim-dubaj-nad-baltykiem-ma-byc-otwarty-w-pierwszym-kwartale-roku/ar/c3-17176581>
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Social SME Entrepreneurship: A Conceptual Model of Innovativeness in Environmentally Sustainable Social Enterprises

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Abstract: Purpose – The awareness of the severity of global sustainability challenges has reinforced appeals to harness and leverage alternative business forms and ecologically sustainable innovations to grant future generations the capability to meet their own needs. This paper aims to develop a conceptual model for innovativeness of Environmentally Sustainable Social Enterprises (ESSEs). Design/methodology/approach – After undertaking a systematic literature review, a conceptual model including eight dimensions is developed. This is tested by means of a standardized self-completion online questionnaire among ESSEs. Findings – The analysis of the quantitative data enabled us to revise the conceptual model. Our findings confirm the multidimensional nature of the innovativeness of ESSEs primarily inferred from the studies by Lawson and Samson (2001), Hogan *et al.* (2011), and Iddris (2016). The findings of the study provide a contextually insightful and focused understanding of the eco-innovation capability, related to ESSEs. Originality/value – EI literature predominantly focuses on large, profit-maximizing organizations. Less scientific work examines mission-driven SEs as their object of study. Hence, this study bridges the literature of social entrepreneurship, EI, and innovation management.

Keywords: Social enterprise, Environmentally Sustainable Social Enterprises (ESSE), innovativeness, SME

1. Introduction

The awareness for global sustainability is consistently increasing; however, the changes induced to combat the challenges faced and to aim at a more sustainable world seem to be extremely slow in nature. The challenges faced by humankind are multifarious resulting in global climate change and its severe implications like drought, rise in sea-level, extreme weather conditions, etc. (Silvestre and Țircă, 2019). The heightened awareness of the severity of sustainability challenges has reinforced appeals to harness and leverage alternative business forms and ecologically sustainable innovations to grant future generations the capability to meet their own needs (Vickers and Lyon, 2014).

The slow momentum of the measures taken reflects in the rapid depletion of natural resources, where a large gap is being observed between increasing human demand and the supply of natural resources (Hoefer, 2019). Thus, major attention is steered towards industry and organisations who mainly contribute to environmental degradation. Although they are the main triggers, they are anticipated to have the potential solutions and can reverse their negative environmental impact (García-Granero *et al.*, 2018; Schaltegger and Wagner, 2011). Cohen and Winn (2007, p. 30) argue that environmental degradation can be slowed and the earth's ecosystems can be improved by "harnessing the innovative potential of entrepreneurship with innovative business solutions." Social entrepreneurs are said to bring in the required ecological and social innovations as their entrepreneurship is mission-driven rather than profit-driven; they focus and prioritise social and environmental interests and place them on par with economic interests (DiVito and Bohnsack, 2017; Hall and Wagner, 2012). These social enterprises (SEs) are described in literature as inherently innovative in addressing social, environmental and economic needs (Monroe-White and Zook, 2018; Wilson and Post, 2013).

This study presents the current situation in the field of ecologically sustainable innovations by Environmentally Sustainable Social Enterprises (ESSE); identifies the characteristics and innovativeness of ESSEs, and presents a conceptual model for ESSEs' innovativeness.

2. Literature Review

Substantial literature is available in the field of social enterprises and social entrepreneurship. Research carried out since 1991 concludes that SE and SEship literature is still in the development stage requiring a more formal, rigorous and empirical research methods (Granados *et al.*, 2011). It can be said that these disciplines are maturing and a consistent increase in theory development, empirical testing and validation is seen. This paper focuses on ESSEs and outlines a conceptual model that explains the internal factors determining the innovativeness of ESSEs. It examines mission-driven SEs as its object of study because less scientific work has been conducted in this field so far and the main focus of EI literature has predominantly been on large, profit-

maximizing organisations. Although the majority of SEs are small-sized and young enterprises (Defourny and Nyssens, 2017; Doherty *et al.*, 2014), they contribute largely to the green economy and sustainable development. In effect, ecologically sustainable innovations, also known as eco-innovation (EI) are a composite of business innovation research and sustainable development research. EIs create products and processes that are less wasteful, less resource-intensive and overall more eco-efficient (Leal-Millan *et al.*, 2018).

The Community Innovation Survey (CIS) distinguishes nine types of eco-innovations (CIS, 2014) that are classified into two categories. Six EIs refer to environmental benefits arising from the processes utilised in the production of green goods and services, and the remaining three deal with environmental benefits derived from the consumers' after-sale use of the product or service (Ben Arfi *et al.*, 2018; CIS, 2014). According to CIS (2014, p. 12) the six types of EI benefits are: reduced material use per output unit; reduced energy use per output unit; reduced CO₂ footprint; replaced materials with less hazardous substitutes; reduced soil, water, noise, or air pollution; and recycled waste, effluence or materials. The environmental benefits derived from consumers' after-sale use are (1) consumer benefits, reduced energy use, (2) consumer benefits, reduced air, water, soil or noise pollution, and (3) consumer benefits, improved recycling of product after use.

Thus, innovativeness with the focus on sustainability and vice versa are the key characteristics of EIs (Silvestre and Țîrcă, 2019; Varadarajan, 2017), which have led to the emergence of alternative business forms like Environmentally Sustainable Social Enterprises (ESSE) (Bettiol *et al.*, 2018; Breassan *et al.*, 2016; Picciotti, 2017; Youssef *et al.*, 2018; Kraus *et al.*, 2017) as well as ecological sustainable innovativeness (Gast *et al.*, 2017; Hockerts and Wüstenhagen, 2010; Schaltegger and Wagner, 2011). The ESSEs harness innovation systematically to induce change by combining resources in new ways. They are set at embedding social and/or environmental value into their company's economic value, which makes them novel and distinguishes them from traditional companies. The locus of the ESSEs' innovations is seen in their distinct organisational structures, resources and capabilities (Silvestre and Țîrcă, 2019; Varadarajan, 2017). Thus, the innovativeness of ESSEs is observed and analysed in this study. It explores the internal factors at the meso-level of the ESSEs that drive eco-innovations as well as sheds light on the internal capability of the ESSEs. It highlights how the ESSEs serve as catalysts and internally promote environmentally motivated innovation through more sustainable consumption and production practices.

2.1 Characteristics of ESSEs

ESSEs are catalysts of change as they combine resources in new ways and strive to create more sustainable consumption and production practices. Although novel in their values and committed to sustainability, they face more challenges than traditional companies (Gast *et al.*, 2017). One of their biggest challenge is decision-making as they try to balance environmental protection and adhere to social standards with economic, financial sustainability. Furthermore, ESSEs often tend to lack skilled human resources, technical expertise, access to finance and research that impede innovation, product development and market creation (Gast *et al.*, 2017, p. 52). Such resource constraints may influence their decision-making strategy (Hall and Wagner, 2012). Nonetheless, their size and structure, leadership style, corporate culture and employees' mind set strongly support their innovativeness. The ESSE entrepreneur plays a prominent role in generating innovations portraying not only a dynamic and horizontal leadership style but also strongly imprints the corporate culture. Their lean, flexible hierarchical structure makes them very responsive to changes.

2.2 Innovativeness of ESSEs

The ability to innovate is a firm-wide behaviour that renders innovative activities within as well as outside the organisation. Lawson and Samson (2001) and Hogan *et al.* (2011) acknowledge the multidimensional nature of the innovation capability construct composed of reinforcing practices and mechanisms within the firm. Thus, the internal factors at firm level are decisive and determine the innovativeness of ESSEs. Based on this notion, this paper refers to a conceptual model developed and tested within the scope of a master's thesis. This model is related to firm-specific internal factors only. External determinants such as governmental regulations, etc. are not captured by this model (Hoefer, 2019).

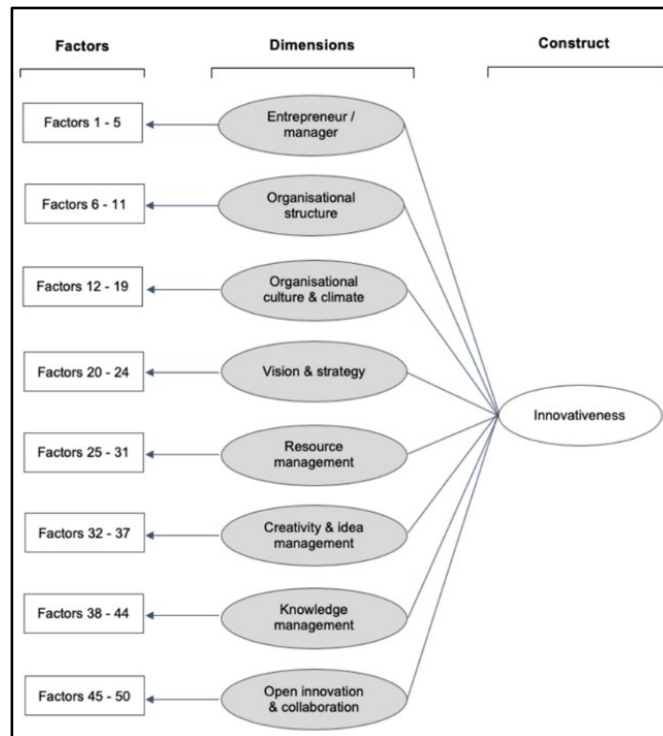


Figure 1: Conceptual Model (Hoefer, 2019, p.37)

As illustrated in the above figure 1, there are eight dimensions that affect the innovativeness of a firm.

2.3 Dimension One–Entrepreneur

The way, how individuals see, understand themselves and act their role as entrepreneurs plays a very important role in the decision making and activities undertaken (Zur, 2020). The social identity of the entrepreneur concentrates on what the entrepreneur actually does (Anderson and Warren, 2011) and plays a central role in the environmentally sustainable innovation processes of a company. It is the sustainability and entrepreneurial orientation of the founder, the founder's personality, managerial experience and green transformational leadership style that are defined as the core factors. Chen and Chang (2013, p. 109) propose the novel notion of "green transformational leadership style" that stimulates the innovative performance of organisations. It refers to the behaviour of an entrepreneur who motivates one's employees to achieve environmental goals and higher performance levels through creative thinking. S/he sees problems from new perspectives; communicates a vision, and provides individual support to one's employees.

2.4 Dimension Two–Organisational Structure

"Organisational characteristics are shown to bear a major influence on a firm's innovative activity" (Martínez-Román and Romero, 2017, p. 549). The more flexible an organisation is, the more reactive it is to its changing environment enabling internal flexibility when it comes to its processes, systems and the way its products or services are delivered (Ben Arfi *et al.*, 2018). Also, less hierarchical structures denote low levels of bureaucracy resulting in a wide span of control, greater flexibility and adaptability (Parzefall *et al.*, 2008).

2.5 Dimension Three–Organizational Culture & Climate

An innovation culture refers to behaviours, values and beliefs that foster an openness to innovation. The concept of climate describes specific facets of a firm's culture like a climate for psychological safety that tolerates mistakes and learns through failure (OECD and Eurostat, 2018; Parzefall *et al.*, 2008). Hence, leaders of ESSEs must try to create and foster a culture compatible with their innovation strategies (Pham *et al.*, 2019). An environmental culture of an organisation can facilitate both proactive and reactive green innovations (Chen *et al.*, 2012). The above-mentioned cultures empower employees giving them autonomy and creative time (Iddris, 2016). This is reflected in participative decision-making, emphasis on learning, support and collaboration, power sharing as well as risk tolerance (Hurley and Hult, 1998).

2.6 Dimension Four– Vision & Strategy

ESSEs are found to have an explicit organisational strategy emphasising proactive environmental sustainability and innovation orientation that is disclosed in their vision and mission statement (Dangelico, 2016; Parzefall *et al.*, 2008; Pham *et al.*, 2019). Such a strategy can serve as a core driver for the overall organisational development (Klewitz and Hansen, 2014). In addition, specific green policies and strategies such as green management, material and energy efficiency, supply chain management and commitment towards limiting negative environmental impact prompt green product innovation development (Dangelico, 2016). Since ESSEs are generally rooted and embedded in a location, they may face organisational identity challenges when they expand globally, which may affect their organisational culture, climate, vision and strategy. Thus, they should align well with both local and global audiences to meet their community visions and goals as well as connect with the realities of the external markets like technological advances, market and customer knowhow (Siegener *et al.*, 2021).

2.7 Dimension Five–Resource Management

ESSEs require the availability of diverse resources, such as people, know-how and technology (Pacheco *et al.*, 2017). People are the most important resource for innovation as they embody the firm's knowledge and are the source of creative new ideas (OECD and Eurostat, 2018). Moreover, ecological sustainable entrepreneurs emphasise on hiring personnel who share their personal values (Gast *et al.*, 2017). The combination of enterprise and social mission is a motivating force that gives employees the intrinsic reward of job satisfaction and the feeling of being meaningful contributors to community (Doherty *et al.*, 2014).

2.8 Dimension Six–Creativity & Idea Management

Creativity is considered “the primary impetus of innovation” (Chen and Chang, 2013, p. 110). It is viewed as thinking differently and expressing ideas in new ways (Pham *et al.*, 2019). It involves brainstorming and requires sufficient time to elaborate on ideas (Pham *et al.*, 2019). Green creativity refers to organisational and marketing practices that drive EI. In addition, “idea management [as one dimension of innovation capability] [...] provide feedback and reward for innovative ideas” (Iddris, 2016, p. 248). Eco design, for instance, requires companies to think of ways to “repair, reuse, disassemble, remanufacture, and/or recycle a product” to achieve a more environmentally benign product design (Klewitz and Hansen, 2014, p. 67).

2.9 Dimension Seven–Knowledge Management

Knowledge management entails the different activities of knowledge creation, sharing and utilisation that encompass a firm's internal and external factors (Wong and Aspinwall, 2004). A firm can source knowledge within the organisation from its employees, through R&D, learning-by-doing and learning-by-failing effects. Additionally, industry knowledge is necessary for acquiring other resources such as more capital, networks or reputational assets without which it would be difficult for technological, environmental innovations to progress into commercial offerings (Halme and Korpela, 2014, p. 559).

2.10 Dimension Eight–Open Innovation & Collaboration

Innovation for the environment and society is undertaken through interactive collaboration and knowledge sharing with a wide range of external stakeholders (Phillips *et al.*, 2015). It can be distinguished between collaboration with actors of the firm's value chain and agents of specific and technical knowledge such as research centres, universities, etc. (Martínez–Román and Romero, 2017).

3. Data Collection and Analysis

A standardised self-completion online questionnaire was designed as the survey instrument using the online survey software Enterprise Feedback Suite (ESF). The questionnaire comprised fifteen questions, grouped into three thematic parts. The first part contained questions on the enterprises' demographics. The second part measured the Social Entrepreneurship Fit (SEF) of the enterprise to ensure that it met the definition of ESSEs. The third part of the questionnaire collected data for all eight latent dimensions of the conceptual model on the innovativeness of ESSEs. Eight closed questions were asked to get a self-reported assessment on the extent to which the enterprises consider the respective identified internal factors to be influential on ESSEs' innovativeness.

The 50 internal factors were measured by means of a four-point Likert scale ranging from “strong influence” to “no influence”. With the additional non-attitude choice "cannot assess," non-attitudes were separated from middle positions (Neuman, 2000). After a pre-test, certain questionnaire items were modified to eliminate ambiguity. 150 questionnaires were sent out to ESSEs and of the 103 respondents, only 52 fully completed the questionnaires. The study could, hence, yield a response rate of 24%. Data analysis was conducted in two stages: (1) univariate analysis to summarize the information collected on the enterprises and their SEF; and (2) Exploratory Factor Analysis (EFA) on the data gathered on the enterprises’ internal factors.

Of the 20 industries that responded to the questionnaire, food, beverages (14%), sustainable fair fashion (13%), retail and e-commerce sector (10%) take the lead in this mission-driven purpose. The responses were mainly from young micro enterprises (67%), of which almost half (46%) have been established between one to four years and are located in the *DACH* region of Europe (89% in total).

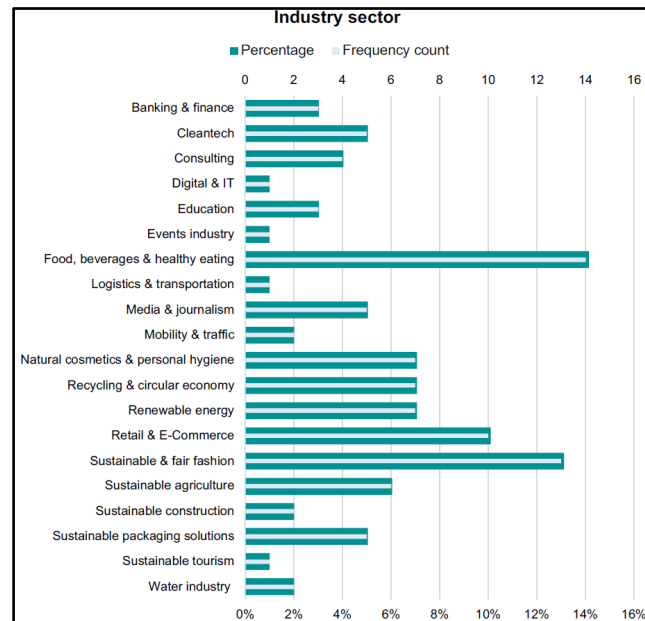


Figure 2: Industry Sector

It was crucial to scrutinize the SEF i.e. mission-driven SEs which place environmental and social impact on par with their economic success. The boxplot determined that the environmental objectives (with a median of 40%) were mainly prioritised over social (with a median of 30%) and economic value creation (with a median of 30%).

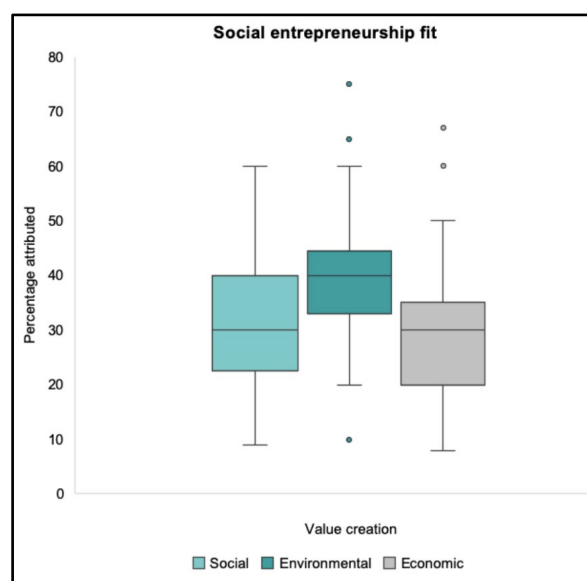


Figure 3: Box Plot, Social Entrepreneurship Fit

In this study, EFA is applied to reduce the number of internal factors from 50 to a smaller set of factors that explain the eco-innovativeness of ESSEs. A series of eight EFAs were conducted on each identified latent dimensions of the conceptual model: (1) entrepreneur (2) organisational structure (3) organisational culture and climate (4) vision and strategy (5) resource management (6) creativity and idea management (7) knowledge management (8) open innovation and collaboration. Next, the principal component analysis (PCA) and the orthogonal factor rotation method *Varimax* were applied to test the probable violation of the EFA assumptions as well as to examine the dimensionality of the eight dimensions, respectively. The stopping rules for factoring i.e. latent root criterion, percentage of variance criterion and parallel analysis were also performed. Finally, the factor structure adequacy was also tested. For instance, factor loadings $\geq .40$ were considered as significant and set as the cut-off value. Similarly, significant cross-loadings [items loading on more than one factor $> .40$] were not shunned by deleting double-loading items, but instead, were viewed as an indicator of the factor on which it loads with higher loading (Maskey *et al.*, 2018). Also, factors were considered adequate when they were theoretically meaningful (Watkins, 2018) and showed a minimum of two salient factor loadings with internal consistency reliability of $\geq .60$ measured by Cronbach's alpha $\geq .70$ desirable, but $\geq .60$ acceptable in exploratory research, as per Hair *et al.* (2019).

4. Results

Preliminary analysis of the statistical assumptions of EFA determined that the correlation among the variables was appropriate for factor analysis. Table 1 shows the results of Bartlett's test of sphericity and the KMO measure of sample adequacy for each of the latent dimensions.

Table 1: KMO and Bartlett Test

Dimension	KMO	Bartlett
Entrepreneur / manager	.732	.000
Organisational structure	.776	.000
Organisational culture & climate	.733	.000
Vision & strategy	.740	.000
Resource management	.701	.000
Creativity & idea management	.645	.000
Knowledge management	.768	.000
Open innovation & collaboration	.672	.000

The Bartlett tests were significant ($p=.000$), and apart from two, the KMO statistics were above the desired value of .70 for conducting a factor analysis. Being close to .70, the KMO values of .645 and .672 still fall within the acceptable level ($> .50$).

The results of the EFAs carried out on each of the eight dimensions of the conceptual model highlight the salient internal factors that influence each dimension. In the case of *entrepreneur*: the two main factors that emerged were the *characteristics of the entrepreneur* and *experience and leadership style*. For the second dimension, *organisational structure*: *organic and flat structure* and *flexibility and responsiveness* were the main factors that appeared.

Table 2: Rotated Component Matrix entrepreneur and organizational structure

Rotated Component Matrix			Rotated Component Matrix		
	Component			Component	
	1	2		1	2
Founder's personality	.845		Lack of hierarchy	.837	
Entrepreneurial orientation of the founder / manager	.812		Little bureaucracy & administrative processes	.720	
Sustainability orientation of the founder / manager	.694		Permeable business boundaries	.669	
Managerial experience of the founder / manager		.905	Responsiveness to changes & opportunities		.865
Green transformational leadership style of the founder / manager	.425	.716	Informal & fast communication channels		.694
Cronbach's alpha	.744	.627	Flexible organisational structure		.653
			Cronbach's alpha	.688	.683

In the third dimension, *organisational culture and climate*: three main factors were observed: *culture of experimentation and learning-by-failing*; *employee participation and job variety*; thirdly, *eco-innovation orientation*. The fourth dimension, *vision and strategy* highlighted *long-term sustainability* and *clear communication of innovation and sustainability*.

Table 3: Rotated Component Matrix organisational culture and climate and vision and strategy

Rotated Component Matrix				Rotated Component Matrix		
	Component				Component	
	1	2	3		1	2
Freedom for risk taking & experimentation	.842			Environmental company policies & strategies	.822	
Tolerance for mistakes & learning-by-failing	.733			Sustainability vision & strategy	.811	
Employee empowerment & autonomy	.497			Long-term strategic focus	.647	
Variety of job tasks		.803		Clear communication of vision	.545	.442
Participative decision making	.422	.631		Innovation strategy		.936
Environmental culture		.588	.495			
Culture of innovation			.853			
Availability of creative time for employees			.640			
Cronbach's alpha	.683	.605	.509	Cronbach's alpha	.674	.427

The fifth dimension, *resource management* indicated three important factors: *qualification and diversity of the workforce*, *availability of resources* and *green training* and *green motivation of employees*. In the sixth dimension: *creativity and idea management*, *employee and team creativity* and *green creativity approaches* were emphasised upon.

Table 4: Rotated Component Matrix resource management and creativity and idea management

Rotated Component Matrix				Rotated Component Matrix		
	Component				Component	
	1	2	3		1	2
Qualified & skilled employees	.829			Employee idea contribution	.892	
Technological expertise	.706			Employee creativity	.844	
Diverse & interdisciplinary workforce	.688			Team creativity	.761	
Sustainability training & development		.858		Green creativity through biomimicry		.882
Access to financial resources		.738		Green creativity through eco-design		.819
Intrinsically motivated employees			.833	Rewarding innovative ideas (removed)		.482
Green shared values of employees		.525	.619			
Cronbach's alpha	.655	.648	.329	Cronbach's alpha	.807	.730

The seventh dimension, *knowledge management* denoted internal knowledge development and utilization, which describes how the organization uses the knowledge held by its employees, and generates new knowledge through environmental R&D. The second factor was external knowledge acquisition & organizational learning. The eighth dimension *open innovation and collaboration* captured *collaboration with external actors*; secondly, *collaboration with partners from the value chain*.

Table 5: Rotated Component Matrix knowledge management and open innovation and collaboration

Rotated Component Matrix			Rotated Component Matrix		
	Component			Component	
	1	2		1	2
Environmental Research & Development	.828		Collaboration with local government	.909	
Industry knowledge	.791		Collaboration with universities and/or research centres	.858	
Internal knowledge sources	.592	.519	Collaboration with environmental groups	.803	
Utilisation of new knowledge	.557	.487	Collaboration with suppliers		.857
Organisational learning		.767	Collaboration with customers through user experience		.797
Knowledge creation & sharing		.694	Collaboration with business partners		.635
External knowledge sources	.465	.530			
Cronbach's alpha	.747	.526	Cronbach's alpha	.838	.680

These salient internal factors that were identified at the meso-level to determine the innovativeness of ESSEs, were adopted and adapted to the conceptual model as illustrated below in figure 4.

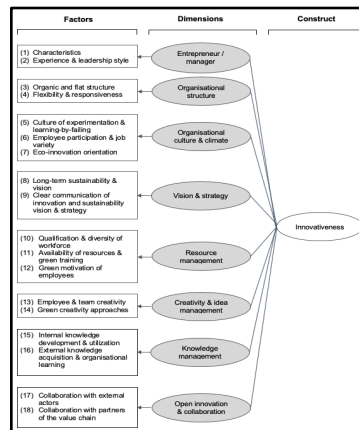


Figure 4: Adapted conceptual model (Hoefer, 2019, p. 75)

5. Discussion and interpretation

Thus, it can be said that the innovativeness of ESSEs is *multidimensional* as well as of internal origin in nature confirming our findings on the multidimensional nature of ESSEs' innovativeness by Lawson and Samson (2001), Hogan *et al.* (2011), and Iddris (2016). The *entrepreneurs* of ESSEs appear to have specific characteristics like entrepreneurial and sustainability orientation, high recognition of environmental opportunity, reactivity, risk tolerance for innovative solutions to complex environmental problems and positive influence of leadership in driving innovation. These findings are in line with studies by Lumpkin *et al.* (2013), Madill *et al.* (2010), and DiVito and Bohnsack (2017).

The *organic and flat structures* with low levels of hierarchy and little bureaucracy among ESSEs stimulate intercommunication within the diverse workforce and give room for individual expression. In view of their organisational structure, flexibility and responsiveness to opportunities and changes are suggested as important. ESSEs often operate in uncharted territory dealing with uncertainty when trying to find innovative sustainable products and services. Thus, our findings are consistent with Lawson and Samson (2001) and Bos–Brouwers (2010). Parzefall *et al.* (2008) postulate that *organisational culture and climate* provide stimulus for employee innovativeness. ESSEs' trial-and-error approach towards innovation processes promotes employee empowerment and encourages experimentation along with learning-by-failure. ESSEs emphasise employee participation and job variety. This is instrumental in motivating employees as it offers an opportunity for learning and personal growth. Their eco-innovation orientation is characterised by allowing employees sufficient time to explore on ideas and to think creatively. These findings are congruent with Keskin *et al.* (2013), Pereira and Vence (2012) and Pham *et al.* (2019). Furthermore, ESSEs' eco-innovative behaviour is strongly intertwined with their long-term sustainability *vision and strategy*. The clear communication of the companies' vision and mission statement establishes a shared green vision that paves the path and orientation for daily business operations. All ideas and projects are weighed against this vision, and their innovation and sustainability strategy determines the mobilisation and allocation of resources for feasible projects. These findings are congruent with Pham *et al.* (2019), who studied determinants of EI and stress the importance of a shared green vision.

ESSEs adopt a *human resource management* that provides a stimulus for innovation activities. They place high value on hiring a qualified and diverse workforce to fulfil tasks in the design phase of innovation. In this manner, those tasks do not need to be outsourced. Also, diversity prompts interaction and knowledge exchange among employees. These findings are congruent with research by Doherty *et al.* (2014) and Gast *et al.* (2017), who find that environmental and social missions provide intrinsic motivation. Moreover, ESSEs make financial resources and green trainings available to its employees to drive innovation, operation and competition. Sustainability trainings and development also enhance the companies' eco-mindedness. This confirms Jenner (2016), who found that participants valued access to financial resources to drive innovation. Lastly, employees' green motivation is found to be an asset for developing innovation as a favourable environment and culture encourages the conception of new products and services. Furthermore, ESSEs adopt eco design and biomimicry in their innovation process to develop more environmental benign product/service designs by assessing the environmental effects and risks of a product. Moreover, ESSEs build innovation capability through internal *knowledge development and idea utilisation*, as well as acquisition of external knowledge and organisational learning to induce eco-innovation within their organisations. ESSEs design their structure and culture such that

they prompt interaction and knowledge sharing among employees and accumulate specialised knowledge necessary for innovation through internal environmental R&D, as proposed by Klewitz and Hansen (2014) and Adams *et al.* (2012). ESSEs are found to leverage the advantages associated with an organisational learning orientation, which is rooted in their learning-by-failure culture. They also make full use of external knowledge sources. This is in line with Cai and Li (2018, p. 111), who state that "the process of eco-innovation is actually environmental knowledge accumulation, integration, and utilisation." Lastly, ESSEs actively seek collaborative networks *with external actors* like universities, research institutes, environmental groups, local governments and partners from the value chain, i.e. business partners (Martínez-Román and Romero, 2017; Dangelico, 2016). Since ESSEs are often faced with resource shortcomings, those networks can be the missing link in development and support in times of need (Albort-Morant *et al.*, 2018). The ESSEs are also found to attribute great importance to the open strategy-approach to innovation.

6. Conclusions

This study has several limitations. The non-probability convenience sampling does not represent the entire population due to the low sample size of 52. Also, the study focuses on the internal capability of ESSEs to develop ESIs, thus, captures firm-specific internal factors only. Other external determinants the so-called "regulatory push/pull" and "market pull factors," that also influence the ESIs are outside the scope of this study. The conceptual model only explains the internal factors that determine the innovativeness of ESSEs. It does not give statistical evidence on the influence the eight dimensions have on ESSEs' innovativeness. Hence, the results do not draw inferences on correlation and causality. Despite those limitations, this study would have significant positive implications on theory, management and policies. EI literature predominantly focuses on large, profit-maximizing organisations. Less scientific work examines mission-driven SEs as their object of study. Hence, this study bridges the literature of social entrepreneurship, EI, and innovation management. It also develops and presents a theoretical conceptual model of the eco-innovativeness of ESSEs reflecting ESSEs internal ability to eco-innovate and delineates eight firm-related antecedents of eco-innovativeness. The findings provide a contextually insightful and focused understanding of the eco-innovation capability of ESSEs. As an exploratory research, the proposed conceptual model could be considered as a first comprehensive step towards a model of overall eco-innovativeness of ESSEs. It could be used as a guideline for prospective social entrepreneurs and as a self-assessment tool for existing social entrepreneurs to check their strengths and weaknesses. It could also serve as a guide to prospective stakeholders when making investment decisions. It is in the face of the current environmental and social challenges that more enterprises are needed with the "DNA" of ESSEs and SEs. An increased recognition and visibility of their efforts along with the social entrepreneurship model in general would be appreciated, as they are also taxpayers, job creators and above all climate crisis fighters.

References

- Anderson, A. R. and Warren, L. (2011) "The Entrepreneur as Hero and Jester: Enacting the Entrepreneurial Discourse", *International Small Business Journal: Researching Entrepreneurship*, Vol 29, No 6, pp. 589–609.
- Bettiol, M., De Marchi, V., and Di Maria, E. (2018) "Social Entrepreneurship and Upgrading in Emerging Economies: The Indian Case of Industree and Its Brand Mother Earth", In A. Leal-Millan, M. Peris-Ortiz, & A. Leal-Rodríguez (Eds.), *Sustainability in Innovation and Entrepreneurship: Policies and Practices for a World with Finite Resources* (pp. 103–118). Cham: Springer International Publishing.
- Bos-Brouwers, H. (2010) "Corporate sustainability and innovation in SMEs: Evidence of themes and activities in practice", *Business Strategy and the Environment*, Vol 19, No 7, pp. 417–435.
- Breassan, A., Muskat, B., Zehrer, A., and de Burgh-Woodmann, H. (2016) "Conceptualising on Sustainable-Oriented Innovation SMEs: A Cross-National study", EURAM, June 1-3 2016, Université Paris-Est Créteil, France.
- Cai, W., and Li, G. (2018) "The drivers of eco-innovation and its impact on performance: Evidence from China", *Journal of Cleaner Production*, Vol 176, pp. 110–118.
- Chen, Y.-S., and Chang, C.-H. (2013) "The Determinants of Green Product Development Performance: Green Dynamic Capabilities, Green Transformational Leadership, and Green Creativity", *Journal of Business Ethics*, Vol 116, No 1, pp. 107–119.
- Doherty, B., Haugh, H., and Lyon, F. (2014) "Social Enterprises as Hybrid Organizations: A Review and Research Agenda", *International Journal of Management Reviews*, Vol 16, No 4, pp. 417–436.
- García-Granero, E. M., Piedra-Muñoz, L., and Galdeano-Gómez, E. (2018) "Ecoinnovation measurement: A review of firm performance indicators", *Journal of Cleaner Production*, Vol 191, pp. 304–317.
- Gast, J., Gundolf, K., and Cesinger, B. (2017) "Doing business in a green way: A systematic review of the ecological sustainability entrepreneurship literature and future research directions", *Journal of Cleaner Production*, Vol 147, pp. 44–56.

- Glowka, G., Zehrer, A., Peters, M., and Eller, R. (2018) "Sustainable attitudes of family businesses in the alpine tourism region of Tirol", 32nd RENT Conference, November 14-16, 2018. Toledo, Spain.
- Granados, M. L., Hlupic, V., Coakes, E., and Mohamed, S. (2011) "Social enterprise and social entrepreneurship research and theory. A bibliometric analysis from 1991 to 2010", *Social Enterprise Journal*, Vol 7, No 3, pp. 198-218.
- Hillman, J., Axon, S., and Morrissey, J. (2018) "Social enterprise as a potential niche innovation breakout for low carbon transition", *Energy Policy*, Vol 117, pp. 445-456.
- Hockerts, K., & Wüstenhagen, R. (2010) "Greening Goliaths versus emerging Davids - Theorizing about the role of incumbents and new entrants in sustainable entrepreneurship", *Journal of Business Venturing*, Vol 25, No 5, pp. 481-492.
- Horbach, J., Rammer, C., and Rennings, K. (2012) "Determinants of eco-innovations by type of environmental impact - The role of regulatory push/pull, technology push and market pull", *Ecological Economics*, Vol 78, pp. 112-122.
- Mills, C., and Pawson, K. (2012) "Integrating Motivation, Risk-Taking and Self Identity: A Typology of ICT Enterprise Development Narratives", *International Small Business Journal: Researching Entrepreneurship*, Vol 30, No 5, pp. 584-606.
- Picciotti, A. (2017) "Towards sustainability: The innovation paths of social enterprises", *Annals of Public and Cooperative Economics*, Vol 88, No 2, pp. 233-256.
- Schaltegger, S., and Wagner, M. (2011) "Sustainable entrepreneurship and sustainability innovation: Categories and interactions", *Business Strategy and the Environment*, Vol 20, No 4, pp. 222-237.
- Shepherd, D., and Haynie, J.M. (2009) "Family Business, Identity Conflict, and an Expedited Entrepreneurial Process: A Process of Resolving Identity Conflict", *Entrepreneurship Theory and Practice*, Vol 33, No 6, pp. 1245-1264.
- Siegner, M., Panwar, R., and Kozak, R. (2021) "Community forest enterprises and social enterprises: the confluence of two streams of literature for sustainable natural resource management", *Social Enterprise Journal*, Vol 17, No 4, pp. 584-603.
- Silvestre, B., and Țîrcă, D. (2019) "Innovations for sustainable development: Moving toward a sustainable future", *Journal of Cleaner Production*, Vol 208, pp. 325-332.
- Triguero, A., Moreno-Mondéjar, L., and Davia, M. (2013) "Drivers of different types of eco-innovation in European SMEs", *Ecological Economics*, Vol 92, pp. 25-33.
- Varadarajan, R. (2017) "Innovating for sustainability: a framework for sustainable innovations and a model of sustainable innovations orientate", *Official Publication of the Academy of Marketing Science*, Vol 45, No 1, pp. 14-36.
- Vickers, I., and Lyon, F. (2014) "Beyond green niches? Growth strategies of environmentally-motivated social enterprises", *International Small Business Journal*, Vol 32, No 4, pp. 449-470.
- Youssef, A. B., Boubaker, S., and Omri, A. (2018) "Entrepreneurship and sustainability: The need for innovative and institutional solutions", *Technological Forecasting and Social Change*, Vol 129, pp. 232-241.
- Zur, A. (2020) "Entrepreneurial Identity and Social-Business Tensions – The Experience of Social Entrepreneurs", *Journal of Social Entrepreneurship*, Vol 12, pp. 438-461.

The Socioscientific Issues Approach to Entrepreneurial Thinking Among Fifth Graders

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Abstract: This research was conducted to examine the effects of the socioscientific issue approach (SSI) with thinking wheel map (TM) on entrepreneurial science thinking (EST) and the constructs of Observation, New Ideas, Innovation, Creativity, and Value. A teaching and learning (TL) module was developed to guide teachers in implementing the infusion of SSI with TM TL approach on EST among fifth graders. A quasi-experimental quantitative research was conducted on 345 fifth graders in urban primary schools in Malaysia. A total of three TL groups were assigned randomly; namely, i) SSI-TM approach (n=115), ii) SSI (n=115) and iii) Conventional approach (CONV, n=115). The Entrepreneurial Science Thinking Test Instrument (ESTT) was developed to measure the level of entrepreneurial science thinking. Data analysis was performed using MANCOVA, ANCOVA, and Effect Size. The results of the MANCOVA analysis showed a significant effect across the three groups of TL approach for EST. Meanwhile, the ANCOVA analysis results showed a significant effect of the SSI-TM TL approach compared to SSI and CONV on EST and in all constructs of EST. The SSI-TM TL approach showed a higher post-test mean score than the SSI, and then the SSI post-test mean score was significantly higher than the CONV in all constructs studied except the Observation. The findings prove that the SSI-TM TL approach positively impacts the cultivation of EST among fifth graders.

Keywords: Entrepreneurial Science Thinking, Fifth Graders, Socioscientific Issues Approach, Thinking Wheel Map

1. Introduction

Entrepreneurial thinking has been identified as one of the key cognitive skills that needs be mastered by students in facing an increasingly challenging future. According to Edwards-Schachter et al. (2015), entrepreneurial thinking is necessary to produce students who can master the characteristics and ethics of entrepreneurship, manage current resources and face future challenges efficiently. The element of entrepreneurship had been applied in the Malaysian school curriculum, for example through the subjects of Basics Finance and Entrepreneurship which were offered to secondary school students of the Literature stream only. Although this effort has been made, students have been found to lack the elements and skills of entrepreneurship in their lives (Malaysian Ministry of Education, 2013).

Now, there is a high demand for the application of entrepreneurial thinking in the school curriculum. Like any other countries, Malaysia is currently preparing school students with the global needs of the world through the Education Blueprint 2013-2025. In the 2017 Revised Primary School Standard Curriculum (Curriculum Development Centre, 2017), elements of entrepreneurship across the curriculum are applied in all subjects including Science. Despite the increased emphasis on fostering students' entrepreneurial thinking in the revised curriculum, there is a little evidence to demonstrate research done on entrepreneurial thinking among primary school students. This scenario carries a connotation that a learning approach that integrates innovation and entrepreneurship in the science curriculum needs to be introduced so that the students who are produced are able to create, innovate and have entrepreneurial values thus being able to meet the expected human capital criteria by the year 2030. This is also one of the efforts to fulfill the aspirations set in the revised Primary School Standard Curriculum 2017 which is to produce students who are creative in solving problems in accordance with the needs of society.

According to Sadler and Zeidler (2009), the socioscientific issues approach is a consistent process in guiding students to apply scientific knowledge and be creative thinkers to create a more competitive future. Through the discussion of social issues with a scientific component related to real life, students can create meaningful learning outcomes in addition to allowing them to connect and apply Science knowledge in an environment outside the classroom (Prain & Tytler, 2012). However, a teaching and learning (TL) approach can only achieve the maximum objective if the teaching medium supports it. Thus, an added value is needed to make teaching and learning approaches easier to understand and teaching and learning objectives easier to achieve. In this regard, thinking maps (TM) are seen as a tool that can improve thinking skills among students (Hyerle, 2009). In fact, its use has also been identified to increase students' understanding in identifying the potential effects and consequences of science (Saad & BouJaoude, 2012). This is supported by Hmelo-Silver (2004) and Hyerle (2011), who found that problem-based learning with the help of thinking maps can improve students' critical thinking. Therefore, this research was conducted to examine the effects of the socioscientific issue approach with thinking maps (SSI-TM) on entrepreneurship science thinking.

2. Literature Review

2.1 Entrepreneurial Science Thinking

Entrepreneurial thinking (ET) is a cognitive phenomenon that seeks creative and innovative ideas and opportunities (Krueger, 2005). ET is also defined as the ability to identify opportunities in the market and explore appropriate ways to use them (Bacigalupo et al., 2016). In this regard, ET is not a mindset taught to become an entrepreneur alone. However, ET is a skill that can empower human resources, marketability of work and competition. Following this concept of ET, a new concept called entrepreneurial science thinking (EST) was founded by Halim and Buang (Syukri et al., 2013). In this research, EST is referred to as design thinking skills based on scientific knowledge and entrepreneurial orientation (Buang et al., 2009). EST has five constructs which are: (1) Observation: making observations with a plan and purpose; (2) New Ideas: generating ideas by looking for uniqueness or advantages; (3) Innovation: selecting some ideas that can be modified or improved and evaluating those ideas; (4) Creativity: strengthen and improve ideas in a focused manner; and (5) Value: Ensuring that the ideas or products produced are beneficial to society. All steps in this EST are used as the TL phase in the SSI-TM learning module developed by researchers (Ahmad & Siew, 2021a).

2.2 Socioscientific Issues Approach

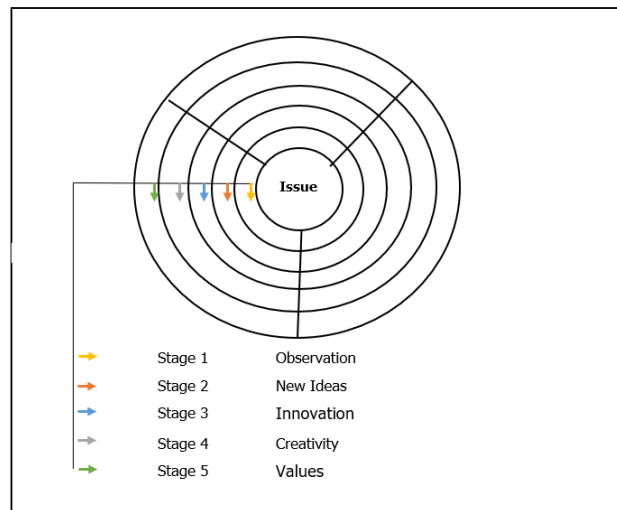
In cultivating entrepreneurial science thinking, the researcher has chosen the socioscientific issue approach (SSI). SSI is an approach that requires students to make decisions about social issues that involve moral implications in a scientific context (Sadler, 2004; Zeidler & Keefer, 2003; Zeidler et al., 2005). These issues also allow students to study and connect science, daily life and society in the community (Driver et al., 2000; Sadler, 2004). In SSI-based learning, students will be asked to argue and debate in a more conflictual discussion context to discuss current societal issues (Martini et al., 2021). This is in line with the objective of fostering entrepreneurial science thinking, where students who can connect science with society will be able to produce invented products adapted to the needs of society and solve socioscientific issues that occur in society.

2.3 Thinking Wheel Map

The researcher used the thinking wheel map (TM) adapted from Bloom (1956), Glenn (1972) and Bengston (2016) (Figure 1). This TM is a thinking tool that helps students identify the implications of a change. TM was used in groups through a structured brainstorming process to determine changes and impacts at various levels (Bengston, 2016). The TM contains a centre and five levels to help students generate and organize their ideas. During the use of SSI-TM TL module, students are given socioscientific issues to discuss and argue. At this time, any logical and scientific reasoning ideas are written in the centre of the map. These ideas are the trigger ideas for students to solve in the next stage. Then, students write their ideas at each level according to the constructs of Observation, New Ideas, Innovation, Creativity, and Values. In the first stage, Observation, students are given stimulus pictures that display current product designs. Then, students are asked to make observations to obtain information about the building materials, design, and product characteristics. The second stage is New Ideas, where students produce ideas by finding uniqueness or advantages in the product observed in the building materials, design, and product characteristics. This stage is followed by the third stage, which is the Innovation stage, where students have to choose three out of six uniqueness or advantages in the observed product. Following the selection, students are asked to evaluate the ideas by stating why they choose them.

In the fourth stage, Creativity, students are asked to strengthen and improve ideas in a focused manner based on the ideas selected in the previous step. All of these reinforced ideas are written in the fourth stage of TM. Then, students are asked to sketch and label their product designs on a piece of A3 paper. Students are also required to name their product design and state the selling price and the target group of buyers. All this information needs to be written on the thinking map. Finally, there is the fifth level, Value, where students have to express the values of products that benefit society. Students can express the benefits of cost savings, product functionality, and values and ethics in product creation. The students then present the designed products in front of the class. After that, they explain the benefits of their products with the help of TM.

Figure 1: Thinking Wheel Map



Source : Adapted from Bloom (1956), Glenn (1972) & Bengston (2016)

2.4 Purpose and Research Questions

Overall, this research was conducted to determine the effects of the Socioscientific Issue Approach with Thinking Wheel Map (SSI-TM) in fostering the entrepreneurial science thinking of fifth graders compared to the Socioscientific Issue (SSI) and Conventional (CONV) approaches. This research focused on comparisons between two different forms of SSI TL approach, as well as comparisons with non-SSI TL approach in order to determine if other mode of SSI was equally effective in producing desired student outcomes. Consequently, this research was undertaken to further investigate if there were any significant differences in student's entrepreneurial science thinking between learners who were taught in three different TL approaches.

The research question that drive this research was: Would students taught via the SSI-TM TL approach perform significantly better than students taught via the SSI approach, who in term perform significantly better than students taught via conventional approach in entrepreneurial science thinking and the constructs of i) Observation, ii) New Ideas, iii) Innovation, iv) Creativity, and v) Value?

3. Research Methodology

3.1 Research Design and Sample

The research employed a quasi-experimental pre-test and post-test control group design to examine the effects of three different TL approaches on fifth graders' entrepreneurial science thinking. The independent variable was the three TL approaches: the SSI-TM (Experimental group), and SSI (placebo group), and the CONV (control group). Dependent variables are based on students' attainment of entrepreneurial science thinking and the constructs of i) Observation, ii) New Ideas, iii) Innovation, iv) Creativity, and v) Value. The research lasted three months from January to March 2021.

The research population consisted of all fifth graders totaling 4222 people (Tawau District Education Office, 2019) in Tawau district, Sabah, Malaysia. A purposive sampling technique was employed. The schools were selected based on criteria such as the number of classes in the school, socioeconomic background, cultural diversity and the level of academic performance of students in a school. Approximately 60% of parents were government employees, while 40% were working for a small business and industry sectors such as palm oil. The majority of the parents are made up of the Bajau, Suluk, Ida'an and Bugis tribes as well as the Chinese. This shows the uniqueness of students in Tawau compared to other geographical areas in Malaysia. A total of 345 fifth graders from four schools were involved as research samples, comprising of 186 (54 %) females and 159 (46 %) males aged 11 years old. In each school, three groups of students were involved and randomly assigned to the SSI-TM approach, the SSI approach and the conventional (CONV) approach. In total, each group of SSI-TM, SSI, and CONV has 115 students.

3.2 Teaching and Learning (TL) Approaches

The SSI-TM learning module was utilized in the SSI-TM TL approach. The SSI-TM module was found to have a valid and reliable content which is feasible in nurturing fifth-graders' entrepreneurial science thinking (Ahmad & Siew, 2022). The SSI-TM learning module was administered in six separate activities in six weeks, with each learning activity would take about 90 minutes to complete. The SSI-TM activities were conducted in groups of four to five students under the facilitation of their teachers. At the end of the learning sessions, the groups presented their sketches and prototypes to the class, while other groups gave comments. From the input given by their peers and teacher, the groups made improvements to their sketches and prototypes.

The students taught in the SSI group undertook similar learning activities as their counterparts in the SSI-TM group in groups of 4-5 people but were not exposed to the utilization of thinking wheel maps. Students could use i-Think Maps such as Flow Maps to which they had been exposed in previous science lessons to carry out the learning activities. In the CONV TL approach, students completed the learning activities in a conventional way without using SSI-TM module and TM. Students in their own groups build sketches and prototypes. Students approached their teachers for assistance if they encountered problems during the learning activities. At the end of the learning sessions, students made presentation and improvements of their sketches and prototypes as their counterparts in the SSI-TM group and SSI group.

3.3 Entrepreneurial Science Thinking Test (ESTT)

The Entrepreneurial Science Thinking Test (ESTT) was developed to measure students' entrepreneurial science thinking (Ahmad & Siew, 2021b). ESTT has evidence of good construct validity and reliability assessed using the Rasch Measurement Model (MPS). The ESTT test is an instrument of open-ended questions requiring students to answer questions in statements and idea sketches. The constructs in ESTT are built based on the construct of Entrepreneurial Science Thinking (EST) by Buang et al. (2009), namely Observation, New Ideas, Innovation, Creativity, and Value. Overall, the ESTT includes five constructs and ten items. The ESTT scoring criteria was adapted from Ho et al. (2013), where each item provided in this test carries a minimum score of 0 and a maximum score of 3.

3.4 Data Analysis

The data obtained from the ESTT instrument were analyzed descriptively and inferentially using SPSS software version 26. For descriptive analysis, the means (*M*), standard deviations (*SD*) and mean difference (*MD*) were calculated. The mean value for each construct and the whole is using the scale recommended by De Vaus (2002), where the mean classification is according to low, medium, and high levels can be made by dividing the full value of each construct into three parts according to the context of the research. Table 1 shows the level of analysis and interpretation of the mean in this research.

Table 1: Level of Mean Analysis and Interpretation of Mean

Level	EST Construct	EST
Low	.00 – 2.00	.00 – 10.00
Moderate	2.01 – 4.00	10.01 – 20.00
High	4.01 – 6.00	20.01 – 30.00

For inferential analysis, multivariate analysis of variance (MANOVA) was used to compare the average score of the answers obtained from the pre-test. Multivariate analysis of covariance (MANCOVA) was used to evaluate the effect of three different teaching and learning groups on the whole and construct of entrepreneurial science thinking. The researcher handled six covariates: pre-EST, pre-Observation, pre-New Idea, pre-Innovation, pre-Creativity, and pre-Value. This covariate served as a control variable for teaching and learning groups, adjusting for possible differences between groups. The next step of statistical analysis is if the ANCOVA results are statistically significantly different in the three teaching and learning groups, a post-hoc comparison technique is performed to determine which group is significantly different compared to the other group for each dependent variable. The significance level was set at $p < .05$, which means that the researcher determined a difference between the research groups.

4. Research Results

Through MANCOVA analysis, the results of Pillai's Trace multivariate test (Table 3) show that overall there is a significant effect of independent variables (teaching and learning (TL) approaches) [$F(10, 666) = 42.043, p < .05$] on entrepreneurial science thinking. However, there was no effect of control variables or covariates (pre-EST) on the dependent variable of entrepreneurial science thinking [$F(5, 332) = 1.612, p > .05$]. The same findings are also seen in the construct of entrepreneurial science thinking, where there is a significant effect of TL approaches [$F(10, 666) = 42.043, p < .05$] on the construct post-Observation, post-New Idea, post-Innovation, post-Creativity, and post-Value. However, there was no effect of control variables or covariates (pre-Observation, pre-New Idea, pre-Innovation, pre-Creativity, and pre-Value) on the dependent variable of the post-Observation construct [$F(5, 332) = 1.651, p > .05$], post-New Ideas [$F(5, 332) = 1.876, p > .05$], post-Innovation [$F(5, 332) = 1.471, p > .05$], post-Creativity [$F(5, 332) = 1.590, p > .05$], and post-Value [$F(5, 332) = 1.488, p > .05$] respectively. This shows that by controlling covariate variables, TL approaches contribute to the mastery of entrepreneurial science thinking and the mastery of the constructs of Observation, New Ideas, Innovation, Creativity, and Values.

Table 2: Summary of the Results of Multivariate MANCOVA and Univariate ANCOVA Tests for the Effect of TL approach and Entrepreneurial Science Thinking Covariate

Effect	MANCOVA			ANCOVA			
	Pillai's Trace F	df	p	F	df	p	Partial ETA Square (η^2)
TL Approach	42.043	10, 666	$p < .05$	393.918	2, 341	$p < .05$	.698
Pre-EST	1.612	5, 332	.156	3.429	1, 341	.065	.010
TL Approach	42.043	10, 666	$p < .05$	74.875	2, 341	$p < .05$	.305
Pre- Observation	1.651	5, 332	.146	.091	1, 341	.763	.000
TL Approach	42.043	10, 666	$p < .05$	238.940	2, 341	$p < .05$	.584
Pre- New Ideas	1.876	5, 332	.098	3.490	1, 341	.063	.010
TL Approach	42.043	10, 666	$p < .05$	239.017	2, 341	$p < .05$	.584
Pre- Innovation	1.471	5, 332	.199	.235	1, 341	.628	.001
TL Approach	42.043	10, 666	$p < .05$	309.394	2, 341	$p < .05$	.645
Pre- Creativity	1.590	5, 332	.162	2.578	1, 341	.109	.008
TL Approach	42.043	10, 666	$p < .05$	211.114	2, 341	$p < .05$	.553
Pre-Value	1.488	5, 332	.193	.005	1, 341	.942	.000

Further, the researcher conducted an ANCOVA test to identify whether the independent variable (TL approaches) affects the dependent variable, which is entrepreneurial science thinking, and constructs of observation, new ideas, innovation, creativity, and values. ANCOVA analysis shows that there is a significant effect of TL approaches on entrepreneurial science thinking [$F(2, 341) = 393.918, p < .05, \eta^2 = .698$], Observation [$F(2, 341) = 74.875, p < .05, \eta^2 = .305$], New ideas [$F(2, 341) = 238.940, p < .05, \eta^2 = .584$], Innovation [$F(2, 341) = 239.017, p < .05, \eta^2 = .584$], Creativity [$F(2, 341) = 309.394, p < .05, \eta^2 = .645$], and Value [$F(2, 341) = 211.114, p < .05, \eta^2 = .553$]. The high relationship was found between TL approaches, with the dependent variable showing that 69.8% (entrepreneurship science thinking), 30.5% (Observation), 58.4% (New ideas), 58.4% (Innovation), 64.5% (Creativity), and 55.3% (Value). The variance obtained is taken into account by the SSI-TM TL approach.

Post-Hoc analysis was also performed to determine the effect of the independent variable on the dependent variable. Table 4 shows the results of mean pairwise comparison tests and effect sizes for the effect of TL approaches on EST, along with the constructs of Observation, New Ideas, Innovation, Creativity, and Values. Mean pair comparison shows that the SSI-TM TL approach is significantly higher than the SSI approach for the entire EST as well as all the constructs in the EST ($p < .05$) except for the Observation construct ($p = .062$). Meanwhile, the mean pair comparison also shows that the SSI-TM approach is significantly higher than the CONV approach for the entire EST and all constructs ($p < .05$). The same finding is also seen in the mean pair comparison

between the SSI and CONV approaches, where the SSI approach is significantly higher than the CONV approach for the entire EST as well as all constructs in the EST ($p < .05$).

For the effect size analysis, in the aspect of EST as a whole, students exposed to the SSI-TM TL approach showed a larger effect size ($d = 1.89$) than the SSI approach. In addition, a large effect size was also seen in the comparison between the CONV approach with the SSI-TM ($d = 3.84$) and SSI ($d = 1.76$) approaches. The same findings can also be seen on all constructs in EST except for the Observation construct. In this regard, the SSI-TM approach showed a small effect size compared to the SSI approach in the Observation construct ($d = 0.36$). Statistically, the SSI-TM approach effectively improves entrepreneurial science thinking and constructs New Ideas, Innovation, Creativity, and Value.

Table 3: Mean Pair Comparison Test Results and Effect Size for the Effect of TL approaches on Entrepreneurial Science Thinking along with Constructs

Construct	Pair Comparison	<i>MD</i>	<i>p</i>	<i>d</i>	Interpretation (Cohen, 1988)
EST	SSI-TM vs SSI	5.417	$p < .05$	1.89	Big
	SSI-TM vs CONV	10.894	$p < .05$	3.84	Big
	SSI vs CONV	5.477	$p < .05$	1.76	Big
Observation	SSI-TM vs SSI	0.298	.062	0.36	Small
	SSI-TM vs CONV	1.480	$p < .05$	1.48	Big
	SSI vs CONV	1.182	$p < .05$	1.12	Big
New Ideas	SSI-TM vs SSI	1.173	$p < .05$	1.46	Big
	SSI-TM vs CONV	2.312	$p < .05$	2.98	Big
	SSI vs CONV	1.139	$p < .05$	1.36	Big
Innovation	SSI-TM vs SSI	1.384	$p < .05$	1.71	Big
	SSI-TM vs CONV	2.365	$p < .05$	2.98	Big
	SSI vs CONV	0.982	$p < .05$	1.14	Big
Creativity	SSI-TM vs SSI	1.428	$p < .05$	1.81	Big
	SSI-TM vs CONV	2.543	$p < .05$	3.70	Big
	SSI vs CONV	1.115	$p < .05$	1.37	Big
Value	SSI-TM vs SSI	1.105	$p < .05$	1.42	Big
	SSI-TM vs CONV	2.217	$p < .05$	2.78	Big
	SSI vs CONV	1.112	$p < .05$	1.28	Big

5. Discussion

This finding shows that the mean score for the SSI-TM TL approach is significantly higher than the SSI and CONV approaches. The intervention of SSI-TM that applies the socioscientific issue approach and the thinking wheel map provides a systematic and structured space for students to develop their entrepreneurial science thinking. Furthermore, exposure to the SSI-TM module allows students to produce unique products by finding uniqueness or advantages in existing products. In the investigation of uniqueness and advantage, the use of a thinking wheel map helps students research uniqueness in a more structured way, reveal their abstract concepts and share ideas among group members more systematically (Omar et al., 2020). Due to the ability of the socioscientific issue approach to improving entrepreneurial science thinking, the implementation of the socioscientific issue approach with the help of a thinking wheel map is highly encouraged in the teaching and learning of Science (Friedrichsen et al., 2016).

Even so, for the Observation construct, the difference in mean scores for students who follow the SSI-TM and SSI approaches is insignificant. This proves that TM does not help students improve the observation construct. In improving the observation construct of entrepreneurial science thinking, the approach to socioscientific issues alone is sufficient. This is due to the ability of the socioscientific issue approach to increase student involvement in learning and arguing about issues of community benefit (Owens et al., 2017), which leads to a significant increase in knowledge (Sadler, 2011). Students in the SSI group exposed to socioscientific issues provide a

meaningful learning experience to increase students' level of observation and understanding regarding an issue (Zeidler, 2016). Focused socioscientific issues revealed to students increase students' powers of observation where they need to observe many things, including the characteristics of objects, building materials, and the design of existing objects (Topçu et al., 2018). The significant increase for the SSI group also shows that the approach of socioscientific issues that highlight social issues around students stimulates low-level thinking, such as making preliminary observations. This is in line with Piaget's Theory of Cognitive Constructivism, which states that based on early observations, with the help of an environment with various signs, symbols, and tools, a more progressive process will occur and create a higher level of the thinking process. In this context, the cultivation of constructs after Observation is more high-level, namely New Ideas, Innovation, Creativity, and Values in the thinking of entrepreneurial science.

In the context of improving the New Idea construct of entrepreneurial science thinking, the SSI-TM approach in this research displays a significant improvement with a large effect size compared to the SSI and CONV approaches. Coinciding with the use of SSI, students were exposed to various socioscientific issues that could lead to differences of opinion among students based on their respective beliefs. Scientific and social knowledge built as a result of a debate among students that is shared among them will generate their ideas to identify the uniqueness or advantages found in the objects they observe (Walker & Zeidler, 2007). In the SSI-TM TL approach, students are given space to argue critically, provide justification and reasoning for each argument they argue (Martini et al., 2021) and record all their ideas in the second stage of the thinking wheel map systematically. The infusion of the socioscientific issue approach, together with the wheel thinking map, allows students to easily record any of their ideas in a systematic approach (Bengston, 2016). Any idea thought to be logical and compatible with the observed uniqueness or advantage is included in the second stage of the TM. This makes it easier for students because the concept of levels in the wheel helps in the rapid collection of data to find the uniqueness or advantage of an observed object. As a result, the infusion of SSI with TM can help students master the construction of New Ideas where the TM is easy for students to understand and stimulate their systematic thinking during the group brainstorming process (Krueger, 2005).

Next, the dominance of the Innovation construct has also shown that the mean score for the SSI-TM TL approach is significantly higher than the SSI and CONV approaches. At the same time, the SSI approach also showed a significantly higher mean score than the CONV approach. The infusion of the socioscientific issue approach and the thinking wheel map helps students select ideas more easily because all the new ideas that have been identified have been expressed in the previous second stage. With the help of the SSI-TM approach, the selection can be made more efficiently compared to the SSI approach, which requires students to make the selection abstractly in their minds. At this stage of Innovation, students should analyze by making the best choice of ideas from the uniqueness and advantages of the products listed before and justify the evaluation made. This is where the thinking wheel map helps in mastering the Innovation construct. The increase in the mean score for students who follow SSI-TM compared to SSI and CONV can also be explained by the ability of SSI to infuse with TM in fostering the construct of Innovation. In mastering the Innovation construct, students need to do research before choosing a unique product idea to be developed (Crespi & Scellato, 2015). In this regard, mapping in the wheel map helps students make the best choices to ensure that the unique ideas chosen at this stage can lead to the production of creative and innovative products (Najafi-Tavani et al., 2018).

The activities designed based on the infusion of SSI and TM have the potential to help students to strengthen and improve ideas in a focused way based on the ideas selected in the previous step. In this construction, students express ideas that have been improved by making design sketches, labelling, and building product design models. Students were asked to state the product's name, the price offered, and the target group of buyers for the product. Careful planning of activities in this teaching and learning module can help students to explore various possibilities and stimulate students to produce something new, more unique, and cutting-edge (Repenning et al., 2021). As a result, the intervention carried out for the SSI-TM TL approach positively impacted the mastery of the Creativity construct.

SSI-TM provides students the opportunity to consider the issues that occur, evaluate statements, analyze evidence, and evaluate various views on ethical issues through discussion and debate. This can clearly help in fostering the fifth construct of EST, which is Value, where students need to ensure that the ideas or products produced are beneficial to the community. In addition, students are also trained to relate ethical issues in product creation. This can be realized through SSI-TM TL approach because students will be actively involved in the issue debate process, especially in matters involving ethical issues (Lindahl et al., 2019). In addition, the learning concept for the SSI-TM TL approach organizes students' ideas through the consideration of

socioscientific issues from various aspects of life (science concepts, student needs, society, economy, politics and the environment), which also affects the mastery of this construct.

6. Conclusion

The results of the research showed a significant positive effect of the SSI-TM TL approach compared to SSI and CONV approaches in improving entrepreneurial science thinking and its constructs: New Ideas, Innovation, Creativity, and Value. Nevertheless, for the Observation construct, it was found that the SSI TL approach recorded a significant improvement compared to the SSI-TM and CONV approaches. Overall, the cognitive effects obtained show that the implementation of SSI-TM TL approach is better than SSI and Conventional approaches. This proves that the infusion of SSI and TM TL approaches in the teaching and learning process can make teaching based on explicit thinking to be implemented. This situation can improve the mastery of the lesson's content and the aspect of students' entrepreneurial science learning.

For future research, the researcher proposes to conduct an SSI-TM infusion approach for secondary school students, which will provide more findings from different cognitive levels. The target focus sample can also be widely distributed to students in rural schools to find out if rural school students have the potential to develop their entrepreneurial science thinking compared to their peers in urban schools.

References

- Ahmad, J., & Siew, N. M. (2021a). *Modul PISPP: Pemikiran sains keusahawanan dan sifat ingin tahu terhadap STEM* [PISPP module: Entrepreneurial science thinking and curiosity towards STEM]. UMS Press.
- Ahmad, J., & Siew, N. M. (2021b). Development of a children entrepreneurial science thinking test for STEM education. *Journal of Baltic Science Education*, Vol. 20, No. 4, pp 528-545. <https://doi.org/10.33225/jbse/21.20.528>
- Ahmad, J., & Siew, N. M. (2022). An entrepreneurial science thinking module based on the socioscientific issues approach with thinking wheel map for primary school students in STEM education. *Problems of Education in the 21st Century*, Vol. 80, No. 1, pp 30-51. <https://doi.org/10.33225/pec/22.80.30>
- Bengston, D. N. (2016). The futures wheel: A method for exploring the implications of social–ecological change. *Society and Natural Resources*, Vol. 29, No. 3, pp 374-379. <https://doi.org/10.1080/08941920.2015.1054980>
- Bloom, B. S. (1956). *Taxonomy of educational objectives, Handbook 1: Cognitive domain* (2nd ed.). David McKay.
- Buang, N.A., Halim, L., & Mohd. Meerah, T.S. (2009). Understanding the thinking of scientists entrepreneurs: Implications for science education in Malaysia. *Journal of Turkish Science Education*, Vol. 6, No. 2, pp 3-11.
- Crespi, F., & Scellato, G. (2015). Knowledge cumulability and path dependence in innovation persistence. In C. Antonelli & A. Link (Eds.), *The Routledge handbook of the economics of knowledge* (pp. 116–134). Routledge.
- Curriculum Development Division. (2017). Primary School Standard Curriculum Revision 2017. Ministry of Education Malaysia.
- Driver, R., Newton, P., & Osborne, J. (2000). Establishing the norms of scientific argumentation in classrooms. *Science Education*, Vol. 84, No. 3, pp 287-312. [https://doi.org/10.1002/\(SICI\)1098-237X\(200005\)84:3<287::AID-SCE1>3.0.CO;2-A](https://doi.org/10.1002/(SICI)1098-237X(200005)84:3<287::AID-SCE1>3.0.CO;2-A)
- Edwards-Schachter, M., García-Granero, A., Sánchez-Barrioluengo, M., Quesada- Pineda, H., & Amara, N. (2015). Disentangling competences: Interrelationships on creativity, innovation and entrepreneurship. *Thinking Skills and Creativity*, Vol. 16, pp 27-39. <https://doi.org/10.1016/j.tsc.2014.11.006>
- Friedrichsen, P. J., Sadler, T. D., Graham, K., & Brown, P. (2016). Design of a socio- scientific issue curriculum unit: Antibiotic resistance, natural selection, and modeling. *International Journal of Designs for Learning*, Vol. 7, No. 1, pp 1-18. <https://doi.org/10.14434/ijdl.v7i1.19325>
- Glenn, J. (1972). Futurizing teaching vs. futures courses. *Social Science Record*, Vol. 9, No. 3, pp 26-29.
- Hmelo-Silver, C. E. (2004). Problem-based learning: What and how do students learn? *Educational Psychology Review*, Vol. 16, No. 3, pp 235-266. <https://doi.org/10.1023/B:EDPR.0000034022.16470.f3>
- Ho, H. C., Wang, C. C., & Cheng, Y. Y. (2013). Analysis of the scientific imagination process. *Thinking Skills and Creativity*, Vol. 10, pp 68-78. <https://doi.org/10.1016/j.tsc.2013.04.003>
- Hyerle, D. N. (2009). Beyond the wall of text: Thinking maps as a universal visual language for transforming how we see knowledge, thinking and learning. In J. E. Pedersen & K. D. Finson (Eds.), *Understanding and applying visual data to research in education* (pp. 31–49). Brill. https://doi.org/10.1163/9789087905163_004
- Hyerle, D. N. (2011). *Student successes with thinking maps school-based research, results, and models for achievement using visual tools*. Sage.
- Hyerle, D. N., & Yeager, C. (2007). *Thinking maps: A language for learning*. Thinking Maps.
- Krueger, N. F. (2005). The cognitive psychology of entrepreneurship. In Z. J. Acs & D. B. Audretsch (Eds.), *Handbook of entrepreneurship research* (pp. 105–140). Kluwer Law International. https://doi.org/10.1007/0-387-24519-7_6

- Lindahl, M. G., Folkesson, A. M., & Zeidler, D. L. (2019). Students' recognition of educational demands in the context of a socioscientific issues curriculum. *Journal of Research in Science Teaching*, Vol. 56, No. 9, pp 1–28. <https://doi.org/10.1002/tea.21548>
- Malaysian Ministry of Education (2013). Malaysia Education Blueprint 2013-2025. Ministry of Education.
- Martini, M., Widodo, W., Qosyim, A., Mahdiannur, M. A., & Jatmiko, B. (2021). Improving undergraduate science education students' argumentation skillsthrough debates on socioscientific issues. *Jurnal Pendidikan IPA Indonesia*, Vol. 10, No. 3, pp 428-438.
- Najafi-Tavani, S., Najafi-Tavani, Z., Naudé, P., Oghazi, P., & Zeynaloo, E. (2018). How collaborative innovation networks affect new product performance: Product innovation capability, process innovation capability, and absorptive capacity. *Industrial Marketing Management*, Vol. 73, pp 193-205. <https://doi.org/10.1016/j.indmarman.2018.02.009>
- Omar, A., Othman, Y., & Saleh, W. M. (2020). The impact of a strategy based on thinking maps in the teaching of science on educational achievement and developing Marzano's productive habits of mind at preparatory school pupils. *PalArch's Journal of Archeology of Egypt / Egyptology*, Vol. 17, No. 4, pp 836-870.
- Owens, D. C., Sadler, T. D., & Zeidler, D. L. (2017). Controversial issues in the science classroom. *Phi Delta Kappan*, Vol. 99, No. 4, pp 45-49. <https://doi.org/10.1177/0031721717745544>
- Prain, V., & Tytler, R. (2012). Learning through constructing representations in science: A framework of representational construction affordances. *International Journal of Science Education*, Vol. 34, No. 17, pp 2751-2773. <https://doi.org/10.1080/09500693.2011.626462>
- Repenning, A., Lamprou, A., & Basawapatna, A. (2021). Computing effect sizes of a science-first-then-didactics computational thinking module for preservice elementary school teachers. In [M. Sherriff](#), [L. D. Merkle](#), [P. A. Cutter](#), [A. E. Monge](#), [J. Sheard](#) (Eds), *SIGCSE '21: The 52nd ACM Technical Symposium on Computer Science Education* (pp. 274-280), ACM. <https://doi.org/10.1145/3408877.3432446>
- Saad, R., & BouJaoude, S. (2012). The relationship between teachers' knowledge and beliefs about science and inquiry and their classroom practices. *Eurasia Journal of Mathematics, Science and Technology Education*, Vol. 8, No. 2, pp 113-128. <https://doi.org/10.12973/eurasia.2012.825a>
- Sadler, T. D. (2004). Informal reasoning regarding socioscientific issues: A critical review of research. *Journal of Research in Science Teaching*, Vol. 41, No. 5, pp 513-536. <https://doi.org/10.1002/tea.20009>
- Sadler, T. D. (2011). *Socio-scientific issues in the classroom: Teaching, learning and research*. Springer.
- Sadler, T. D., & Zeidler, D. L. (2009). Scientific literacy, PISA, and socioscientific discourse: Assessment for progressive aims of science education. *Journal of Research in Science Teaching*, Vol. 46, No. 8, pp 909 - 921.
- Syukri, M., Halim, L., Mohd. Meerah, T.S., & Buang, N.A.. (2013). Pengetahuan pedagogi isi kandungan guru sains sekolah rendah dalam mengajarkan pemikiran sains keusahawanan: Satu kajian kes [Pedagogical content knowledge of primary school science teachers in teaching entrepreneurial science thinking: A case study]. *Jurnal Teknologi*, Vol. 63, No. 2, pp 13-19. <https://doi.org/10.11113/jt.v63.1999>
- Tawau District Education Office. (2019). *Primary school student statistics*. Ministry of Education Malaysia.
- Topcu, M. S., Foulk, J. A., Sadler, T. D., Pitiporntapin, S., & Atabey, N. (2018). The classroom observation protocol for socioscientific issue-based instruction: Development and implementation of a new research tool. *Research in Science & Technological Education*, Vol. 36, No. 3, pp 302-323. <http://doi.org/10.1080/02635143.2017.1399353>
- Walker, K. A., & Zeidler, D. L. (2007). Promoting discourse about socioscientific issues through scaffolded inquiry. *International Journal of Science Education*, Vol. 29, No. 11, pp 1387-1410. <http://doi.org/10.1080/09500690601068095>
- Zeidler, D. L., & Keefer, M. (2003). The role of moral reasoning and the status of socioscientific issues in science education: Philosophical, psychological and pedagogical considerations. In D. L. Zeidler (Ed.), *The role of moral reasoning on socioscientific issues and discourse in science education* (pp. 7-38). Kluwer Academic.
- Zeidler, D. L., Sadler, T. D., Simmons, M. L., & Howes, E. V. (2005). Beyond STS: A research-based framework for socioscientific issues education. *Science Education*, Vol. 89, No. 3, pp 357-377. <https://doi.org/10.1002/sce.20048>

The Effect of Entrepreneurship Education on Micro-entrepreneurial Outcomes Funded by MFIs

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Abstract: As evident, micro finance institutions (MFIs) are widely catering to millions of customers deprived of mainstream lending services. Beyond doubt they are fulfilling their goal of loan provision to the deprived creating an opportunity for them to better their lives. Herein, arises a critical question, whether loan is enough to achieve the primary purpose of this very loan, which is the upliftment of the borrower, or more than funding is needed? Deep investigation is deemed to explore an answer to this. In this process, this paper compares the performance of micro entrepreneurs who undergo and who do not undergo entrepreneurial training and education programs. Thus, establishing the impact of entrepreneurial training and education programs on micro-enterprises. This scientific research provides discreet insight for researchers to narrow in on related significant research topics and presents the organizations an opportunity to decide the thrust they want to apply on entrepreneurial training and education programs being in a position to evaluate the long-term impact of their approach and investment. It is a longitudinal study performed on the 121 MFI clients of 4 microfinance institutions in 2 different states (Bihar and Orissa) of India. All the clients have taken loan with the purpose of starting micro-enterprise. 61 received entrepreneurial education provided by MFIs and rest have started without any entrepreneurial education. Every year from 2015 to 2021, semi-structured, in-depth telephonic interviews were performed to track, measure, and analyze respondents' transition from loan disbursement to entrepreneurship. Though, all the beneficiaries do not find the education programs in absolute synchronisation with their development needs in terms of skills and knowledge, still the results of those who have attended such programs are found to be better than of those who haven't. Also, the majority of them appear content with the results of their entrepreneurship education and are performing better in comparison to those who have not undergone it. The results advocate that the effective education should be provided on entrepreneurial, social, health and family aspects by each MFI to achieve the basic purpose of its existence. The study provides valuable insights for the stakeholders involved in developing micro enterprises.

Keywords: Micro Entrepreneurship, Entrepreneurial Education, Microfinance Institutions, Longitudinal Study

1. Introduction

The primary objective of microfinance institutions is well-being through poverty alleviation, by means of microcredit support to help micro-enterprises generate income. Studies throughout the world suggest that impact created by microcredit is not substantial enough (Sahai et al., 2020) and there is dearth of evidence to support the claim that microfinance has a beneficial effect on the well-being of underprivileged (Duvendack and Mader, 2020).

Although microcredit provides the opportunity to its clients to invest in their small businesses, however, to make them profitable, a basic business acumen and sensitization to improve their livelihood is required (Chhatoi, 2022). Therefore, microcredit alone seems to be insufficient to bring about significant changes in an individual's life as is sometimes claimed to be (Swain and Garikipati, 2019).

According to Ilavarasan (2019) informal microenterprises are the enterprises of the poor. They are having low literacy rates and their exposure to systemic usage of loans, entrepreneurial processes and strategies are very limited. Thus, support of microfinance institutions in terms of client training and development, may be coined as a foundation to alleviate poverty by gradual transformation in the livelihood of clients. In most nations, over the past 20 years, education regarding entrepreneurship has grown dramatically (Matlay and Carey, 2006; Mukesh et al., 2020). With respect to the contents of educational programs, significant development has been observed between these time periods. This growth may be interpreted as a sign of prominent government optimism towards the beneficial effects that entrepreneurship, irrespective of magnitude, can have on a country's socioeconomic framework (Clevenger et al., 2022). Effective education/training for upcoming micro entrepreneurs stepping into the economy is expected to lead to a corresponding rise in their number as well as caliber. However, it should also be acknowledged that the increasing number of studies of empirical investigation in this field have proved the notion that education in entrepreneurship may result in better outcomes.

We attempted to assess the impact that entrepreneurship education has created on a target sample of 121 MFI clients of 4 microfinance institutions in 2 different states (Bihar and Orissa) of India. Out of these 121

clients 61 are administered entrepreneurship education and training while the rest of the 60 are limited to availing benefit of financing alone by MFI. This study is performed with the objective to narrow down the growing credibility gap that exists between MFIs diction and hard entrepreneurial realities. All respondents in the research sample selected were willing to start their own micro-entrepreneurship with the help of loan amounts received by MFIs. To track, quantify, and analyze participants' transition from loan beneficiary to entrepreneur, semi-structured, comprehensive phone interviews were conducted from 2015 to 2021. This paper holds high significance as it sheds light on the variance in performance of micro entrepreneurs who underwent entrepreneurial education and those who did not, followed closely, for a long cycle of six years. It brings out the difference in the outcomes of these two categories of micro entrepreneurs quiet discreetly, more importantly in a long time-cycle.

2. Literature Review

Microfinance institutions (MFIs) have the potential to reduce poverty and improve the lives of poor people through microcredit (Thu and Duong, 2018). But the studies show that its impact on livelihood and income of micro-entrepreneur is not significant (Kaka, 2017) and in some cases it becomes even negative despite being a powerful financial tool (Crépon et al., 2015). It shows that for the growth of micro-entrepreneurs only credit is not enough, although it is a critical factor (Mwakalikamo, 2020). However, the basic objective of establishment of the poor has been observed to be successful only when credit is complemented with social and business development education along with professional microfinance services.

It is well known that people who decide to pursue entrepreneurship are affected by a number of "push" and "pull" aspects, which eventually influence and govern the entrepreneurial pathways they undertake (Pliakoura et al., 2022). Likewise, a variety of circumstances may control how the value and necessity of education in entrepreneurship and/or related training is viewed (Jami, and Gökdeniz, 2020). In this regard, Kunaka and Moos (2019) assert that professionals and/or specialists in education can impart knowledge about entrepreneurship, or certain significant aspects of it, before, during, and after the start of entrepreneurial journey. But not everybody follows this system for entrepreneurial education. For example, Johannison (1991) states that to educate someone to evolve not only into ambitious but entrepreneurial individuals, also is a task which in terms of time and magnitude is beyond the abilities of an educator". Matlay (2008) also asserts that the knowledge typically provided in entrepreneurship classes is crucial but not enough to develop a person into an accomplished entrepreneur. Given these entirely different viewpoints, there is a disagreement between researchers on the question that whether or not these educational/training programs can actually increase the count and competency of the entrepreneurs (Farhangmehr et al., 2016).

In this context Khalid et al., (2019) argued that business training is an important tool to improve performance throughout the world. According to Sustad and Cohen (2007) the focus of microenterprise training programs for many years has been money management skills. Gradually training in record keeping and cash flow management has become an essential part to many microenterprise programs comprising credit Siekei et al., (2013). But now the microfinance market is getting more competitive and to sustain, micro entrepreneurs need to have skills to promote products and manage different aspects such as cost, uses and alternatives.

Various researchers Davidson and Wiklund (1999), Shane et al. (2003), Benzing and Chu (2009) Abdallah (2022) have found that business performance is not solely dependent upon the credit received but also influenced by other motivational factors. According to Chaiwongyard el al. (2019) and Rafiki (2020), these factors include the training on business opportunity, accomplishment of challenging tasks, ascending movement of enterprise accomplishments, generating additional prospects for business, learning innovative abilities and at times livelihood promoting or poverty reduction motives. According to Basargekar (2009) "The holistic approach of moving from "credit only" to "credit plus" will bring out the desirable effect on entrepreneurship development".

Valdivia (2015) studied the impact of training on the group of female micro entrepreneurs. Some of them were provided with general training and the remaining were provided technical training. The results demonstrated improvement in the utility of borrowings and profit making, higher efficiency and increased sales revenues as well as the self-adoption of recommended business practices along with life quality improvements. Raven & Le (2015) also found in their study of women microcredit recipients that teaching business skills improves business performance. Karlan & Valdivia (2011) found that the enterprises that received only credit were not able to perform to an optimal level, whereas those which received both credit as well as business training managed their resources well and performed better. These training programs include insight on several entrepreneurial

opportunities which are coming up in the market. Also, t h e y include training on how to keep separate finances for business and household expenses, reinvestment of received profit, maintaining record of sales and other financial activities they are into and the process of thinking proactively for their betterment.

Kessy and Temu (2010), performed a comparative study of impact analysis of performance of borrowers who have undergone business training to start their setup and the borrowers who have had no business training but started their own enterprise. Results revealed that those micro credit client-enterprises who have received training created more assets and generated higher sales revenue as compared to the enterprises owned by those who did not receive training.

Noponen (2005), in his three-year study of 906 clients that include several entrepreneurs of ASA17, a MFI working with 60,000 rural women in Tamil Nadu, India, where he has seen several encouraging impacts on the clients. These impacts were on clients' livelihood, their social status, living conditions, consumption standards and their say in their home as well as society. Counselling and training were found to play a critical role in generating these impacts.

3. Research Methodology

This research based on longitudinal study provides for the foundation of educating entrepreneurs in MFIs. An analysis has been conducted to investigate the effects of entrepreneurial education on a target sample of 121 MFI clients (out of which 72% of the clients were females and the rest were male) of 4 microfinance institutions in India. All the clients have taken loan with the purpose of starting micro-enterprise like tailoring, spare part shops, hardware shops, dairy, clothing, vegetables, fruits, cereals and salons etc. The loan amount varies between Rs. 50,000 to 100,000 for a tenure of 1-3 years. Out of 121 respondents 61 received entrepreneurial education provided by MFIs and rest 60 have been given loan without any entrepreneurial education. Semi-structured, in-depth, recurring telephone interviews were conducted thrice during a six-year period year of 2015 to 2021 to document, evaluate and analyse respondents' progress. Further, in the last year while interviewing the clients we also collected the response about their perception related to the relevance and importance of education provided in their entrepreneurial journey on 5 point Likert scale.

4. Results and discussion

All respondents in the sample were very interested in starting their own microentrepreneurial venture with help of loan amount. Since the clients of MFIs usually belong to villages and suburban areas where poverty percentage is high and illiteracy is also high, for them the monetary support is important but along with that, the education related to proper use of money such as procuring inventories and operational aspects of specific enterprises, is also equally important. Confirming it, Sievers and Saarelainen (2011) quoted that incorporating value chains in micro entrepreneurial firms can help in enhancing their economic performance, boost employment and improve working conditions. The second component includes training related to loan repayment and parallel financial products. These are the factors which guide the client towards the accountability of loan repayment as well as provision of savings, credit, and insurance facilities for betterment of financial condition. The third component related to interpersonal skills includes networking and teamwork which helps the entrepreneur to grow by getting support and awareness. Finally, the last component includes education/counseling related to child education, medical care, domestic violence, and liquor addiction, these are the factors responsible for improvement in living standard.

The MFIs designed the education programmes eyeing two aspects, one related to starting and scaling up of micro entrepreneurship and the other related to sustainability of the same (for ex. counselling related to domestic violence, liquor addiction, health and hygiene etc).

Modules of the education programme are as follows:

Basics of entrepreneurship - Entrepreneurial opportunities, front end assessment technique, inventories and operational aspect, value chain support system.

Basics of finance - Managing accounts, loan repayment, parallel financial products.

Interpersonal skills - Networking and teamwork.

Life skills - Health and hygiene, domestic violence, liquor addiction, child education.

4.1 Knowledge of entrepreneurship prior to entrepreneurship education

MFI clients were required to estimate their understanding and expertise on four aspects that were necessary to launch and maintain an entrepreneurship. The self-evaluation questionnaire required participants to rate their responses on a scale of 1 (not at all) to 5 (very good) over the phone. The findings revealed that, prior to undergoing the educational program, majority of these clients had a "below average" understanding of the fundamentals of entrepreneurship.

Table 1: Basic entrepreneurial knowledge in MFI clients before education program

Modules of the education programme-	No. of clients rated themselves 1 on Likert scale	No. of clients rated themselves 2 on Likert scale	No. of clients rated themselves 3 on Likert scale	No. of clients rated themselves 4 on Likert scale	No. of clients rated themselves 5 on Likert scale
Basics of entrepreneurship	16	24	15	4	2
Basics of finance	19	21	12	6	3
Interpersonal skills	6	15	20	11	9
Life skills	2	5	25	15	14

4.2 Knowledge of entrepreneurship after receiving entrepreneurship education

Clients were again invited to review the same general and particular entrepreneurial knowledge and abilities that were examined during the first telephone interviews, after completing a one-month entrepreneurship education curriculum (Table-II). They were given identical self-evaluation questionnaires, and they had to rate their responses on a scale of 1 (not at all) to 5 (very good). The second set of findings revealed that majority of them had enhanced the specific entrepreneurial abilities by the end of their training.

Table 2: Basic entrepreneurial knowledge in MFI clients after education program

Modules of the education programme-	No. of clients rated themselves 1 on Likert scale	No. of clients rated themselves 2 on Likert scale	No. of clients rated themselves 3 on Likert scale	No. of clients rated themselves 4 on Likert scale	No. of clients rated themselves 5 on Likert scale
Basics of Entrepreneurship	3	7	12	29	10
Basics of finance	2	10	10	23	16
Interpersonal skills	4	6	23	15	13
Life skills	2	3	21	20	15

4.3 One year after sanction of loan and completion of entrepreneurial education programme

As per the responses out of 61 clients who underwent the entrepreneurial education programme, 39 respondents started their own micro entrepreneurship, 3 respondents started farming, 11 joined some employment such as daily wage worker or as an assistant in some enterprises and 13 respondents were unemployed. None of the respondents have taken another loan for the purpose of expansion and 13 respondents out of 61 repaid total loan amount (Table III). Further we have identified another 60 respondents who have been given only loan amount as there was no provision for entrepreneurial training in the MFIs from where they have taken loan, but the purpose was same for the loan i.e. to start own micro entrepreneurship.

Table 3: Respondents' (attended education program) micro entrepreneurial growth after one year.

Work profile of MFI clients after one year (received loan for the purpose of starting their micro entrepreneurial ventures and attended entrepreneurial education programme)	No of clients (Total 61)	%
Started own micro entrepreneurship	39	63.93
Farming	3	4.91
Employment (mostly daily wage)	12	19.67

Work profile of MFI clients after one year (received loan for the purpose of starting their micro entrepreneurial ventures and attended entrepreneurial education programme)	No of clients (Total 61)	%
Unemployed	7	11.47
Repaid total loan amount	13	21.311
Availed another loan for expansion	0	0

Table 4: Respondents' (not undergone education program) micro entrepreneurial growth after one year.

Work profile of MFI clients (only received loan for the purpose of starting their micro entrepreneurial ventures)	No of clients (Total 60)	%
Started own micro entrepreneurship	31	51.66
Farming	6	10
Employment (mostly daily wage)	8	13.33
Unemployed	15	25
Repaid total loan amount	19	31.66
Availed another loan for expansion	0	0

4.4 Three years after sanction of loan and completion of entrepreneurial education programme

As observed in table V, post three years of loan disbursement 33 out of 39 respondents were continuing with the same venture while 5 respondents started afresh their micro-entrepreneurship after one year. Number of respondents doing nothing were 6. All the loans were repaid and interestingly 7 of them had taken another loan for the expansion and growth of their venture. In case of respondents who took loan unaccompanied by education programme (Table VI), 11 out of 31 discontinued their ventures, 15 were unemployed and only one person took another loan for expansion of his venture. 59 repaid all the loan and the loan for 1 respondent was closed without repayment as he was no more.

Table 5: Respondents' (attended education program) micro entrepreneurial growth after three years.

Work profile of MFI clients after three years (received loan for the purpose of starting their micro entrepreneurial ventures and attended entrepreneurial education programme)	No of clients (Total 61)	%
Started own micro entrepreneurship after an year	6	9.83
Out of 39, still continuing	33	54.09
Farming	2	3.27
Employment (mostly daily wage)	14	22.95
Unemployed	6	9.83
Repaid total loan amount	61	100
Availed another loan for expansion	7	11.47

Table 6: Respondents' (not attended education program) microentrepreneurial growth after three years.

Work profile of MFI clients after three years (only received loan for the purpose of starting their micro entrepreneurial ventures)	No of clients (Total 60)	%
Started own micro entrepreneurship after an year	2	3.33
Out of 31, still continuing	20	33.33
Farming	6	10
Employment (mostly daily wage)	17	28.33
Unemployed	15	25
Repaid total loan amount	59	98.33

Availed another loan for expansion	1	1.66

4.5 Six years after sanction of loan and completion of entrepreneurial education programme

After six years, total no. of respondents who were continuing with their venture were 34 in total, 5 were unemployed, loan repayment was 100 % and 11 respondents out of 34 had taken another loan for expansion purpose. 1 respondent started his micro venture in the fifth year and successfully pursuing (Table VII). On the other hand, no of unemployed respondents in 2nd lot were 22, only 16 out of 31 were continuing with their ventures and 18 joined different jobs for earnings (Table VIII).

Table 7: Respondents' (attended education program) micro entrepreneurial growth after six years.

Work profile of MFI clients after six years (received loan for the purpose of starting their micro entrepreneurial ventures and attended entrepreneurial education programme)	No of clients (Total 61)	%
Started own micro entrepreneurship after 5 year	1	1.63
Out of 33+5=38, still continuing	34	55.73
Farming	2	3.27
Employment (mostly daily wage)	19	31.14
Unemployed	5	8.19
Repaid total loan amount	61	100
Availed another loan for expansion	7+4=11	18.03

Table 8: Respondents' (not attended education program) microentrepreneurial growth after six years.

Work profile of MFI clients after six years (only received loan for the purpose of starting their micro entrepreneurial ventures)	No of clients (Total 60)	%
Started own micro entrepreneurship after 5 year	0	0
Out of 20, still continuing	16	26.66
Farming	4	6.66
Employment (mostly daily wage)	18	30
Unemployed	22	36.66
Repaid total loan amount	59	98.33
Availed another loan for expansion	1+2=3	5

Table 9: Table of chi-square test showing difference in sustainability in the microenterprises received and not received the entrepreneurial education

	No. of micro enterprises sustained till 6 years	No. of micro Enterprises not able to be sustained till 6 years	Marginal Row Total	Pearson Chi-square value	Sig.
Trained	34	27	61	10.542	.001
Untrained	16	44	60		
Marginal Column Total	50	71	121		

Significant at $p < .05$

According to table IX there is a significant difference ($p = .001$) between the enterprises of trained i.e. those entrepreneurs who underwent entrepreneurial education program and the untrained, those who did not. Giving precise training in regard to starting new entrepreneurship, handling their finances and strategies for loan repayment helps the clients not only in starting a microenterprise but also sustaining it for longer duration. The table suggests a critical association between entrepreneurial training and sustainability as the enterprises

whose owners underwent training are seen to run successfully for six years more than double the numbers of those owners who did not undergo such training.

Table 10: Correlation analysis of training aspects.

	F1	F2	F3	F4
Basics of Entrepreneurship F1	1	.273	.070	.351
Basics of finance F2		1	.120	.157
Social orientation F3			1	.297
Life skills F4				1

From Pearson correlation test it was found that there is no significant correlation between the different training aspects.

Table 11: Results of Multiple Linear Regression on education modules associated with entrepreneurial growth.

Modules	Coefficients	Std. Error	T	Sig.
Basics of Entrepreneurship	0.134	0.309	2.693	.001
Basics of finance	0.150	0.214	3.024	.003
Social orientation	0.134	0.221	2.692	0.001
Life skills	0.162	0.199	3.263	.000

Based on the 34 responses of 6th year for the question “rate the importance of different modules in your entrepreneurial growth” we have found the given results. In this table multiple linear regression analysis was done to get the education module importance in entrepreneurial success. The value of R square is 0.722, which suggests that the model can explain 72.2% of the variance in dependent variable. Result showed that basics of entrepreneurship ($\beta=.134$, $p=.001$), basics of finance ($\beta =.150$, $p=.003$), social orientation ($\beta =.134$, $p=.01$), and life skills ($\beta =.162$, $p=.000$), were significantly associated with the sustainable growth of microentrepreneurship.(Table XI). In micro entrepreneurs associated with microfinance institutions, growth and establishment depend not merely on loans but training and counselling also play an important role.

5. Conclusion

The study established that majority of the entrepreneurs did not have skills and experience in areas such as business planning, financial management and interpersonal skills. All the respondents expressed the desire for training that would enable them to improve their businesses. Revelations from this study profoundly establish that entrepreneurship education substantially impacts the success, failure, overall performance of the borrower and in turn the very purpose of societal impact of a micro finance institution. However, some enterprises have experienced growth, even though the respondents have never received any training on entrepreneurship. The six yearlong exploration brings out that the micro entrepreneurs who were out of business at the culmination of six years were only 8% in case of those who had been going through entrepreneurial education and training while it was almost five times i.e. 37% in case of those who did not undergo such programs. The progress was speedier in case of those subjected to training as the efficiency was reflected in outcomes. The interviews conducted in the study also find that those subjected to entrepreneurial education and training reflected much higher confidence, conviction, and composure. Overall, on critical aspects examined herein, the micro entrepreneurs administered with education and trainings on entrepreneurship can be seen to be discretely better from those who went without such training and education. This establishes the positive impact of entrepreneurial education and training administered at the time of beginning of the micro entrepreneurship.

6. Limitations

Though, our study follows a micro entrepreneur between long six years and produces commendable insight into the impact of entrepreneurial education and training facilitating discreet examination of differences in the outcomes of both categories of micro entrepreneurs, it is limited to a small number of respondents. Secondly,

it does not observe the impact of regular trainings as trainings at regular intervals were not conducted for micro entrepreneurs studied here in.

References

- Abdallah, G.K., Masurel, E., Naudé, W.A. and Eijdenberg, E.L., (2022). "Unboxing entrepreneurial motivations in Tanzania: Business-related and personal-related factors" *Journal of African Business*, Vol 23, No 1, pp.60-78.
- Basargekar, P. (2009) "How Empowering is Micro Entrepreneurship Developed through Microfinance?" *Asia-Pacific Business Review* Vol. V. pp. 67-76.
- Benzing, C. & Chu, H. M. (2009) "A Comparison of the motivations of small business owners in Africa", *Journal of Small Business and Enterprise Development*, Vol. 16, No. 1, pp. 60-77.
- Clevenger, M.R., Crews, M.I., Cochran, S.L., Underdahl, L., Leach, R.G., Perlman, J.R., Isele, E., Krueger, N.F., Knight, M. and Udomsak, D.P. (2022) *Entrepreneurology of formal and informal education, co-curricular and extra-curricular programming, vocational and technical entrepreneuring, and learning from failure to support and empower entrepreneurs*. In *Entrepreneurial Communities and Ecosystems* pp. 143-192. Routledge.
- Crépon, B., Devoto, F., Duflo, E. and Parienté, W. (2015) "Estimating the impact of microcredit on those who take it up: Evidence from a randomized experiment in Morocco", *American Economic Journal: Applied Economics*, Vol 7, No 1, pp.123-150.
- Davidsson, P. & Wiklund, J. (1999) "Theoretical and methodological issues in the study of firm growth." *Jonkoping International Business School, Working Paper Series*, 6.
- Duvendack, M. and Mader, P. (2020) "Impact of financial inclusion in low-and middle-income countries: A systematic review of reviews." *Journal of Economic Surveys*, Vol 34, No 3, pp.594-629.
- Chhatoi, B.P. (2022) "Sustainable micro-enterprise: matching and analysing success of microfinance", *International Journal of Indian Culture and Business Management*, Vol 26, No 1, pp.120-144.
- Farhangmehr, M., Gonçalves, P. and Sarmiento, M. (2016) "Predicting entrepreneurial motivation among university students: The role of entrepreneurship education", *Education+ Training*, Vol 58, No 7/8.
- Ilavarasan, P.V., (2019) "Present and future of the use and impact of information and communication technology in informal microenterprises: Insights from India", *The Electronic Journal of Information Systems in Developing Countries*, Vol 85, No 3, pp 12091.
- Jami, Y. and Gökdeniz, I. (2020) "The role of universities in the development of entrepreneurship", *Przedsiębiorczość-Edukacja*, Vol16, No1, pp.85-94.
- Kaka, e.j. (2017) "The effect of micro-credit on poverty reduction in northeast Nigeria".
- Karlan, D. & Valdivia, M. (2011) "Teaching entrepreneurship: impact of business training on microfinance clients and institutions", *Review of Economics and Statistics*, Vol. 93, No. 2, pp. 510-527.
- Kessy, S. & Temu, S.S. (2010) "The impact of training on performance of micro and small enterprises served by microfinance institutions in Tanzania", *Research Journal of Business Management*. pp. 103-111.
- Khalid, N., Islam, D.M.Z. and Ahmed, M.R.M., (2019) "Sentrepreneurial Training and Organizational Performance: Implications for Future", *Humanities & Social Sciences Reviews*, Vol 7, No 2, pp 590-593.
- Kunaka, C. and Moos, M.N. (2019) "Evaluating mentoring outcomes from the perspective of entrepreneurs and small business owners". *The Southern African Journal of Entrepreneurship and Small Business Management*, Vol1, No 1, pp1-11.
- Matlay, H. (2008). "The impact of entrepreneurship education on entrepreneurial outcomes", *Journal of small business and enterprise development*, Vol 15, No 2, pp.382-396.
- Matlay, H. and Carey, C., (2006) "Impact of entrepreneurial education on graduates in the UK: Conceptual and contextual implications", In *EFMD 36th EISB Conference (Entrepreneurship, Innovation and Small Business Conference) Proceedings*.
- Mukesh H V , Pillai K. R. & Mamman Jose. (2020) "Action-embedded pedagogy in entrepreneurship education: an experimental enquiry", *Studies in Higher Education*, 45:8, 1679-1693, DOI: [10.1080/03075079.2019.1599848](https://doi.org/10.1080/03075079.2019.1599848)
- Mwakalikamo, S. (2020) "The Impact of Training on Entrepreneurship Performance in Tanzania: A Case of Kinondoni District" (Doctoral dissertation, Mzumbe University).
- Sahai, S., Ray, R.S. and Tapasvi, S.K. (2020) "Determinants of growth for the informal sector micro-enterprises: An empirical study in India", *Enterprise Development & Microfinance*, Vol 31, No 2, pp76-91.
- Noponen, H. (2005) "The internal learning system: Assessing impact while addressing participant learning needs", *International Development*, Vol 17, No 2, pp 195-209.
- Pliakoura, A.P., Beligiannis, G.N., Chatzitheodoridis, F. and Kontogeorgos, A., (2022) "The impact of locus of control and motivations in predicting entrepreneurial intentions among farmers: field research", *Journal of Agribusiness in Developing and Emerging Economies*, Vol 12, No 2, pp 183-203.
- Rafiki, A., (2020) "Determinants of SME growth: An empirical study in Saudi Arabia", *International Journal of Organizational Analysis*, Vol 28, No 1, pp 205-225.
- Shane, S., Locke, E. A. & Collins, C.J. (2003) "Entrepreneurial Motivation", *Human Resource Management Review*, Vol. 13, No. 2, pp. 257-279.
- Sievers, M. and Saarelainen, E. (2011) *Value Chains for Rural Development*, International Labour Office.

- Swain, R.B. and Garikipati, S., (2019) "Microfinance in the Global South: Examining Evidence on Social Efficacy "(No. 201908).
- Raven, P. & Le, Q.V. (2015) "Teaching business skills to women: impact of business training on women's microenterprise owners in Vietnam", *International Journal of Entrepreneurial Behavior & Research*, Vol. 21, No. 4, pp. 622-641.
- Thu, N.H. and Duong, P.B., (2018) "Impact of formal credit on the living standards of poor households in mountainous northern Vietnam. *Enterprise Development & Microfinance*, Vol 29 No 3, pp 244-261.
- Valdivia, M. (2015) "Business training plus for female entrepreneurship? Short and medium-term experimental evidence from Peru", *Journal of Development Economics*. Vol. 113, pp. 33-51.

Efficacy of the WIPO Global Innovation Index as a Driver of Innovation: Analysis of GII Data for the ten ASEAN Economies

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Abstract: There is a worldwide trend to take account of the WIPO Global Innovation Index (GII) when driving the innovation potential of national economies at a high level as well as at the micro level to encourage local industries. Analysis of the background data shows that such approaches might be misplaced. This study is an in-depth analysis of the underlying GII data of the ten ASEAN economies to determine each economy's patterns, strengths, and weaknesses. The literature guides which pillars and sub-pillars for innovation should be assessed. Analysis should keep at the front of mind that developing nations have significantly differentiated institutional structures, so policy measures from one system cannot be simply taken from one jurisdiction and applied to another. Assessing the components of the seven innovation pillars used by WIPO to develop the annual GIIs shows that a number of the components cannot be improved over the short term. Hence, they will have limited effect on improving the innovation potential of a particular industry. In other words, there is a need to drill down into the data and identify areas for focus to improve innovation potential in both short and medium terms. Simply focussing on the components and pillars that will have the most significant impact on improving the GII is a fool's errand as it may have a limited impact on innovation output. The paper explore the GII rankings at the component level of each of the ten economies: one is developed, six are developing, and three are least developed, according to United Nations criteria. Some components can only be improved at the government level, whilst others can be improved at the industry level. Strategies will then be presented on how industries can improve their innovation potential and hence improve the nation's potential.

Key Words: Global Innovation Index, innovation, WIPO, industrial capacity, European Innovation Scoreboard, PISA, STEM.

1. Introduction

A policy brief by the *Economic Research Institute for ASEAN and East Asia* has analysed development within the ten nations of the ASEAN (Ambashi, 2020: 1). The key messages from the review were:

- a.) Foreign direct investment (FDI) and trade will continue to be significant development drivers for the ASEAN members;
- b.) To create business opportunities, private enterprise organisations need to enhance their innovation capability;
- c.) The policy of human resource development and technology and adoption of each member state should be arranged to match their industrial development stages; finally,
- d.) ASEAN Member states 'can use new development strategies based on 4IR [4th Industrial Revolution] and establish an "innovation niche" that is competitive, attractive, and unique to the rest of the world' (p. 1).

Initially, innovation was simply measured in terms of 'inputs (such as expenditures on research and development and the number of research personnel) and outputs (such as patents)' (Organisation for Economic Co-operation and Development, 1997: 1). It argues that, over time, the limitations of such an approach became evident and that there was the need to understand the linkages between the actors in innovation to improve technology performance. This, in turn, led to the development of national innovation systems (p. 1).

The most recognised measure of innovation is the annual Global Innovation Index (GII) which is based on a detailed analysis of seven pillars, namely: institutions, human capital & research, infrastructure, market sophistication, business sophistication, knowledge and technology outputs, and creatives output (Cornell University et al., 2020). The GII is, however, reported as a ranking based on the overall score of the economy. The Global Innovation Index (GII) is based on a detailed analysis of seven pillars: institutions, human capital & research, infrastructure, market sophistication, business sophistication, knowledge and technology outputs, and creatives output. The GII is, however, reported as a ranking based on the overall score of the economy (INSEAD, 2011: 8-9). Each of the input pillars constitutes 20% of the total input score. Each of the output pillars constitutes 50% of the total output score. Then, the input and output scores are added to calculate the total score. Finally, the total scores are ranked.

Every economy appears to have the ambition to move up the GII rankings. Is such an ambition realistic or a fool's errand? What has to be considered is that if all of the economies improved by the same quantum, there would be no change in the rankings. This would apply even though the total score of the inputs plus outputs would have increased across the board. As will be seen, some literature focuses on which pillars, sub-pillars, and individual indicators should be prioritised to improve the GII score and hence the country ranking. Surely the aim should be to improve the innovativeness of the country and the subsequent benefits that it brings.

This study includes an in-depth analysis of the underlying GII data of the ten ASEAN economies to determine the patterns and the strengths and weaknesses of each economy. The literature review will guide which pillars and sub-pillars should be assessed.

2. The Literature

Several recent studies have investigated the efficacy of the GII in measuring innovation. The studies fall into one of two categories: analyses of the efficacy of the GII *per se* or studies investigating innovation in countries based on GII data.

Evidence shows that innovation input positively impacted innovation output, but the impact was more intense at the lower quantiles (Reis et al., 2018: 640). They argue that this seems to contradict, to a certain extent, the argument that the more efforts are directed to innovation, the greater the innovation output. It seemed "more plausible at lower quantiles" (p.640). Analysis of the relationship between Innovation Input and Innovation Output using the GII data from 2013-2020 found that Business sophistication, Human capital and research, and Creative outputs were "the most important and explanatory factors in the formation of the innovation score" (Oturakci, 2021: 7). Finally, there was a statistical difference between income levels of countries and the three significant pillars. The cultural influence on "innovativeness" by investigating the linkages between the "Culture Map" concept and the GII concluded that their study reinforced the outcomes of previous research that "[c]ultural aspects clearly influence the innovativeness of a nation" (Guillén and Deckert, 2021: 8).

A 2017 study analysed the innovation inputs and outputs of the BRICS (Brazil, Russia, India, China, and South Africa) using the GII results for 2008-2013 (Franco and de Oliveira, 2017: 82). They found that for BRICS as a whole, the inputs can explain the output of knowledge. However, the outcome changed when the analysis was undertaken country by country. They argue that "[P]erhaps this result shows the need for the BRICS countries to cooperate to stimulate the development of the innovation process" (p. 85). They considered that the GII could be improved by focusing on the Human Capital, Market Sophistication and Business sophistication pillars. The question: "which innovation inputs are more strongly related to innovative outputs?" was the basis of a study by Duarte and Carvalho (2020: 2). Overall, Knowledge Absorption was key in determining innovation readiness in the Eurozone countries. As a result, they considered that improving the knowledge absorption capacity of domestic firms is likely to enhance the innovation outputs of Portugal.

Pençe et al. (2019) found that the 27 GII indicators identified by Şimşit et al. (2014) were "good enough for estimating the ranking scores of countries... Consequently, if a country wants to improve its ranking on the GII list, it needs to improve only these selected features" (pp. 19470007-11 – 19470007-12). Following research using the GII data for 2013, Sohn et al. (2016) opined that the results showed that infrastructure or business sophistication is more important than human capital and research. Analysis of GII data from Kazakhstan found that dependence between components of the indices is subjective as the "data array over the countries increases every year", and the total rating of a country and the main sections of the indices of a country depends on the rating positions of other countries and could give incorrect results (Stavbunik and Pelucha, 2019: 13-14). It has also been argued that innovation policies or their economic impacts have only been analysed in a few in-depth studies (Dobrzanski and Bobowski, 2020: 2)

Any analysis should keep at the in mind an earlier article by Gu (1999) in which he argues that as developing nations have significantly differentiated institutional structures, policy measures from one system cannot be simply moved from one jurisdiction to another. Therefore, detailed policy measures may be better made only based on intimate analysis of local situations in technology, institution, human capital, and other aspects. Moreover, an initiated policy must be open to timely adjustment (p. 61).

Based on the abovementioned findings as to which pillars and sub-pillars should be assessed, this paper then investigates the potential impediments to innovation in the ten ASEAN economies.

3. Findings

3.1 Trends in the GII of the ASEAN Economies

The Organisation for Economic Cooperation and Development (OECD) reported in 2013 that a coherent policy focus on innovation was lacking in most ASEAN countries. However, several have adopted an R&D-centric approach to developing innovation (OECD, 2013: 111).

Singapore and Malaysia were the exceptions, as innovation is included in their national development strategies (p. 111). It was considered that “[i]nnovation policy is not likely to compensate for seriously flawed framework conditions” (113). In many parts of the region, regulatory and legal systems created barriers to innovation (p. 114). Whilst the IP regulatory regimes generally met international practices, the institutional and legal capacity in the lesser developed countries was insufficient to manage and provide legal support in IP matters (p. 116).

The OECD findings are not really surprising considering that ASEAN consists of one *High-Income* country (Singapore), two *Upper Middle Income* (Malaysia and Thailand) and six *Lower Middle Income* (Cambodia, Indonesia, Lao PDR, Myanmar, Philippines, Vietnam) (World Bank, 2022). Despite their *Lower Middle Income*, the United Nations Conference on Trade and Development (UNCTAD) includes Cambodia, Lao PDR and Myanmar in their list of *least-developed countries* (UNCTAD, 2022). In addition, Myanmar is in a state of economic turmoil following a coup d'état that overthrew the democratically elected government in 2021. It is too soon for the impact of the coup to be reflected in the data being considered for this study.

The Global Innovation rankings of the ASEAN members for 2011 – 2022 are provided in Table 1. Singapore is by far the best-performing ASEAN member. The three lowest performing countries are the least developed: Cambodia, Lao PDR and Myanmar. The Philippines has shown the most significant improvement over the ten years, with Thailand and Vietnam significantly improving. Malaysia has been reasonably consistent, whilst Indonesia has improved but is still relatively poorly placed.

Table 1: Global Innovation Indices of ASEAN Members 2011-2022

Country	Global Innovation Index											
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Brunei Darussalam	-	53	74	88	-	-	71	67	71	71	82	92
Cambodia	111	129	110	106	91	95	101	98	98	110	109	97
Indonesia	99	100	85	87	97	88	87	85	85	85	87	75
Lao PDR	-	-	-	-	-	-	-	-	-	113	117	112
Malaysia	31	32	32	33	32	35	37	35	35	33	36	36
Myanmar	-	-	-	-	-	-	-	-	-	129	127	116
Philippines	91	95	90	100	83	74	73	73	54	50	51	59
Singapore	3	3	8	7	7	6	7	5	8	8	8	7
Thailand	48	57	57	48	55	52	51	44	43	44	43	43
Vietnam	51	76	76	71	52	59	47	45	42	42	44	48

Source: (INSEAD, 2011; WIPO and INSEAD, 2012; Cornell University et al., 2013; Cornell University et al., 2014; Cornell University et al., 2015; Cornell University et al., 2016; Cornell University et al., 2017; Cornell University et al., 2018; Cornell University et al., 2019; Cornell University et al., 2020; WIPO, 2021; WIPO, 2022)

We next drill down into the 2022 data to analyse the innovation scores on each of the seven pillars (Table 2). The *input GII score* is the sum of 20% of each of the scores of input pillars. The *output GII score* is the sum of 50% of each of the scores of the two output pillars. The overall GII is the mean of the output and input scores. *Innovation Efficiency* is simply the *output GII* divided by the *input GII*.

Table 2: Global Innovation Scores of ASEAN Members Overall and by Pillars 2022

Country	Overall GII	Output GII	Input GII	Innovation Efficiency	Institutions	Human Capital & Research	Infrastructure	Market Sophistication	Business sophistication	Knowledge and Technology Outputs	Creative Outputs
Brunei Darussalam	22.2	3.1	41.2	0.08	74.5	35.2	45.5	23.5	27.4	4.2	2.0
Cambodia	20.5	9.6	31.4	0.31	50.4	20.0	30.9	38.2	17.6	11.9	7.3
Indonesia	27.9	18.8	36.9	0.51	55.1	22.4	43.4	41.7	22.1	19.0	18.6
Lao PDR	17.4	6.1	28.8	0.21	46.7	16.4	26.1	34.8	20.0	7.2	5.0
Malaysia	38.7	29.4	48.0	0.61	68.8	41.0	48.6	45.3	36.3	31.5	27.4
Myanmar	16.4	9.3	23.4	0.40	38.1	18.4	21.4	25.1	14.1	12.0	6.6
Philippines	30.7	25.7	35.7	0.72	48.7	25.0	38.7	29.2	36.9	30.8	20.5
Singapore	57.3	43.9	70.6	0.62	95.9	61.5	61.4	68.4	65.7	49.3	38.5
Thailand	34.9	27.6	42.1	0.66	52.5	29.8	47.7	45.3	35.3	30.0	25.2
Vietnam	34.2	28.4	40.1	0.71	60.6	27.2	42.5	38.4	31.6	26.0	30.8
Contribution to Inputs					20%	20%	20%	20%	20%		
Contribution to Outputs										50%	50%

Source: (WIPO, 2022)

To better understand the data, the methodology utilised by the European Union to prepare the European Innovation Scoreboard (European Commission Directorate-General for Research and Innovation et al., 2022) was followed. The mean of the GII 2022 scores is 31.53; the data is provided in Table 3. The process is based on the mean value and uses four categories:

- Emerging Innovators - < less than 70% of the mean
- Moderate Innovators – between 70% and 100% of the mean
- Stronger Innovators – between 100% and 125% of the mean
- Innovation Leaders – greater than 125% of the mean

Table 3: Analysis of GIIs using the European Innovation Scoreboard Approach

Country	GI Rank	Overall GII Score	Performance Score	Category
Brunei Darussalam	92	22.2	70	Moderate Innovator
Cambodia	97	20.5	65	Emerging Innovator
Indonesia	75	27.9	88	Moderate Innovator
Lao PDR	112	17.4	55	Emerging Innovator
Malaysia	36	38.7	123	Strong Innovator
Myanmar	116	16.4	52	Emerging Innovator
Philippines	59	30.7	97	Moderate Innovator
Singapore	7	57.3	182	Innovation Leader
Thailand	43	34.9	111	Strong Innovator
Vietnam	48	34.2	108	Strong Innovator

As expected, the results show that Singapore is an Innovation Leader and is well ahead of all other ASEAN members in terms of innovation. Whilst Malaysia is only seven steps ahead of Thailand on the GII ranking, its performance is 10 points higher than that of Thailand. On the other hand, Thailand is 43 on the GII ranking, which is five steps ahead of Vietnam, but all have similar performance scores. Space precludes further discussion of this approach, but it is considered that it should be investigated further.

3.2 Drilling Down into the Key GII Components

Table 3 provides the 2022 rankings on the components identified by (Pençe et al., 2019) as the areas a country needs to improve to improve its GII ranking. Some interventions will bring about significant improvement but will only occur gradually over a significant timeframe. Others will possibly bring about improvements over a shorter timeframe. Other components may impact the GII but will have little impact on improving a country's innovation potential. The examples are used for illustration as a detailed analysis of all ten member states is impossible to report in this article.

Table 3: Rankings of ASEAN Members on Key GII Components 2022

Country	Brunei Darussalam	Cambodia	Indonesia	Lao PDR	Malaysia	Myanmar	Philippines	Singapore	Thailand	Vietnam
Human Capital and Research										
2.1.4 PISA scales in reading, maths and science	53	n/a	72	n/a	48	n/a	77	2	61	16
2.2.2 Graduates in science and engineering	4	47	73	49	3	12	52	9	27	54
2.3.1 Researchers	n/a	102	75	n/a	38	101	84	5	41	60
2.3.2 Gross expenditure on R&D (GERD)	81	102	80	n/a	40	95	75	19	36	59
Infrastructure										
3.1.3 Government's online services	80	112	72	130	24	127	60	5	42	78
3.1.4 Online e-participation	93	111	57	129	29	128	57	6	51	70
Business Sophistication										
5.1.1 Knowledge-intensive employment	44	110	123	95	52	119	80	2	90	106
5.1.3 GERD performed by business	n/a	84	82	n/a	41	n/a	68	21	30	45
5.1.4 GERD financed by business	100	66	79	n/a	45	100	47	20	1	10
5.1.5 Females employed with advanced degrees	63	105	88	97	52	86	58	6	71	85
5.2.1 University/industry research collaboration	40	85	13	63	36	126	64	7	38	26
5.2.3 GERD financed from abroad	92	52	94	n/a	43	79	89	37	80	59
5.3.2 High-tech imports	116	126	32	123	4	77	3	6	13	1
5.3.3 ICT services imports	27	99	39	128	37	87	50	13	119	130
5.3.4 Foreign direct investment net inflows	27	9	76	17	72	58	66	5	105	15
Knowledge and Technology Outputs										
6.1.4 Scientific and technical publications	68	114	128	115	52	126	122	32	79	90

Country	Brunei Darussalam	Cambodia	Indonesia	Lao PDR	Malaysia	Myanmar	Philippines	Singapore	Thailand	Vietnam
6.2.3 Total computer software spending	n/a	109	24	n/a	34	n/a	61	50	54	45
6.2.5 High-tech manufacturing	n/a	n/a	43	100	18	67	28	1	22	44
6.3.2 Production and export complexity	n/a	86	60	90	24	108	28	5	23	56
6.3.3 High-tech exports	103	68	46	45	1	69	2	1	8	3
6.3.4 ICT services exports	129	109	92	101	75	100	14	47	126	120
Creative Outputs										
7.2.1 Cultural and creative services exports	106	n/a	96	n/a	63	64	83	1	103	94
7.3.1 Generic top-level domains (gTLDs)	47	92	89	78	48	127	90	23	51	71
7.3.2 Country-code top-level domains (ccTLDs)	83	121	93	66	59	127	101	37	100	70
7.3.3 GitHub pushes received (replacing Wikipedia monthly edits)	65	96	72	114	62	122	85	1	80	63
7.3.4 Mobile app creation	102	56	60	n/a	66	100	62	4	59	8

Source: (WIPO, 2022)

3.2.1 Human Capital & Research

The biggest impediment to innovation appears to be the education system as measured by the PISA score (OECD, 2018; Adams and Wu, 2002).

For example, the ranking of Thailand is 61 (GPS, 2019). Delving further into the PISA data for Thailand showed that:

- Student performance in reading was some of the lowest in the 76 countries and economies in 2018, with girls performing statistically better than boys by 39 points;
- Student performance in mathematics was significantly lower than the OECD average, with girls performing statistically better than boys by 30 points; and
- There were similar results in science, with girls performing significantly better than boys by 20 points.

Clearly, there are significant deficiencies in the Thai education system, and this is potentially the most significant impediment to innovation in Thailand. Nevertheless, Thailand has obviously been effective in attracting students to STEM (science, technology, engineering and mathematics) courses.

3.2.2 Infrastructure

The components identified as key for infrastructure improvements were key initiatives during the COVID-19 pandemic (Smith and Perry, 2022: 507).

3.2.3 Business Sophistication

Business sophistication has the most complex set of components. Singapore appears to have been able to address all of the components. For most countries, however, the focus should be on the components of most relevance. For instance, Thailand may not require foreign direct investment (FDI) inflows but Thailand and Vietnam should concentrate on improving knowledge-intensive employment opportunities.

3.2.4 Knowledge and Technology Outputs

There are issues with abstracting services used to assess scientific and technical publications. It only includes articles included in the Clarivate Web of Science database (WIPO, 2022: 249). In addition, in most of the

countries, English is not the language of education. Researchers often have difficulty writing in English. Therefore they publish in journals in the national language, which is not indexed (see, for instance, Smith, 2019). Again, the government should select areas where it seeks to excel. For instance, the Philippines has developed a niche in ICT exports. Thailand and Vietnam are able to focus on other areas.

3.2.5 Creative Outputs

It is considered that there are also issues in measuring creative outputs. There is little action that countries can take concerning topic-level domains and country-code top-level domains, as many types are excluded (WIPO, 2022: 253). “GitHub commit pushes received refers to the number of batched changes received by publicly-available projects on GitHub within a specific economy” (p. 254) and replaces Wikipedia edits.

4. Discussion & Recommendations

The preliminary analysis above demonstrates that countries need to examine the data to ascertain where improvements need to be made to improve their innovation potential. They should focus not just on improving their GII ranking but on areas of improvement that are effective. There is no sense in trying to pursue all areas. Most, but not all, the ASEAN economies must focus on fundamental changes to their primary and secondary school systems. There must be a greater emphasis on creative thinking rather than rote learning. There is a similar role to be played within the university system.

Countries, as well as private industry, should promote and fund the study of STEM (science, technology, engineering and mathematics) courses. Women should be encouraged to undertake postgraduate studies and then be employed in industry and government. Universities must provide resources for their staff to become fluent in English language writing and to be able to publish in English. This comment is not meant to denigrate the use of the mother tongue but rather to give their research outputs a greater audience and, hence, a more significant impact. This also enhances their reputation through greater communication.

The GII, per se, is not an efficacious driver of innovation. It drives innovation if countries and industries drill down into the data. That is where the most benefit can be achieved. Adopting the European Innovation Scoreboard Approach to present the data should also be considered as a more relevant course. This would, hopefully, encourage countries to dig deeper into the data and explore its finer nuances rather than just trying to move up the GII rankings.

Acknowledgements

This research is supported by an Australian Government Research Training Program (RTP) Scholarship to the first author.

References

- Adams R and Wu M (2002) *PISA 2000 Technical Report*. Paris: OECD.
- Ambashi M (2020) ASEAN Development and Innovation Strategy in the Era of New Industrialisation. *ERIA Policy Brief* 2020(6).
- Cornell University, INSEAD and WIPO (2013) *The Global Innovation Index 2013: The Local Dynamics of Innovation*. Geneva, Ithaca, and Fontainebleau.: Cornell University, INSEAD and WIPO.
- Cornell University, INSEAD and WIPO (2014) *The Global Innovation Index 2014: The Human Factor in Innovation*. Fontainebleau, Ithaca, and Geneva: Cornell University, INSEAD and WIPO.
- Cornell University, INSEAD and WIPO (2015) *The Global Innovation Index 2015: Effective Innovation Policies for Development*. Ithaca, Fontainebleau, and Geneva: Cornell University, INSEAD and WIPO.
- Cornell University, INSEAD and WIPO (2016) *The Global Innovation Index 2016: Winning with Global Innovation*. Ithaca, Fontainebleau, and Geneva: Cornell University, INSEAD and WIPO.
- Cornell University, INSEAD and WIPO (2017) *The Global Innovation Index 2017: Innovation Feeding the World*. Ithaca, Fontainebleau, and Geneva: Cornell University, INSEAD and WIPO.
- Cornell University, INSEAD and WIPO (2018) *Global Innovation Index 2018: Energising the World with Innovation*. Ithaca, Fontainebleau, and Geneva: Cornell University, INSEAD and WIPO.
- Cornell University, INSEAD and WIPO (2019) *Global Innovation Index 2019: Creating Healthy Lives—The Future of Medical Innovation*. Ithaca, Fontainebleau, and Geneva: Cornell University, INSEAD and WIPO.
- Cornell University, INSEAD and WIPO (2020) *Global Innovation Index 2020: Who Will Finance Innovation?* Ithaca, Fontainebleau, and Geneva: Cornell University, INSEAD and WIPO.
- Dobrzanski P and Bobowski S (2020) The Efficiency of R&D Expenditures in ASEAN Countries. *Sustainability* 12(2686).

- Duarte MP and Carvalho FMPO (2020) Portugal in the Global Innovation Index: A panel data analysis. Research Paper: Gabinete de Estratégia e Estudos do Ministério da Economia.
- European Commission Directorate-General for Research and Innovation, Hollanders H, Es-Sadki N, et al. (2022) *European Innovation Scoreboard 2022*. Publications Office of the European Union.
- Franco C and de Oliveira RH (2017) Inputs and outputs of innovation: analysis of the BRICS Theme 6 – innovation technology and competitiveness. *RAI Revista de Administração e Inovação* 14: 79.
- GPS E (2019) *Thailand student performance (PISA, 2018)*. Available at: <https://gpseducation.oecd.org/CountryProfile?primaryCountry=THA&treshold=10&topic=PI>.
- Gu S (1999) Implications of National Innovation Systems for Developing Countries - Managing Change and Complexity in Economic Development. *UNU/INTECH Discussion Papers*.(9903).
- Guillén VIN and Deckert C (2021) Cultural influence on innovativeness - links between “The Culture Map” and the “Global Innovation Index”. *International Journal of Corporate Social Responsibility* 6(7): 1.
- INSEAD (2011) *The Global Innovation Index 2011: Accelerating Growth and Development*. Fontainebleau: INSEAD.
- OECD (2013) *Innovation in Southeast Asia*. Paris: OECD Publishing.
- OECD (2018) *PISA: Preparing our youth for an inclusive and sustainable world - the OECD PISA global competence framework*. Paris: OECD.
- Organisation for Economic Co-operation and Development (1997) *National Innovation Systems*. Paris: OECD.
- Oturakci M (2021) Comprehensive analysis of the global innovation index: statistical and strategic approach. *Technology Analysis & Strategic Management* online: pp 1-13.
- Pençe İ, Kalkan A and Çeşmeli MŞ (2019) Estimation of the Country Ranking Scores on the Global Innovation Index 2016 Using the Artificial Neural Network Method. *International Journal of Innovation and Technology Management* 16(4, 1940007).
- Reis DA, de Moura FR and de Aragão IMG (2018) The Linkage between Input and Output in the Global Innovation Index. In: Costa C, Au-Yong-Oliveira M and Amorim MPC (eds) *ECIE 2018 PDF - The Proceedings of the 13th European Conference on Innovation and Entrepreneurship 20-21 September 2018*. Portugal: Academic Conferences International Limited, pp.635.
- Şimşit ZT, Fırat SÜO, Es HA, et al. (2014) Analysis of The Global Innovation Index in the Context of Information and Communication Technologies and Clustering Countries Using Data Mining. In: *Yönetim Bilişim Sistemleri Kongresi'2014*, Bogaziçi University, pp.13. <https://www.researchgate.net/publication/308415750>.
- Smith RB (2019) Harmonisation of Laws in ASEAN: The Issue of English. In: *International Seminar on Politics, Administration and Development 2019 (INSPAD2019)*, Walailak University, THAILAND, pp.273-282. School of Government, Universiti Utara Malaysia.
- Smith RB and Perry M (2022) Legal Incentives and Constraints on Innovation: Keeping the Balance. In: *Proceedings of the 17th European Conference on Innovation and Entrepreneurship ECIE 2022* (eds Sklias P and Apostolopoulos N), Neapolis University Paphos, Cyprus, pp.504-511. Academic Conferences International Limited.
- Sohn SY, Kim DH and Jeon SY (2016) Re-evaluation of global innovation index based on a structural equation model. *Technology Analysis & Strategic Management* 28(4): 492.
- Stavbunik Y and Pelucha M (2019) The Innovation System of Kazakhstan in the Context of the Global Innovation Index. *The Innovation Journal: The Public Sector Innovation Journal* 24(1, article 2): 1.
- UNCTAD (2022) *UN list of least developed countries*. Available at: <https://unctad.org/topic/least-developed-countries/list>.
- WIPO (2021) *Global Innovation Index 2021: Innovation Investments Resilient Despite COVID-19 Pandemic*. Geneva: World Intellectual Property Organization.
- WIPO (2022) *Global Innovation Index 2022: What is the future of innovation-driven growth?* Geneva: World Intellectual Property Organization.
- WIPO and INSEAD (2012) *The Global Innovation Index 2012: Stronger Innovation Linkages for Global Growth*. Fontainebleau and Geneva: WIPO and INSEAD.
- World Bank (2022) *Country Classifications by Income: FY 2021-2022*. Available at: <https://datatopics.worldbank.org/world-development-indicators/the-world-by-income-and-region.html>.

University Extension Programs to Promote the Traditional Knowledge of Marginalised Rural Communities in the ASEAN Region

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Abstract: Many indigenous and marginalised communities, particularly those in tropical regions, traditionally use herbs and medicinal plants to treat various illnesses and disorders. This “traditional knowledge” requires protection. Unfortunately, the World Intellectual Property Organization members have been unable to agree on a definition. However, member states have acted in concert with other members or independently. Initially, the paper analyses the legal instruments utilised by each of the ten countries of ASEAN to protect and promote traditional knowledge. For instance, in 1999, Thailand legislated its Protection and Promotion of Traditional Thai Medicinal Intelligence Act and Plant Varieties Protection Act. The World Health Organization recognises the role of herbal medicines. Universities can play a pivotal role in working with the local communities for the common good and including the community in the rewards from any commercial production. Roles for universities require personnel with the ability to work with local communities and gain their confidence and trust. This knowledge obtained from the community will be held in high regard. Nevertheless, its pharmacology and efficacy must be tested. Universities can also play a role in every step of product development. Finally, examples of successful roles provided by universities and other research institutions are presented. Such projects require a comprehensive team of specialists with a variety of skills, such as scientists, agriculturalists, pharmacists, medical practitioners, intellectual property lawyers, and business development and marketing specialists. Finally, any research and development activities must acknowledge traditional knowledge holders.

Key Words: Traditional knowledge, innovation, university outreach, marginalised communities, ASEAN.

1. Introduction

Many indigenous and marginalised communities, particularly those in tropical regions, traditionally use herbs and medicinal plants to treat various illnesses and disorders (World Intellectual Property Organization (WIPO, 2015). “Many modern drugs and vaccines are based on natural resources and associated traditional knowledge” (p 1). The World Intellectual Property Organization (WIPO) agrees that this “traditional knowledge” requires protection. Unfortunately, as the WIPO members have been unable to agree on a treaty for decades, the General Assembly of WIPO at its July 2022 meeting resolved that a draft international instrument be drafted, and talks be concluded not later than 2024 (Heilprin, 2022). In this vacuum, some member states have acted in concert with other members or independently, as is the case with the ten members states of ASEAN, namely, Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand and Vietnam.

The World Health Organization South-East Asian Region has investigated the feasibility study into integrating traditional and complementary medicine (T&CM) into the pharmacovigilance systems in Bangladesh, Bhutan, India, Indonesia, the Maldives, Nepal, Sri Lanka and Thailand (Suwankesawong, 2019). It found that it is “feasible for T&CM to be integrated with, or separated from, the existing national pharmacovigilance system depending on the context of each country. . . .To enhance the system functions, it should operate alongside an effective national drug regulatory system so that the signal could be aligned with proper regulatory measures” (Suwankesawong, 2019, p 16). The study also found that the significant challenges in accomplishing the safety surveillance of T&CM products in the Region is the limited resources and “also the lack of knowledge and expertise regarding the analysis of the association between products and adverse drug reactions (ADRs). Insufficient information and difficulties in accessing reliable information support are other critical challenges” (Suwankesawong, 2019, p 15).

Protection and promotion of traditional knowledge are key activities that can assist marginalised communities to improve their living standards and become more sustainability. In addition, this knowledge can benefit the wider population with efficacious Traditional and Complementary Medicines (TCMs). The paper provides a definition of traditional knowledge and its role in agriculture. It then follows with a call to action where is outlines a role for universities in assisting local communities in the protection and promotion of their traditional

knowledge which will involve both innovation and entrepreneurship. The article focuses on Southeast Asia but is relevant to communities worldwide.

2. Literature review

2.1 Definition

For this article, we are considering traditional knowledge in the strict sense and only as it applies to agriculture:

“Traditional knowledge refers to the knowledge, innovations and practices of indigenous and local communities around the world. Developed from experience gained over the centuries and adapted to the local culture and environment, traditional knowledge is transmitted orally from generation to generation. It tends to be collectively owned and takes the form of . . . agricultural practices, including the development of plant species and animal breeds. Traditional knowledge is mainly of a practical nature, particularly in such fields as agriculture, fisheries, health, horticulture, and forestry.” (Secretariat of the Convention on Biological Diversity, n.d.).

An argument could be made for adopting the Thai phrase “local wisdom”, which is probably self-explanatory without the need for an explanation of nearly 100 words. Charoenyomphrai et al (2006) used the term “knowledge and local wisdom” in their study of the “customary use of biological resources by highland communities in Northern Thailand” (p 5).

2.2 Protection of traditional knowledge in the ASEAN region

In 2000 ASEAN issued the ASEAN Declaration on Cultural Heritage, which declared that “ASEAN Member Countries shall ensure that traditional communities have access, protection and rights of ownership to their own heritage (*ASEAN Declaration on Cultural Heritage*, art 9). ASEAN Members must “cooperate for the enactment of international laws on intellectual property to recognise indigenous populations and traditional groups as the legitimate owners of their own cultural heritage” (art 9). Also,

“Every person has the right to enjoy the benefits of modern scientific and economic progress and their applications. However, certain advances, notably in the biomedical and life sciences as well as in information technology, may potentially have adverse consequences on the cultural heritage of ASEAN. Therefore, ASEAN Member Countries shall strengthen regional cooperation to ensure that commercial utilisation does not impinge upon the integrity, dignity and rights of particular ASEAN societies” (*ASEAN Declaration on Cultural Heritage*, art 11).

In 2014 ASEAN issued its *Guidelines on Claims and Claims Substantiation for Traditional Medicines (TM)* (ASEAN Traditional Medicines and Health Supplements Scientific Committee Meeting, 2014). The guidelines took into consideration similar guidelines prepared by the WHO, EU, USA, Canada and Australia and the regulatory situation and stakeholders’ interests in the ASEAN region” (ASEAN, 2014, s 1). “The TM claims refer to any message that states, suggests, or implies that a TM ingredient/product has a positive contribution and benefit to human health. A balanced approach between consumer protection and encouraging science and innovation is important in implementing the harmonised ASEAN Guidelines on Claims and Claims Substantiation for Traditional Medicines.” (s 1). It covers three types of claims: traditional health use claims, traditional treatment claims, and scientifically established treatment claims (ASEAN, 2014, s 4.1). Evidence required to support different types of claims is shown in Table 1.

Amongst the significant initiatives of ASEAN are two compendiums of ASEAN herbal and medicinal plants. The first volume was published in 2010 (Ali et al, 2010), with Volume II published in 2017 (Sukmajaya et al, 2017). The plants are reported succinctly by country. Each entry includes a photograph, scientific name, vernacular names, brief plant description, propagation method, geographical distribution/ecology, chemical constituents, reports on medical usage (i.e. uses supported by experimental/clinical data; uses in traditional medicine), contraindications, and bibliography. A series of studies have been undertaken on plant variety protection (PVP) systems in Southeast Asia (Janke et al, 2020; Kanniah & Antons, 2012).

Table 1: Degree of evidence required to support different Traditional Medicine Claims

Type of Tradition Medicine Claim	Level of Evidence	Evidence to Substantiate Claim
Traditional Health Use	Evidence from documented traditional use and knowledge	Evidence of documented traditional use or history of use that may be found in the following: • Classical TM Texts • Pharmacopoeias and Monographs • Reference Textbooks/Journals
Traditional Treatment	Evidence from documented traditional use and knowledge	Evidence of documented history of traditional treatment that may be found in the following: • Classical TM Texts • Pharmacopoeias and Monographs • Reference Textbooks/Journals
Scientifically Established Treatment	Scientific data and traditional medicine principles	Compulsory evidence: Substantiation of TM claims based on scientific data as required by the regulatory authority to be conducted on finished products or ingredient(s). Justification must be provided to the regulatory authority if evidence provided is based on the ingredients. At least one piece of additional evidence: Evidence of documented history of traditional treatment that may be found in the following: • Classical TM Texts • Pharmacopoeias and Monographs • Reference Textbooks/Journals

Source: ASEAN (2014) Table 2.

A legal analysis by Rohaini (2015) of the legal situation in Indonesia concluded that adequate protection is not provided by reliance on intellectual property laws alone. Therefore a sui generis law is required, but this “may impede the equity-oriented goals of some traditional knowledge communities” but “is needed to protect intangible property right that will prohibit anyone other than the rights holders from making any utilisation of this intergenerational knowledge without consent” (Rohaini, 2015, p 718). For instance, Thailand enacted the *Protection and Promotion of Traditional Thai Medicinal Intelligence Act* in 1999, and Myanmar enacted the *Myanmar Traditional Medicine Council Law* in 2019.

Thailand provides the most comprehensive rights for domestic users of the ASEAN Member States under the *Plant Varieties Protection Act*. In particular, it allows for the registration of a plant variety that only grows in a particular locality and has not been registered as a new plant variety (s 42). It can be registered by a community that can share in the profits so generated (s 49). In addition, the Act established a Plant Varieties Protection Fund to provide funds to assist and subsidise activities related to plant varieties conservation, research and development (s 54).

2.3 Traditional Knowledge in Agriculture

A glimpse of the diversity of studies in the field of traditional knowledge can be obtained from the edited book by Wijesuriya and Court (2020). Water management is critical to sustainability in agriculture. Two chapters show how traditional knowledge continues to have an active role in managing water resources:

- *Implementation of Tri Hita Karana philosophy for the sustainability of the subak irrigation system in Bali, Indonesia*; and
- *Khmer water management in Cambodia: traditional practices and religious associations*.

Whilst another chapter presents the case for harnessing traditional knowledge to build resilience to flooding, whilst the fourth paper seeks to learn from historical water management systems to ensure resilience and sustainable agricultural development into the future:

- *Traditional Knowledge Systems for reducing disaster risk and building resilience in India*; and
- *Harnessing traditional knowledge at Ayutthaya, Thailand: resilience and sustainable development*.

In **Malaysia**, a case study provided an example where the indigenous classification of trees by the Iban and Dusun tribes, based on their traditional knowledge, that a tree classified as a single under the Linnean system was, in fact, two species (Teow et al, 2022). The classifications of the trees by the indigenous peoples was confirmed by subsequent DNA testing. In the Linnean system, the tree was classified as *Artocarpus odoratissimus*. The Iban of Malaysian Borneo called the two varieties *Iban Lumok* and *Pingan*, whilst the Dusun people of Sabah called them *Timadang* and *Tonggom-Onggom*, respectively. “[T]his case example highlights the significance of indigenous knowledge developed through generations of societies on the land, and the failure to appreciate and engage with indigenous knowledge may result in the loss of opportunities to achieve better biodiversity conservation outcomes” (Teow et al, 2022, p 2).

A case study from **Indonesia** shows the importance of listening and investigating before criticising long-held myths and legends. In Indonesia, rice is the dominant staple food and “the dominant traditional ecological knowledge (TEK) on food in Indonesia is rice” (Sumarwati, 2022). However, the TEK of the Tawangmangu District of Central Java is about non-rice food security.

“This is based on the two folktales allowing farmers to plant vegetables and pulses instead of rice, disregarding climatic and geographical conditions. Tawangmangu District is, located on the Mount Lawu slopes and is a cold area with high rainfall, unsuitable for planting rice. Therefore, the folktales described several taboo statements, especially prohibiting planting rice. Breaking this rule will expose the residents to a deadly disease outbreak” (Sumarwati, 2022).

Sumarwati (2022) identified community sustainability practices and strategies, including crop selection for non-rice food, the use of irrigation of terraced agricultural land, intercropping of vegetables, water resources management, and harvest management (sorting crop commodities, cleaning, classifying, and storage). The community also protects the forest areas of Mount Lawu slopes “as their source of life by prohibiting logging and reforestation”.

Whilst minority communities in **Vietnam's** North Mountainous Region (NMR) have developed climate-resilient agroecological farming practices, wider adoption has been limited (Son et al, 2021). It was argued that for Indigenous Knowledge to be more valuable, there must be “a change in awareness and attitudes of policymakers, community development advocates, government authorities, university educators, and local communities” (Son et al, 2021, p 519). This lack of awareness occurred despite national legislation promoting linkages between the various stakeholders, as there was a lack of an enabling environment.

In **Malaysia**, the Indigenous Peoples Assistance Facility (IPAF) provided funding to improve the livelihoods of the Jukan people of the Malaysian forests, who are “looking after the forests and only using what they need to live” (IPAF, n.d.). Unfortunately, their traditional livelihoods are at risk. The project focussed on strengthening “their social enterprise, improving access to fair markets, strengthening cultural values, and enriching the diversity of their agriculture” (IPAF, n. d.).

3. Methodology

This research is based on the documentary research concept as it describes Traditional Knowledge and provides examples from Southeast Asia. Much of the traditional knowledge remains unrecorded, especially in the area of Traditional and Complementary Medicines. The authors consider that there is a potential role for universities in the protection and promotion of this knowledge and provide examples of several successful projects. Finally it provides an analysis of the legal remedies available to protect traditional knowledge and the products that may be derived from the exploitation of this knowledge.

4. Discussion

4.1 Potential Extension Roles for Universities

Universities are by far the best placed to undertake outreach in the Agricultural sector of marginalised rural communities as they can provide an integrated “one-stop-shop” for the required services (Smith and Perry, 2023). A comprehensive team to support the protection and commercialisation of traditional knowledge in the agriculture sector might include: agronomists, biologists, botanists, business development specialists, chemists, climate resilience specialists, dieticians, epidemiologists, ethicists, food technologists, foresters, intellectual property lawyers, marketing development specialist, pharmacists, process engineers, soil scientists, traditional medicine researchers and water engineers. Some marginalised communities may also require guidance and skills

development in areas such as financial management; language skills; the care, cultivation and breeding of crops and animals (i.e. farm husbandry). Most importantly, the community is the owner of the knowledge, and the role of the university or the research institute must be that of a trusted advisor.

Not only is community outreach encouraged in some Southeast Asia countries it is mandated as a social contract between the university and the community. For instance, in Thailand the *Higher Education Act B.E. 2562 (2019)* requires that higher education institutions provide academic services that are beneficial to the development of communities, society and the country. Students and academics must participate in “the development of communities, rural societies and socially disadvantaged groups in order to create responsibility towards the community and society” (s 12 translated).

4.2 Extension Programs in Action

Researchers from the University of Northern Philippines investigated the indigenous knowledge of medicinal plants used by traditional healers in the **Province of Ilocos Sur in the Philippines** (Molina et al, 2015). They found that the traditional healers “possess rich ethnic pharmacological knowledge”. They found that the local healers lacked awareness of appropriate hygiene, lacked certification for their medicines and “did not work in cooperation with therapeutical professionals in the preparation of their medicine”. The study concluded that there were high-value medicinal plant species for potential economic development. They recommended that traditional healers be provided with training in primary health care delivery and that the medicinal plants be harvested sustainably, especially as many of the plant species were reported to be rare.

A study in Prey Lang province of **Cambodia** sought to generate a plant list to create a database to support community-based biodiversity monitoring (Turreira Garcia et al, 2017). The study was undertaken on a participatory basis, with local people gaining ownership of the outcome. The study design ensured that the results would be provided to the communities as an ethnobotanical book. Unsurprisingly, “this motivated study participants to extensively collect useful plants and explain their uses in detail” (p 86). The plant collectors hoped the “book might motivate younger generations to take interest in the subject, and subsequently pass on their knowledge to future generations” (p 86). The study's authors pointed out that additional plants may have been used in the past or elsewhere in the province. Nevertheless, it was considered an indicator of the biocultural diversity of the province. They also considered that the ecosystem should be conserved to ensure the sustainability of the local communities.

As synthetic dyes are being utilised in preference to plant dyes, traditional knowledge of plants used for dying is disappearing. To counter this trend, Ling and nine colleagues from universities and research institutes from China, Israel, Myanmar, Thailand, and the USA researched the traditional knowledge of textile dying plants in the Chin ethnic group in **Western Myanmar** (Ling et al, 2022). They interviewed 2070 informants from 14 Chin communities who “used a total of 32 plant species for textile dyeing from 29 genera in 24 families” (p 1). They considered that “understanding traditional textile dyeing and colour extraction from local plants is crucial to the Chin people because their cultural identity is expressed through traditional clothing” (p 12). Among their recommendations was conducting a further study to improve the dye extraction method and its stability. The study should include an evaluation of the pigments' phytochemical properties, bioactivity, and safety. They also recommended pilot plant development to “produce the pigments on a larger scale to sustainably supply users nationally and internationally” (p 12).

A study from **Malaysia** found that the home gardens of Kampung Masjid Ijok were “important reservoirs for medicinal plant species and traditional knowledge” (Ramli et al, 2021). They considered that home gardens are “one of the important places to study ethnopharmacology” as the knowledge is practised and preserved among family members. The study identified more than sixty plants that could be investigated for possible selection as medicinal plants for cultivation in home gardens. The medicinal plants in the home gardens are primarily used to treat the most common ailments in rural areas, namely gastrointestinal and respiratory disorders. Details reported were species name, family name, local names, habit, part of plant utilised in the preparation of traditional medicine, frequencies of occurrence in home gardens, ailment for which product is utilised, and method of preparation and then its administration to the patient.

The Agro-Biodiversity Initiative (TABI) in the uplands of **Laos PDR** was an initiative of the National Agriculture and Forestry Research Institute of the Ministry of Agriculture and Forestry and the Swiss Agency for Development and Cooperation (Rodericks, 2020). TABI was established to leverage agro-biodiversity, which was “the legacy of the upland farmers' agricultural knowledge and practices passed down over generations” (Rodericks, 2020, p vi). The design of TABI sought to mobilise the ownership, commitment and participation of

diverse stakeholders, including organisations, individuals, proponents of other development projects, and government departments. Participation was planned to be across sectors and at different levels within the organisations and grew into a 10-year commitment.

“The intent of the initiative was to leverage the country’s rich biodiversity to help realise development goals in the near term without jeopardising future capacity to do so. The initiative sought to conserve, enhance, manage, and sustainably utilise the biological diversity found in upland farming landscapes in order to improve the livelihoods of farming families in the region” (Rodericks, 2020, p vi).

The successful outcome of the initiative and the challenges it faced are described in the book authored by Rodericks (2020).

Duakaju and Imang (2021) undertook a qualitative study in Kalimantan, **Indonesia**, to study the traditional agriculture of different ethnic and sub-ethnic groups. They found that swidden (“slash and burn”) agricultural practices were widely practised by several ethnic groups utilising inland land and forest areas sufficiently large for farming.

“The results showed that the farming system was still widely practised in the tropics by several ethnic groups who generally live in inland areas and utilise land and forests that are large enough for farming. In this cultivation system, various local wisdoms and knowledge are identified in practising swidden agriculture, starting from the stages of looking for land, determining soil fertility, cutting, burning, controlling pests, harvesting and storing rice, especially rice for preparation of seeds for planting in the following year” (Duakaju and Imang, 2021, p 25).

They found that integrating various local knowledge and wisdom practised by various ethnic groups at each activity stage “can increase the production and productivity of upland rice and as a form of sustainable and environmentally friendly agriculture”.

4.3 Protection of Traditional Knowledge

Once the traditional knowledge has been identified, several ways could be explored to provide protection. It may be by way of a patent, trademark or geographical indication. Regardless of the method chosen, ethically, the ownership must remain with the community.

A patent may be used to protect devices, substances, methods or processes (IP Australia, 2023d). To be granted a patent, it must pass the following tests: it must be new, useful, and inventive in that it is different from what already exists and must be suitable subject matter. Patents are not granted for “human beings or the biological process for their generation, artistic creations, mathematical models, or mathematical models, plans, schemes or other purely mental processes” (IP Australia, 2023d). In the case of traditional knowledge, the most likely way a patent could be granted would be for a “novel” product manufactured from medicinal plants, herbs and the like but not for the plant themselves.

If, however, a plant (or its components or materials) has been developed “through a technical intervention such as breeding, mutation or genetic engineering”, it may be patentable (IP Australia, 2023a). Examples of patentable plant materials are:

- a. “Genes or chromosomes that [the claimant] has developed through mutagenesis or genetic engineering;
- b. Reproductive material such as seeds, whole plants, cuttings, cells or protoplasts;
- c. Products from plants, including fruit, flowers, oils, starches, chemicals or pharmaceuticals;
- d. Plant material such as cell lines that are used in industrial processes; and
- e. Methods or processes for using, testing or producing plants or plant products, including:
 - i. Genetic engineering techniques;
 - ii. Plant tissue culture;
 - iii. Cell and protoplast culture; and
 - iv. Mutagenesis” (IP Australia, 2023a).

Alternatively, it may be protected by registration under national legislation on plant breeders’ rights. Countries that accede to the *International Convention for the Protection of New Varieties of Plants (amended as of 19 March 1991)* must enact such legislation (*UPOV Convention*, Ch II). Examples could be rice varieties developed to thrive under challenging conditions.

If it is a product, it could be protected by a trademark. Depending on the jurisdiction, the trade mark can be a word or phrase, a fancy font, characters in Roman or non-Roman script, a logo or figurative trade mark, a colour trade mark, a shape trademark, a sound trademark, a scent trade mark, or a movement trademark (IP Australia, 2023c). Possibly the best protection and commercially valuable trademark is a geographical indication (GI). The method of registering a geographical indication could vary by jurisdiction and has several features. Most importantly, it indicates to consumers that the product comes from a specific geographical region and has “a distinctive set of qualities or reputation attributable to that region” (IP Australia, 2023b).

The GI rules may include: “how a product is made, what ingredients are used, the environmental or agricultural features of the region which give the product distinctive qualities”, and most importantly, “a strong reputation in the region for producing a particular product of a certain quality” (IP Australia, 2023b). Probably one of the best-known examples of a Geographical Indication is that of *Parmigiano Reggiano*, a hard cheese originating from certain specified provinces in Italy, which is produced in a particular manner. In a recent case in Singapore, the General Division of the Singapore High Court ruled that under the *Geographical Indications Act 2014* of Singapore not only is the name *Parmigiano Reggiano* protected but also is the term *Parmesan* (Allen and Gledhill, 2023). The court ruled that the term *Parmesan* is a translation of the geographical indication *Parmigiano Reggiano*. Therefore the generic term “Parmesan cheese” cannot be used to describe a cheese other than registered by the Consorzio del Formaggio Parmigiano Reggiano which is responsible for certifying that the cheese meets the requirements to be called *Parmigiano Reggiano*. It might be noted in passing that the Consorzio is very active in protecting its cheese under Geographical Indications legislation in key markets around the world.

5. Conclusion

There is a considerable role that Universities can play in protecting and promoting the traditional knowledge of marginalised rural communities and so improve their living standards and sustainability. This article has provided examples from the ASEAN region, but the need is worldwide. Tradition knowledge in the agricultural sector is not restricted to indigenous people but can be found amongst can probably found among primary producers everywhere.

Finally, any research and development activities must acknowledge traditional knowledge holders.

Acknowledgments

This research is supported by an Australian Government Research Training Program (RTP) Scholarship to the second author.

References

- Ali, R.M., Samah, Z.A.S., Mustapha, N. M. and Hussein, N. (2010) *ASEAN Herbal and Medicinal Plants*, ASEAN Secretariat, Jakarta.
- Allen and Gledhill (2023) “Singapore High Court rules that *Parmesan* is a translation of geographical indication *Parmigiano Reggiano*”, <https://www.allenandgledhill.com/sg/publication/articles/23553/high-court-rules-that-parmesan-is-a-translation-of-geographical-indication-parmigiano-reggiano>.
- ARISE+ (2019) *Geographical Indications in the ASEAN Region*. ASEAN Intellectual Property Rights, Bangkok, https://euipoef.eu/sites/default/files/arise-docs/2019/ASEAN_GI-Booklet.pdf.
- ASEAN Declaration on Cultural Heritage, 25 July 2000, <https://asean.org/wp-content/uploads/2021/01/ASEAN-Declaration-on-Cultural-Heritage.pdf>.
- ASEAN Traditional Medicines and Health Supplements Scientific Committee Meeting (2014). “Annex VII - ASEAN Guidelines on Claims and Claims Substantiation for Traditional Medicines”, ASEAN, Jakarta, <http://asean.org/wp-content/uploads/2017/09/ASEAN-Guidelines-on-Claims-Claims-Substantiation-TM-V2.0-with-discla....pdf>.
- Charoenniyomphrai, U., Pichetkulsamphan, C. and Tharawodome, W. (Eds.) (2006) *Indigenous Knowledge, Customary Use of Natural Resources and Sustainable Biodiversity Management: Case Study of Hmong and Karen Communities in Thailand*. Inter Mountain Peoples Education Education and Cultures in Thailand Association (IMPECT), Chiang Mai, <http://www.forestpeoples.org/sites/fpp/files/publication/2010/08/10cthailandimpectjun06eng.pdf>.
- Duakaju, N. N. and Imang, N. (2021) “The practices of traditional knowledge and wisdom by multi-ethnics on swidden agriculture of Kalimantan, Indonesia”, *The International Journal of Humanities & Social Studies*, Vol. 9, No. 3, pp 25-30.
- Fonterra Brands (Singapore) Pte Ltd v Consorzio del Formaggio Parmigiano Reggiano [2023] SGHC 77, https://www.elitigation.sg/gd/s/2023_SGHC_77.

- Geographical Indications Act 2014 (Singapore, 2014 rev ed, as amended by the Intellectual Property (Dispute Resolution) Act 2019)*, <https://wipo.int/en/text/550139>.
- Heilprin, J. (2022) "Breakthrough on genetic resources treaty", *Health Policy Watch*, <https://healthpolicy-watch.news/breakthrough-on-genetic-resources-treaty/>.
- Higher Education Act B.E. 2562 (2019) (Thailand)*, <https://www.mhesi.go.th/images/2563/pusit/legal-all/1p2562.pdf>.
- International Convention for the Protection of New Varieties of Plants (amended as at 19 March 1991)*, https://www.upov.int/edocs/pubdocs/en/upov_pub_221.pdf.
- IP Australia (2023a) *Can I patent my new plant?* Australian Government, <https://www.ipaustralia.gov.au/patents/what-are-patents/can-i-patent-my-new-plant>.
- IP Australia (2023b) *Geographical indications and trade marks*, Australian Government, <https://www.ipaustralia.gov.au/trade-marks/what-are-trade-marks/types-of-trade-marks/geographical-indications>.
- IP Australia (2023c) *Types of trade marks*, Australian Government, <https://www.ipaustralia.gov.au/trade-marks/what-are-trade-marks/types-of-trade-marks>.
- IP Australia (2023d) *What are patents?* Australian Government, <https://www.ipaustralia.gov.au/patents/what-are-patents>.
- IPAF (n.d.) *Indigenous communities in Malaysia building capacity for resilience through IPAF*. Indigenous Peoples Assistance Facility (IPAF), Rome, <https://www.ifad.org/nl/web/latest/-/photo/indigenous-communities-in-malaysia-building-capacity-for-resilience-through-ipaf>.
- Janke, T., Curtis, L., Goulding, P., McNeill, S., Mundine, J., and Auld, R. (2020) *Comparative Study on Genetic Resources, Traditional Knowledge and Traditional Cultural Expressions (GRTKTCE)*. Terri Janke and Company Pty Ltd, Roseberry, https://aanztfa.asean.org/uploads/2021/10/Comparative-Study-GRTKTCE_Final-For-Public.pdf
- Kanniah, R. and Antons, C. (2012) "Plant Variety Protection and Traditional Agricultural Knowledge in Southeast Asia", *Australian Journal of Asian Law*, Vol. 13, No. 1, pp 1-23.
- Molina, G. G. V., Eder, M. N. R., and Gascon, V. (2015) "Indigenous knowledge of medicinal plants used by traditional healers in Ilocos Sur", *International Journal of Scientific & Engineering Research*, Vol. 6, No. 12, pp 159-170.
- Myanmar Traditional Medicine Council Law (Law No. 1/2019 of January 25, 2019)*, <https://wipo.int/en/legislation/details/20426>.
- Plant Varieties Protection Act BE 2542 (1999) (Thailand)*, <https://wipo.int/en/text/129781>.
- Protection and Promotion of Traditional Thai Medicinal Intelligence Act, BE 2542 (1999) (Thailand)*, <https://wipo.int/en/text/179713>.
- Ramli, M. R., Milow, P. and Malek, S. (2021) "Diversity and traditional knowledge of medicinal plants in home gardens of Kampung Masjid Ijok, Perak, Malaysia", *Biodiversitas*, Vol. 22, No. 5, pp 2458-2465.
- Rodericks, A. (2020) *Living landscapes: Embracing agro-biodiversity in Northern Laos*. National Agriculture and Forestry Research Institute (NAFRI), Ministry of Agriculture and Forestry, Vientiane.
- Rohaini (2015) "Establishing the sui generis laws for protecting traditional knowledge in Indonesia", *US-China Law Review*, Vol. 12, pp 708-718.
- Secretariat of the Convention on Biological Diversity. (n.d.). *Traditional Knowledge and the Convention on Biological Diversity*, <https://www.cbd.int/doc/publications/8j-brochure-en.pdf>.
- Smith, R. B. and Perry, M. (2023). University Extension Programs to Develop Intellectual Property in the Agriculture Sector of Marginalized Rural Communities in the ASEAN Region. In T. Walker, K. Tarabieh, S. Goubiran, and G. Machnik-Kekesi (Eds.), *Sustainable Practices in Higher Education: Finance, Strategy, and Engagement*, Palgrave-Macmillan, London (in press).
- Son, H. N., Kingsbury, A. and Hoa, H. T. (2021) "Indigenous knowledge and the enhancement of community resilience to climate change in the Northern Mountainous Region of Vietnam", *Agroecology and Sustainable Food Systems*, Vol. 45, No. 4, pp 499-522.
- Sukmajaya, D., Permatasari, A., Mohtar, M., Kiong, L. S., Badron, U. H. and Ali, R. M. (2017) *ASEAN Herbal and Medicinal Plants, Volume II*, ASEAN Secretariat, Jakarta.
- Sumarwati, S. (2022) "Traditional ecological knowledge on the slope of Mount Lawu, Indonesia: all about non-rice food security", *Journal of Ethnic Foods*, Vol. 9, No. 9, pp 1-13, <https://doi.org/10.1186/s42779-022-00120-z>.
- Suwankesawong, W. (2019) *Pharmacovigilance and Traditional and Complementary Medicine in South-East Asia: A Situation Review*. World Health Organization, Regional Office for South-East Asia.
- Teow, H. H., Tang, S., Ahmed, P. K., Nair, M., & Vaithilingam, S. (2022) "Roles of Malaysian indigenous communities in biodiversity conservation: A case study approach", *International Conference on Sustainable Development ISD 2022*, https://ic-sd.org/wp-content/uploads/2022/11/submission_262.pdf
- Turreira Garcia, N., Argyriou, D., Chhang, P., Srisanga, P. and Theilade, I. (2017) "Ethnobotanical knowledge of the Kuy and Khmer people in Prey Lang, Cambodia", *Cambodian Journal of Natural History*, Vol 2017, No. 1, pp 76-101.
- Wijesuriya, G., & Court, S. (Eds.) (2020) *Traditional Knowledge Systems and the conservation and management of Asia's heritage*, International Centre for the Study of the Preservation and Restoration of Cultural Property, Rome. <https://www.iccrom.org/news/traditional-knowledge-systems-conservation-and-management-asia%E2%80%99s-heritage>.
- World Intellectual Property Organization (2015) "Intellectual Property and Traditional Medical Knowledge", *Background Brief*, No. 1, https://www.wipo.int/edocs/pubdocs/en/wipo_pub_tk_6.pdf.

Diversification Strategies and the Emergence of a new Industrial Value-chain: Challenges and Opportunities for Companies

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Abstract: Marine renewable energy technologies (MRET) can contribute to the decarbonization of energy, as well as to the revitalisation of other sectors, but are still an emerging and uncertain area. The development of these technologies entails the construction of a new industrial value chain, requiring the involvement of established firms from a variety of industries. Thus, it is important to understand how established firms can be mobilised to support MRET development, by pursuing diversification strategies. This paper addresses this question by looking at the case of Portuguese firms that expressed willingness to engage with MRET and investigating how they perceive the opportunities for diversification into the new business area, the changes they may need to introduce in their resources and capabilities to exploit those opportunities, and the obstacles they expect to face.

Keywords: New Industrial Value Chain; Diversification Strategies; Marine Renewable Energy Technologies; Firms' Perceptions

1. Introduction

Marine renewable energy technologies (MRET) have the potential to become an important source of clean energy and, simultaneously, contribute to the revitalisation of other sectors (Fontes et al., 2021). Realizing such potential requires the development of a new industrial value chain that combines competencies associated with new technologies with a variety of complementary resources and competencies already existent in established industries (Makitie et al., 2018). However, mobilizing established firms to acting as suppliers or co-developers to a technology that has not yet reached the commercial stage can be problematic.

This paper addresses this problem by investigating how firms from existing sectors perceive the requirements of an early involvement with emerging technologies. For this, it looks at the case of firms that expressed willingness to engaging with MRET and investigates how these firms view: i) the opportunities for diversifying into the new business area; ii) the requirements such move may raise in terms of competences and resources; and iii) the problems to be expected. The research draws on data from a questionnaire survey of firms from sectors that are potential contributors to the development, production, installation, and operation of MRET. It analyses the information obtained from 138 firms that are not yet involved in MRET but declared the intention of entering this area in the future.

The results provide important insights into how to motivate and support established firms – in particular firms that are not the typical “prime mover” – to become involved with emerging technologies, profiting from the opportunities thus created to achieve diversification and innovation. These insights are relevant to assist the formulation of policies targeting firms whose contribution can be critical to the development of sustainable technologies.

2. Literature review

The sustainability transitions literature has shown that the development of a new technology requires the construction of a new system (Bergek et al., 2008). In the early phases, this system is still being formed, and thus highly dependent on the interactions with the context from which it emerges, namely the industrial context that can provide actors and resources (Bergek et al., 2015; Markard, 2020). At this stage, actors are mainly engaged in R&D and experimentation with technologies and their possible applications (Markard, 2020). However, in the case of complex technologies that entail large scale experimentation, such as MRET, production and business capabilities are critical (Bjørghum & Netland, 2017; Makitie, et al, 2018), requiring the early involvement of established firms, acting as suppliers or co-developers (Fontes et al., 2021).

From the standpoint of these firms, involvement in the new technology can effectively correspond to an early process of diversification into a new business area. Firms engage in corporate diversification to pursue growth opportunities in other markets (Wiersema & Beck, 2017). This can be done by introducing their current products in the new market, or by following an innovation strategy, whereby they develop new products for that market. According to the resource-based view, firms diversify strategically to exploit underutilized resources with value-

creating potential in other businesses, profiting from economies of scope (Penrose, 1995). Diversification may entail an expansion of the number/range of businesses in which the firm operates, implying the sharing of resources contemporaneously between existing and new businesses (intra-temporal economies of scope); or entering into new product-markets while partially or completely exiting from old ones, shifting resources from the old to the new business (inter-temporal economies of scope) (Helfat & Eisenhardt, 2004). The latter strategy can be particularly significant for firms whose markets are experiencing slow growth, namely those in mature or declining industries, since redundant competencies and resources can be re-used and upgraded (Helfat & Eisenhardt, 2004; Karim & Capron, 2016).

It has been shown that firms benefit from diversifying into businesses that are related to the ones in which they already operate - relatedness being understood as having “a common skill, resource, market, or purpose” (Rumelt, 1974:29) - since this enables existing resources or competences to be at least partly redeployed (Adner & Zemsky 2016). Since there are several dimensions along which businesses can be related, the type and combinations of resources that can be redeployed vary, including human capital, equipment, management capabilities, knowledge, among others (Lüthge, 2020).

But firms may nevertheless be required to develop or gain access to new resources and combine them with the existing ones (Nerkar, 2003). The reconfiguration of firms’ resource portfolio is described as central for firms’ adjustment to a changing environment (Barney, 1991; Penrose, 1959), and can be done by adding resources, creating resources within the firm, or substituting old resources with new ones. Thus, resource reconfiguration may take place internally or externally through networks and alliances, the latter being particularly relevant for smaller firms (Thomas & Douglas, 2022; Lu & Yang, 2019).

These processes may be more complex when they entail engaging with an emerging technology, not only because of its potential novelty, but also due to the high technological and market uncertainty that is associated with the pre-commercial stages of development (Anderson & Tushman, 1990).

However, the literature has pointed out some conditions under which involvement of established firms in the early stages of technology development may occur (Turnheim & Sovacool, 2020). Incumbents threatened by the new technology may attempt to enter in order to follow its development (Ansari & Krop, 2012), or even to shape it according to their interests (Apajalahti et al., 2018). Recent research on the “incubation stage” of new industries (Agarwal et al., 2017) has shown that a variety of actors are involved in experimentation to reduce technological and market uncertainty. These include established firms, not only incumbents from threatened industries profiting from specialized complementary assets, but also firms from related industries leveraging their knowledge through diversification. These firms capture value from their early investment in different ways, not just through product commercialization but also through markets for technology and corporate control (Moeen & Agarwal, 2017).

The focus of this literature has been on the motivations and strategies of firms that attempt to have a prime move into the new industry, tendentially large firms, often powerful incumbents and frequently technology intensive. Similarly, the diversification literature tends to focus on large, often multi-business firms, with enough resources and slack organization to support this strategy. Even in the case of declining markets, less attention has been given to smaller firms, which may also face the problem but may have less margin to address it (Thomas & Douglas, 2022).

However, the development of emerging technologies may also benefit from the resources and competences possessed by a wider range of established firms than those strategic early entrants (Fontes et al., 2021). Therefore, it will be important to motivate a wider and more heterogeneous set of firms, from a variety of industries, to start engaging with the new technology. For this, policies are critical (Janssen & Frenken, 2019).

Policies can give direction – that is signal government strategic interest in the technology - and also provide direct support to actions that firms will need to conduct in order to deploy resources in the new area, including the creation of, or access to, new resources (Andersson et al., 2017; Bush et al., 2017). Policies thus encourage firms to commit under conditions of some uncertainty (Chang & Andreoni, 2020) and offer incentives that address key entry requirements of firms that might be willing to engage but can be deterred by the difficulties perceived.

The objective of this paper is to contribute to understand how to motivate this “second line” of potential entrants to engage with a still emerging technology. For this, it is necessary to gain a better understanding of these firms’ views on the conditions in which entry into the new area can take place. Therefore, the paper investigates:

- Which are firms' perspectives regarding entry, i.e., which type of strategy they would be willing to adopt: market diversification (supply existing products to the new market); or product /market diversification (supply new products to the new market).
- How firms perceive the requirements to enter: i) which types of resources they perceive as necessary to change, develop or gain access to; ii) which obstacles they perceive as limiting their ability to enter.
- Whether diverse strategies lead to differences in firms' perceptions on resource needs and obstacles.

3. Methodology

The empirical research is based on a questionnaire survey of Portuguese firms from sectors identified as potential contributors to marine renewable energy technologies (MRET), which in the case of Portugal encompass wave energy and offshore wind energy.

The survey targeted both firms previously identified as active in MRET (e.g., as formal partners in funded projects or as suppliers in experimental activities), and firms with no previous known involvement, but whose area of activity indicated potential to participate in activities related to MRET. The latter included: i) firms that had shown interest in MRET through participation in events related to the area of marine energies; ii) firms from sectors presented in various studies as potential contributors to the to the development, production, installation and operation of MRET, for which there was also evidence of some innovative capacity/orientation, based on: participation in funded research and technology development projects; participation in networks, clusters or other collective activities with innovation and technology development objectives; referencing by sectoral associations, national agencies or studies on their respective sectors.

The questionnaire survey obtained 344 answers: 90 from firms currently involved in MRET; 138 from firms not involved but that declared to be intending to enter MRET in the future; and 116 from firms not active and that had no interest in MRET. This research will focus on the case of the 138 potential entrants.

In this group of firms, "micro enterprises" predominate (62%), followed by "small and medium-sized enterprises" (SMEs), which account for 30% of the sample (Figure 1).

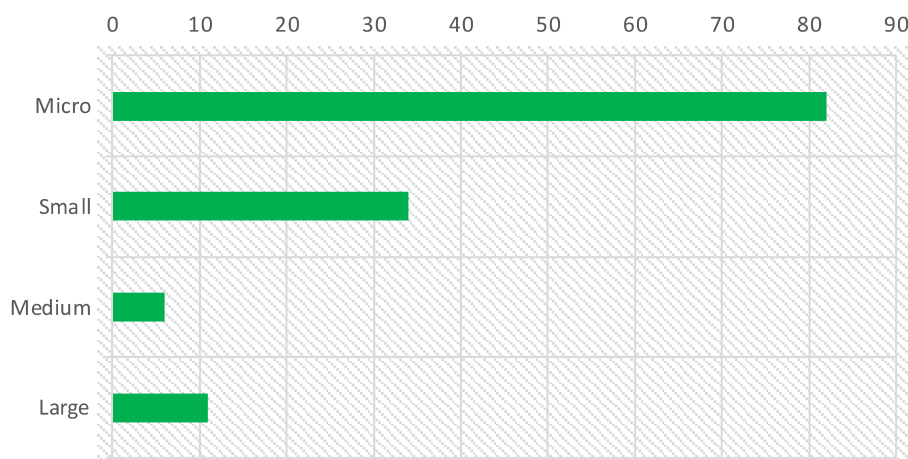


Figure 1: Size of firms willing to enter MRET

Regarding the sector of activity (Figure 2), the majority of these firms are operating in manufacturing sectors (41%) followed closely by service sectors (36%), with particular predominance of R&D and engineering services. There is also a small group of firms in sectors such as construction, retail (often suppliers of imported components and systems) and transport (ports).

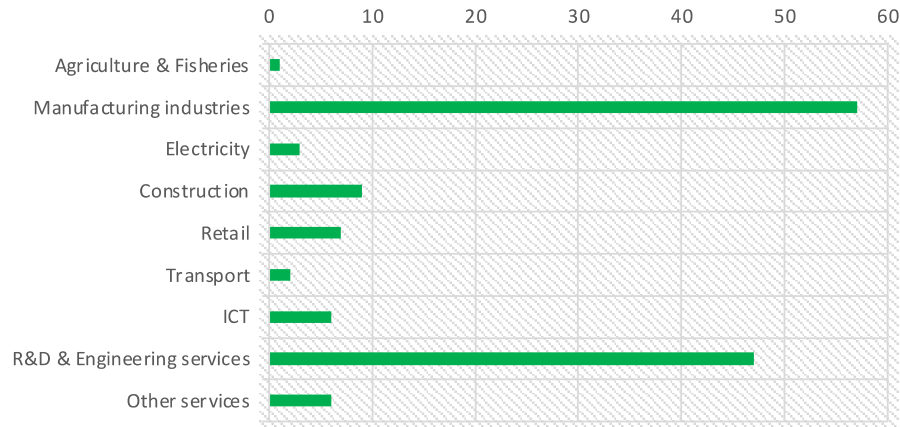


Figure 2: Sector of activity of firms willing to enter MRET

In order to investigate the perspectives and perceptions of firms willing to enter MRET, the research draws on the answers of these 138 firms to survey questions concerning:

- Their readiness to enter, i.e., the expected time horizon for entry;
- Their planned innovation strategy, expressed in the novelty of the products services they expected to bring to the new business;
- The changes in resources and capabilities they expected to be necessary, in order to operate in the new area;
- The main obstacles they foresaw.

4. Results

In this section we present the results on firms' perspectives regarding entry in MRET and their perceptions on the requirements of such strategic decision.

4.1 Perspectives on entry in MRET

Regarding the readiness to enter, the majority of the firms in the sample (70%) have not yet decided to actually enter MRET (Figure 3). The remaining have already identified some opportunities, but only 10% are developing actions to enter in the short/medium term.

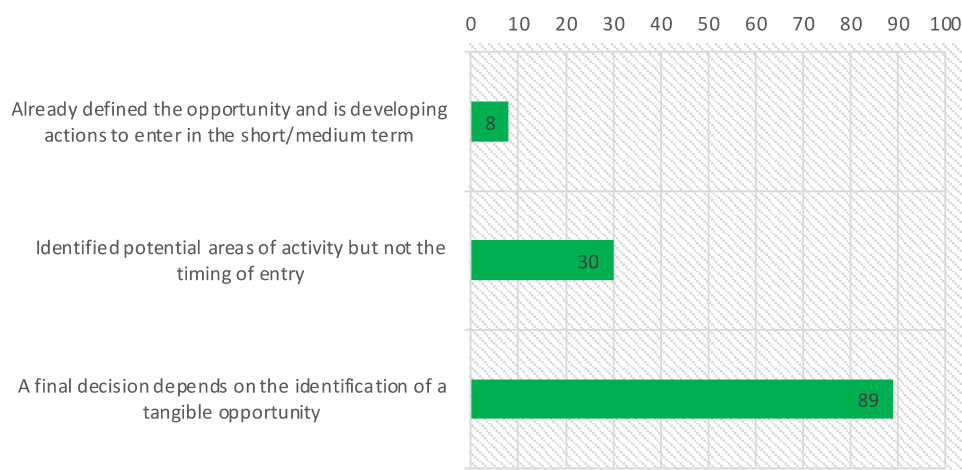


Figure 3: Readiness to enter (number of firms)

Concerning the strategy to be adopted to enter MRET, it is important to highlight that the majority of firms reveal an innovative intent (Figure 4). In fact, 63% of the respondents intend to sell new products or services (whether or not combined with existing ones). Alternatively, 22% intend to adapt existing products and services and 15%

intend only to sell current products or services in the new market. While these results must be considered with care, since they correspond to intentions that may or may not be concretized, they nevertheless suggest a perception of high innovation opportunities in the new area.

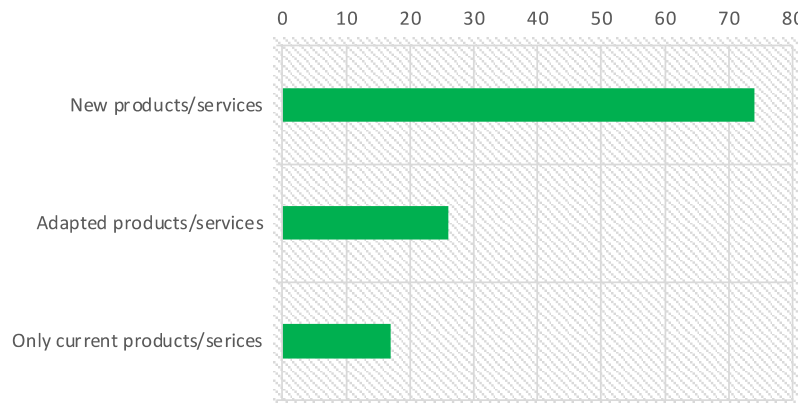


Figure 4: Planned innovation strategy (number of firms)

4.2 Perceptions on entry requirements

Respondent firms are aware that to enter the new area and thus diversify, they must make changes in their resources and capabilities. Only 22% of the firms stated that they did not foresee the need for changes. The establishment of new partnerships, the development of new skills by existing human resources, the recruitment of new human resources, and the purchase of new equipment are the main changes pointed out by the firms (Figure 5).

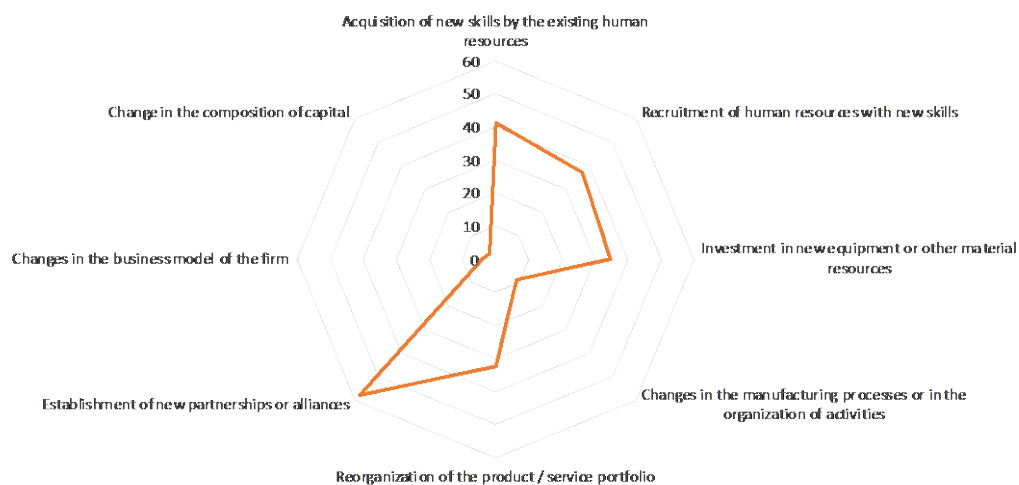


Figure 5: Entry requirements: changes in resources and capabilities

But are these changes equally important for all firms? The results show that they are not. Indeed, statistically significant differences emerge between groups of firms, when we take into account their planned innovation strategy and their "readiness to enter".

Considering the planned innovation strategy, the Kruskal-Wallis tests (Table 1 reports only the significant tests, $p < 0.1$) reveal significant differences in the perception of the importance of the following changes:

- Recruitment of new human resources with new skills: firms that intend to develop new products/services feel more frequently the need to make this change. Firms that intend to maintain their offer are the ones that feel less frequently the need to hire new employees.

- Reorganization of the product/service portfolio. Companies that intend to develop new products/services feel more frequently the need to make this change. Companies that intend to maintain their offer are the ones that feel less frequently the need to reorganize their product/service portfolio.
- Establishment of new partnerships/alliances: the need to develop new alliances/partnerships is least felt by firms wishing to adapt their products/services and is felt with the same intensity by firms wishing to develop new products/services and by those wishing to maintain their offer.

Table 1: Changes: Differences between groups according to the planned innovation strategy

	Planned innovation strategy	N	Mean Rank
Recruitment of human resources with new skills Kruskal-Wallis H = 4,499 p<0,1	Expects to have new products or services	74	63,01
	Expects to have adapted products	26	54,25
	Only expects to offer current products/services	17	48,82
	Total	117	
Reorganization of the product / service portfolio Kruskal-Wallis H = 14,704 p<0,001	Expects to have new products or services	74	66,38
	Expects to have adapted products	26	48,50
	Only expects to offer current products/services	17	42,94
	Total	117	
Establishment of new partnerships / alliances Kruskal-Wallis H = 5,270 p<0,1	Expects to have new products or services	74	62,16
	Expects to have adapted products	26	47,50
	Only expects to offer current products/services	17	62,85
	Total	117	

Considering the readiness to enter in the MRET area, the Kruskal-Wallis tests (Table 2 reports only the significant tests, $p<0.1$) also reveal relative differences in the perception of the need to make changes in the manufacturing processes or in the organization of activities, which is more frequently felt by firms that intend to develop new products/services and less frequently felt by firms that intend to maintain their offer.

Table 2: Changes: Differences between groups according to the readiness to enter MRET.

	Readiness to enter	N	Mean Rank
Changes in manufacturing processes or in the organization of activities Kruskal-Wallis H = 7,027 p<0,05	Already defined the opportunity and is developing actions to enter in the short/medium term	8	74,38
	Has identified potential areas of activity but not the timing of entry	30	69,08
	A final decision depends on the identification of a tangible opportunity	89	61,35
	Total	127	

The respondent firms are also conscious of the existence and need of overcoming some obstacles to diversify. The results show (Figure 6) that the most prominent obstacles are: lack of opportunities to develop skills in the area due to the scarcity of projects; absence of direct support policies for activities in this area; and the need to develop new skills and/or acquire new resources.

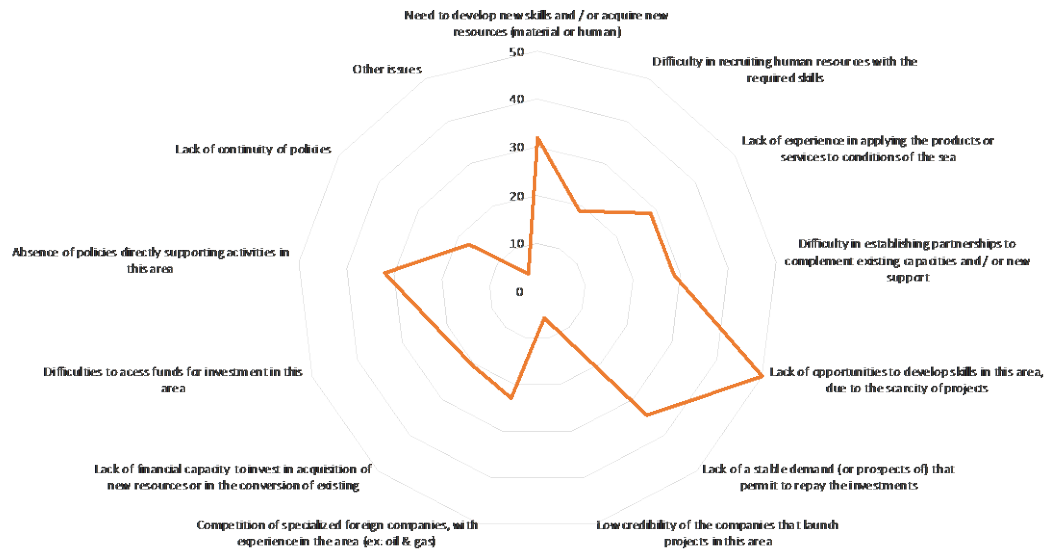


Figure 6: Entry requirements: Obstacles

Again, at the level of obstacles, we found statistically significant differences between groups of firms, according to the planned innovation strategy and readiness to enter the field.

Considering the planned innovation strategy, the Kruskal-Wallis tests (Table 3 reports only the significant tests, $p < 0.1$) reveal significant differences in the perception of the importance of the following obstacles:

- Need to develop new skills and / or acquire new resources (material or human): firms that intend to develop new products/services feel more frequently this obstacle. Firms that intend to maintain their offer are the ones that feel less frequently the need to renew skills and resources.
- Lack of prospects of a stable demand that allows to repay the investment: Firms that intend to develop new products/services feel more frequently this obstacle. Firms that intend to maintain their offer are less worried about the level of demand and its effects on the return of investment: they are investing less and thus facing a lower level of risk.
- Competition from specialized foreign companies, with experience in the area (e.g., oil & gas): firms that intend to maintain their offer feel this obstacle more frequently. Firms that intend to develop new products/services are less worried about competition from established foreign companies: innovation prospects seem to protect them from this competition threat.

Table 3: Obstacles: Differences between groups according to the planned innovation strategy

	Planned innovation strategy	N	Mean Rank
Need to develop new skills and / or acquire new resources (material or human) Kruskal-Wallis H = 5,736 $p < 0,1$	Expects to have new products or services	74	61,55
	Expects to have adapted products	26	61,25
	Only expects to offer current products/services	17	44,44
	Total	117	
Lack of prospects of a stable demand that permit to repay the investment. Kruskal-Wallis H = 6,306 $p < 0,05$	Expects to have new products or services	74	63,51
	Expects to have adapted products	26	54,75
	Only expects to offer current products/services	17	45,88
	Total	117	
Competition of specialized foreign companies, with experience in the area (e.g., oil & gas) Kruskal-Wallis H = 6,711 $p < 0,05$	Expects to have new products or services	74	55,28
	Expects to have adapted products	26	60,75
	Only expects to offer current products/services	17	72,53
	Total	117	

Finally, the Kruskal-Wallis tests (Table 4 reports only the significant tests, $p < 0.1$) also reveal significant differences in the perception of the importance of some obstacles, according to the readiness to enter in the new area:

- Difficulty to access funds for investment in this area: firms that have defined the opportunity and are developing actions to enter in the short/medium term feel more frequently this obstacle. They are seeking money to invest, and this is a critical issue for them. Firms that have not yet found a tangible opportunity give less relevance to this obstacle.
- Difficulty in establishing partnerships to complement existing capacities and/or support entrance in the new area: firms that have already identified potential areas of activity but not the timing of entry feel this obstacle more frequently. This suggests that securing access to complementary resources is critical at this stage. Firms that have not yet found a tangible opportunity give less relevance to this obstacle.

Table 4: Obstacles: Differences between groups according to the readiness to enter MRET

	Readiness to enter	N	Mean Rank
Difficulty to access funds for investment in this area Kruskal-Wallis H = 5,063 $p < 0,1$	Already defined the opportunity and is developing actions to enter in the short/medium term	8	83,25
	Has identified potential areas of activity but not the timing of entry	30	64,20
	A final decision depends on the identification of a tangible opportunity	89	62,20
	Total	127	
Difficulty in establishing partnerships to complement existing capacities and/or support entrance in the new area Kruskal-Wallis H = 7,758 $p < 0,05$	Already defined the opportunity and is developing actions to enter in the short/medium term	8	64,38
	Has identified potential areas of activity but not the timing of entry	30	76,02
	A final decision depends on the identification of a tangible opportunity	89	59,92
	Total	127	

5. Conclusions and policy implications

This paper addressed the conditions in which firms from existing sectors can be motivated to an early engagement with emerging technologies, to whom they can provide critical competences and resources. The goal was to go beyond the case of the typical prime movers – e.g. threatened incumbents attempting to gain some hold in the new technology, or large multi-product business firms exploring opportunities to expand the business range – and address the less known case of other, often smaller companies, that may see the demand from the new technology as an opportunity to redeploy or reconfigure their production or business capabilities, but may face greater obstacles.

The analysis, conducted on a group of 138 firms that expressed willingness to become involved with a new sustainable technology – marine renewable energy –, showed that an early engagement with the new technology may prove to be an opportunity for business diversification and innovation. But because such strategic decision entails investments (for changing resources or creating new ones), which are greater for more innovative strategies; and because of the uncertainty still surrounding the technology, firms perceive several obstacles that may restrain them from making the move. Thus, policies are required to motivate firms to effectively diversify into the new field.

The results suggest the need for a policy mix, combining a set of instruments traditionally used in the framework of industrial policy and innovation policy. This would allow to reduce risk perception and support the process of resource deployment.

The results also suggest that this policy mix should include both measures to accelerate the entry of established firms into the new area; and measures to promote the development of new products/services, which demands more changes and involve a higher level of risk.

In order to accelerate the entry of established firms, promoting the development of a domestic value chain, policies should:

- Support changes in manufacturing processes.
- Support access to funding.
- Support partnerships that facilitate entry.

In order to induce the development of new products/services targeting the new area, policies should:

- Support the development/access to new skills and resources (with particular emphasis on human resources).
- Support reorganizations in product/service portfolios.
- Support development of new partnerships.
- Support dealing with market demand uncertainty.

References

- Adner, R., and Zemsky, P. (2016). Diversification and performance: Linking relatedness, market structure, and the decision to diversify. *Strategy Science*, 1, 32–55.
- Agarwal, R. Moeen, M. and Shah, S.K. (2017) Athena's Birth: Triggers, Actors, and Actions Preceding Industry Inception. *Strategic Entrepreneurship Journal*, 11: 287–305
- Andersson, J., Vico, E.P., Hammar, L. and Sandén, B.A. (2017) The critical role of informed political direction for advancing technology: The case of Swedish marine energy. *Energy Policy*, 101 (2017) 52–64.
- Anderson, P. and Tushman, M. L. (1990). Technological Discontinuities and Dominant Designs: A Cyclical Model of Technological Change. *Administrative Science Quarterly*, 35, 604–633. <https://doi.org/10.2307/2393511>
- Ansari, S. and Krop, P. (2012) Incumbent performance in the face of a radical innovation: Towards a framework for incumbent challenger dynamics. *Research Policy*, 41: 1357–74.
- Barney, J. B. 1991. Firm resources and sustained competitive advantage. *Journal of Management*, 17: 99–120.
- Bergek, A., Hekkert, M., Jacobsson, S., Markard, J., Sandén, B. and Truffer, B. (2015). Technological innovation systems in contexts: Conceptualizing contextual structures and interaction dynamics. *Environmental Innovation and Societal Transitions*, 16: 51–64. <https://doi.org/10.1016/j.eist.2015.07.003>.
- Bergek, A., Jacobsson, S., Carisson, B., Lindmark, S. and Rickne, A. (2008). Analyzing the functional dynamics of technological innovation systems: a scheme of analysis. *Research Policy*, 37, 407–429. <https://doi.org/10.1016/j.respol.2007.12.003>
- Björgum, O. and Netland, T.H. (2017). Configuration of supply chains in emerging industries: a multiple-case study in the wave-and-tidal energy industry. *International Journal of Manufacturing Technology and Management*, 31, 133–152. <https://doi.org/10.1504/IJMTM.2017.082007>
- Busch, J., Foxon, T.J. and Taylor, P.G. (2018) Designing industrial strategy for a low carbon transformation. *Environmental Innovation and Societal Transitions*, 29, 114–125
- Chang, H.J and Andreoni, A. (2020) Industrial Policy in the 21st Century. *Development and Change*, 51(2): 324–351. DOI: 10.1111/dech.12570
- Eeva-Lotta Apajalahti, Armi Temmes and Tea Lempiälä (2018) Incumbent organisations shaping emerging technological fields: cases of solar photovoltaic and electric vehicle charging. *Technology Analysis & Strategic Management*, 30:1, 44–57, <https://doi.org/10.1080/09537325.2017.1285397>
- Fontes, M., Bento, N. and Andersen, A.D. (2021). Unleashing the industrial transformative capacity of innovations. *Environmental Innovation and Societal Transitions*, 40, 207–221. <https://doi.org/10.1016/j.eist.2021.07.004>
- Helfat, C. E., & Eisenhardt, K. M. (2004). Inter-temporal economies of scope, organizational modularity, and the dynamics of diversification. *Strategic Management Journal*, 25(13), 1217–1232.
- Janssen, M.J. and Frenken, K. (2019). Cross-specialisation policy: rationales and options for linking unrelated industries., *Cambridge Journal of Regions, Economy and Society*, 12(2), 195–212.
- Karim, S., and Capron, L. (2016). Adding, redeploying, recombining and divesting resources and business units. *Strategic Management Journal*, 37(13), 1–20. <http://doi.wiley.com/10.1002/smj.2537>
- Liu, H., and Yang, H. (2019). Managing network resource and organizational capabilities to create competitive advantage for SMEs in a volatile environment. *Journal of Small Business Management*, 57(2), 155–171. <https://doi.org/10.1111/jsbm.12449>
- Lüthge, A. (2020). The concept of relatedness in diversification research: review and synthesis. *Review of Managerial Science*, 14, 1–35.
- Makitie, T., Andersen, D.A., Hanson, J., Normann, H.E. and Thune, T.M., 2018. Established sectors expediting clean technology industries? The Norwegian oil and gas sector's influence on offshore wind power. *Journal of Cleaner Production*, 177, 813–823. <https://doi.org/10.1016/j.jclepro.2017.12.209>
- Markard, J. (2020). The life cycle of technological innovation systems. *Technological Forecasting and Social Change*, 153, 119407. <https://doi.org/10.1016/j.techfore.2018.07.045>

- Moeen, M. and Agarwal, R. (2017) Incubation of an industry: Heterogeneous knowledge bases and modes of value capture. *Strategic Management Journal*, 38: 566–587
- Nerkar, A. (2003). Old is gold? The value of temporal exploration in the creation of new knowledge. *Management Science*, 49(2):211–229. <https://doi.org/10.1287/mnsc.49.2.211.12747>
- Penrose, E.T. (1995) *The Theory of the Growth of the Firm*. Oxford University Press, Oxford.
- Rumelt, R.P. (1974). *Strategy, Structure, and Economic Performance*. Harvard Business School Press: Boston, MA.
- Thomas, G.H. and Douglas, E.J. (2022) Resource reconfiguration by surviving SMEs in a disrupted industry. *Journal of Small Business Management*, <https://doi.org/10.1080/00472778.2021.2009489>
- Turnheim, B. and Sovacool, B.K. (2020). Forever stuck in old ways? Pluralising incumbencies in sustainability transitions. *Environmental Innovation and Societal Transitions*, 35, 180–184. <https://doi.org/10.1016/j.eist.2019.10.012>.
- Wiersema, M.F., and Beck, J.B. (2017). Corporate or Product Diversification. In *Oxford Research Encyclopedia of Business and Management* (Issue June, pp. 1–20). Oxford University Press.

Teaching Sustainable Development Goals through Virtual Exchange in Design Thinking Courses

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Abstract: The stated objective of the United Nation's Sustainable Development Goals (SDGs) are to serve as a shared blueprint for peace and prosperity around the planet. If this blueprint is to become a reality, the inclusion of the SDGs in university curricula is essential. Yet how can we be sure that we teach a unified and shared view of these goals? This paper examines the value of using virtual exchange in teaching the UN SDGs in Business School Design Thinking courses. Specifically, the experience of a partnered course run at both the Boise State University's College of Business and Economics and the Lebanese American University's Adnan Kassar School of Business serves as a case-study. Results from a survey of both student groups indicate that the experience of working with students from outside their home culture did improve their cross-cultural communication skills. Furthermore, learning about the SDGs was a valued experience. However, learning about the SDGs in collaboration with "foreign" team members was eclipsed by the broader experience of engaging with students outside their home culture.

Keywords: Design Thinking, Virtual Exchange, Sustainable Development Goals

1. Introduction

Design thinking incorporates an approach well suited for coming to terms with complex, poorly structured problems. Accordingly, studies advocate that managers embrace a design perspective in their work by emulating the ways in which skilled designers deal with the tasks and problems they confront (Collopy and Boland, 2004; Brown, 2008). Responding to this call, several business schools revised their curricula to incorporate design thinking (Beckman and Barry, 2007; Boni, Weingart and Evenson, 2009; Kimbell, 2011; Liedtka and Ogilvie, 2011). The motivation for these changes is the recognition that design tools comprise ways of approaching, thinking about, and dealing with poorly understood problems – a task faced by every manager. Remarkably, design thinking strategies can, to a considerable extent, be taught in the form of cognitive approaches, methods, and techniques. The idea behind these curricular revisions is not to replace the all-important scientific and analytical approaches to business topics but to help impart an additional skill set with which future managers can handle complex business issues.

Another skillset that is often touted as missing among business graduates is that of good communication skills – with a particular need for better cross-cultural communication (Wardrope, 2002; Alshare, Lane and Miller, 2011; Lolli, 2013). Brink & Costigan (2015) even go so far as to note that business schools, in their drive to meet AACSB set standards, have inverted the real communication needs of employers by over-emphasizing presenting skills and under-emphasizing listening skills. In order to bridge this gap, the concept of virtual exchange or Collaborative Online International Learning (COIL) experiences entered the management education domain (Nava-Aguirre, Garcia-Portillo and Lopez-Morales, 2019).

Virtual exchange emerged in the 1990s as a way to enhance the world-view of university students through online partnered discussions, collaborative presentations or writing activities (O'Dowd and Lewis, 2016). Online intercultural experiences enable students to develop intercultural competence and communication skills by engaging with peers from different cultural backgrounds. Through this engagement, listening and conversing skills are emphasized in line with what employers seek (Brink and Costigan, 2015). Once students' perspectives expand to encompass the whole world, problems of global relevance become tangible. For this reason, the UN's Sustainable Development Goals make a good backdrop for virtual learning of cross-cultural communication skills in management design thinking courses (Heilmann, Philippart and Lessmann, 2023).

This paper examines the value of using virtual exchange in teaching the UN SDGs in Business School Design Thinking courses. Specifically, the experience of a partnered course run at both the Boise State University's College of Business and Economics and the Lebanese American University's Adnan Kassar School of Business serves as a case study. The remainder of this article is organized as follows. The next section provides background on the three course elements at the heart of this case study – design thinking, virtual exchange, and the UN

SDGs. Subsequently a methodology section describes key learning outcomes of the courses, how the students were partnered, the activity they were assigned and how feedback was solicited throughout the learning experience. The learning experience is then analyzed using both qualitative and quantitative methods. The paper concludes with a discussion of the implications for curricular design in management schools more broadly.

2. Background

Calls for a business curriculum that balances between analytical and “soft skills” are not new. As early as 1967, Simon was also aware that the business school emphasis on a scientific, analytic curriculum left a deficit in the area of developing graduates with practical skills in synthesizing the knowledge gained. For a balance to be met, Simon held that design thinking and a codified design pedagogy should take its rightful place beside scientific pedagogy in business schools (Simon, 1967). In the present work, we extend this view on design thinking to introduce problems of global scale alongside the need to listen to those from outside one’s home environment. In this way we solidify the balance that Simon sought through experiential learning in a manner that serves to enable changing what currently exists into what is envisioned (Simon, 1996).

2.1 Design Thinking

Design thinking is an iterative and interactive process blending analytic and creative tools in provision of solutions to wicked problems (Razzouk and Shute, 2012). As espoused by the Stanford d.School, the design thinking process follows five steps: Empathize, Define, Ideate, Prototype, and Test (Banerjee and Gibbs, 2016). By rapidly cycling through this process, design thinking allows for the provision of effective solutions to problems which is attractive to engineering and business domains. Part of the success of design thinking is due to the proper framing of the problem which comes from putting the “user” at the heart of the process from the very first step of “empathize”. This act of engaging with the “user” yields an excellent way to teach business students the key skills of listening and conversing (Panke, 2019).

The act of listening to and conversing with a user – another human being – can be difficult for students who have been trained to listen to faculty members speaking in a unidirectional manner. Nevertheless, the act of listening does have an important role to play in business curricula (Ferrari-Bridgers and Murolo, 2022). While design thinking is a key tool to improve critical listening, virtual exchange also provides another modality by which students can practice these skills.

2.2 Virtual Exchange and Cross-Cultural Learning Experiences

Virtual exchange is not a new concept. In many ways, the tradition of having “pen pals” is an early form of virtual exchange. Moving into the realm of technology enabled cross-cultural or international exchange, there are two primary models of virtual exchange espoused in the literature: e-tandem and intercultural collaboration (O’Dowd, 2020). In the e-tandem model learners are assigned to partners or into discussions groups with the aim of serving in alternating mentor/mentee roles to support learning about the other’s culture, communication style, or language. In the intercultural collaboration model, the virtual exchange experience is integrated into the course material and classes are paired across universities such that learners work together to deliver a project in support of the course learning outcomes. In this paper, we describe an intercultural collaboration model of virtual exchange.

Within management curricula, the benefits of virtual exchange have been amply documented. Most notably in the study by Taras *et al.* (2013) who performed a multisource longitudinal study of 6,000 students engaged in a virtual exchange activity for two months. Their work reveals positive outcomes in learning, attitudes, and behaviors, among others. Similarly, Cheikhrouhou and Marchewka (2020) demonstrate the value of virtual exchange in entrepreneurship through a project partnering Polish and Tunisian university students to explore the similarities and differences between the two countries’ entrepreneurial ecosystems. Among the benefits noted was an increase in self-confidence. The key to a successful virtual exchange – following either model – is a topic to discuss or focus a project on; for this the UN Sustainable Development Goals are a natural choice.

2.3 Teaching and Learning Sustainable Development Goals

The United Nations (UN) Sustainable Development Goals are seen very differently based on where someone is from, how they were raised, their personal experiences and their education level. Exploring these differences allows for new ideas on how to tackle these issues. As the UN SDGs serve as a framework for identifying and

addressing ethical and sustainability problems they can also serve improve societal awareness within business curricula (Fang and O'Toole, 2023).

The seventeen United Nations Sustainable Development Goals of the 2030 Agenda for Sustainable Development were officially adopted by world leaders on January 1st, 2016 (UN DESA, 2022). As the United Nations underlines, the SDG agenda is about transformative change, radical and simultaneous improvements in social justice, equality, and environmental sustainability (Holmes *et al.*, 2022). One of the things that all of the individual goals have in common is the extent to which each requires schooling and education for success. The work of schools is central to the achievement of the SDGs, not only when it comes to achieving SDG 4 (Quality Education), but also when it comes to achieving the other goals (Chiba *et al.*, 2021). The United Nations has identified higher education institutions as key to implementing the 2030 Agenda for Sustainable Development.

Design Thinking courses within business school curricula are the ideal place to insert the SDGs. Design thinking is particularly suited for driving innovation and dealing effectively with messy, ill-structured situations. Yet, to overcome those who believe that the SDGs are over ambitious and cannot be financed without unprecedented and improbable amounts of external assistance, the innovations designed to address the SDGs must make good business sense as well (Burnett, Lewin and Heyneman, 2022).

In this study, a design thinking class in the United States of America (USA) was partnered through virtual exchange with a design thinking class in Lebanon. The students were tasked with designing for a problem under one of the United Nations' 17 Sustainable Development Goals. The next section describes the structure of the courses and the design of the virtual exchange activity along with the survey strategy undertaken to measure the impact of the experience.

3. Methodology

As this research lays at the crossroads of education and innovation, the methodology applied is best labeled as a case study, but more in the tradition of Stake (1995) than Yin (2018). In that tradition, the virtual exchange experience forms the bounded system within which we focus on the experience of the individuals by probing their perceptions. To elucidate the bounds of our case study environment, we provide a full description of the two courses and the virtual exchange activity. Subsequently, we describe the data collection tools within the case framework which, as advocated by Stake(1995), remained flexible yet focused on issues of internationalization. In contrast, we also launched a pre- and post-survey based on the communications skills portion of the validated Science Student Skills Inventory more inline with the recommendations of Yin (2018). The blending of these two methodologies within a case study is acceptable within both the education and innovation sectors (Yazan, 2015; Goffin *et al.*, 2019).

At the heart of this study are the courses paired between the USA (College of Business and Economics, Boise State University) and Lebanon (Adnan Kassar School of Business, Lebanese American University). While both courses were undergraduate design thinking courses housed in AACSB accredited schools of business, the exact context and focus of the courses differ.

In Lebanon, the course, "Data-Driven Design Thinking", is offered as a business elective open to all undergraduate business students while also serving as a core course in the Data Analytics minor which is open to all majors. As such, the students who matriculate in the course span a diversity of majors including Computer Science, Bioinformatics, and all emphases of Business (Accounting, Banking and Finance, Family and Entrepreneurial Business Management, Information Technology Management, International Business, Management, Marketing). As the course is housed in the Data Analytics Minor the course learning outcomes focus on the use of data analysis within the design thinking process. Specifically, at the end of the Data-Driven Design Thinking Course, the graduate will be able to:

1. Execute each step of the design-thinking process.
2. Create a data pipeline to support the design-thinking process.
3. Create and execute a data analysis plan to achieve a stated goal within the design-thinking process.
4. Communicate effectively in cross-cultural teams.

In the USA, the course, "Design Thinking and Strategy", is offered as a special topics elective open to undergraduate business students. The course is popular among senior students as it leverages all aspects of their management education. In contrast to the data-focus of the design thinking course in Lebanon, the design thinking course at Boise State University focuses on the strategic management aspects of advancing the products or services designed. Specifically, the course not only defines "What" constitutes a sustainable competitive

strategy, but also emphasizes “How” managers can shape the evolution of such a strategy. In short, students study how they can facilitate the design of innovative products, processes and, ultimately, strategies for designing a new product or service for an unmet need, frustration or gap along with creating a functional, business-level, and corporate-level strategy business plan. At the end of the Design Thinking and Strategy course, the graduate will be able to:

1. Understand the Design Thinking process.
2. Use Design Thinking as a wicked multi-faceted problem-solving approach.
3. Compare the traditional sequential analytical linear problem-solving approach to the Design Thinking approach.
4. View business from multiple perspectives.
5. Understand the relationship between a firm's economic context, competitive environment, and strategic options.
6. Understand the need for growth and innovation in a business.

Given the core focus of both courses on the design thinking process, the virtual exchange experience was centered around analyzing the design of a product or service from the perspective of business strategy as mapped to the Hambrick Model. In order to make the cross-cultural communication aspect of virtual exchange relevant, the UN Sustainable Development Goals were chosen as a starting point for the students to identify a product or service to analyze. Specifically, the assignment required teams of students to (1) select one of the 17 UN SDGs, (2) design or select from the existing market a product or service targeted at the selected SDG, (3) prepare and deliver a presentation (via FlipGrid) analyzing the selected product or service business model using the Hambrick Diamond (Hambrick and Fredrickson, 2005), and (4) prepare and post responses to a set of self-reflection questions chosen by the students from a list of possible questions. Students were also required to respond, individually, via the FlipGrid discussion board to at least three other team presentation posts.

The student teams were assigned by the faculty members who worked to form the teams in such a way as to respect a balance between the two locations and genders. In Fall 2022, this led to ten teams – three teams with five members and seven teams with six members. Due to an imbalance in student numbers between BSU (42 students) and LAU (15 students), five of the teams had one student from LAU and five had two students from LAU.

A partnered version of both courses was run as a pilot in Fall 2021 before preceding to the more focused virtual exchange experience in Fall 2022. Similarly, the case study strategy also evolved from a set of reflective journal entries to a mixed method with a validated scale and open-ended questions administered in a pre- and post-survey format.

In order to capture changes in the students’ cross-cultural communication capabilities and their thoughts relative to the virtual exchange experience, a pre-survey and post-survey were administered. The pre-survey, issued one-week prior to the exchange experience, included eight questions adapted from the Science Student Skills Inventory (SSSI) relative to communication (Mercer-Mapstone and Matthews, 2017), eleven questions probing their level of concern relative to specific issues (eg. language barrier, time difference, etc), and two open ended questions probing what the students were most excited about and most worried about relative to the upcoming virtual exchange. The post-survey, issued one-week after the exchange experience, included the same eight communication related questions and eleven questions regarding concerns, but the open-ended questions were changed to include five questions capturing their experience more broadly:

1. What goal did you have for this experience?
2. Did you achieve your goal?
3. In 1-2 sentences, what is one of the most memorable/exciting/interesting things you learned from this virtual exchange assignment?
4. What are 1-2 words you would use when asked about this international assignment?
5. What did you learn from this international assignment?

4. Analysis And Results

The open-ended questions were coded independently by each member of the research team. Each researcher read the comments and listed the most immediate one to three themes that came to mind following their reading. After all three members of the team performed their coding, the results were triangulated and any major differences discussed. As part of the open-ended questions, prior to the experience, the LAU students

expressed a general interest in meeting new people and seeing how it would be to work with people from “the other side of the world”. After the experience, the LAU students reported that the BSU students were not so different. Although, they did express surprise at how the BSU students were generally a bit older and had more work experience – this was humbling for the LAU students who for the most part live at home with their parents and haven’t worked.

“Honestly, learning about the different side jobs my American peers have and the way they're juggling the demands of both their academic and professional work was really interesting and eye-opening.” – LAU Student

With regards to the activity itself, the LAU students were already familiar with the SDGs, but expressed surprise at how their understanding of the SDGs expanded when talking to students from BSU.

“I generally consider myself a solutions expert and being faced with such a deepened topic [the SDGs] made me learn how important it is to really discuss solutions before going for them entirely and to consider all factors.” – LAU Student

Like the LAU students, the BSU students were excited for the exchange experience to gain new perspectives from the other students. In contrast, many BSU students did not have a background with the SDGs and enjoyed discussing international solutions with their LAU teammates.

“I learned a lot about the 2030 goals! I had no idea these existed before this assignment. After reading about them I think that more people should learn and hear about these.” – BSU Student

Overall, like the LAU students, the BSU students noted that this was a very memorable and satisfying experience where they gained more knowledge about other cultures and saw the value in combining different perspectives when coming up with SDG solutions.

“One of the most memorable experiences I have from this assignment is getting to hear the two international students communicating with each other and no one else being able to fully comprehend. Then afterwards, the better speaking student would explain what they had discussed and then we were able to break down the problem in a different way.”- BSU Student

The quantitative questions within the pre-and post-survey were compared through t-tests both internally (ie paired t-tests comparing the LAU pre- to LAU post-survey results) and across entities (ie unpaired t-tests comparing LAU and BSU student).

We begin our quantitative analysis by focusing on the students’ perceptions of the eleven problems they might face highlighting the difference between the LAU and BSU students perceptions prior to the virtual exchange experience. Figure 1 shows the average rating given by each student group for each issue.

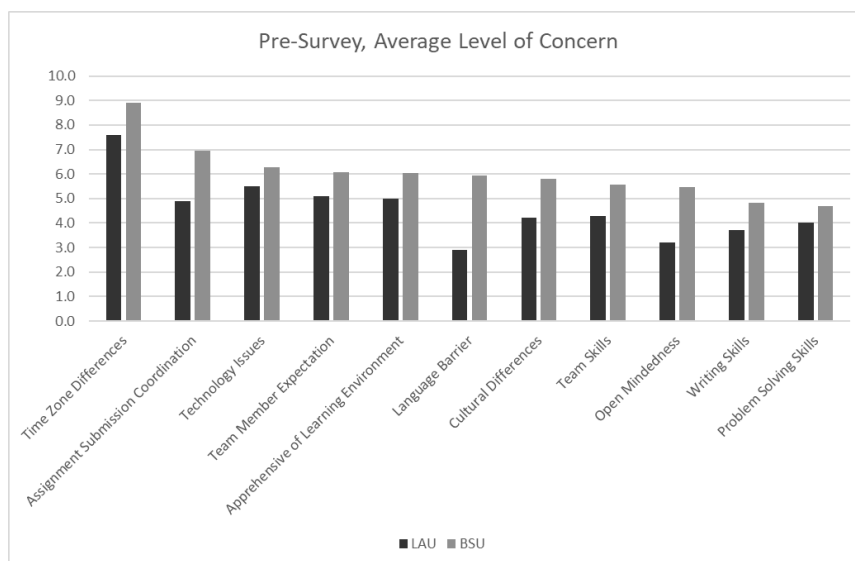


Figure 1: Average rating of level of concern across eleven possible areas; 0 = least concerned, 10 = most concerned.

Figure 1 indicates that the LAU students were on average less apprehensive regarding the potential issues than the BSU students. In an unpaired t-test with constant variance comparing the responses across the LAU and BSU student groups, we find that these differences were significant at the 0.05 alpha-level for Language Barrier ($p = 0.004$), Time Zones ($p = 0.01$), Assignment Submission Coordination ($p = 0.026$), and Open Mindedness ($p = 0.009$). Interestingly, the areas with the biggest difference in the average level of concern prior to the exercise were Language Barrier and Open Mindedness with the LAU students not seeing these issues as potentially problematic as their BSU counterparts.

Unfortunately, due to a technical glitch in the survey administration software at BSU, the responses to the post-survey across these 11 issues were lost. Nevertheless, a comparison within the LAU pre- and post-data relative to these 11 issues revealed that there was a decrease in the mean level of concern across all areas after the exchange, with two areas exhibiting a statistically significant decrease -- time zones ($p = 0.027$) and assignment submission coordination ($p = 0.051$).

Overall, as illustrated in Figure 2, the LAU students, as compared to the BSU students, expressed a higher level of agreement with the opinion questions in both the pre- and post-surveys, with the exception of the questions probing whether activities or assessments of cross-cultural communication skills were included as part of their regular university curriculum. For both of these questions, the BSU students indicated that such activities and assessments were to a certain extent included in their curriculum (approximately 7 for BSU and 5 for LAU). In terms of a significant difference between the pre- and post-surveys as measured via a paired t-test, the BSU students on average placed a higher importance on cross cultural communication after the experience ($p = 0.000$); they also expressed a statistically significant improvement in their assessment of their own cross-cultural communication skills ($p = 0.006$). Interestingly, there was also a significant difference among the BSU students relative to the importance of working with an international student on a global problem ($p = 0.039$) -- in this case, the BSU students showed a drop in opinion in that regard. In contrast to the BSU students, the LAU students also revealed a statistically significant difference in their stated level of importance for including cross cultural communication as part of the curriculum ($p = 0.048$), with more importance following the experience.

The statistically significant increase in opinion of the LAU students regarding the importance of a cross-cultural communication experience in the university curriculum is likely due to their comparatively low rating on the availability of such experiences in their university curriculum. The lack of a difference in the self-rating of cross-cultural communication skills among the LAU students may be because the class included two students from the broader MENA, outside of Lebanon, which might have affected the difference in the Pre-/Post- comparison.

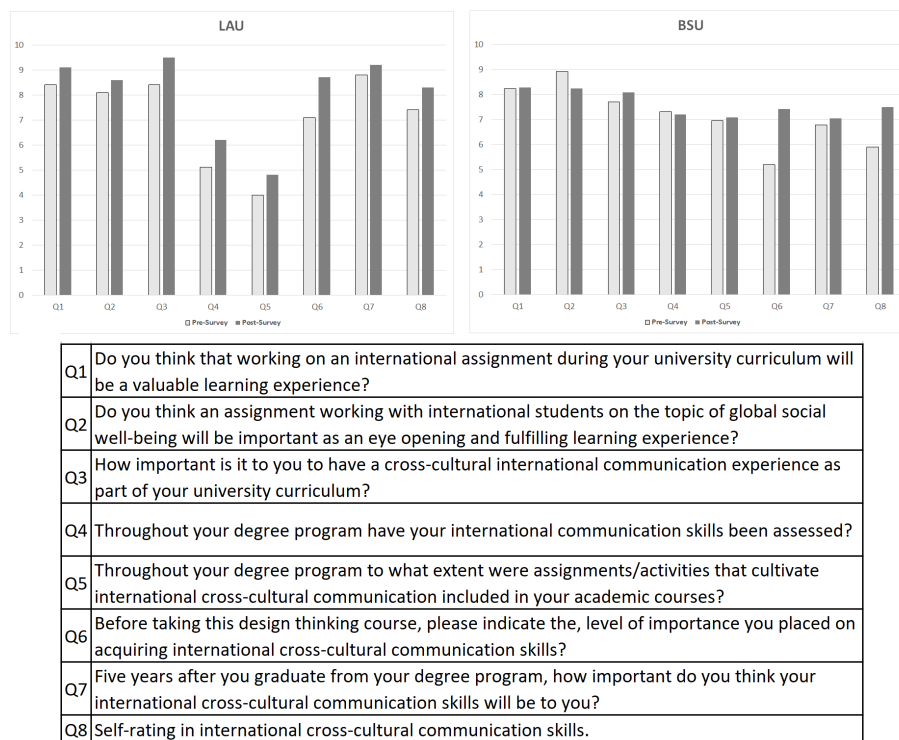


Figure 2: Comparison of LAU and BSU average responses to opinion questions noted in the legend below the graph.

5. Discussion

This case study highlights the positive value of virtual exchange relative to the UN SDGs within Design Thinking courses. All students reported a generally positive experience with a significant change in their perception of the importance of acquiring international cross-cultural communication skills. Reflecting more deeply on this result, we ask whether this result was unique to this group of students or whether we expect a similar result from all students who engage in virtual exchange relative to the SDGs. While it is impossible to know for sure, we can break down our reflection into the impact of virtual exchange and the impact of working with the UN SDGs.

With regards to virtual exchange, other courses at LAU that have been partnered with other universities achieve similar results with students reporting a great appreciation for the chance they had to communicate with students from other countries. These results consistently emerge from across all schools housed at LAU. For this reason, we believe that the positive results seen in this particular virtual exchange experience are not spurious.

With regards to the UN SDGs, the disparity in knowledge between the BSU and LAU students prior to the activity might have influenced their enthusiasm for the activity as a whole. On the other hand, the expertise that this allowed the LAU students to share may also have helped put them at ease. Having this point of “expertise” might have helped the LAU students overcome any anxiety felt by being the minority group within the activity teams.

6. Conclusion

Among these results, what is most striking is the consistent increase in the recognized value of greater cross-cultural collaboration within the university experience. While the focus on SDGs was valuable as a motivator within the project and allowed for a natural inclusion of virtual exchange within the design thinking courses, the exchange experience as a whole framed the students’ overarching perception of the experience. Specifically, no matter what level of inclusion the respective university curricula have for cross-cultural experiences, at the individual level both groups of students experienced an increase in their own perception of the importance of acquiring these skills for themselves.

Both groups of students valued learning more about other people's culture and how their lifestyles are different. There were also multiple comments noting that current technology allowed for easy communication leading to meaningful collaboration. This depth of interaction led to heart felt comments such as “at the end of the day, no matter where you come from, we are all just humans as we all have something in common and we are not always so different.” Beyond recognizing their similarities, both groups of students expressed that their differences and the diversity of opinions expressed were helpful in creating something of value. These thoughts challenged the students to think outside of the box for new solutions to the SDG problems. In the end, bringing on diverse opinions and mindsets, in a collaborative manner, allowed students to break down the SDG goal into manageable parts. Thus, faculty members should seek complex, multi-faceted problems around which to frame their virtual exchange experiences. In this regard, the SDGs provide an excellent platform.

Reflecting on the differences in levels of apprehension prior to the virtual exchange experience, the LAU class was held in-person which allowed the students to receive immediate reassurance thereby lessening anxiety. Additionally, many of the LAU students have previous international experiences either from having lived in other countries or from having relatives living in other countries. Thus, faculty seeking to introduce virtual exchange activities in an online course should host at least one “synchronous” session to ready the students for the experience. Additionally, partnering faculty might consider hosting a “meet and greet” session where the students are placed into virtual breakout rooms to meet each other before starting the activity. If scheduling makes a synchronous “meet and greet” session difficult, students and faculty can also use tools such as FlipGrid to post introductory videos that can be watched prior to the start of the co-creation activity.

The experience changed the students’ perceptions of the importance of cross-cultural communication as a skill and their ability to engage in cross-cultural communication. Due to the universal change in the perceived importance of cross-cultural communication, one could conclude that whether the experience was bad or good it heightened the students' awareness of the need for these skills. This realization should serve to lower the entry barriers for faculty members who worry that they might not “get it right” when hosting a virtual exchange. It is apparent that no matter the experience, it is impactful.

References

- Alshare, K.A., Lane, P.L. and Miller, D. (2011) 'Business Communication Skills in Information Systems (IS) Curricula: Perspectives of IS Educators and Students', *Journal of Education for Business*, 86(3), pp. 186–194. Available at: <https://doi.org/10.1080/08832323.2010.497819>.
- Banerjee, B. and Gibbs, T. (2016) 'Teaching the Innovation Methodology at the Stanford d.school', in B. Banerjee and S. Ceri (eds) *Creating Innovation Leaders*. Cham: Springer International Publishing (Understanding Innovation), pp. 163–174. Available at: https://doi.org/10.1007/978-3-319-20520-5_9.
- Beckman, S.L. and Barry, M. (2007) 'Innovation as a learning process: Embedding design thinking', *California Management Review*, 50(1), pp. 25–56.
- Boni, A., Weingart, L. and Evenson, S. (2009) 'Innovation in an academic setting: Designing and leading a business through market-focused, interdisciplinary teams', *Academy of Management Learning & Education*, 8(3), pp. 407–417.
- Brink, K.E. and Costigan, R.D. (2015) 'Oral Communication Skills: Are the Priorities of the Workplace and AACSB-Accredited Business Programs Aligned?', *Academy of Management Learning & Education*, 14(2), pp. 205–221. Available at: <https://doi.org/10.5465/amle.2013.0044>.
- Brown, T. (2008) 'Design Thinking', *Harvard Business Review*, 86, pp. 84–92.
- Burnett, N., Lewin, K. and Heyneman, S. (2022) 'The future of aid for education: Three essays', *International Journal of Educational Development*, 90, p. 102571. Available at: <https://doi.org/10.1016/j.ijedudev.2022.102571>.
- Cheikhrouhou, N. and Marchewka, M. (2020) 'Exploring foreign entrepreneurial ecosystems through virtual exchange', in F. Helm and A. Beaven (eds) *Designing and implementing virtual exchange – a collection of case studies*. 1st edn. Research-publishing.net, pp. 81–91. Available at: <https://doi.org/10.14705/rpnet.2020.45.1117>.
- Chiba, M. et al. (2021) 'Investigating effective teaching and learning for sustainable development and global citizenship: Implications from a systematic review of the literature', *International Journal of Educational Development*, 81, p. 102337. Available at: <https://doi.org/10.1016/j.ijedudev.2020.102337>.
- Collopy, F. and Boland, R. (2004) *Managing as designing*. Stanford Business Books.
- Fang, J. and O'Toole, J. (2023) 'Embedding sustainable development goals (SDGs) in an undergraduate business capstone subject using an experiential learning approach: A qualitative analysis', *The International Journal of Management Education*, 21(1), p. 100749. Available at: <https://doi.org/10.1016/j.ijme.2022.100749>.
- Ferrari-Bridgers, F. and Murolo, S. (2022) 'Assessing Critical Listening Skills in Accounting Community College Students: An Exploratory Inquiry of How Exercising Listening Skills Positively Impacts Students' Test Performance', *Business and Professional Communication Quarterly*, 85(4), pp. 468–485. Available at: <https://doi.org/10.1177/23294906221090504>.
- Goffin, K. et al. (2019) 'Perspective: State-of-the-Art: The Quality of Case Study Research in Innovation Management', *Journal of Product Innovation Management*, 36(5), pp. 586–615. Available at: <https://doi.org/10.1111/jpim.12492>.
- Hambrick, D.C. and Fredrickson, J.W. (2005) 'Are you sure you have a strategy?', *Academy of Management Perspectives*, 19(4), pp. 51–62. Available at: <https://doi.org/10.5465/ame.2005.19417907>.
- Heilmann, A., Philippart, N. and Lessmann, J. (2023) '"Innovation and Sustainability"—A Virtual German-American Student Exchange Project', in W. Leal Filho et al. (eds) *Educating the Sustainability Leaders of the Future*. Cham: Springer Nature Switzerland (World Sustainability Series), pp. 227–243. Available at: https://doi.org/10.1007/978-3-031-22856-8_13.
- Holmes, J. et al. (2022) 'Online learning and teaching for the SDGs – exploring emerging university strategies', *International Journal of Sustainability in Higher Education*, 23(3), pp. 503–521. Available at: <https://doi.org/10.1108/IJSHE-07-2020-0278>.
- Kimbell, L. (2011) 'Rethinking design thinking: Part I', *Design and Culture*, 3(3), pp. 285–306.
- Liedtka, J. and Ogilvie, T. (2011) *Designing for Growth: A Design Thinking Toolkit for Managers*. New York: Columbia Business School.
- Lolli, J.C. (2013) 'Interpersonal communication skills and the young hospitality leader: Are they prepared?', *International Journal of Hospitality Management*, 32, pp. 295–298. Available at: <https://doi.org/10.1016/j.ijhm.2012.02.010>.
- Mercer-Mapstone, L.D. and Matthews, K.E. (2017) 'Student perceptions of communication skills in undergraduate science at an Australian research-intensive university', *Assessment & Evaluation in Higher Education*, 42(1), pp. 98–114. Available at: <https://doi.org/10.1080/02602938.2015.1084492>.
- Nava-Aguirre, K.M., Garcia-Portillo, B.I. and Lopez-Morales, J.S. (2019) 'Collaborative Online International Learning (COIL): An Innovative Strategy for Experiential Learning and Internationalization at Home', in M.A. Gonzalez-Perez, K. Lynden, and V. Taras (eds) *The Palgrave Handbook of Learning and Teaching International Business and Management*. Cham: Springer International Publishing, pp. 721–746. Available at: https://doi.org/10.1007/978-3-030-20415-0_34.
- O'Dowd, R. (2020) 'A transnational model of virtual exchange for global citizenship education', *Language Teaching*, 53(4), pp. 477–490. Available at: <https://doi.org/10.1017/S0261444819000077>.
- O'Dowd, R. and Lewis, T. (eds) (2016) *Online Intercultural Exchange*. 0 edn. Routledge. Available at: <https://doi.org/10.4324/9781315678931>.
- Panke, S. (2019) 'Design Thinking in Education: Perspectives, Opportunities and Challenges', *Open Education Studies*, 1(1), pp. 281–306. Available at: <https://doi.org/10.1515/edu-2019-0022>.

- Razzouk, R. and Shute, V. (2012) 'What Is Design Thinking and Why Is It Important?', *Review of Educational Research*, 82(3), pp. 330–348. Available at: <https://doi.org/10.3102/0034654312457429>.
- Simon, H.A. (1996) *The Sciences of the Artificial*. Cambridge, MA: MIT Press.
- Stake, R.E. (1995) *The art of case study research*. Thousand Oaks: Sage Publications.
- Taras, V. et al. (2013) 'A Global Classroom? Evaluating the Effectiveness of Global Virtual Collaboration as a Teaching Tool in Management Education', *Academy of Management Learning & Education*, 12(3), pp. 414–435. Available at: <https://doi.org/10.5465/amle.2012.0195>.
- UN DESA (2022) *The Sustainable Development Goals Report 2022 - July 2022*. New York, USA: UN DESA. Available at: <https://unstats.un.org/sdgs/report/2022/>.
- Wardrobe, W.J. (2002) 'Department Chairs' Perceptions of the Importance of Business Communication Skills', *Business Communication Quarterly*, 65(4), pp. 60–72. Available at: <https://doi.org/10.1177/108056990206500406>.
- Yazan, B. (2015) 'Three approaches to case study methods in education: Yin, Merriam, and Stake', *The qualitative report*, 20(2), pp. 134–152.
- Yin, R.K. (2018) *Case study research and applications: design and methods*. Sixth edition. Thousand Oaks, California: SAGE Publications, Inc.

Introducing Sources of self-efficacy and Dysfunctional Career Beliefs in Socio-cognitive Career Theory in Entrepreneurship

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Abstract: A missing link between entrepreneurship education and career choices is how and when alumni decide to behave entrepreneurially. This question pertains to the impact of entrepreneurship education as envisaged in various educational policies. The vast majority of relevant studies have examined the concepts of entrepreneurial self-efficacy and entrepreneurial intention across courses and audiences worldwide. A recent trend adopts more systematic career development theories as the social cognitive career theory (SCCT). In this line, the present article provides new insights in SCCT models including the construct of dysfunctional career beliefs that represents an essential element in career decision-making. The article presents a small-scale quantitative research through a sample of Greek adults aimed to examine the relations between entrepreneurial intention and dysfunctional career beliefs as well as the informational sources of self-efficacy representing fundamental premises of SCCT. The pilot findings show that “significant others”, a dimension of dysfunctional career beliefs, influence the entrepreneurial career decision process as an extraneous personal parameter. Linear multiple regression analysis demonstrated that positive emotions, mastery experiences and the perceptions regarding significant others’ influence in career decision-making significantly predicted entrepreneurial intention. It is also shown that influence from significant others moderates the relationship between positive emotions and entrepreneurial intention, that is, intensifying the previous relationship when influence of significant others is low and decreasing it when this influence is high. These findings are discussed in the context of entrepreneurial career decision making with implications to educational and career counselling practices.

Keywords: Entrepreneurship Education, Entrepreneurial Intention, Dysfunctional Career Beliefs, Socio-Cognitive Career Theory, Career Decision-Making

1. Introduction

Entrepreneurship has been internationally viewed as a panacea for firm performance, technological innovation and economic development. Moreover, entrepreneurship is suggested as a key-mechanism for endogenous growth and social cohesion in modern, knowledge-driven societies and economies (Kakouris, Dermatis & Liargovas 2016). As a result, studies of entrepreneurial intention and behaviour have been attractive for many researchers and policy makers (e.g. Belchior & Lyons 2021). However, despite these desirable directions which are reflected in the various policies, the failure rates of start-ups are particularly high (around 90%), a fact that deters a large number of population and stakeholders from entrepreneurship. Formal or informal training and counselling is provided to strengthen the entrepreneurial behaviour of young people, while entrepreneurship is proposed as a career option (Walmsley, Decker-Lange & Lange 2022) for graduates in all disciplines (Tampouri, Kaliris, & Kakouris, 2023) across the globe.

The creation of a new venture is often viewed as an intentional, planned behaviour (Krueger et al., 2000) thus entrepreneurial intention (Thompson, 2009) has received extensive attention in the entrepreneurship literature (e.g. Krueger et al. 2000; Liñán & Fayolle 2015). Entrepreneurial intention has been conceptualized as a state of mind directing a person’s attention, experience, and actions towards the specific goal of creating a new business venture (Bird & Jelinek 1989). However, the formation of intention may be identified a long time before actual behaviour, whereas behaviour may also never take place. Several studies show that several variables (e.g. personal inputs, background variables, beliefs regarding entrepreneurial success and others) may also be crucial regarding the formation of entrepreneurial behaviours (e.g. Belchior & Lyons 2021; Kakouris 2019; Laukkanen 2022; Liguori et al. 2020) and can affect the formation of intention for one to be an entrepreneur. Krueger (2009) argues that intention is a core construct “deeply fundamental to human decision making” (p. 53) that might offer multiple fruitful opportunities to researchers to study new theories and models relating to decision making under risk and uncertainty. In this line, emerging models used to investigate the phenomenon of entrepreneurial intentions are becoming more integrative of past models, such as combining those generated by Ajzen (1991) and Shapero (1984), and extending them to include demographic characteristics, perceived university support, entrepreneurial conviction, tolerance for risk, perceived benefits and so forth (Liguori et al. 2020). A variety of

new theoretical frameworks, techniques and methods have been recently implemented by several researchers (Tampouri et al. 2023).

To better understand the formation of entrepreneurial intention and entrepreneurship as a career choice, we draw on Social Cognitive Career Theory (SCCT) (Lent et al., 1994), an approach with great explanatory power which has proven useful in identifying the relationships between core variables that underpin career decision-making (Blaese, Noemi & Brigitte 2021; Lent et al. 2000, 2002, 2008; Liguori, et al. 2018; 2020; Meoli et al. 2020). Stemming from Bandura's theory, the sources of self-efficacy have received attention in research on SCCT's content models, particularly in the context of mathematics (e.g., Lent, Lopez, & Bieschke 1991), STEM education (e.g. Sheu et al. 2016), Holland theme domains (e.g., Schaub & Tokar 2005) and quite recently in the context of formulating career counselling self-efficacy beliefs (e.g. Kaliris 2019). However, there have been few studies investigating associations between the sources of self-efficacy, goals, intention and outcome expectations regarding career process behaviours, such as decision-making (Lent et al. 2017).

Much research in the entrepreneurial intention inquiry has drawn attention to the impact of entrepreneurial self-efficacy on entrepreneurial intention (e.g Wilson, Kickul, & Marlino 2007; Zhao, Seibert and Hills 2005). However, there is a void in the entrepreneurship literature in examining the theoretical antecedents of self-efficacy beliefs that may, in turn, affect entrepreneurial intention. These informational sources have more general features than task-specific entrepreneurial self-efficacy which has been commonly investigated as predictor of intention so far. Further, these sources may be conceptualised as the origins of self-efficacy beliefs which reflect distinctive influential learning experiences. Thus, these primary learning sources could act as particular pillars of tailored career counselling and educational interventions for potential young entrepreneurs. Apart from Bandura's sources of self-efficacy, we also explore the potential role of dysfunctional career beliefs in the formation of entrepreneurial career choices, as they have been recognized as an important factor in the career decision-making process (Austin et al. 2004; Hechtlinger & Gati 2019). Thus, the driving research question for the rest of the article pertains to the role of the sources of self-efficacy along with dysfunctional career thoughts (or beliefs) in the formation of entrepreneurial intention.

2. Theoretical framework and research questions

A person's beliefs about his or her abilities seem to be shaped through four main sources that are linked both to the environment and to the cognitive interpretation that the individual makes of the influences he or she receives from it (Bandura 2012). Thus, the sources of self-efficacy read as follows:

- i. **Mastery experiences.** Research results on various learning-educational domains, for example, academic achievement and academic attainment (Fong & Krause 2014; Phan & Ngu 2016), self-efficacy in writing (Pajares et al. 2007), mathematics, and reading (Butz & Usher 2015; Usher & Pajares 2009) suggest that past performance experiences are potentially the strongest source of self-efficacy information because they are based on experiences of skill over which the individual exercises personal control (Bandura 1997). Successes tend to increase the strength and generalisation of self-efficacy beliefs, while repeated failures cause them to weaken.
- ii. **Vicarious learning.** This source is provided by social role models (teachers, parents, peers, colleagues, etc.). Often, one's perception of self-efficacy for a situation is a reflection of the results related with others' efforts and behaviours. The more individuals feel they resemble a model of success or failure, the more likely they are to change their beliefs about their self-sufficiency by following that model (Schunk 1987).
- iii. **Verbal persuasion.** This informational source, referred as social persuasion as well, is about advice, verbal patterns, encouragement as well as stories or "myths" conveyed by others that shape one's level of confidence in one's abilities. Positive, encouraging messages about evaluating specific outcomes, especially when perceived as realistic and authentic, contribute to enhancing one's effort as a result of positive feedback (Fong & Krause 2014, p. 252). Those who are verbally convinced that they possess the abilities to control their actions are likely to be motivated and more persistent in solving problems that may arise.
- iv. **Physiological and emotional states.** People rely, to some extent, on the level of emotional arousal they experience to judge how dangerous a stressful situation is and interpret their anxious reactions as signs of vulnerability. Consequently, these emotions can lead to poor performance. Thus, people feel that

they are effective in situations where they do not experience much tension, whereas in activities that require strength and endurance, they may judge fatigue, anxiety and pain as obstacle (Bandura 1997).

In the entrepreneurship domain, although past research has examined relationships between entrepreneurial self-efficacy beliefs and formation of entrepreneurial intentions, there is a lack of research investigating the links between the previous four core informational self-efficacy sources and entrepreneurial intention. Therefore, in this study we intended to examine the relations between the above variables. Accordingly, the following research question is articulated:

RQ1: Are informational sources of self-efficacy beliefs associated with entrepreneurial intention?

Beyond sources of self-efficacy, the dysfunctional career thoughts (or beliefs) have been recognised as an important factor in the career decision-making process (Austin et al. 2004). They refer to prejudiced or twisted career beliefs, unreasonable expectations, various career myths, negative estimations regarding the individual's actions and professions, which influence each one's ambitions and his actions. Career counsellors have observed that many clients express some dysfunctional thoughts and beliefs about their careers, which affect and impede the resolution of problem solving and decision making (e.g. some people expect to find the perfect career, others believe that career choice is only possible once and cannot be changed in the future, etc.). Such dysfunctional beliefs may lead the individual to avoid the decision-making process, to give up when difficulties arise at some stage of the decision-making process, or cause uncertainty about the appropriateness of the choice and lack of commitment to it. The recognition of the individual's dysfunctional beliefs about career issues is a particularly critical issue for the provision of career counselling and educational services (Hechtlinger & Gati 2019; Kleiman et al. 2004). In this line, dysfunctional beliefs might prevent an individual from selecting entrepreneurship as an optimal career choice. Grounded on this rationale, the following research questions is articulated:

RQ2: Do the dysfunctional career beliefs act as a moderator between the sources of self-efficacy beliefs and entrepreneurial intention?

A pilot quantitative survey follows in order to confront the previous research questions.

3. Methodology

3.1 Procedure

A pilot sample of N=102 responses to a questionnaire was collected in Greece. Snowball sampling was employed as the data collection method. In this technique, initial participants are selected based on their availability and they are then asked to assist in expanding the sample by identifying other potential participants. This technique was selected as it provides practical advantages such as low cost and less time for the data collection without implying significant bias for the explorative results. The questionnaire was administered online, including brief instructions on the aim of the research project, the importance of participating in it, and on confidentiality credentials. The participants' acceptance to complete the questionnaire was thus considered a form of informed consent. A dropout rate of 50% was observed (about half of the responses were found incomplete).

3.2 The research instrument

For data collection, a number of constructs were included in the questionnaire:

(I) Beliefs about Career Decisions Questionnaire (BCD, Hechtlinger & Gati 2019)

Beliefs about Career Decisions Questionnaire (BCD) is consisted of 16 statements investigating difficulties in decision-making regarding the career path. They are scored on a nine-point Likert scale (1= completely disagree ... 9= completely agree). BCD assesses the following five factors: i) The role of chance or fate, ii) The criticality of the decision, iii) The role of significant others, iv) The role of professional help, and v) The role of gender stereotypes. Internal consistency reliability coefficients are above 0.70 for all factors. The factor structure of the questionnaire was tested with exploratory and confirmatory factor analysis and there is evidence of concurrent validity with other decision making tools.

(II) Entrepreneurial Intention Scale (Thompson 2009)

Entrepreneurial Intention Scale is consisted of 6 items/statements (direct and inverted) scored by the respondents on a seven-point Likert scale (1=completely untrue ... 7=completely true).

(III) Sources of Entrepreneurial Self-Efficacy

In order to measure the sources of entrepreneurial self-efficacy, an adapted scale including selected items drawn from a Lent et al.'s (2017) scale measuring sources of decision-making self-efficacy, was constructed by the authors. This new adapted scale consists of seven items that evaluate sources of entrepreneurial self-efficacy. The first six questions evaluate personal entrepreneurial mastery experiences (e.g., successes and failures), verbal persuasion (e.g., social encouragement or discouragement of entrepreneurship), vicarious learning (i.e., observation of entrepreneurial role models), on a 5-point Likert-type scale using the anchors 1 "totally disagree" to 5 "totally agree". Further, the fourth source of self-efficacy, "physiological and affective states", is assessed via the last question regarding the extent to which a person has a particular feeling of those included in a given list based on a 5-point Likert scale, ranging from 1 "not at all" to 5 "greatly". Four positive and four negative emotions were included from which two variables are constructed (positive and negative emotions). Example items for the scale are: "I admire people who own an enterprise, with whom I share common traits" and "I have gathered effectively information and resources regarding the initiation of a new business venture". All Cronbach alphas were found over 0.7.

(IV) Impromptu Questionnaire of Individual – Demographic elements.

A few demographic and other relevant information to the research objectives were assessed (8 questions in total). More specifically, there were included questions on the respondents' gender, age, educational level and work experience. Additionally, the participants were asked if they had taken an entrepreneurship course in the past and if their parents have or had had a business.

3.3 Sample

The sample of this research consisted of N=102 participants, aged from 19 to 64, with an average age of 39 (SD=13.31). As to gender, 60 (59%) were male and 42 (41%) female. Regarding the educational level of the sample, 48 individuals (47.1%) had completed secondary education by the time the survey took place and 38 participants (37.3%) had completed tertiary education. Fourteen persons (13.7%) hold a Master's degree, and only one was a PhD holder. From the total sample only 33.3% had developed a type of entrepreneurial action (7.8% had their own employees in their enterprise whereas 25.5% stated they are self-employed). Forty one percent of the participants (42 individuals) had attended at least one entrepreneurial course whereas the rest of them (64.7%) had not. Variability was observed in length of work experience with half of the participants possessing extensive experience, over 15 years.

4. Results

4.1 Descriptive statistics and correlations

It is seen from Table 1 that all sources of self-efficacy (except negative emotions) and significant others variable from Beliefs about Career Decisions (BCD) (referred as dysfunctional career beliefs here) can be considered as determinants of entrepreneurial intention. Since positive correlations of all self-efficacy sources (except negative emotions) were found, the research question (RQ1 is answered positively. It has to be noted that despite non-significant in the present sample, negative emotions anticorrelate with intention and positively correlate with significant others ($p=.263$, $p<.008$). Stepwise linear regression (Table 2) for these five predictors of entrepreneurial INTENTION reveals POSITIVE EMOTIONS as the most significant one, MASTERY the second most significant and SIGNIFICANT OTHERS as the third one. Thus, the basic model of the present study is:

$$\text{INTENTION} = \beta_1 \times \text{POSITIVE EMOTIONS} + \beta_2 \times \text{MASTERY} + \beta_3 \times \text{SIGNIFICANT OTHERS} + c \quad (1)$$

Table 1: Mean, standard deviation and significant Spearman correlations between the variables

	INT.	SOURCES OF SELF-EFFICACY					BCD				
	1	2	3	4	5	6	7	8	9	10	11
MEAN	4.06	3.34	3.19	3.75	3.75	2.46	2.74	2.16	4.43	3.92	3.43
SD	1.37	1.06	1.08	1.11	1.00	1.10	1.74	1.48	2.03	1.88	2.23
1. INT.	-	.364**	.235*	.315**	.355**	n.s.	n.s.	-.243*	n.s.	n.s.	n.s.
* $p<.05$, ** $p<.01$											

1. ENTREPRENEURIAL INTENTION, 2. MASTERY, 3. SOCIAL PERSUASION, 4. VICARIOUS LEARNING, 5. POSITIVE EMOTIONS, 6. NEGATIVE EMOTIONS, 7. CHANCE OR FAITH, 8. SIGNIFICANT OTHERS, 9. CRITICALITY, 10. PROFESSIONAL HELP, 11. GENDER STEREOTYPES

Table 2: Stepwise regression model summary for ENTREPRENEURIAL INTENTION

Model	Adj. R ²	R ² Change	F Change	p(F Change)
POSITIVE EMOTIONS	.144	.153	16.617	.000
POSITIVE EMOTIONS MASTERY	.172	.037	4.185	.044
POSITIVE EMOTIONS MASTERY SIGNIFICANT OTHERS	.202	.038	4.380	.039

4.2 Multiple regression model

Linear multiple regression analysis for the basic model (1) and for the interaction model are shown in Table 3. The two models are statistically significant and no multicollinearity issues were observed (all VIFs are well below 4). Standardized beta coefficients are positive for all variables except significant others which show a negative effect on entrepreneurial intention. Through the interaction model, a statistically significant moderation effect by significant others is observed on the influence of positive emotions on entrepreneurial intention ($\beta = -3.005$, $p < .003$). This effect is shown in Figure 1.

Table 3: Multiple regression models for ENTREPRENEURIAL INTENTION

	Basic model			Interaction model		
	Stand. B	t	p	Stand. β	t	p
POS. EMOTIONS	.275**	2.687	.009	.225*	2.225	.029
MASTERY	.255*	2.471	.015	.215*	2.149	.034
SIG. OTHERS	-.199*	-2.093	.039	-.250*	-2.421	.018
POS. EMOTIONS X MASTERY				.122	1.341	.183
POS. EMOTIONS X SIG. OTHERS				-.303**	-3.005	.003
MASTERY X SIG. OTHERS				.149	1.411	.162
R ²	.228			.310		
F-value	8.850**			6.525**		
ΔR ²	.228			.083		
F(ΔR ²)	8.850**			3.471*		
* p<.05, ** p<.01						

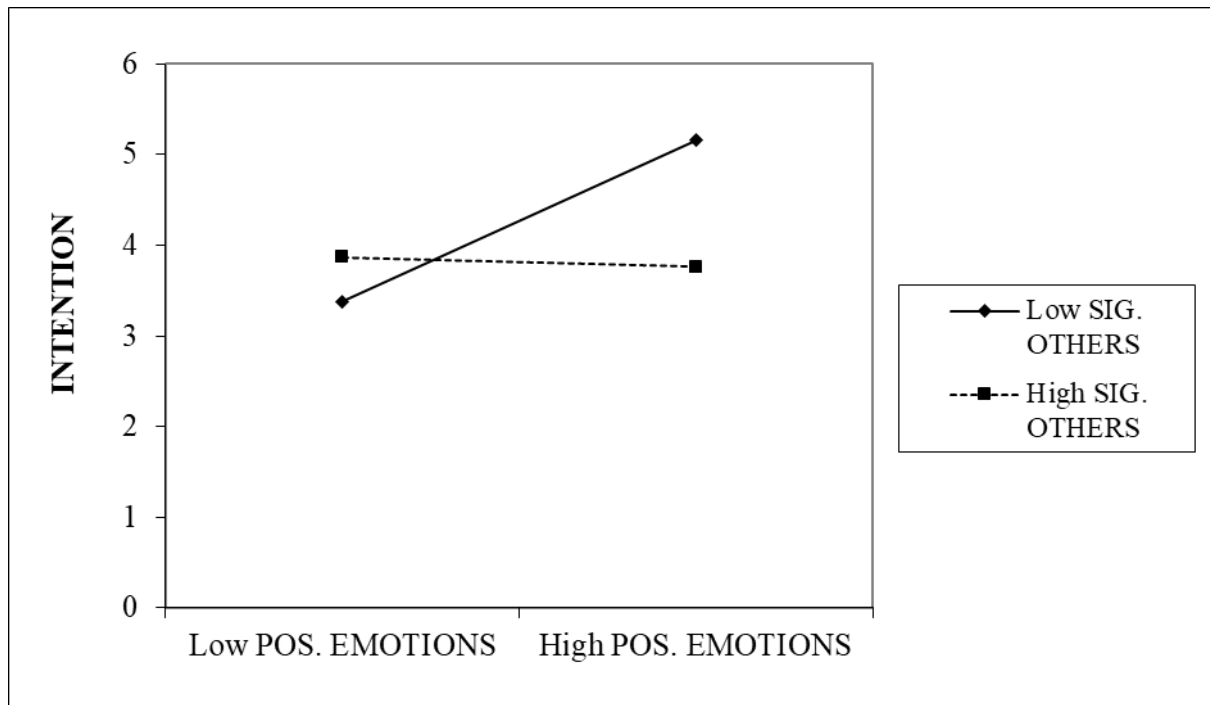


Figure 1: Moderation effect of significant others BCD on the dependence of entrepreneurial intention on positive emotions.

The moderation effect of Figure 1 shows that positive emotions increase entrepreneurial intention when the personal influence from significant others is low where high personal influence from significant others reverses this relationship. Thus, the answer to research question RQ2 is that the personal influence from significant others, a dysfunctional career belief, does moderate the impact of positive emotions, a source of self-efficacy, to entrepreneurial intention.

5. Discussion

As entrepreneurship education, and other policy-driven campaigns, have undergone a tremendous expansion phase for the last twenty years (e.g. Kakouris & Georgiadis 2016), it is timely to relate the outcomes with career decision-making theories capable of consistently joining them with career options acknowledged in educational policies for entrepreneurship. Most studies in the field employ entrepreneurial self-efficacy as the major construct that determines entrepreneurial intention and can be affected by educational and other interventions. Nonetheless, career decision making is known to be a more complicated process confronted through psychological models such as the social career choice theory (SCCT, Lent et al. 2000, 2002, 2008). In this approach, sources of self-efficacy are important, more general and enduring constructs that formulate self-efficacy. These constructs interweave with others and can influence the career decision process at several points.

Since scarce research in entrepreneurship has examined the sources of self-efficacy, this work demonstrated the positive correlation of most of them with entrepreneurial intention (Table 1). Mastery experiences, vicarious learning, social persuasion and emotional states positively influence entrepreneurial intention whilst positive emotions and mastery experiences prove to be the most significant explanators of it (Table 2). Not surprisingly, most of educational and other policies have focused on these sources in order to encourage the entrepreneurial behaviour of the youth. Experiential learning, for example, aims at equipping trainees with authentic entrepreneurial learning experiences indicative for the genuine nature of business venturing and its aspects in which trainees have to attain self-confidence. The commonly highlighted influence from a business family, or other role models massively promoted in the modern era of entrepreneurship, is also essential for vicarious learning. Widespread entrepreneurial narratives, success stories, or even propagating myths (e.g. Shane, 2008), tend to create social persuasion towards entrepreneurship. The accommodative environments of business incubators and other entrepreneurial ecosystems also strengthen the social persuasion for entrepreneurship. Perhaps, the less explored source of self-efficacy pertains to the emotional states of the individuals despite their major importance (e.g. Kakouris 2015; Zampetakis et al. 2017). This pilot study underscores the influence of

Bandura's sources of self-efficacy on entrepreneurial intention suggesting special attention to mastery experiences (through education and training) along with personal emotional states in future research.

Another contribution of the present findings concerns the role of dysfunctional career beliefs (Hechtlinger & Gati 2019) in considering entrepreneurship as a career option. Amongst them, personal influence from significant others was found to have a negative correlation with entrepreneurial intention (Table 1). Those who are influenced more by significant others do not exhibit high entrepreneurial intention. This result aligns with other studies in the field which demonstrate that entrepreneurs possess internal locus of control (e.g. Asante & Affum-Osei 2019). In this way, influence by significant others can moderate the impact of sources of self-efficacy on intention. In the present dataset the moderation is striking for the dependence of entrepreneurial intention on positive emotions (Figure 1). People with positive feelings about entrepreneurship exhibit higher entrepreneurial intention as far as they are not strongly influenced by significant others. Else, the previous positive relationship is reversed. The inclusion of dysfunctional career beliefs in the social career choice theory in entrepreneurship is new and needs further investigation since this type of beliefs is known to play an important role in career decisions in other contexts and populations (e.g. Sidiropoulou-Dimakakou, Mylonas, Argyropoulou & Tampouri 2012).

In sum, coherent career decision models are needed to inform how individuals decide to undertake entrepreneurial action. Social carer choice theory is currently adopted in entrepreneurial intention studies but there is room for enriching it through relevant psychological constructs such as sources of self-efficacy and dysfunctional career beliefs examined here. Once these sources are understood better, relevant effective interventions can be scheduled.

6. Conclusion

The study of entrepreneurship as a career option needs to employ systematic psychological theory on how individuals make career decisions. In this vein, well known sources of self-efficacy along with dysfunctional career beliefs are important constructs that interfere in entrepreneurial career decision making. Their role introduces certain implications for educators and counsellors as well as institutions which aim to support entrepreneurship. Cross-cultural research (e.g. Fleck et al. 2020) in this direction is also possible. The present results encourage further research on the formation of entrepreneurial intentions and behaviours from targeted populations under informed interventions once some of the limitations of the present exploratory study are waived.

Acknowledgements

The authors acknowledge funding from the University of the Peloponnese towards participating in the ECIE 2023 conference.

References

- Ajzen, I. (1991), "The theory of planned behavior", *Organizational Behavior and Human Decision Processes*, Vol 50 No 2, pp 179-211.
- Asante, E. A. and Affum-Osei, E. (2019), "Entrepreneurship as a career choice: The impact of locus of control on aspiring entrepreneurs' opportunity recognition", *Journal of Business Research*, Vol 98, pp 227-235.
- Austin, R. K., Wagner, B., and Dahl, D. (2004), "Reducing career indecisiveness in adults", *International Journal of Disability Community and Rehabilitation*, Vol 3 No 2.
- Austin, M. J. and Nauta, M. M. (2016), "Entrepreneurial role-model exposure, self-efficacy, and women's entrepreneurial intentions", *Journal of Career Development*, Vol 43 No 3, pp 260-272.
- Bandura, A. (1997), *Self-Efficacy: The Exercise of Control*. New York, NY: Freeman.
- Bandura, A. (2012), "On the functional properties of perceived self-efficacy revisited", *Journal of Management*, Vol 38 No 1, pp 9-44. doi: 10.1177/0149206311410606
- Belchior, R. F. and Lyons, R. (2021), "Explaining entrepreneurial intentions, nascent entrepreneurial behavior and new business creation with social cognitive career theory—a 5-year longitudinal analysis", *International Entrepreneurship and Management Journal*, Vol 17 No 4, pp 1945-1972.
- Bird, B. and Jelinek, M. (1989), "The operation of entrepreneurial intentions", *Entrepreneurship Theory and Practice*, Vol 13 No 2, pp 21-30.
- Blaese, R., Noemi, S. and Brigitte, L. (2021), "Should I stay, or should I go? Job satisfaction as a moderating factor between outcome expectations and entrepreneurial intention among academics", *International Entrepreneurship and Management Journal*, Vol 17 No 3, pp 1357-1386.

- Butz, A. R. and Usher, E. L. (2015), "Salient sources of early adolescents' self-efficacy in two domains", *Contemporary Educational Psychology*, Vol 42, pp 49-61. <http://dx.doi.org/10.1016/j.cedpsych.2015.04.001>
- Fleck, E., Kakouris, A. and Winkel, D. (2020), "Cultural traits of entrepreneurship education: a cross-national study", *Journal of Entrepreneurship in Emerging Economies*, Vol 13 No 5, pp 838-863. <https://doi.org/10.1108/JEEE-02-2020-0030>
- Fong, C. J., and Krause, J. M. (2014), "Lost confidence and potential: a mixed methods study of underachieving college students' sources of self-efficacy", *Social Psychology of Education*, Vol 17, pp 249-268. doi: 10.1007/s11218-013-9239-1
- Hechtlinger, S. and Gati, I. (2019), "Dysfunctional career decision-making beliefs: A multidimensional model and measure", *Journal of Career Assessment*, Vol 27 No 2, pp 209-229. doi:10.1177/1069072717748677
- Kaliris, A. (2019). *Perceived self-efficacy resources of career counselors and trainees* (Unpublished Doctoral Dissertation). Department of Philosophy, Pedagogy, and Psychology, National and Kapodistrian University of Athens. <https://www.didaktorika.gr/eadd/handle/10442/45999>
- Kakouris, A. (2015), "Entrepreneurship pedagogies in lifelong learning: emergence of criticality?", *Learning, Culture and Social Interaction*, Vol 6, pp 87-97. <https://doi.org/10.1016/j.lcsi.2015.04.004>
- Kakouris, A. (2019), "The ASKO dialectical framework for entrepreneurial courses construction: theoretical foundation", *Entrepreneurship Education*, Vol 2 No 1/2, pp 51-69. <https://doi.org/10.1007/s41959-019-00013-4>
- Kakouris, A., Dermatis, Z. and Liargovas, P. (2016), "Educating potential entrepreneurs under the perspective of Europe 2020 plan", *Business & Entrepreneurship Journal*, Vol 5 No 1, pp 7-24.
- Kakouris, A. and Georgiadis, P. (2016), "Analysing entrepreneurship education: a bibliometric survey pattern", *Journal of Global Entrepreneurship Research*, Vol 6 No 1, pp 6. <https://doi.org/10.1186/s40497-016-0046-y>
- Kleiman, T., Gati, I., Peterson, G., Sampson, J., Reardon, R. and Lenz, J. (2004), "Dysfunctional thinking and difficulties in career decision making", *Journal of Career Assessment*, Vol 12 No 3, pp 312-331.
- Krueger, N.F., Reilly, M.D. and Carsrud, A.L. (2000), "Competing models of entrepreneurial intentions", *Journal of Business Venturing*, Vol 15 No 5/6, pp 411-432. [https://doi.org/10.1016/S0883-9026\(98\)00033-0](https://doi.org/10.1016/S0883-9026(98)00033-0).
- Krueger, N. (2009), "Entrepreneurial intentions are dead: Long live entrepreneurial intentions", in M. Brannback & A. L. Carsrud (Eds.), *Understanding the entrepreneurial mind*, pp 51-72, Springer, New York.
- Laukkanen, M. (2022), "What lies behind entrepreneurial intentions? Exploring nascent entrepreneurs' early belief systems", *International Journal of Entrepreneurial Behavior & Research*, Vol 28 No 9, pp 177-197.
- Lent, R. W., Brown, S. D., and Hackett, G. (1994), "Toward a unifying social cognitive theory of career and academic interest, choice, and performance", *Journal of Vocational Behavior*, Vol 45 No 1, pp 79-122. <https://doi.org/10.1006/jvbe.1994.1027>
- Lent, R. W., Brown, S. and Hackett, G. (2000), "Contextual supports and barriers to career choice: A social cognitive analysis", *Journal of Counseling Psychology*, Vol 47 No 1, pp 36-49. <https://doi.org/10.1037/0022-0167.47.1.36>
- Lent, R. W., Brown, S. D. and Hackett, G. (2002). "Social cognitive career theory", *Career Choice and Development*, Vol 4 No 1, pp 255-311.
- Lent, R. W., Lopez, F. G. and Bieschke, K. J. (1991), "Mathematics self-efficacy: Sources and relation to science-based career choice", *Journal of Counseling Psychology*, Vol 38 No 4, pp 424.
- Lent, R. W., Lopez, A. M., Jr, Lopez, F. G. and Sheu, H. B. (2008), "Social cognitive career theory and the prediction of interests and choice goals in the computing disciplines", *Journal of Vocational Behavior*, Vol 73 No 1, pp 52-62. <https://doi.org/10.1016/j.jvb.2008.01.002>
- Lent, R. W., Ireland, G. W., Penn, L. T., Morris, T. R. and Sappington, R. (2017), "Sources of self-efficacy and outcome expectations for career exploration and decision-making: A test of the social cognitive model of career self-management", *Journal of Vocational Behavior*, Vol 99, pp 107-117.
- Liguori, E. W., Bendickson, J. S. and McDowell, W. C. (2018), "Revisiting entrepreneurial intentions: A social cognitive career theory approach", *International Entrepreneurship and Management Journal*, Vol 14 No 1, pp 67-78.
- Liguori, E., Winkler, C., Vanevenhoven, J., Winkel, D. and James, M. (2020), "Entrepreneurship as a career choice: intentions, attitudes, and outcome expectations", *Journal of Small Business & Entrepreneurship*, Vol 32 No 4, pp 311-331.
- Liñán, F. and Fayolle, A. (2015), "A systematic literature review on entrepreneurial intentions: Citation, thematic analyses, and research agenda", *International Entrepreneurship and Management Journal*, Vol 11 No 4, pp 907-933.
- Meoli, A., Fini, R., Sobrero, M. and Wiklund, J. (2020), "How entrepreneurial intentions influence entrepreneurial career choices: The moderating influence of social context", *Journal of Business Venturing*, Vol 35 No 3, Article 105982. <https://doi.org/10.1016/j.jbusvent.2019.105982>
- Pajares, F., Johnson, M. J. and Usher, E. L. (2007), "Sources of Writing Self-Efficacy Beliefs of Elementary, Middle, and High School Students", *Research in the Teaching of English*, Vol 42 No 1, pp 104-120.
- Phan, H. P. and Ngu, B. H. (2016), "Sources of self-efficacy in academic contexts: A longitudinal perspective", *Social Psychology of Education*, Vol 31 No 4, pp 548-564. doi: 10.1037/spq0000151
- Schaub, M. and Tokar, D. (2005), "The role of personality and learning experiences in social cognitive career theory", *Journal of Vocational Behavior*, Vol 66, pp 304-325. <http://dx.doi.org/10.1016/j.jvb.2004.09.005>.
- Schunk, D. H. (1987), "Peer models and children's behavioral change", *Review of Educational Research*, Vol 57, pp 149-174.

- Shane, S. A. (2008), "The illusions of entrepreneurship: The costly myths that entrepreneurs, investors, and policy makers live by", Yale University Press.
- Shapero, A. (1984), "The entrepreneurial event", in C. A. Kent (Ed.), *The Environment for Entrepreneurship*, pp 21-40, Lexington Books, Lexington, MA.
- Sheu, H., Lent, R., Miller, M. J., Truong, N.N., Penn, L.T. and Cusick, M.E. (2016), "Meta-analysis of social cognitive predictors of STEM choice in underrepresented students". Paper presented at the meeting of the American Psychological Association, Denver, CO.
- Sidiropoulou-Dimakakou, D., Mylonas, K., Argyropoulou, K. and Tampouri, S. (2012), "Career decision-making difficulties, dysfunctional thinking and generalized self-efficacy of university students in Greece", *World Journal of Education*, Vol 2 No 1, pp 117-130.
- Tampouri, S., Kaliris, A. and Kakouris, A. (2023), "Researching entrepreneurial beliefs in career decision-making", *Business & Entrepreneurship Journal*, Vol 12 No 2), pp 33-50. <https://doi.org/10.47260/bej/1222>
- Thompson, E.R. (2009), "Individual entrepreneurial intent: Construct clarification and development of an internationally reliable metric", *Entrepreneurship Theory and Practice*, Vol 33 No 3, pp 669-694.
- Usher, E. L. and Pajares, F. (2009), "Sources of self-efficacy in mathematics: A validation study", *Contemporary Educational Psychology*, Vol 34, pp 89-101.
- Walmsley, A., Decker-Lange, C. and Lange, K. (2022), "Conceptualising the entrepreneurship education and employability nexus", in A. Walmsley, C. Decker-Lange & K. Lange (Eds.), *Theorising Undergraduate Entrepreneurship Education: Reflections on the Development of the Entrepreneurial Mindset*, pp 97-114, Springer International Publishing, Cham.
- Wilson, F., Kickul, J. and Marlino, D. (2007), "Gender, entrepreneurial self-efficacy, and entrepreneurial career intentions: Implications for entrepreneurship education", *Entrepreneurship Theory and Practice*, Vol 31 No 3, pp 387-406.
- Zampetakis, L. A., Kafetsios, K., Lerakis, M., and Moustakis, V. S. (2017), "An emotional experience of entrepreneurship: Self-construal, emotion regulation, and expressions to anticipatory emotions", *Journal of Career Development*, Vol 44 No 2, pp 144-158.
- Zhao, H., Seibert, S. E. and Hills, G. E. (2005), "The mediating role of self-efficacy in the development of entrepreneurial intentions", *Journal of Applied Psychology*, Vol 90 No 6, pp 1265-1272.

From Hype to Reality: Navigating the Challenges of RPA Implementation

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Abstract: The term Robotic Process Automation (RPA) was first utilised in 2012 (Hindle, 2018). The term began to gain traction in 2014 when businesses started to announce major savings because of automation. In early 2016, RPA back office automation became more significant but during this period it was still relatively limited (Willcocks & Lacity, 2016). From 2016 to 2017 the global RPA market increased by 64% (Fersht, 2017). They also reported a 42% increase in the global market for RPA between 2017 and 2018 and an anticipated increase of a further 94% between 2018 and 2021 (Fersht, 2017). The demand for RPA has increased using AI and software robots are expected to be the key drivers of growth. RPA continues to gather prominence throughout Europe as companies are eager to improve customer experience and to offer a streamlined service particularly for the financial services industry (Information Services Group, Inc., 2018). The key objective is to improve organizational performance and the customers' experience using an RPA solution. The RPA solution will enable the organization to provide around the clock robot assistance to the client, enhancing effectiveness and efficiency of the compliance process, faster return on investment (ROI), reduced processing time as well as helping to meet deadlines, improved quality with reduced human errors (Pattfaut and Borghoff, 2022). However, RPA is an extensive process and requires expertise in this space, structured input, and governance to achieve optimal implementation. The research objective of this investigation therefore is to explore methods for automating business processes while reducing operating costs and improving efficiency. In doing so, three research questions are presented: 1) What are the key phases in an RPA implementation?: 2) What activities are involved in each of the phases?; and 3) What should be the focus of each of these activities?

Keywords: Robotic process automation, innovation, development, performance, efficiency, scaling up

1. Introduction

Robot Process Automation (RPA) can be defined as *"a preconfigured software instance that uses business rules and predefined activity choreography to complete the autonomous execution of a combination of processes, activities, transactions, and tasks in one or more unrelated software systems to deliver a result or service with human exception management"* (IEEE Corporate Advisory Group, 2017). In recent years, RPA has emerged as a transformative technology, revolutionizing the way organizations operate by using software robots or "bots" to automate repetitive and rule-based tasks that were previously performed by humans (Lacity and Willcocks, 2017). This phenomenon has gained prominence due to advancements in artificial intelligence (AI) and machine learning (ML). The convergence of these technologies has led to the development of sophisticated software bots capable of emulating human actions. The earliest applications of RPA can be traced back to screen scraping and macros, but modern RPA solutions are far more advanced, incorporating AI and ML algorithms to handle complex tasks. Organizations across various sectors are embracing RPA to streamline their operations and drive efficiency, which has delivered several benefits (Soltani et al., 2017).

Firstly, RPA enables organizations to automate repetitive and time-consuming tasks, resulting in significant improvements in efficiency and cost reduction. By freeing up human resources from mundane activities, RPA allows employees to focus on more strategic and value-added tasks, leading to enhanced productivity (Müller et al., 2018). For example, routine data entry, invoice processing, and report generation can be automated through RPA, saving valuable time, and reducing error rates. Secondly, from the perspective of accuracy and compliance, RPA bots are designed to follow predefined rules and workflows consistently. This ensures a higher degree of accuracy, reducing the likelihood of errors. Moreover, RPA provides a robust audit trail, enhancing compliance and regulatory adherence for organizations operating in highly regulated industries. By automating tasks such as compliance reporting and data validation, organizations can minimize the risk of non-compliance and associated penalties. Thirdly, RPA allows organizations to scale operations rapidly without incurring

additional infrastructure costs, increasing organizational agility (Fernandes et al., 2019). Bots can be easily deployed and scaled up or down to accommodate fluctuations in workload. This flexibility enables organizations to adapt quickly to changing business demands and market conditions. For instance, during peak periods, RPA can handle increased transaction volumes efficiently, ensuring timely service delivery without the need for additional human resources.

1.1 Research Gap

RPA-based solutions are transforming business processes by delivering fast, accurate service, and improving the customer experience. Organizations are seeking to leverage the potential of RPA and provide better business and tech solutions (Bhaskar et al., 2021). More recently, industries are giving increased importance to automation as it is disrupting the current state of daily business processes, keeping well balanced with organizational drivers such as cost, productivity, and efficiency (da Silva Carvalho et al., 2021). We thus state our research questions as:

1) What are the key phases in an RPA implementation?

Understanding the key phases in an RPA implementation is vital for organizations planning to adopt this technology. RPA implementation involves a structured and systematic approach to ensure successful deployment and integration into existing processes. Identifying the key phases provides a roadmap for organizations and helps them allocate resources, plan timelines, and manage expectations. By studying these key phases, organizations can gain insights into the overall implementation process, allowing them to make informed decisions and develop strategies that align with their specific needs and goals.

2) What activities are involved in each of the phases?

Building on the first research question, the focus of this question addresses the activities involved in each of the phases of an RPA implementation, as this deeper level is crucial for organizations aiming to execute successful deployments. Each phase in the implementation process comprises specific activities that need to be executed to achieve the desired outcomes. By identifying and understanding the activities involved in each phase allows organizations to develop detailed implementation plans, allocate resources accordingly, and ensure smooth execution. It provides clarity on the tasks to be performed, the sequence in which they should be carried out, and the dependencies between activities. This knowledge can help organizations manage the implementation process more efficiently, minimize risks, and optimize the utilization of resources.

3) What should be the focus of each of these activities?

Going deeper still, the focus of each activity in the different phases of an RPA implementation is crucial for organizations to prioritize their efforts and allocate resources effectively. Each activity within a phase serves a specific purpose and contributes to the overall success of the implementation.

Decision makers need to appreciate the focus of each activity, and how they can determine the critical aspects that require attention and resources. It helps in defining clear objectives and key performance indicators for each activity, ensuring that they are aligned with the overall goals of the implementation. By identifying the focus areas, organizations can concentrate on mitigating risks, addressing potential challenges, and optimizing outcomes in each phase of the implementation process.

2. Methodology

This qualitative research study aims to develop a framework for RPA implementation in companies. Semi-structured interviews were selected for this study due to their flexibility and ability to uncover diverse perspectives, ideas, and themes related to RPA implementation. The semi-structured format allows the researcher to have a set of predetermined questions while also providing room for interviewees to discuss additional topics or ideas that they find relevant. This flexibility enables the exploration of emerging themes and in-depth understanding of the key phases, activities, and focus areas on RPA implementation. The interview responses can be further probed and clarified, ensuring a comprehensive examination of the research questions. Moreover, through semi-structured interviews, the researcher can capture not only the explicit information shared by interviewees but also their tacit knowledge, personal experiences, and insights that may not be readily apparent.

The inclusion strategy for selecting interviewees focused on eleven industry experts who possess existing knowledge and/or experience in managing RPA projects. These individuals were targeted professionals from organizations that have successfully implemented RPA or experts who have provided consultation and guidance in RPA deployments. By including these individuals, the study was designed to benefit from their practical insights, lessons learned, and expertise in navigating the challenges and complexities of RPA implementation. Their experiences and perspectives were considered vital to provide valuable input for developing the RPA implementation framework. Furthermore, the inclusion of industry experts ensures that the framework is grounded in real-world experiences and reflects the practical considerations and best practices.

While conducting data analysis, the process involved coding the emerging topics, themes, and ideas from the interviews to establish credibility and integrity of the findings. The researcher transcribed and analysed the interview data, identifying recurring patterns, ideas, and perspectives that emerged from the interviews, which were subsequently coded and categorized, facilitating a systematic analysis of the data. As per Mayring (2003), this involved three phases: summary, explication, and structuring. In the summary phase, the data was reduced to essential information by condensing and summarizing the key points, concepts, and themes. This phase allowed for a concise overview of the interview data. The explication phase involved seeking additional information and clarification through follow-up interviews or consultations with the interviewees or by referring to existing literature. This phase ensured a comprehensive understanding of the topics and themes identified, filling any gaps in knowledge and addressing any ambiguities. Finally, in the structuring phase, the most important aspects and insights were extracted from the data and organized into a coherent framework that outlines the key phases, activities, and focus areas of RPA implementation. This phase involved synthesizing the data and identifying the relationships between different themes and concepts to develop a comprehensive and practical framework for RPA implementation.

This approach to data analysis ensured rigor, transparency, and reliability in interpreting the content obtained from the interviews, leading to trustworthy and meaningful findings that can inform the key decision makers on the implementing RPA technologies. It also allows for a holistic understanding of the research questions and facilitates the identification of common patterns, challenges, and success factors in RPA implementation across various industry contexts.

3. Findings

This section will present the findings of the research, outlining the three research questions outlined previously, namely: the key areas, key activities, and the key focus of RPA implementation. These results are illustrated below in Figure 1.

Key Areas	Key Activities	Key Focus
1. Planning	i. Understand current operations ii. Establish business case iii. Explore capabilities iv. Identify external variables v. Create project road map	i. Select business case ii. Align stakeholders iii. Select tools iv. Identify skills required
2. Piloting	i. Run pilot project for identified business case ii. Monitor performance	i. Prioritize business processes ii. Develop infrastructure
3. Scaling-Up	i. Refine strategy ii. Improve model	i. Analyze lessons learned ii. Evolve RPA strategy and operating model
4. Steady-State	i. Innovate	i. Integrate design thinking ii. Establish culture of innovation

Figure 1: RPA Implementation Framework

3.1 Planning

Planning phase is the most important phase of the entire implementation journey as most of the activities are carried out in this phase. These are some key activities that will be carried out in the planning phase:

3.1.1 Understand Current Operations

For any organization, it is very important to understand the current state of their processes. By analysing the current state of the organizations process, organizations should identify processes which are the best suited for automation. After identifying the process(s), they should map out the current capabilities and outcomes. The

organization should also work towards the understanding of current automation technologies available and the possible outcome they can achieve. In short, this 3-way process can help a company to understand their capability maturity versus the outcomes. The gap between the current and the target state can then be easily seen. The execution path to fill the gap depends on multiple factors. In terms of the outcomes and the capability maturity of any organization, the outcomes can have an impact on business, operation, and cost.

Most interviewees agreed that because of COVID-19, organizations are going to have to switch to online learning instead of classroom type settings for increasing the shared knowledge throughout the firm. Although this is a new cost associated with resourcing as now eLearning modules will have to be created, deployed, and monitored. However, this method of learning will be far more cost-effective. *“In September, what we normally do with our system is classroom training, obviously classroom training can take place anywhere in the world but not anymore because of Covid-19 we are all working from home. So, now upskilling happens using eLearning platform which is cost effective”* (E-11). While it is impossible to mitigate every risk for an organization, according to interviewees one of the most effective methods of reducing the risks within the organization is through upskilling and enhancing the shared knowledge throughout the company. *“It can be pretty difficult to overcome concerns without a level of shared knowledge. It’s important to make sure everyone understands what’s at stake and where the risks are and how best to mitigate this. This can be achieved through upskilling”* (E-7). Many interviewees conveyed the challenges associated with locating the resources required for RPA implementation. This can be seen as there is a lack of individuals available who have the necessary skillset for RPA implementation. Currently, organizations tend to hire those with a specific skill set or an individual who has specialised knowledge. This can ensure the reliability of the employees and their skills. *“Businesses try to find people who have a specific set of skills like if you have Salesforce experience then that will really help or if someone is specialised in all things UiPath”* (E-8). While most companies will require the basic technical skills, they are also actively seeking those who meet the technical requirements but also possess a good understanding of business. *“Having the basic technical skills is a requirement but then they should also have a good understanding of the business aspects”* (E-7).

3.1.2 Establish Business Case

After gaining an understanding of the current state and market capabilities i.e., deciding the current RPA capabilities and the desired business outcomes, the next step in the process would be to examine the use case for automation. The best-suited use case for the different levels of automation would provide great success. Based on the different use cases, there can be different states of automation. There are numerous automation options available with RPA or intelligent automation, and finding the right fit for different use cases is key. For example, invoice processing might consist of four major tasks: invoice data extraction, invoice exception handling, vendor account reconciliation, and vendor inquiry. Based on the different use cases, different states of automation can be applied, as outlined further below in Table 1.

Table 1: Use cases and related automation strategy options

Automation State	Description	Use Cases
State 1	No automation	First stage of business process where requirement gathering and business flows related to invoices have been analyzed and decided.
State 2	RPA	Email monitoring systems – Robotic processing and monitoring of a large number of emails 24/7. Whenever a new email arrives, the tool downloads the invoice attached to the email and stores for future reference.
State 3	RPA and Intelligent Data Processing (IDP)	Data extraction from the invoice – Building on the previous step, IDP can be used to digitize and extract data from invoice.
State 4	RPA, IDP, and Chat Bot	Handling enquiries from vendors – Chat bots can be used to handle queries from vendors and create tickets to assign to customer agent.
State 5	RPA, IDP, Chat Bot, AI	Analysis of payment pattern – AI can be used to handle any exception, with machine learning being used to analyze and predict vendor payment pattern.

Based on the interviews, it was found that most interviewees want to achieve a reduction in costs, greater efficiency, scalability, and regulatory compliance and perceive these as the main benefits of RPA. *“Currently, reducing operating costs, increase efficiency and speed are the key agenda for bank. To stay competitive and continuously available, we need a fast pace working environment, which can offer more advanced services”* (E-7). Many interviewees also expressed that staying competitive and ensuring continuous innovation is also very important to them currently. *“To stay innovative and competitive, Banks want to appear forward-thinking to*

customers. However, implementation of an RPA system depends on a lot of factors such as the ability of bank to adopt this new system, regulation and government concern over the system" (E-6).

3.1.3 Explore Capabilities

In order to carry out the RPA journey further, it is very important to understand the desired business capabilities and how they relate to the possible outcomes. After the completion of stage 1 and 2, at this stage of the journey, organizations must identify their journey component and associated key areas. Based on the data gathered throughout this investigation, an organization's capability can depend on these five key components: "Vision", "Implementation", "Technology", "Organization", and "Resourcing". Table 2 below will illustrate the key focus areas that need to be considered in order to achieve the right outcome.

Table 2: Organization's RPA

Capability Component	Description
Vision	- Understanding of an organization's vision towards RPA system. - Understanding of inherent challenges. - Ascertain organization's readiness in respect to process, risk and security.
Implementation	- Investigate scope and scale of RPA system to be adopted in less time - Conducting project feasibility and due diligence
Organization	- Establish governance model to implement RPA system among different teams - Analysis of management strategies for working culture in response to change
Technology	Exploration of various aspects: i.e. how the bot should be developed, which advanced cognitive technology would be used in conjunction with RPA etc...
Resourcing	Analyze current training programs and hiring practices to align with new processes

3.1.4 Identify External Variables

At this stage of the RPA journey, organizations should complete an assessment of all the factors that can affect the companies' target outcomes from RPA and the decided execution path to follow that target outcomes. The findings outline that variables can range from those directly impacted by the project, such as expected return on investment, capability to achieve desired state, and targeted outcome, to variables more specific to the nature of the project, such as the sensitivity to change, expertise required, risk management, people management and overall governance. If two different organizations take the same RPA journey who are at the same level of maturity and try to reach the same target goals, their execution path largely depends on their environment determinants. Hence, it is very important for organizations to have the best fit execution path to deliver target outcomes. Analysing all the RPA-related variables, allows organizations to create a successful execution plan.

3.1.5 Create Project Road Map

After finalising the best fit for the execution path, organizations can take advantage of a variety of tools and best practices to develop an execution strategy and follow along to achieve their target goals. The output of the execution plan and the entire road map depends on how cost and volume is mapped across automation potential factors. On one hand, where the cost and volume measures cost per transaction for the entire volume of the transaction in the year. On the other hand, the automation potential has been decided based on five main factors: process complexity, extent of digitisation, technology fragmentation, technology fragmentation, scale of operation, and existing process health. The execution plan will also include the process of choosing the best RPA tool. This is essential in terms of getting the best yield from an RPA strategy. Choosing an RPA tool depends on the companies' objectives and their automation requirements. Ten important guidelines emerged that should be followed when selecting the right RPA tool: ease of implementation, ease of use, speed, technical features, ownership cost, scalability, architecture, exceptional handling, vendor support, and governance.

One key finding from this category is the importance of leadership as one of the key challenges presented was communicating a problem to both the business team and the technical team. *"Banks now tend to have multi-disciplinary teams but there is still often a business team and a technical team. It can be challenging to communicate with both teams. Requires good leadership on both ends"* (E-5). A similar challenge was presented

in terms of many organizations' talent management strategies. Some interviewees suggested that such strategies should be continuously developed to ensure that potential employees with the appropriate and required skill sets are hired as it can be challenging to locate people with the necessary technical skills for RPA implementation and also have a good understanding of the necessary business jargon. *"Analyse the talent management strategies for working culture-related changes in organization"* (E-10).

3.2 Piloting

3.2.1 Run Pilot Project for Potential Business Case

To validate an RPA strategy and its guidelines, it is vital to run a pilot project for RPA implementation. This includes building a small end-to-end solution on the production environment. Exploring the practical aspect of any project saves organizations from any kind of risk that could happen in the future, or any kind of mismanagement associated past the initial stage. Knowing all the affecting factors and associated risks helps companies to solve them and meet the end goal successfully. At this stage, all the aligned stakeholders are involved and surveyed for proper feedback on the solution. Based on the feedback, challenges and risks that have been analysed proposed mitigation plan is set out. Feedback also helps to make the necessary changes in the methodologies and framework to deliver a stronger solution. Running pilot projects also helps organizations to identify the estimated budget for the entire solution, the RPA skills/resources that are required, the creation of the initial infrastructure, an analysis of the RPA vendors, an evaluation of the scripts/bot functions which can be tested against the initial solution design.

For example, several interviewees discussed their initial exploration of cognitive technologies in the form of chatbots. Such bots can be beneficial as they provide immediate customer support which can improve customer relationships. *"Using ML to automate customer support would be very cost effective for example using chatbots to answer the less critical questions"* (E-5). Technical problems are a major risk for companies, and this can often make organizations reluctant to try new technologies. The employees within the organization and their response to changes in technology are typically not well received when it involves learning something new. *"Technical troubles tend to be a major risk"* (E-3). A similar issue that was also presented by the interviewees that organizations can sometimes be reluctant to admit when they do not have a good understanding or require technical assistance from third party vendors. According to the interviewees, this type of challenge is particularly seen in banks. *"...lack of understanding of technology. Banks are sometimes afraid to admit that they don't actually know how to implement RPA in addition to the government and regulatory concerns. This creates bottleneck while making use of RPA"* (E-7).

3.2.2 Monitor Performance

Monitoring the performance of the robots is one of the most important aspects of a project which focuses on the implementation journey of RPA. It is necessary to monitor the implementation of the robot to ensure that it is effective and successful at the task assigned. The performance of the project should be monitored using different KPIs across cost reduction, increased efficiency, improvement to quality, control, audit, and timeliness for each key process. *"While analysing risk factors, one potential risk factor would be business readiness including how much budget is planned, analysis of current infrastructure, availability of resources and so on"* (E-6). For other interviewees, the customer was the focus of everything they do. They respond to their customers' needs and demands to maximise customer satisfaction. This can help maintain a good customer relationship. *"The key directives would be to respond to customer's needs...."* (E-5).

3.3 Scaling Up

3.3.1 Refine Strategy

After measuring and evaluating all the key parameter indicators – Cost, Efficiency, and Quality, there would be a need for improvements in the RPA strategies once again. This depends on the type and the nature of the business processes in the firms. In order to meet the future business needs, being sustainable, and competitive, firms need to opt for technology that can be scalable. The RPA strategy mainly focuses on the company's current status and the factors that can impact business outcome of the process. For example, regulatory compliance is very important to companies within the financial services, given the nature of the data. Governing this data is becoming an increasingly difficult task particularly for the banking sector as they must maintain large quantities of personal information on their customers. It is the responsibility of the organization and its employees to

ensure that they operate in line with GDPR and CCPA regulations. *“Data is increasingly challenging as the quantity of unstructured data being inputted from sources has increased. This is important to consider so that bank can operate in line with GDPR and CCPA regulations”* (E-5). Due to COVID-19, many organizations are also turning to eLearning to increase the knowledge in the company. This is one method used by companies to mitigate potential risks to the organization such as regulatory compliance factors. *“...upskilling increases the knowledge in the firm. This will now be done through eLearning because of Covid-19...”* (E-11).

3.3.2 Improve Model

Six components emerged from the findings to describe the traditional RPA model, and how organizations can view the development of these projects through an iterative approach. Firstly, the need for effective strategy and governance emerged as being needed to define the overall vision and standard of the RPA at the organizational level. Understanding the vision at the early stages of this process can help organizations scale their target projects out faster. Secondly, the process life cycle itself must also be analysed for the identification and prioritization of different processes for automation. Recent development and maintenance to existing processes can also be considered here, while based on feedback from the piloting phase, there could also be some further project developments. Thirdly, value management is vital at this juncture to establish how the end result can be measured against the expected goal, i.e., how organizations are able to prove they are in a better position after the implementation of these technologies, than the organizations were before they had them at their disposal. Fourthly, decision makers must be able to align and change the various aspects of these processes at the different business levels for a successful implementation. Fifthly, in the pilot phase, the type of infrastructure and architecture needed for overall RPA journey is chosen.

While selecting RPA tools, it is important to understand whether the tool supports scalability or not.

Keeping the technology aspect in mind, all types of improvements can be made at this component of the operating model. Lastly, key decisions surrounding the enterprise integration should be discussed to ascertain the most similar functionalities and capabilities within the organization where the RPA project can be carried out at the same pace. This further raises the importance of better governance and overview of activities throughout the implementation process.

3.4 Steady State

3.4.1 Innovate

The main reason to go for RPA is to mimic the repetitive, time-consuming tasks meaning tasks that take a lot of time to complete and add less value to organisation. These tasks could be picked for automation and replace humans to complete such tasks using RPA bots. These bots can offer benefits in terms of consistency of business process. They can perform routine tasks the same as human and maintain a level of consistency every time based on defined captured flow. While enterprise-level software and applications are complex, they use a lot of different layers in the architecture and at each layer. In this kind of scenario, it is important to understand the breadth of access to RPA bots., and how they should offer interconnectivity with other software at different levels.

4. Discussion, Conclusions, and Implications

The objective of this research project was to create and develop a strategy to assist organizations in implementing RPA in various settings. Business processes for many back-office activities tend to be monotonous and time consuming, which can subsequently impact an organization's capacity for innovation and create an unpleasant customer service experience. This research has provided a strategic solution to overcome these problems by providing a framework that organizations can utilise when implementing RPA. The identification of four distinct phases, comprising of ten steps represents the main contributions of this paper, which outline a strategic blueprint for key decision makers to follow from a practical perspective. We contribute to the literature surrounding RPA by highlighting the importance of a structured approach when implementing these technologies, and in doing so, several managerial implications have also been presented. Firstly, this research serves to reinforce the strategic nature of implementing these technologies to aid existing business cases, and while this literature is still developing, this investigation advocates that key decision makers should not neglect the due diligence to ensure the overall success of the project. Secondly, our findings confirm that practitioners need to do more than simply identify potential use cases. There is an array of decisions to be made including the blend and reliance of technologies, in addition how these fit with the capability components outlined in the

findings (vision, implementation, organization, technology, and resourcing). Practitioners should recognise the potential value created through the development of structured approach to these projects, rather than considering them only to be supportive tools.

As with all research endeavours, this investigation has several limitations, chiefly among them the size of participants. For this exploratory investigation, eleven participants were interviewed and while this may present generalizability problems, the findings generated were able to provide an accurate representation of RPA project development across four distinct phases. While this study offers an initial insight to how successful projects may be implemented, future studies are now advised to develop this project map further, and to focus on specific technologies within the RPA paradigm. For example, cognitive technologies like AI, ML and Natural Language Processing can be combined with RPA to improve value propositions being sought.

References

- Bhaskar, R., Sarma, A., & Jaiswal, M. P. (2021). Robotic Process Automation Adoption and Its Impact on Organizational Performance: An Empirical Investigation. *Journal of Enterprise Information Management*, 34(4), 781-805. DOI: 10.1108/JEIM-11-2020-0377
- da Silva Carvalho, R., Filho, J. M., & Santos, M. Y. (2021). Robotic Process Automation and Its Impact on Organizational Performance: A Systematic Review. *International Journal of Information Management*, 56, 102205. DOI: 10.1016/j.ijinfomgt.2020.102205
- Fernandes, K., Rossignoli, C., & Barreto, J. M. (2019). Robotic Process Automation and Its Impact on Organizational Agility. In *International Conference on Agile Processes in Software Engineering and Extreme Programming* (pp. 259-274). Springer. DOI: 10.1007/978-3-030-19135-8_18
- Fersht, P. S., 2017. The Robotic Automation Market will Reach \$443 Million This Year. *Horses for Sources* (10:6) https://www.horsesforsources.com/RPA-marketsize-HfS_061017/
- Hevner, A.R., March, S.T., Park, J. and Ram, S., 2008. Design science in information systems research. *Management Information Systems Quarterly*, 28(1), p.6.
- Hindle, J., Lacity, M., Willcocks, L. and Khan, S., 2018. Robotic process automation: benchmarking the client experience. *Knowledge Capital Partners*, pp.6-7.
- Lacity, M. and Willcocks, L.P., 2017. Robotic process automation and risk mitigation: The definitive guide. SB Publishing.
- Peffer, K., Tuunanen, T., Rothenberger, M.A. and Chatterjee, S., 2007. A design science research methodology for information systems research. *Journal of management information systems*, 24(3), pp.45-77.
- Mayring, P., 2008. Qualitative content analysis. *Basics and Techniques*. Beltz, Weinheim.
- Müller, O., Fay, M., & vom Brocke, J. (2018). The Effect of Robotic Process Automation on Human Resources: An Exploratory Study. In *International Conference on Information Systems (ICIS) Proceedings* (Vol. 2018, No. 1)
- Plattfaut, R. and Borghoff, V., 2022. Robotic process automation: a literature-based research agenda. *Journal of Information Systems*, 36(2), pp.173-191.
- Soltani, Z., Rosemann, M., & Kurpijuweit, S. (2017). The Impact of Robotic Process Automation on Business Process Performance. In *International Conference on Business Process Management* (pp. 95-110). Springer. DOI: 10.1007/978-3-319-65000-5_6
- Willcocks, L.P. and Lacity, M., 2016. Service automation robots and the future of work. SB Publishing.

Advancing Sustainable-Smart Innovations Through a Transdisciplinary Learning Intervention: Insights From The Quintuple Helix Model

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Abstract: The urgent need to shape the future of societies necessitates complex collaborative partnerships that co-create sustainable solutions. This whilst maintaining a balance between ecological, economic, and sociocultural concerns. The aforementioned creates complexity, calling for a transdisciplinary focus to circumvent the narrow lenses of disciplinary boundaries to develop new systems for educating young professionals. Within this context, we explore how a transdisciplinary learning intervention can result in sustainable-smart innovations that address real-world community challenges. To engage this question, we draw on findings from a longitudinal Design-Based Research (DBR) study that commenced in February 2020. Two iterations of this study have been completed and the third iteration commenced in 2023. Data is drawn from student project artefacts and reflections. This study utilises the potential of transdisciplinary student projects, between urban planning and information system students, and other stakeholders, to develop sustainable-smart innovations. It focuses on community challenges related to SDG 11 as experienced by marginalised township communities in Cape Town, South Africa. The study is founded on key concepts: Education for Sustainable Development, Transdisciplinary, Digital Social Innovations, Society 5.0, and Inclusive collaborative partnerships. These concepts allow the interrogation of the complexities that reside in wicked problems related to the localisation of SDGs. The introduction of the quintuple helix model during the project's third iteration to analyse the wider contribution from different stakeholders and the shift to Mode 3 knowledge application in innovation is of special value. This model lends itself to transdisciplinary methodologies specifically to merge many voices toward sustainable-smart innovations. The co-creation of sustainable-smart innovations involves unifying various stakeholders from academia, industry, government and the community, to jointly develop and implement sustainable and technology-enabled solutions. The contribution of this paper lies in the expansion of discourse on innovations for sustainability through our engagement with the quintuple helix model in a transdisciplinary learning intervention.

Keywords: sustainable-smart innovations, design-based research, transdisciplinary learning, quintuple helix model, collaborative partnerships

1. Introduction

There is an urgent call on universities to create an inclusive environment that fosters sustainable-smart innovations to tackle socio-ecological and cultural challenges. In particular, the paper highlights the need for South African Higher Education to demonstrate social responsibility and contribute to social and community value given its resource-limited context.

Although the importance of education for sustainable development is widely acknowledged, there is limited knowledge of how to design curricula that support the development of the competencies required for interdisciplinary and transdisciplinary learning (Horn *et al.*, 2023). In this paper, we explore this challenging task and ask the question of how a transdisciplinary learning intervention can result in sustainable-smart innovations that address real-world community challenges. We draw on findings from a study that commenced in 2020 between two universities in Cape Town, South Africa. The focus is to explore the value of co-creating digital social innovations in interdisciplinary and transdisciplinary student projects between Information Systems (IS) and Urban Planning (URP) students and other stakeholders. Data is drawn from the third iteration that commenced in 2023.

The paper commences with a review of the literature to explore a number of foundational concepts that frame and influence the student project. This includes a discussion on the Quintuple Helix model as an analytical framework. Subsequently, the methodology, results and findings are discussed to highlight the significance of transdisciplinary approaches to facilitate the convergence of diverse perspectives and fields of knowledge to enable sustainable-smart innovations.

2. Literature Review

2.1 Education for Sustainable Development through a Transdisciplinary Focus

Education for Sustainable Development (ESD) represents a significant approach that endeavours to embed sustainability and Sustainable Development Goals (SDGs) at all levels of education (Rieckmann, 2018). The overarching objective of ESD is to cultivate a cohort of learners who possess the necessary tools and competencies to effectively respond to intricate socio-ecological or wicked challenges. By fostering agency, ESD aims to empower students, as future decision-makers, to become catalysts for change, capable of addressing the threats to the sustainability of our planet (Sinakou et al., 2019).

Addressing such complex challenges demands competencies that transcend individual disciplinary boundaries (Mausser et al., 2013). An interdisciplinary approach, as opposed to a mere multidisciplinary approach that amalgamates contributions from various disciplines without integrating them, is vital for acquiring the knowledge to tackle current and future challenges (Bernstein, 2015). Furthermore, the range of knowledge required to address these challenges extends beyond the domain of science, necessitating a transdisciplinary focus (ibid, 2015). This underscores the significance of transdisciplinary learning in both education and collaborative innovation. To effectively address societal issues and facilitate collaborative knowledge co-creation, a comprehensive understanding of the implications of transdisciplinary learning for present and future sustainability challenges is indispensable. Thus, adopting transdisciplinary approaches is essential for addressing sustainability issues by means of collaborative knowledge co-creation involving multiple stakeholders from academia, government, and civil society (Horn et al., 2023).

Implementing inter and transdisciplinary learning practices is a complex endeavour that requires meticulous planning. Equipping students with the ability to operate in conditions of high uncertainty and encouraging them to approach challenges experimentally and iteratively are vital aspects. The focal point should be on generating unforeseen possibilities rather than incremental approaches that merely enhance performance (Baumber, 2022). The application of a design thinking methodology that incorporates reflexivity, continuous feedback, and scaffolding constitutes key elements in enabling the integration of knowledge among diverse participants (van den Berg and Verster, 2022).

2.2 Digital social innovations and Society 5.0

Digital social innovation refers to the use of digital technologies to improve social challenges related to marginality, inequality and social exclusion (Qureshi et al., 2021). It applies to projects that use digital technologies in conjunction with community engagement and collaboration, co-creation strategies and bottom-up approaches to address societal needs.

The concept of Society 5.0 is a vision first proposed by the Japanese government where the benefits of technology and innovation are applied in a human-centred way to solve social problems and enhance the quality of life for all citizens (Fukuyama, 2018). This concept envisions a super-smart society that merges the virtual with the real world and emphasises social development, quality of life, economic growth and social justice whilst respecting sustainability (Sá et al. 2022). It seeks to integrate evolving technologies used in Industry 4.0 for business purposes into the everyday lives of ordinary people to improve the quality of life for individual human beings and benefit society as a whole (Gladden, 2019). This super-smart society represents a balance between human and technocentric approaches to development and innovation and is considered a crucial step in ensuring a sustainable future (Carayannis and Morawska-Jancelewicz, 2021).

The two concepts are incorporated into the learning environment by sparking the vision of Society 5.0 in the co-creation of sustainable-smart innovations. The design of the interventions continuously balances the innovation process, the social world and the digital ecosystem within an iterative process. It is emphasised that the focus of innovation is not on the technology but on the process of working together with different stakeholders to co-create a more sustainable and equitable society, where everyone has access to the resources and opportunities they need to thrive.

2.3 Inclusive collaborative partnerships

This refers to partnerships that intentionally include individuals and groups who may have historically been excluded or marginalised. These partnerships seek to ensure that all voices are heard and valued and that all

parties involved have an equal opportunity to contribute to and benefit from the collaboration (Gupta et al., 2017). This type of partnership is critical in contexts where power dynamics may be unequal, such as between institutions and community groups, or between individuals from different socio-economic backgrounds. Inclusive collaborative partnerships, as opposed to collaborative partnerships, thus prioritise both inclusivity and power dynamics that can have a major impact on the success of partnerships.

Our focus is also on empowering marginalised communities by incorporating the insights and experiences of community members in the design of sustainable-smart innovations. The value of their "local lived knowledge" is emphasised to recognise the value of practical, experiential, and contextual knowledge that individuals and communities possess within a specific geographic area. By tapping into this knowledge, learners can gain a deeper understanding of the issues and challenges faced by people in that area and the unique perspectives and solutions that have emerged from their experiences. This approach also fosters a sense of community engagement and collaboration, as learners work alongside local residents to co-create knowledge and solutions. In the context of ESD, this knowledge can serve as a rich source of real-world information, enabling the development of curricula and learning experiences that are relevant and responsive to the needs and aspirations of local communities. This is especially powerful within the South African context with its limited availability of resources to both communities and education.

Recognising the essential contribution of inclusive collaborative partnerships to solve wicked problems has led our research to the potential of the quintuple helix model (Carayannis and Campbell, 2010; Carayannis and Morawska-Jancelewicz, 2021). The application thereof to balance techno and human-centric approaches to innovation and integrate knowledge, innovation and the environment are discussed in the following section.

2.4 The Quintuple Helix Model as an analytical framework

The triple helix model (Etzkowitz and Leydesdorff, 2000) incorporated the intersection of universities, industry and governments. In contrast, the quadruple helix (Carayannis and Campbell, 2009) added the perspective of civil society to highlight the importance of a social dimension to innovation. The quintuple helix (Carayannis and Campbell, 2010) expands on this by adding the context of the environment to frame knowledge and innovation. This emphasises that environmental sustainability must be integrated into the innovation process and that all five helices must work collaboratively to achieve this goal.

Moreover, the concepts of Mode 1 and Mode 2 knowledge production occur in the triple helix model. Mode 1 is a linear model of innovation through basic research produced by universities in a disciplinary manner (Carayannis and Campbell, 2010). Mode 2 includes the execution of knowledge where knowledge is applied and put into practice. Mode 3 is aligned with the broader perspective of quadruple and quintuple helix innovation systems that support the co-creation of several knowledge and innovation modes that support non-linear innovation processes (Kitsios and Kamariotou, 2021).

Including the quintuple helix model as an analytical framework for reviewing the outcome of student projects during the third iteration in 2023 has the benefit of including a transdisciplinary focus to integrate different perspectives. It can be applied as a framework for understanding the complex relationships and interactions between different stakeholders involved in innovation processes. It furthermore supports the conceptualisation of Society 5.0 as it relates to the digital social innovations generated by student teams as well as the inclusion of local lived knowledge within collaborative partnerships. It can also help to identify gaps or areas where collaboration or intervention may be needed to achieve the desired outcomes.

3. Method

The paper represents the analysis of findings from the third iteration of a longitudinal study where the method of Design-Based Research (DBR) was used. Two iterations of this study have been completed in 2021 and 2022 and the third iteration in 2023. In a DBR study, researchers gain an in-depth understanding of a problem before testing and refining solutions over several iterations (Mckenney and Reeves, 2020). DBR develops both theoretical insights and practical solutions, together with stakeholders within authentic settings (ibid, 2020).

The first two iterations had an interdisciplinary focus as wider representation was limited due to the COVID-19 pandemic (Verster and van den Berg, 2022). In the third iteration, additional stakeholders from the local government, industry, and Dunoon's community could be included, opening up the potential for a transdisciplinary focus. This prompted the research question: How can a transdisciplinary learning intervention result in sustainable-smart innovations that address real-world community challenges? To explore the research

question, we apply the quintuple helix framework as a lens and draw on Mode 3 knowledge application (innovation networks and knowledge clusters) in the student projects (see Table 1). Data is drawn from student project artefacts and reflections from students and researchers. A thematic data analysis was done to review the contribution of the different stakeholders within each of the five helixes. Examining the stakeholder groups' interactions and their overall impact enabled us to identify gaps and develop interventions for future iterations as well as propose theoretical and practical possibilities (see Section 5).

Table 1: Stakeholder groups in the Quintuple Helix and their contributions to innovation.

Quintuple Helix	Project Stakeholders	Data Analysis
Civil Society Helix Emphasises the importance of public engagement and social responsibility in innovation	Community members, informal businesses and NGOs in Dunoon, Cape Town	The project can be evaluated based on its ability to engage with civil society and promote social inclusion and equity.
Academic Helix: Emphasises the importance of academic research and knowledge transfer in driving innovation	Academic staff and students from UWC and CPUT universities	The project can be assessed based on knowledge creation and dissemination, subject matter expertise, the research process, and skills development
Government Helix The role of government policies and regulations in promoting innovation	City of Cape Town Local Government stakeholders in the Urban Sustainability and IS Units	The project can be evaluated based on its alignment with government policies and regulations, and its ability to influence government policies through its innovative approaches.
Industry Helix The role of businesses and industries in driving innovation	Guest Lecturers from NGOs, Technology Consulting Organisations and Entrepreneurs	The project can be evaluated based on its ability to attract and involve businesses and industries, and its potential to promote economic growth and development.
Natural Environment Helix The role of the natural environment as a driver for further knowledge creation and innovation	Sustainable Development Goals – focus on SDG 11 (sustainable cities and communities) in Dunoon, Cape Town	The project can be evaluated based on its ability to promote sustainability and its commitment to sustainable development goals and well-being.

3.1 Project Brief

Eight student project groups were selected comprising four students from IS and three students from URP. Each group had a thematic area or problem that was randomly assigned after an icebreaker activity. The themes included challenges related to the informal economy, lack of public services and facilities, informal housing, unemployment, lack of sanitation, lack of recreation opportunities, challenges to the natural environment and food security.

The three project iterations conducted in 2021, 2022, and 2023 were preceded by a preliminary pilot study in 2020. Each of the three iterations followed the same design phases, as documented in Table 2.

Table 2: Project design phases and activities

Design Phases & Learning Activity	Output
Pre-Production Phase: Discussion topics: Digital Social Innovation, Human Centered Design, Society 5.0 and SDGs	Submit a draft problem statement and literature review. Determine a potential target population within Dunoon.
Phase 1: Empathize Discussion topics: Interview techniques, Personas and Digital Stories Group: Prepare questionnaires: use the IDEO interview toolkit as a base.	Develop a questionnaire for interviews with the community.
Phase 1: Define Group: Group members participate in the site visit to Dunoon and conduct interviews.	Complete questionnaires with seven or more members of the target population. Develop two personas from insights obtained Finalise the storyboard for the digital story.

Design Phases & Learning Activity	Output
Phase 2: Ideate and Prototype Discussion topic: Value of community voice and street-smart local lived knowledge to explore the feasibility and viability of potential solutions. Group: Brainstorming, ideation, decision matrix and selection of potential prototypes.	Present personas to other stakeholders Present ideas from brainstorming Apply a decision matrix to determine ideas that can be prototyped. Pitch ideas and blueprints of prototypes to other stakeholders. Select four potential prototypes to develop
Phase 3: Testing and Production Group: Test prototype for viability and feasibility by other practitioners and stakeholders in Dunoon. Finalise prototype design specifications Conduct commercialisation feasibility report	Project presentations. Finalise Group Project portfolios. Present prototype design specifications to Local Government and Industry representatives. Determine implementation strategy

4. Findings

Table 1 was used for the analysis of the data and the identification of gaps that can be addressed in subsequent iterations of the project.

Civil Society Helix: In the third iteration in 2023, the project was designed to focus on Dunoon, a severely under-resourced and over-populated community where people largely live in informal structures. Each student group was assigned a problem to investigate in collaboration with community members, informal businesses and NGOs in the area. The emphasis was on their local lived knowledge of the problem and the capturing of their voice to define potential sustainable-smart innovations that promote social inclusion and equity. Student groups interviewed community members and engaged with them to clearly understand the problem from their perspective and the outcome was to develop personas and digital stories to collectively generate new insights, perspectives, and potential solutions. See reflection:

It allowed us to understand how the people of Dunoon feel, not from our perspective, but from theirs in their own words. This allowed us to know exactly what their thoughts are and how they genuinely feel about their situation and the harsh realities they face.

We experienced the actual problem and not just what we initially thought the problem was. Seeing how the people of Dunoon lived created a sense of urgency to want to improve these conditions with them. It also helped to create prototypes that were human-centred and would benefit the community.

The full impact from the community's perspective cannot fully be measured yet as the projects are still being rolled out. However, the quality of prototypes created far exceeds previous years due to the active engagement from the community. Students continuously mentioned engagement with the community as one of the biggest 'value-adding' experiences in the project. The gaps that we can identify are the lack of community representation in the identification of potential themes or community problems. It would be more beneficial to involve the community from the start and to get their insights and input in problem definition as well as more community participation during the ideation phase in the form of co-creation workshops.

4.1 Government Helix:

Since the beginning of the 2023 project iteration, we had active participation from local government representatives in the project through a series of guest lectures, guided site visits and as respondents to student project development.

Further, the local government's contribution to the project includes providing local policy documents to guide the literature review aspect of the student project. Policy documents such as the Cape Town Municipal Spatial Development Framework and the Environmental Strategy played a key role in shaping the students' understanding of the development trajectory within which their projects are located. Understanding the context, particularly the policy context, is a significant determinant of the relevance of the sustainable-smart innovations that the groups develop.

The impacts of this student project can be directly linked to the meta objectives of the provincial and local governments as the following: "Resilience for Inclusive Development" aligns strategically with the project objectives of foregrounding the community voice (inclusivity) and unpacking and responding to local

environmental challenges through sustainable-smart innovations (resilience). Further “Infrastructure, new technologies and sustainability” and “citizenship and democracy” have specific and direct relevance with active citizenship being a central aim of the project both as it applies to the local community voice and the location of our students as active and responsible community members.

A concerning gap that currently exists is the presence of a power imbalance between local government and civil society (communities) because of political influences that shape relationships. Academics need to be aware of these and be able to negotiate the contested space between academia, government and civil society, which is especially burdened by the South African Apartheid legacy. A further gap that was highlighted by student reflections is the difficulty students experienced on-site to gain access to community members willing to participate. This is in part due to what was mentioned previously as the political influence that manifests as mistrust by civil society. To address the above concerns, we will in future partner with community champions to gain the trust and cooperation of community members.

4.2 Industry Helix:

Stakeholders from the industry include representatives from the Industry Board at one of the participating universities and external moderators from the other university. They play an advisory role as guest lecturers and reviewers primarily. There is more active participation in the projects by local entrepreneurs within the area of Dunoon.

A lack of understanding about the potential value and economic incentives linked to social innovation in the informal economy as well as the complex political situation within the area are deterrents to active participation. More active collaboration to share the project outcomes and success stories with the industry partners and their participation in co-creation workshops needs to be encouraged. Industry partners can also be more active in the further development and implementation of sustainable-smart innovations and use this as an opportunity to build their reputation as socially responsible organisations. This could include branding and marketing opportunities, as well as networking events.

4.3 Academic Helix:

The stakeholders include academics and students from two universities in Cape Town, South Africa. The project has been highly beneficial in shifting knowledge creation from Mode 1 to Modes 2 and 3. The students have cited the shifting of their perspectives and the development of new skills and competencies for example:

The different perspectives influenced my learning by enabling me to view situations from other people's positions and to consider other people's views, experiences and beliefs. This provided me with a deeper understanding and empathy which decreases prejudice, judgment, and conflict, within the area and among my group.

I never thought that we will get a chance to engage with the community and interview them, and share the issues that they experience. I am also surprised by the skills that I developed from this project like creating digital stories and designing prototypes.

To date, the impact from an academic perspective has been positive resulting in a number of research publications and wider collaboration with other academics, government and community stakeholders. This is an ongoing project and the largest present gap is to establish continuity from one year to the next and build on the results of previous iterations. The focus on a single community is recommended and also to increase the participation by other stakeholders through more formalised agreements on project scope and outcomes. The results should also be widely showcased on a project platform which is currently being developed.

5. Natural Environment Helix:

The project is based on the "Education for Sustainable Development" (ESD) approach, which prioritises the promotion of constructive and sustainable changes within society. ESD is typically found at institutional and educational policy levels with limited curriculum uptake. By embedding the sustainability principles within every aspect of this student project, we sensitised students, as future leaders, to concepts such as the sustainable development goals (SDG) and specifically SDG 11, sustainable-smart cities and Society 5.0. Further, as the environment is usually the most vulnerable stakeholder in the quintuple helix, the themes, as mentioned under the Project Brief section, all have an environmental footprint.

One of the major impacts was the focus on a sustainable-smart approach as a single, entangled concept. We propose sustainable-smart to refer to smart, technology-driven innovations underpinned by a sustainability mandate. A further medium to longer-term impact is the contribution to the Dunoon sustainability campus (in partnership with international and local donors) that is in the formation phase. The sustainability campus is intended to upskill the local community as well as disseminate practical information that can contribute to all aspects of better living.

The gap currently is to be able to track the real-world environmental impacts of this project as this is the first engagement within this community. In the past students worked in the communities in which they reside as we were not able to access communities under lockdown restrictions.

6. Discussion: Theoretical Insights and Practical Solutions

The analysis of the transdisciplinary learning intervention through the lens of the quintuple helix model of innovation provides valuable theoretical insights and practical solutions.

Two main considerations for theory were highlighted by the above project findings, as first, the concept of shifting "Mode 1" to "Modes 2 and 3" knowledge creation as a move in the academic helix towards more collaborative and applied research. The potential role of universities to take on a more significant role in fostering innovation, not only by promoting technology and knowledge transfer but also by acting as intermediaries and facilitators among the various components of the ecosystem through interdisciplinary and transdisciplinary approaches (Ferraris et al., 2020). Secondly, the significance and promotion of sustainability principles within all aspects of education, as emphasised in the ESD approach. What flows from this is our proposal to recognise technology as a main driver of innovation, thus the identification of the sustainable-smart approach as a single, entangled concept, combining smart, technology-driven innovations with a sustainability mandate.

The practical recommendations are to first establish an iterative approach to ensure that the project's impact is cumulative and sustainable. Second, focus on a single community, which allows for deeper engagement and understanding of the local context, traditions, and values. Following on from this, thirdly, to establish partnerships with community champions to gain trust and cooperation from community members. This is of particular importance in societies where political influences and historical legacies have contributed to mistrust. Fourthly, to encourage industry partners to actively participate in the further development and refinement of the student project and future implementation of sustainable-smart innovations within communities.

7. Conclusion

This paper posits that for university programs to make meaningful contributions toward addressing the multifaceted socio-eco-cultural challenges of society, a sustained emphasis on sustainable-smart innovations is necessary. Pursuing sustainable-smart innovations requires a holistic understanding of the environmental, economic, and social factors shaping contemporary challenges.

For this reason, we argued for the integration of concepts such as education for sustainable development, SDGs, Society 5.0, digital social innovations, street-smart local lived knowledge, and collaborative partnerships, through the lens of the quintuple helix model. To achieve this integration, the paper emphasises the importance of transformative and experiential learning approaches that expose students to real-world challenges and enable them to engage in collaborative problem-solving. Furthermore, it underscores the significance of transdisciplinary approaches that facilitate the convergence of diverse perspectives and fields of knowledge by adding the Quintuple Helix Model as a barometer for reflection on the impact and gaps of the intervention.

We envisaged the next phase of this research project to develop a learning theory that focuses on sustainable-smart thinking: learning for sustainable-smart innovations.

Acknowledgement

Funding support from The Cape Higher Education Consortium (CHEC) and the City of Cape Town (CCT) Research Programme.

References

- Baumber, A. (2022). Transforming sustainability education through transdisciplinary practice, *Environment, Development and Sustainability*, 24(6), pp.7622–7639.
- Bernstein, J. H. (2015). Transdisciplinarity: A review of its origins, development, and current issues. *Journal of Research Practice*, 11(1), pp.1–20.
- Carayannis, E. G., and Campbell, D. F. (2009). Mode 3 and Quadruple Helix: Toward a 21st Century Fractal Innovation Ecosystem. *International Journal of Technology Management*, 46(3): pp.201–234.
- Carayannis, E. G., and Campbell, D. F. (2010). Triple Helix, Quadruple Helix and Quintuple Helix and how do knowledge, innovation and the environment relate to each other? A proposed framework for a transdisciplinary analysis of sustainable development and social ecology. *International Journal of Social Ecology and Sustainable Development (IJSESD)*, 1(1), pp.41–69.
- Carayannis, E.G. and Morawska-Jancelewicz, J. (2021). The Future of Europe: Society 5.0 and Industry 5.0 as Driving Forces of Future Universities, *Journal of the Knowledge Economy*, 13, pp. 3445–3471.
- Etzkowit, H., and Leydesdorff, L. (2000). The Dynamics of Innovation: From National Systems and "Mode 2" to a Triple Helix of University–Industry–Government Relations. *Research Policy*, 29(2): pp.109–123.
- Ferraris, A., Belyaeva, Z., & Bresciani, S. (2020). The role of universities in the Smart City innovation: Multistakeholder integration and engagement perspectives. *Journal of Business Research*, 119, 163–171.
- Fukuyama, M. (2018). Society 5.0: Aiming for a new human-centered society. *Japan Spotlight*, 27(5), pp.47–50.
- Gladden, M.E. (2019). Who Will Be the Members of Society 5.0? Towards an Anthropology of Technologically Posthumanized Future Societies, *Social Sciences*, 8(5), pp.148–187.
- Gupta, R., Ardalan, N., and Fraser, J. (2017). The intergroup context of environmental education and approaches to facilitate collaboration. *Small Group Research*, 48(4), pp.420–454.
- Horn, A., Scheffelaar, A., Urias, E. and Zweekhorst, M.B. (2023). Training students for complex sustainability issues: a literature review on the design of inter-and transdisciplinary higher education. *International Journal of Sustainability in Higher Education*, 24(1), pp.1–27.
- Kitsios, F. and Kamariotou, M. (2021). Digital Entrepreneurship Services Evolution: Analysis of Quadruple and Quintuple Helix Innovation Models for Open Data Ecosystems, *Sustainability*, 13(21), p. 12183.
- Mausser, W., Klepper, G., Rice, M., Schmalzbauer, B.S., Hackmann, H., Leemans, R. and Moore, H. (2013). Transdisciplinary global change research: the co-creation of knowledge for sustainability. *Current opinion in environmental sustainability*, 5(3–4), pp.420–431.
- Mckenney, S. and Reeves, T.C. (2020). Educational design research: Portraying, conducting, and enhancing productive scholarship, *Medical Education*, 55(2), pp.82–92.
- Qureshi, I., Pan, S.L. and Zheng, Y. (2021). Digital social innovation: An overview and research framework, *Information Systems Journal*, 31(5), pp. 647–671.
- Rieckmann, M. (2018). Learning to transform the world: Key competencies in Education for Sustainable Development. *Issues and trends in education for sustainable development*, 39, pp. 39–59.
- Sá, M.J., Serpa, S. and Ferreira, C.M., 2022. Citizen Science in the Promotion of Sustainability: The Importance of Smart Education for Smart Societies. *Sustainability*, 14(15), p.9356.
- Sinakou, E., Donche, V., Boeve-de Pauw, J. and Van Petegem, P. (2019). Designing powerful learning environments in education for sustainable development: A conceptual framework. *Sustainability*, 11(21), p.5994.
- van den Berg, C. and Verster, B., 2022. Exploring Interdisciplinary Collaborative Online Learning Spaces through Sociomateriality in Cape Town, South Africa. *Electronic Journal of e-Learning*, 20(4), pp.467–482.
- Verster, B. and van den Berg, C., 2022. Theorising With Sociomateriality: Interdisciplinary Collaboration in Socio-Technical Learning Environments. *Educational Research for Social Change*, 11(2), pp.39–56.

Twin Green and Digital Innovation by SMEs in the Construction Sector

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Abstract: The Twin green and digital innovation is a fundamental element of the European SME Strategy and European Green Deal. While larger corporations have initiated a transition towards more sustainable and data-driven business, only a limited part of SMEs in Europe are actively investing in Twin innovation. Most SMEs presume elevated costs of Twin innovation and are unaware of the potential impact on their business performance. The study describes a usable generic framework to analyse the Twin innovation options, the impact on business performance and a roadmap for implementation by SMEs in the construction sector. The paper offers practical tools for SME owners and directors seeking to engage in Twin innovation. The findings are also relevant for other researchers in this field interested to gain a better understanding of twin innovation, as well as policy makers who seek to steer support programs towards innovation in SMEs.

Keywords: twin green and digital innovation, twin innovation, SMEs, construction sector

1. General introduction

Green and digital innovation represent two leading but still separated trends that are shaping the transformation of business and hitherto mainly adopted by larger corporations as an answer to the pressure from internal and external stakeholders (Martins *et al.*, 2022). The combination of digital and green innovation of business is a more recent approach to achieve long term transformation of business and the society at large towards a more competitive and sustainable future. The twin green and digital innovation (hereafter indicated as Twin innovation) has recently been marked as a priority for European business (Muench *et al.*, 2022). The twin seeks to achieve a climate-neutral, resource-efficient, and agile digital economy at the level of European SMEs across industrial sectors (European Union, 2022).

SMEs will have to catch up with Twin innovation due to a combination of increasing pressure from different stakeholders including government, corporate clients and increasingly customers. Where larger companies invest in Twin innovation, SMEs are lagging behind as it is seen as complicated and sometimes considered as competing transitions (Muench *et al.*, 2022). SMEs are facing a number of challenges to invest in Twin innovations including a lack of general knowledge about relevant Twin innovation options, high costs and a perceived lack of impact on business performance (George, Merrill and Schillebeeckx, 2021). It is indicated that research focuses on Twin innovation in public sectors and larger companies, research on SMEs is very limited. Similarly, there is limited literature on the impact of digital technologies on green innovation by SMEs (George, *et al.*, 2022). In this context, this article seeks to identify a framework to identify relevant Twin innovation options for SMEs, to analyse their impact on business performance and to define a roadmap for its implementation in the construction sector.

2. Literature review

2.1 SMEs and green and digital innovation

Small and Medium Business (SMEs) play a central part in the challenges Europe is facing given their overall contribution to European production and employment. SMEs represent over 99% of all companies in the European Union, generate 57% of value added and generate 67% of employment. SMEs account for 99.8% of the total number of enterprises and 66.6% of total EU employment (European Commission, 2020). SMEs play a large role in their region at community level and can thereby have an important contribution to a greener production pattern in Europe. As key actors SMEs are essential to build a more sustainable economy (Martins *et*

al., 2022). However, SMEs have limited knowledge and resources for structural innovation (PWC, 2022; Szewieczek *et al.*, 2022).

From an environmental perspective, SMEs are to embark on green innovation to diminish their environmental impact. SMEs have a significant share in the deteriorating environment in most environmental processes including the combat in climate change and environmental degradation caused by higher concentrations of carbon dioxide, methane and nitrous oxide, biodiversity loss, and ocean acidification, changes in freshwater consumption and land use for commercial exploitation and chemical pollution (Muench *et al.*, 2022). The emission of carbon dioxide by SMEs alone represents 63% of all emissions by companies in Europe (European Union, 2022). Although data are scarce, a study indicates that SMEs represent around 36% of energy use in the UK, most of which is based on fossil energy sources (Blundel, 2022). SMEs are main actors in the European road transport sector and still dependent on fossil fuels. Related to the green transition, Blundel has stated that SMEs are central, but widely-neglected actors in the Net Zero transition (Blundel, 2022).

Digital innovation, referring to the adoption of digital technologies and data by companies to improve business performance is also highly relevant to SMEs (Muller *et al.*, 2021). Research indicates that they can provide broad benefits for SMEs in terms of better access to skills and talent, productivity and competitiveness, finance, product development and markets (Ramdani, Raja and Kayumova, 2021). These tools are perceived as of strategic value to market expansion and internationalisation (Coronel, 2020; Falco, 2020). Emerging digital technologies or Industry 4.0 can have a large impact on products, processes, customer experience and the overall business model (Bär, Lee Hansen and Khalid, 2018; European Commission, 2021). Scuotto (2017) has shown that digitalisation is highly instrumental in new product development. Others have shown the most impact of digital transformation on customer satisfaction (Balan and Feng, 2019).

2.2 Current status of Twin innovation in SMEs

The Twin green and digital innovation was adopted as a new concept by the European Union as part of its European SME Strategy and the European Green Deal (European Commission, 2021). Next to the need for digitalisation in general, SMEs are required to embrace the adoption of digital technologies and data to be able to demonstrate and measure the environmental footprint of their business activities. Twin innovation creates important opportunities to create additional value to SMEs. Green innovation combined with digital tools to analyse emission levels can generate competitive advantages in material usage and production processes and create new markets for green products and services (George *et al.*, 2021).

However, a recent survey (European Union, 2022) indicates that most SMEs in Europe take limited and isolated actions to reduce resource usage, some with support of basic digital tools. Only 25% of SMEs in Europe have a strategy to reduce their carbon dioxide emissions and 4% indicate that they are carbon neutral. Next to green innovation, digital technologies and capabilities can act as a catalyst and create synergies for green innovation processes and products through optimization of processes, monitoring and tracking of resources and virtualisation of green products and services (Muench *et al.*, 2021). Despite the overall potential impact of digitalisation, there is still a clear gap between the level of digitalisation of both basic and emerging digital technologies among SMEs and larger companies. A recent study of PWC shows that SMEs have a significant gap in digital transformation even in basic technologies such as E-commerce, cloud computing, ERP or big data analysis (PWC, 2022).

Despite the increased attention for resource efficiency, investment by SMEs in green measures and technology is still limited (European Union, 2022). SMEs face important barriers to Twin innovation including a perceived lack of benefits and the impact of both green and digital solutions on business performance (Szewieczek *et al.*, 2022). Earlier studies indicate that SME business owners are mostly reactive as they see environmental measures as costly and affecting competitiveness without providing tangible benefits (Studer, Welford and Hill, 2006). Another obstacle is found in the lack of internal environmental and digital expertise, with only 15% of small companies and 42% of mid-sized companies compared with 75% of larger companies (Muller *et al.*, 2021). SME capabilities are insufficient to identify a roadmap for planning and implementation Twin innovation (Martins, *et al.*, 2022).

2.3 Twin innovation in the construction sector

In this paper it is chosen for the construction sector because it has a large need for twin innovation due its high pollution levels and low adoption rate. The sector has a 35% share in greenhouse emissions in the European Union. It uses half of all raw materials, one third of water usage and waste in Europe and only 1% of all materials are reused in new buildings. The sector consumes 40% of European energy use related to energy intensive construction methods and low energy efficiency of the larger part of building stock in Europe (Muench *et al.*, 2021). As part of the carbon emission objectives in Europe, emission intensities of the sector need to be reduced by an additional 50% (Li, Wiedmann and Hadjikakou, 2020). Therefore, the sector provides important opportunities to become more sustainable and resource efficient in materials, energy, water and waste (European Union, 2022). There is also scope for green products and services including circular design, low-carbon material choices and reuse of construction material, renewable energy use in construction and building usage, renovation and retrofitting, reduced demand for buildings by rethinking home and co-working and virtualisation of products and services (European Commission, 2021).

While the challenges of SMEs hitherto described apply to most economic sectors, the type and adoption levels of Twin innovations and the sectoral contribution to European environmental pollution vary widely among sectors. In general manufacturing, infrastructure and service industries are much ahead in Twin innovations (European Commission, 2022). In the construction sector, only 40% of companies are using emerging digital technologies in support of green innovation and an even lower percentage of companies engaged in organisation-wide green innovation (Muller, P., *et al.*, 2021). The construction sector is slow to implement Twin innovations as a result of its highly decentralised, a lack of collaboration in the value chain and a lack of expertise (Goh, 2020). SMEs are key actors in the sector representing 99.9% of all companies, 90% of employment and 83% of value added in the European Union (European Commission, 2021). SMEs in the sector have limited capacity to implement and use digital technologies to support the green transition (Muench *et al.*, 2022). Similar to SMEs in other sectors, SMEs in the construction sector will only be able and interested to engage in a twin transition process if they gain better insights in the twin options and their impact of twin innovations on business performance.

2.4 A framework for Twin innovation in the construction sector

To be able to understand options and the potential benefits and impact of Twin innovation on business performance a framework can assist in the methodological analysis of the Twin and its impact at the level of different business activities in the value chain. The first element of the framework are the three key business processes of a traditional value chain including supply chain management, operations and products and markets (table 1). These three business processes are aligned with the standard greenhouse gas emissions or carbon footprint of business activities, including scope 1 emissions of direct emissions in operations, scope 2 emissions from energy usage by the company and scope 3 level indirect emissions of suppliers and clients' products and services (Li, 2020).

Secondly, the framework covers a set of economic, social and environmental indicators (table 1) based on the Triple Bottom Line and adjusted to the realities of the construction sector that supports a better integration of sustainable development practices (Goh, 2020). Basic economic impact indicators include revenues, price, costs and productivity, customer satisfaction and compliance with government regulations (Ramdani *et al.*, 2021; Martins *et al.*, 2022). As for social impact indicators companies can expect an impact on their access to new talent, employment numbers and employee satisfaction and impacts on the community (Martins *et al.*, 2022). Environmental impact indicators include greenhouse emissions, materials, energy and water efficiency levels and the impact on sustainability of cities (Muench *et al.*, 2021; Rockstrom *et al.*, 2009). To optimise the framework, for each business activity level, the most relevant impact indicators are selected.

To be relevant, the framework is to identify as a third element of a set of Twin innovations that are **salient** to the construction sector (table 1). Within the supply chain of the construction sector, key green and digital innovations include the use and local sourcing of low carbon and nature-based materials and digital tools to compare materials and transport costs (European Union, 2022; Muench *et al.*, 2022). At business operations level, construction companies are to seek greener, less use and recycling of materials, energy, water and waste products with support of data analytics, smart metres and enterprise resource planning tools (European Commission, 2021). When looking at product and service development, the construction sector can benefit from

green innovations in efficient building processes, maintenance and energy sourcing and renovation and service based real estate services empowered by product digital tracking and tracing technologies, big data analysis and machine learning (Blundel, 2021; Muench *et al.*, 2022).

Table 1: A framework for Twin innovation in the construction sector

Business process	Twin green and digital innovation options in the construction sector		Key impact indicators on business performance
Supply chain management level (Scope 3)	1. Use of low carbon materials (low grey energy, lifetime, energy efficiency, potential for repair and recyclability) 2. Use of nature-based materials 3. Local sourcing of materials	1. Digital tracking and data analytics to measure carbon intensity & cost analysis of materials (sensors, databases & dashboards and product passport)	Economic 1.1 Purchasing costs 1.2 Customer compliance 1.3 Government compliance Social 2.1 Access to new talent 2.2 Employee satisfaction Environmental 3.1 Greenhouse gas emissions 3.2 Materials efficiency 3.3 Recycling of materials
Business operations level (Scope 1 and 2)	1. Improved efficiency of materials 2. Technologies to enhance waste reduction, reuse & recycling 3. Technologies to reduce and clear water 4. Electrification 5. Use of renewable energy	1. Enterprise Resource Planning (ERP) 2. Smart digital metres & data analytics (databases, dashboards, AI) 3. Smart production methods (robotica en 3d printen)	Economic 1.1 Production costs 1.2 Productivity 1.3 Competitiveness 1.4 Customer compliance 1.5 Government compliance Social 2.1 Access to new talent 2.2 Employee satisfaction Environmental 3.1 Greenhouse gas emissions 3.2 Materials efficiency 3.3 Recycling materials 3.4 Water efficiency 3.5 Energy efficiency
Products and markets level (Scope 3)	1. Integrated building design and planning based on sustainable, resilient and recyclable materials 2. Improved efficiency of materials 3. Building retrofitting through energy renovation (shading, solar & geothermal energy) 4. Low carbon heating & cooling systems 5. Development of business service models for living and office buildings	1. Integrated digital building modelling 2. Life cycle analysis, simulation and forecasting models for buildings 3. Digital building management systems 4. Digital platforms for living and office space sharing	Economic 1.1 Product costs 1.2 Revenues 1.3 Customer compliance 1.4 Government compliance 1.5 Local competitiveness 1.6 International competitiveness Social 2.1 Access to new talent 2.2 Employee satisfaction Environmental 3.1 Greenhouse gas emissions 3.2 Recycling materials 3.3 Materials efficiency 3.4 Recycling materials

Sources: Based on inputs from Blundel, 2021; European Commission 2021; European Union, 2022; Goh, 2020; Goh, 2020; Li, 2020; Martins *et al.*, 2022; Muench *et al.*, 2021; Ramdani *et al.*, 2021; Rockstrom *et al.*, 2009 and Authors.

3. Research questions and methodology

The key research questions of this study are:

1. What are relevant Twin innovations in the construction sector?
2. What is the expected impact of Twin innovations on SMEs in the construction sector?
3. What can be a roadmap for the implementation of the Twin innovations by SMEs in the construction sector?

The choice of research method is based on the purpose of this study. This study uses a qualitative case-study research design to answer the explanatory research questions (Yin, 2016). In contrast to an experimental design or a survey, a case study method presents more flexibility, allowing an in-depth analysis of a complex research problem within a highly-contextualised environment (Yin, 2016). This research design helps answer the research questions because it allows the use of the replication logic as a possibility to obtain external and internal validities as well as to analyse pattern-matching properties between the theoretical framework and the case (Yin, 2016).

This method is apt to develop new insights and develop emerging concepts such as the Twin and enables the creation of new frameworks (Snyder, 2019). This method also enables us to integrate interdisciplinary - economic, social, environmental and technological- conditions that companies need to consider when making decisions on innovation. To enhance the practical relevance of the framework it is chosen to develop a framework for a specific sector, in this the construction sector.

The framework is validated by semi-structured interviews with five subject matter experts in the construction sector in the Netherlands about Twins and their impact on business performance. The experts included two decision makers with experience in sustainability and digitalisation, two sustainability experts and one digitalisation expert. The experts all have vast experience in the application of Twin innovations in the construction sector. This way the framework will lay a basis for future empirical case studies among SMEs in the construction sector which can further validate the practical relevance of the framework.

4. Findings on Twin innovations in the construction sector

4.1 Relevant Twin innovations in the construction sector

The relevance of the Twin innovation options identified in the framework is confirmed by the subject matter experts interviewed. To enhance sustainability in the supply chain, the local sourcing of materials has since long been considered as an option to achieve lower emissions and low carbon materials are increasingly chosen as an alternative in building projects (Vreese, 2023). The use of nature-based materials is less common due to elevated costs and limited to pilot projects in the construction sector (Van Doorn, 2023). Larger construction companies combine the green innovation with data analytics to measure material cost and emissions. Eventually, these will be developed into product passports and life-cycle models at product and construction project levels (Spierings, 2023; Van der Mark, 2023). There are also initial experiments with using sensors integrated into infrastructure and buildings to optimise the maintenance activities, e.g. in bridges. In line with other studies earlier mentioned, the adoption of Twin innovation by SMEs is still limited due to higher costs and a lack of knowledge (Kor, 2023; Spierings, 2023).

Whereas business operations are concerned, the interviewees indicate that construction companies seek efficiencies in the use of materials, technologies supporting waste and water reduction, reuse and recycling. Larger construction companies are also experimenting with the electrification of construction and transport equipment, even though this implies additional investment costs and a period of adaptation by staff. They are also investing in renewable energy solutions. In most cases smart metres and some level of data analytics are used to monitor resource usage (Kort, 2023; Spierings, 2023). In a smaller number of cases, the sector experiments novel technologies such as 3D concrete printing (Vreese, 2023; Van Doorn, 2023). However, due to the complexity of integration of environmental data, there is limited integration of related data in ERP systems (Vreese, 2023).

When considering new Twin products and services, the experts interviewed indicate that there is important scope for sustainable construction projects if clients collaborate with constructors to develop a more sustainable and integrated design, planning of infrastructure and buildings, supported by digital modelling. In this area, companies have also started with basic life-cycle analysis (Spierings, 2023; Van der Mark, 2023). This also applies to retrofitting and efficient heating and cooling systems. Due to complex ownership issues, the experts indicate that shared digital building management systems and 'construction as a service' is not yet a viable option in the sector (Vreese, 2023; Van Doorn, 2023; Kor, 2023).

4.2 The impact of Twin innovation in the construction sector

The analysis of the impact of Twin innovation in the construction sector provides a mixed outcome. At the supplier level, the innovation towards the use of low carbon materials supported by data analytics does come with an increase in material costs of construction projects but will strongly contribute to the reduction of scope 3 emissions and positively impact the compliance of customer and government requirements. The use of natural materials and locally acquired materials is seen as less relevant as it will not lead to improved material efficiency or compliance with client or government regulations (Kor, 2023; Freeze, 2023).

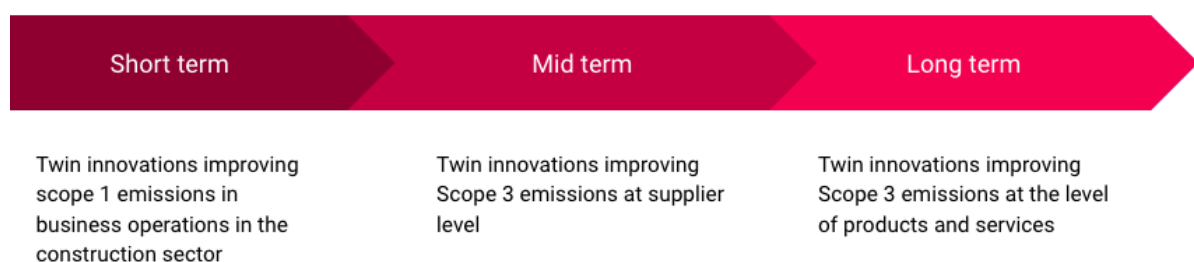
The impact of more efficient and low-carbon material use in combination with digital tools such as smart metres and data analytics is high in terms of scope 1 emission levels, competitiveness and compliance with client demands. Twin innovation in low-carbon building materials and data analytics, where possible supported by smart metres and robotics, is seen as an important longer-term differentiator in which companies are to invest now to secure both competitiveness and compliance with future regulations. It also enhances the satisfaction of employees and attractiveness to new talent. The impact of twin innovations in waste and water reduction and recycling on scope 1 emissions is high and will contribute to more efficient resource usage but has limited impact on other business indicators (Kor, 2023; Vreese, 2023). Electrification of construction equipment and renewable energy solutions can encounter resistance and require additional investments but do gain support from employees once implemented (Kor, 2023; Vreese, 2023; Van Doorn, 2023).

Twin innovations in new products and services are important to diminish scope 3 emissions but will generate additional product costs which cannot be compensated with higher product and service price levels but do strengthen competitiveness and differentiation in the market (Van der Mark, 2023; Van Doorn, 2023). The use of more sustainable construction by using integrated digital planning and life-cycle models for building projects will help in reuse and recycling of building materials and prepare constructors for expected future demands by customers and governments and attract new talent. The companies have gained some experience with advanced business model innovation such as Construction as a Service but this approach is still seen as highly complicated due to its complex legal implications for ownership (Kor, 2023; Van der Mark, 2023).

4.3 A roadmap for twin innovation in the construction sector

The research also enables us to understand at what activity level in the value chain SMEs are best to start with Twin innovation. The timelines applied are based on the necessary adoption rates as a consequence of European current and expected environmental regulatory standards, related customer demands and market opportunities. The short-term time frame covers the next two years and the mid-term period a three to five-year period. The long-term timeline for twin transition refers in the period up to 2030, where major emission and waste targets are set in the construction sector (European Commission, 2021).

Table 2: A roadmap for implementation of the twin innovation in the construction sector



Sources: Authors

The subject matter experts suggest that in the short term companies are to start with Twin innovation at the level of their business operations (Van Doorn, 2023; Vreese, 2023). The first argument is that construction companies are already legally bound to comply with European Climate Law and national government regulations that focus on emission levels scope 1 which are directly related to business operations (European Commission, 2021). Furthermore, companies have more control over their own processes than over suppliers or customers and they can exploit the presence of basic digital infrastructure (Muller *et al.*, 2021). Construction companies can also benefit from the more proven green innovations available. Finally, despite the negative impact on

production costs, twin innovations are expected to have a positive impact on the companies' competitiveness as a result of resource efficiency gains can reduce resource costs and even generate new sources of revenues from the sales of waste and energy (Goh, 2020).

In the middle-long term, companies are to further integrate Twin innovation in their supply chain. This is firstly related to the expected increase in EU and national regulations regarding resource efficiency in the next 3 to 5 years which will oblige suppliers to source more carbon efficient materials (European Commission, 2021). Without the Twin innovation, smaller construction suppliers may not be able to comply with increased standards for green building materials set by contracting construction companies and thereby lose market access and competitiveness. The interviewed experts indicate that improving the sustainability of the supply chain is complicated as some of the larger suppliers of construction materials are reluctant to provide the necessary data and smaller providers do not yet have the required knowledge and resources of digital tools to provide the necessary data (Spierings, 2023; Van der Mark, 2023).

In the longer term from five to ten years, construction companies are to look out for Twin innovation in products and services delivered to customers in the construction sector. This includes multiple innovations to increase material efficiency and reduce emissions by developing digital life-cycle and simulation models and introducing service-based construction (Muench, *et al.*, 2022). These innovations will be needed to respond to fast developing EU and national regulations for buildings in Europe to reduce Scope 3 emissions (European Commission, 2021). They also stress the importance of new forms of collaboration and contracting between construction companies and their clients such as real estate investors or governments where partners seek shared ownership of the innovation process and the necessary additional costs, time and efforts (Van der Mark, 2023; Van Doorn, 2023)).

5. Discussion

Although the literature clearly supports the need for Twin innovation in general and in the construction sector in particular, the study has found limited academic sources that assist in defining a framework to analyse the impact on business performance of SMEs active in the construction sector. While the framework present in this study provides a starting point, the validation of the framework with subject matter experts indicates that there is still a need for a better systematic overview of possible and relevant Twin innovations at each level of the value chain in the construction sector.

Where it concerns the expected impact of Twin innovation, the empirical findings based on the opinions of subject matter experts coincide with the expected social and environmental impact of twin innovation. However, the expert opinions do considerably divert from the literature where the economic impact of twin innovations is concerned. While twin innovation will support competitiveness in the longer term, the innovations are associated with cost increases that will not be compensated by higher market prices. Therefore, successful twin innovations will only be realised if suppliers, contractors and clients work together and share knowledge and investments to identify effective twin innovation in the sector.

Finally, the literature suggests a clear priority to the adoption of twin innovation in internal business operations. Yet, the experts suggest to compensate associated internal investment with the promotion of twin innovation with customers that are prepared to share pilot investment and benefit from reduced scope 3 emission levels in the construction sector. Similarly, different from what was expected, despite the high potential of environmental gains at supplier levels, the experts indicate most difficulties are to achieve twin innovation at the level of both larger and smaller suppliers in the construction sector.

6. Conclusions and research agenda

This paper confirms the urgent need and opportunities for SMEs active in the European construction sector to engage in Twin innovation. For this, the framework in this paper presents a set of Twin innovation options for SMEs in the construction sector and discusses their impact on business performance. In the short term, SMEs can expect the most positive impact from integrated implementation of Twin innovations at the level of their business operations. In the mid-term, SMEs are to invest in Twin innovation in construction materials to secure their competitiveness in the market. In the longer term, construction companies are to explore Twin innovation

to achieve more sustainable building methods and building management services which will enhance their long-term competitiveness in the market.

Next to direct relevance for SME company owners and directors, these findings are relevant for other researchers in this field interested in deepening research on the twin innovation, as well as policy makers who seek to steer and speed up support programs towards successful Twin innovation among European SMEs.

Where future research is concerned, it is important to conduct further research among SMEs in the construction sector to validate the proposed framework and deepen initial findings. To enhance the relevance of the framework It is recommended to expand the research to case studies in other European countries. Subsequently, the framework can be used to conduct comparative research on the twin transition among SMEs in other economic sectors.

References

- Balan, H, and Feng, X (2019), Success of Small and Medium Enterprises in Myanmar: Role of Technological, Organizational, and Environmental Factors", *Journal of Global Information Technology Management*, Vol 22, No. 1, pp 1-20.
- Bär, K. Lee Hansen, Z.N. and Khalid, W. (2018), Considering Industry 4.0 aspects in the supply chain for an SME, *Production Engineering*, Vol 12, No. 2, Springer.
- Blundel, R. (2022) SMEs and Net Zero: A Personal Reflection on the Principal Challenges for Researchers and Policymakers, *ISBE Annual Conference 2022: New Approaches to Raising Entrepreneurial Opportunity: Reshaping inclusive Enterprise, Policy, and Practice Post-Pandemic*, York, United Kingdom, 27-28 Sep 2022, The Open University, pp. 27-28.
- Coronel, R., Nunez-Castillo, C. and van der Krogt, A. (2020), Adoption of business intelligence for SMEs, *8th International Conference Innovation Management, Entrepreneurship and Sustainability*, Prague, Czech Republic, May 28-29 2020, University of Economics, pp. 140-153.
- European Commission (2020), *User guide to the SME Definition*, Luxembourg, European Commission.
- European Commission (2021), *Scenarios for a transition pathway for a resilient, greener and more digital construction ecosystem*, Brussels, Commission Staff Working Document
- European Commission (2022), *Digital Economy and Society Index (DESI) 2022, Thematic Chapters*, European Commission.
- European Union (2022) *Flash Eurobarometer 498 Report SMEs, green markets and resource efficiency*, European Union.
- George, G., Merrill, R. K., and Schillebeeckx, S. J. D. (2021) Digital Sustainability and Entrepreneurship: How Digital Innovations Are Helping Tackle Climate Change and Sustainable Development, *Entrepreneurship Theory and Practice*, Vol 45 No.5, pp. 999–1027.
- Goh, C.S. et al. (2020) Revisiting triple bottom line within the context of sustainable construction: A systematic review, *Journal of Cleaner Production*, Vol 252, No. 10, April, 119884.
- Kor, H. (2023). Interviewed by Arjan Rensma and Stijn van der Krogt, May 1, Utrecht.
- Li, M., Wiedmann, T. and Hadjikakou, M. (2020), Enabling Full Supply Chain Corporate Responsibility: Scope 3 Emissions Targets for Ambitious Climate Change Mitigation, *Environmental Science & Technology*, Vol. 54 No. 1, pp. 400-411.
- Martins, A. et al. (2022), Sustainability in Small and Medium-Sized Enterprises: A Systematic Literature Review and Future Research Agenda, *Sustainability*, 2022, Vol. 14: 6493.
- Muench, S. et al. (2022), Towards a green and digital future, *Publications Office of the European Union*, Luxembourg, EUR 31075 EN.
- Muller, P. et al. (2021), *Annual report on European SMEs 2020/2021: digitalisation of SMEs, Background Document, Executive Agency for Small and Medium-sized Enterprises*, European Commission, Publications Office
- Ramdani B., Raja, S. and Kayumova, M. (2021), Digital innovation in SMEs: a systematic review, synthesis and research agenda, *Information Technology for Development*, Vol 28, No. 1, pp. 56-80.
- Rockström, J. et al. (2009), A safe operating space for humanity, *Nature*, Vol 461, pp. 472–475.
- Scuotto, V. et al. (2017), Shifting intra- and inter-organizational innovation processes towards digital business: An empirical analysis of SME, *Creativity and Innovation Management*, Vol 26, No. 3, pp. 247-255.
- Spierings, I. (2023). Interviewed by Stijn van der Krogt, May 5, Hoofddorp
- Studer, S., Welford, R. and Hil, P. (2006), Engaging Hong Kong businesses in environmental change: drivers and barriers, *Business Strategy and the Environment*, Vol 15, No. 6, pp 416-431.
- Szewieczek A. et al. (2022), Industry 4.0 Development and implementation in SMEs in Poland, in Trumić, M. (ed.) *Possibilities and barriers for Industry 4.0 implementation in SMEs in V4 countries and Serbia*, Belgrade, University of Belgrade, pp. 13-34.
- Van der Mark, S. (2023), Interviewed by Stijn van der Krogt, May 4, Hoofddorp.
- Van Doorn, E. (2023), Interviewed by Stijn van der Krogt, May 22, Hoofddorp
- Vreese, A. (2023), Interviewed by Arjan Rensma and Stijn van der Krogt, April 24, Hoofddorp
- Yin, R. K. (2016), *Qualitative research from start to finish*, 2e Edition, The Guilford Press, New York City.

Entrepreneurs Creating Entrepreneurs: *Shopkeeper* Supporting the Forming of Micro Businesses

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Abstract: Making clothes and developing your own brand of clothes may not be innovative although it is a sign of entrepreneurial behaviour. However, the entrepreneurship does not stop there. For some years now, a young man has been selling a clothing range, as well as collaborating with other brands, in order to help kids and youths coming from the same background as himself, i.e., surrounded by drugs and criminality. His idea is to catch the kids/youths before they start taking drugs, become addicted or commit a crime, and show them that there are other better ways to live their lives. He is working towards several new goals: One of them is to open a school where they not only learn “the ordinary curriculum”, but which also focuses on making a living for themselves and how to stand up for themselves. It is about adapting the schooling and learning to their life situation, rather than the children adapting to school. The earnings are not great (yet), but his eagerness to present the objective of the business has earned him some attention, not only among potential customers, but also with local and other authorities. His passionate and yet humble appearance appeals to customers and authorities. In addition to earning money to fund other youths, he also invests in them setting up micro businesses in order to become independent. In other words, his entrepreneurship skills have helped develop other entrepreneurs. In this paper, we will present the initial findings of our entrepreneur and his entrepreneurial achievements, characteristics and transformative style. We seek to explain the success behind such entrepreneurial activities using social entrepreneur and transformative leadership theories. We have conducted our first initial semi-structured interviews via zoom using interview guides and more research is planned for the next phase of our research.

Keywords: Social Entrepreneurship, Entrepreneurial Behaviour, Innovativeness, Social Rescue, Crime Prevention

1. Introduction

There are many entrepreneurs who have been successful and made a business out of their inventions or novel ways of doing things. Sometimes, it is about inventing new products or services, while other times it is about how you organize the production or your business. According to Schumpeter (1934, 2021), economic innovation can be defined as developing new combinations, such as introducing a new product that is unknown, or of a different quality, introducing a new method of production possibly based on other business areas, entering a new market, the utilization of different types of material, or different ways of organizing in an organization. There are numerous definitions of innovation which are not only concerned with new combinations, but may also be about “the successful introduction of ideas, perceived as new, into a given social system” (Bradford & Kent, 1977, p. 128). Innovations may be products, but also services or processes (Kvangarsnes, Håvold & Helgesen, 2016).

Entrepreneurship is recognized by the desire of achievement, wanting to work independently, having a desire for achieving quality, being responsible and optimistic, and by having skills and intelligence (Spilling & Alsos, 2006). Spilling and Alsos (2006) also divide the entrepreneurs into three types: the entrepreneur who is about realizing their own ideas, the entrepreneur who needs work, and the entrepreneur who wants to make an impact in the (local) community.

The latter also resembles “Social Entrepreneurship”. Social entrepreneurship emerged in the 1970s as a response to addressing social issues sustainably. The term “social entrepreneur” was coined in 1972 by Joseph Banks to describe the use of managerial skills to tackle both social problems and business challenges (Banks, 1972). The practice of social entrepreneurship gained momentum in the 1980s with the establishment of organizations like Ashoka, which supported social entrepreneurs (El Ebrashi, 2013).

According to El Ebrashi (2013), social entrepreneurship “focuses on achieving a social mission, which is clear in the context and outcomes of the social component” (El Ebrashi, 2013, p. 189). Social impact is defined as assessing the consequences developed from a project or undertaking and embracing any changes the social and/or cultural way may impact their lives, and how they relate to society. Burdge and Vanclay (1996) claim that

cultural impact “involve changes in norms, values, and beliefs of individuals that guide and rationalize their cognition of themselves and their society” (Burdge & Vanclay, 1996, p. 59).

El Ebrashi (2013) cites Robinson, who provides a more specific definition of social entrepreneurship. This definition says that social entrepreneurship is: “a process that includes: the identification of a specific social problem and a specific solution (or set of solutions) to address it; the evaluation of the social impact, the business model and the sustainability of the venture; and the creation of a social mission-oriented for-profit or a business-oriented nonprofit entity that pursues the double (or triple) bottom line”(Robinson, 2006, p. 95; El Ebrashi, 2013, p. 190).

Social entrepreneurship may also be about addressing issues regarding the social distribution of public goods. It is about establishing social organizations that are concerned with innovations, addressing social growth, and executing activities that support the desired social impact (Nteere, 2021). Whilst El Ebrashi (2013) suggests that social entrepreneur addresses market failures related to externalities, public goods, and distributional equity. Unlike traditional entrepreneurs, social entrepreneurs prioritize achieving a social mission, making social value the central driving force of their work. They create social impact and change, which are measured differently from financial profit, often using methods like logic models to assess their social impact (El Ebrashi, 2013). Contrary to this, Nteere claims that “a social business seeks to profit from acts that generate social improvement and solves a broader human development purpose” (Nteere, 2021, p. 460).

The social entrepreneurial business also needs leadership, with the focus of seeking improvement and change, “transformational leadership”, as this embraces change, as well as profitability and productivity (Müller and Turner, 2007).

Transformational leadership was founded by James MacGregor Burns in 1978. It is defined as a process which “changes and transforms people”. Transformational leaders are concerned with emotions, ethics, values and long-term goals. It also involves the assessment of followers’ motives as well as satisfying their needs. Transformational leadership has become part of the “New Leadership” paradigm. It emphasises intrinsic motivation along with follower development (Northouse, 2016, p.161). According to Muller and Turner (2010), numerous organisations have become more interested in choosing transformational leaders, as they are more engrossed on meeting increased adoption of change, profitability and productivity.

According to Gartner reports (2016), about 40% of CIOs are digital transformational leaders within their organisation, simultaneously, 34% are responsible for innovation. The popularity of transformational leadership is due to its emphasis on intrinsic motivation and follower development. According to Bryman (1992), transformational leadership has become part of the “New Leadership” paradigm. This is because it gives more attention to the affective as well as charismatic elements of leadership. This indeed fits the needs of today’s work groups, who want to be empowered and motivated to succeed in times of uncertainty or doubt. Transformational leaders are seen as change agents as well as good role models. This is because they are able to create and articulate a clear vision for an organisation, whilst motivating their followers and empowering them to meet higher standards, thereby improving organisational life (Northouse, 2016).

Characteristics of transformational leader includes ‘inspirational motivation’, ‘intellectual stimulation’, ‘idealised influence’ and ‘individualised consideration’ as follows:

- **Inspirational motivation:** This describes leaders who expect a lot from their followers and uses motivation and vision as a drive to achieve their goals. A good example of a leader who met this trait would be Steve Jobs. He is well known to have pushed his workers, with many of them working 90 hour weeks. Many of the workers who were asked why they worked such long hours explained, they were passionate about the project and motivated by their leader (Folklore, 2020).
- **Intellectual stimulation:** A leader that encourages innovation and creativity as well as critical thinking and problem-solving. Intellectual stimulation involves arousing followers' thoughts and imagination, as well as stimulating their ability to identify and solve problems creatively. For example, this type of leadership is a plant manager who promotes workers’ individual efforts to develop unique ways to solve a problem that have caused slowdowns in production. (Northouse, 2016)
- **Idealised influence:** Also known as charisma influence, it is the emotional component of leadership. They are strong role models, have very high levels of morals and values and provide followers with a vision and a sense of mission (Northouse, 2016). A good example of a leader with the idealised influence would be Elon Musk as he created Tesla, not to make a profit, but rather to accelerate the advent of

electric vehicles (Hawkins, 2017). He also plans to send humans to Mars by 2024 to make humans a multi-planetary species (Space X, 2020). This is a clear example of a sense of mission.

- **Individualised consideration:** This is representative of leaders who provide a supportive climate and listen carefully to the needs of the individual. They could be thought of as coaches and advisers. An example of this type of leadership is a manager as he/she spends time treating each employee in a caring and unique way. To some employees, the leader may give strong affiliation, but to others, the leader may give specific directives with a higher degree of structure (Northouse, 2016).

According to Northouse (2021), transformational leadership is used in recruitment, promotion (encourages innovation and creativity), training (i.e. building vision) and development (developing individual workers) (Northouse, 2016). The transformational leader will develop a vision, seek to motivate the workforce and deliver the vision, present a road map and lead the change. The strengths of the transformational leadership is that it has an emphasis on followers' needs, values and morals, supports productivity, and sees leadership as a process between leaders and the workforce. It begins with making the vision that attracts potential followers, build networks, clear vision and lead the change (Changingmind, 2020, Northouse, 2016). The weaknesses are that the measurement methods may be abused and viewed as a personal trait with the leaders (Northouse, 2021). For example, the issue of the leader developing the recruitment is in opposition to ideas from empowering leadership (Amundsen & Martinsen, 2014), as theories of empowering leadership include the workforce in developing the visions and strategy for the organization. This is also one of the fundamentals of a learning organization (Filstad, 2007, 2016; Irgens, 2011; Örtenblad, 2015).

1.1 The Case Study: Climeit Brothers

Our paper is about how a young man who manages to change his destiny and life path and sets up an ordinary shop with ordinary clothes. He also builds an academy by helping out others setting up their businesses in his shop. In this paper, we will present a case study about a young man called "Mo" (short for Mohammed), who started his business in UK Camden Market selling clothes. The clothes have a special logo called "ClimeIT" and the company is called "ClimeIT Brothers". Many days a week, once you enter the shop you will meet Mo, who is happy to share his story as he wants the "the world" to know about his venture. His vision is that there is hope and there is light despite all darkness, and that it is possible to stay out of trouble.

Mo's background as a very young immigrant to London, attending a school with a system not particularly well adapted to cater to the variety of youths in the suburbs, drove him towards a different life in which crime and drugs were natural components. Being regarded as a "misfit" in the school system, gang members are able to single you out and recruit you as a member. Mo was one of the recruits who realized that this is very much not the path to take, as one by one his friends ended up in jail or even died. Based on the statistics, he is therefore one of the very few who actually made it out alive and without a jail sentence. He also realized that nobody is going to do things for you, as you have to do it yourself. Hence, it is a matter of deciding on what you want to do and he wanted to have his own business, and because of his interest in clothes, he set up his own clothes shop. He soon invited friends to join him so that they could get out of the bad environment, and they "invented" the clothes brand "ClimeIT Brothers" and developed the logo. The name came from the idea that it is important to climb out of what leads you to make bad decisions, and that you can join a different "brotherhood" where you can develop the ability to have a better and independent life, since drugs and crime make you dependent on the tiers above you in the hierarchy.

For several years, ClimeIT Brothers have had a stall in Camden Market, and sold clothes such as t-shirts, sweaters and jackets. They now also have sunglasses, socks and stickers, all as products of other entrepreneurs.

1.2 Research Questions

Our research questions are based on the literature and case study above:

How does ClimeIT Brothers fit the description of "social entrepreneurship"?

How has the leader's leadership style affected others?

In the following, we will present our method of inquiry and our results from the data collection and discuss these data. Lastly, we will conclude and present our future research.

2. Method of Inquiry

We have treated this as a case study (Yin, 2014), as we are studying a “special” case (Yin, 2009, p. 256). To collect the data, we have used semi-structured interviews (Dalen, 2011; Jacobsen, 2015), which resemble open-ended interviews as suggested by Yin (2009, p. 264).

The data is from interviews with the main respondent, conducted both in person and via zoom. The zoom meeting was recorded and transcribed, with the respondent having agreed to the recording. The coding was done manually using categories and sub-categories.

3. Results and Discussion

As demonstrated in the previous research, social entrepreneurs are not primarily concerned with the immediate outputs or service provision of their ventures. Instead, their ultimate goal is to bring about lasting and sustainable change in the lives of people, with a focus on community-wide transformation rather than individual-level outcomes. This means they prioritize achieving social impact over mere outcomes.

Furthermore, social entrepreneurs, much like their counterparts in the private sector, also place a strong emphasis on ensuring the financial sustainability and efficiency of their enterprises. For instance, in the case of Mo, his objective was not solely to improve people's quality of life in the short term. Instead, he aimed to empower individuals with the knowledge and skills needed to sustain a decent life independently, without relying on external assistance. He accomplished this by mobilizing both financial and human resources within the community to create social and environmental impact, ultimately fostering a self-reliant society.

During our interviews and through the zoom interviews, we got confirmation of Mo's social entrepreneurship. He fits the description of Banks (1972), as he uses his position to work for others to be helped out of situations of possible criminality and drug abuse. He also “focuses on achieving a social mission, which is clear in the context and outcomes of the social component” (El Ebrashi, 2013, p. 189), as he is very clear in his statements regarding aiming to convince young people to stay away from criminality and drug abuse. He is critical of the schooling system, but instead of just criticizing it, he has invited himself to schools in order to seek to convince the pupils to avoid being recruited by gangs and groups that are “basically up to no good” (Mo, from his zoom interview). He has also provided lectures in innovation and entrepreneurship for the youth in schools in order to “make them find what makes them ‘tick’, what engages them” (Mo, from his zoom interview). According to Mo, they need to be engaged in order to pursue their dreams. This engagement seeks to change their values and beliefs, which is in coherence with what Burdge and Vanclay (1996) claim about a cultural impact involving “changes in norms, values, and beliefs of individuals that guide and rationalize their cognition of themselves and their society” (Burdge & Vanclay, 1996, p. 59).

Mo has also met others who have been in difficult situations (physical abuse, drug abuse), and he helped them set up their businesses. “We asked him: What is your passion, what do you like doing? And he answered that he liked to draw, and he liked stickers. So, we asked him to draw some awesome drawings that could be made into stickers. And then we got it printed for him, and now they are for sale in the shop”. We interpreted this to be what Robinson (2006) and El Ebrashi (2013) claim as “a process that includes: the identification of a specific social problem and a specific solution (or set of solutions) to address it; the evaluation of the social impact, the business model and the sustainability of the venture; and the creation of a social mission-oriented for-profit or a business-oriented nonprofit entity that pursues the double (or triple) bottom line” (Robinson, 2006, p. 95; El Ebrashi, 2013, p. 190), as he is identifying the individual's social problem, and pointing towards a specific solution (making stickers), in addition to helping him in setting up a business model, as well as allowing him to start up his business in ClimeIT Brothers shop in Camden.

When it comes to explaining his intrinsic motivation, behaviour and the characteristics of his leadership, we see him as a transformational leader, as he does have a clear vision and seeks to motivate his workers and followers. He has the inspirational motivation (uses motivation and vision as a drive to achieve their goals), intellectual stimulation (encourages innovation and creativity as well as critical thinking and problem-solving) idealized influence (has charisma and a strong role model, has high levels of morals and values and provide followers with a vision and a sense of mission) and individualised consideration (provide a supportive climate and listen carefully to the needs of the individual) (Northouse, 2016). He also seems to have an emphasis on the needs of the “followers”, their values and morals (Northouse, 2021). However, he is also very clear about the workers' ideas and contributions to the company and their products. He is also – as the citation above also implies – very concerned about the individuals' passions and inner drives. Hence, we interpret this to also be within the

empowering leadership category of leaders (Amundsen & Martinsen, 2014). He is concerned about the future for the company, and that they are to evolve. “We need to develop and see or make the trends, not for making so much money, we are able to manage, but in order for us to help others. In helping others to make a better living away from crime and drug abuse, we are doing something good for the society” (Mo, interview via zoom). This implies a concern for the company (ClimeIT Brothers) to be a learning organization (Senge, 2006; Irgens, 2011; Örtenblad, 2015; Filstad, 2016)

4. Conclusion

This research aims to enrich the existing body of knowledge on social entrepreneurship by offering fresh insights into the characteristics of social entrepreneurs. It goes beyond merely cataloguing the accomplishments of social entrepreneurs and delves deeper into their motivations and thought processes, analysing their conduct within the realm of social entrepreneurship. The social entrepreneurship theory along with the transformational leadership theory have aid the exploration of the contextual factors that drive the creation of social ventures, the underlying dynamics and structures of this organization, and how this entrepreneur gauges his social impact, mobilizes resources, and facilitates sustainable social change.

We are confident to conclude that ClimeIT Brothers fit the description of a “social entrepreneur” with transformational leadership style. His engagement and commitment to the society is visible and has definitely had an impact on several lives and been responsible for others setting up their own micro businesses. He is also both a transformational (Northouse, 2016, 2021) and empowering leader (Amundsen & Martinsen, 2014). His engagement for the development of the company in order to support even more people is not only admirable, but also shows his ideas for a learning organization (Senge, 2006).

4.1 Further Research

We have planned a follow-up research project, where we will interview the persons that he has helped establish their own companies. We will follow the same research methodology, and treat this as an extended case study (Yin, 2014). We have scheduled meetings in August and December 2023. Our primary aim for this extended case study is to establish how they perceive having set up their own companies, and how they view their position of social entrepreneurship. Are they able to forward the social entrepreneurship, or are they more concerned with their own companies and making a profit from their companies, and how they view and will engage in further initiatives from ClimeIT Brothers?

References

- Amundsen, S. and Martinsen, Ø. L. (2014) ‘Empowering leadership: Construct clarification, conceptualization, and validation of a new scale’, *The leadership quarterly*, 25(3), pp. 487–511.
- Banks, J. A. (1972) *The Sociology of Social Movements*. London: London: Macmillan Education, Limited (Studies in Sociology). doi: 10.1007/978-1-349-01452-1.
- Bradford, M. G. and Kent, W. A. (1977) *Human geography: theories and their applications*. Edited by W. A. Kent. Oxford: Oxford University Press (Science in geography).
- Burdge, R. J. and Vanclay, F. (1996) ‘SOCIAL IMPACT ASSESSMENT: A CONTRIBUTION TO THE STATE OF THE ART SERIES’, *Impact assessment bulletin*, 14(1), pp. 59–86. doi: 10.1080/07349165.1996.9725886.
- Changing Mind. (2020). *Transformational leadership*. Available at: http://changingminds.org/disciplines/leadership/styles/transformational_leadership.htm (Accessed: 01/09/2023)
- Dalen, M. (2011) ‘Intervju som forskningsmetode [Interview as a research method]’, *Oslo: Universitetsforlaget*.
- El Ebrashi, R. (2013) ‘Social entrepreneurship theory and sustainable social impact’, *Social responsibility journal*, 9(2), pp. 188–209. doi: 10.1108/SRJ-07-2011-0013.
- Filstad, C. (2007) *Learning in organizations*. Edited by G. Blåka. Oslo: Cappelen.
- Filstad, C. (2016) *Organizational Learning: from Knowledge to Competency (translated from Norwegian: Organisasjonslæring: fra kunnskap til kompetanse*. 2nd edn. Bergen: Fagbokforlaget.
- Gartner report. (2016). *Building the digital transform*. Available at: https://www.gartner.com/imagesrv/cio/pdf/cio_agenda_insights_2016.pdf (Accessed: 03/09/2023)
- Hawkins, A. (2017). *How Tesla changed the auto industry forever*. Available at: <https://www.theverge.com/2017/7/28/16059954/tesla-model-3-2017-auto-industry-influence-elon-musk> (Accessed: 01.09.2023)

- Irgens, E. J. (2011) *Dynamic and learning organizations: Leadership and development in a changing work-life (Translated from Norwegian: Dynamiske og lærende organisasjoner: ledelse og utvikling i et arbeidsliv i endring)*. Fagbokforlaget Bergen.
- Jacobsen, D. I. (2015) *How to conduct research: introduction to social science research methods (Translated from Norwegian: Hvordan gjennomføre undersøkelser? : innføring i samfunnsvitenskapelig metode"*. 3. utg. Oslo: Cappelen Damm akademisk.
- Kvangarsnes, M., Håvold, J. I. and Helgesen, Ø. (2016) *Innovation and Entrepreneurship (Translated from: Innovasjon og entreprenørskap)*. Scandinavian University Press (Universitetsforlaget). doi: 10.18261/9788215027623-2016.
- Müller, R. and Turner, J. R. (2007) 'Matching the project manager's leadership style to project type', *International journal of project management*, 25(1), pp. 21–32.
- Northouse, P.G. (2016). *Leadership. Theory and Practice*. 7th ed. Sage: Publication
- Northouse, P. G. (2021) *Leadership: Theory and practice*. Sage publications.
- Nteere, K. K. (2021) 'Theories of social entrepreneurship:and empirical review', *The Strategic Journal of Business & Change management*, 8(2), pp. 459–465.
- Örtenblad, A. (2015) 'Towards increased relevance: context-adapted models of the learning organization', *The Learning Organization*.
- Robinson, J. (2006) 'Navigating social and institutional barriers to markets: How social entrepreneurs identify and evaluate opportunities', in, pp. 95–120. doi: 10.1057/9780230625655.
- Schumpeter, J. A. (1934) *The theory of economic development : an inquiry into profits, capital, credit, interest, and the business cycle, Theorie der wirtschaftlichen Entwicklung*. Cambridge, Mass: Harvard University Press (Harvard economic studies).
- Schumpeter, J. A. (2021) *The Theory of Economic Development*. Milton: Milton: Taylor and Francis (Routledge Classics). doi: 10.4324/9781003146766.
- Space X. (2017). *Making Life multiplanetary*. Available at: https://www.spacex.com/media/making_life_multiplanetary_transcript_2017.pdf (Accessed: 01.09.2023)
- Spilling, O. R. and Alsos, G. A. (2006) *Entrepreneurship in Norwegian (translated from: Entreprenørskap på norsk)*. 2. utg. Bergen: Fagbokforl.
- Yin, R. K. (2009) 'How to do better case studies', *The SAGE handbook of applied social research methods*, 2(254–282).
- Yin, R. K. (2014) *Case study research: design and methods*. 5. edition. Los Angeles: Los Angeles: SAGE.

Determinants of Green Innovation in Family Firms

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Abstract: Family firms represent a unique kind of company and extent research characterizes them to be rather risk-averse in their commitment to innovation but consider them to be more efficient in their innovation efforts in contrast to non-family firms. Although family firms have a widespread impact on the worldwide economy, there has been limited research on the heterogeneity in their innovation behavior in both family firm and innovation literature. The growing body of research on green innovation indicates that it is a distinct type of innovation due to its unique characteristics and common knowledge on general innovation in family firms cannot be transferred to their behavior with respect to green innovation. Therefore, we aim to investigate why family firms engage in green innovation and which factors determine their green innovation performance. To investigate this new phenomenon and contribute to theory, we conduct a multiple-case study based on a sample of German family firms from different industries by collecting and analyzing data from both publicly available sources and interviews conducted with the top management of these firms. Thereby, these firms cover the spectrum family firm heterogeneity in this field ranging from high to low green innovation performance and their approach to green innovation supports our argumentation. Our findings suggest that family firms develop and adopt green innovation due to their SEW aspirations, as these lead them to think and invest for the long term. If they engage in the development and implementation of green innovation, however, their success depends on their familiness, namely their social capital, human capital, and financial capital, as these resources are crucial to successfully manage the complexity of the green innovation development process. This study is equally important for researchers, practitioners, and policy makers as it highlights the key obstacles and requirements for family firms to successfully develop and implement green innovation.

Keywords: Family firm, green innovation, case study, German family firms

1. Introduction

Family firms are acknowledged as playing a crucial role in the global economy as they contribute to prosperity, competitiveness, and innovation (e.g., Aldrich and Cliff, 2003; La Porta, Lopez-De-Silanes and Shleifer, 1999). Their success of developing and implementing green innovation is critical to the desired green transformation of the global economy (Bammens and Hünermund, 2020). Thereby, green innovation has been shown to improve competitiveness and firm operating performance (e.g., Chiou et al, 2011; Holzner and Wagner, 2022). However, family firms have been found to innovate less and vary greatly in their innovation input (Duran et al, 2016). Despite being more responsive to stakeholders and concerned about reputation (e.g., Berrone et al, 2010; Gómez-Mejía et al, 2011), the interplay of green innovation and family firms has been little explored.

We aim to explore why family firms engage in green innovation and which factors determine their green innovation performance as family firms inhibit unique characteristics such as high levels of family control and socioemotional wealth (SEW) preservation goals (e.g., Gómez-Mejía et al, 2011). We conduct a multiple-case study based on 13 German family firms with both high and low green innovation performance (Eisenhardt, 1989; Yin, 2018). We find evidence that family firms develop and adopt green innovation due to their SEW aspirations as these lead family firms to think and invest for the long term. However, the green innovation success of family firms depends on their distinctive familiness, in this case their social capital, human capital, and financial capital, to effectively manage the intricate operations of green innovation development.

Our findings present novel insights as previous research has focused on the differences between family and non-family firms and general innovation. We analyze the reasons for the heterogeneity in green innovation performance among family firms and reply to future research avenues proposed in the literature review by Calabrò et al (2019). Our qualitative study design allows us to dive deeper in the underlying motivations and reasons for observed family firm behavior regarding green innovation compared to previous quantitative studies (e.g., Bammens and Hünermund, 2020; Bendell, 2022). As current literature on general innovation in family firms suggests that family firms generally display lower levels of engagement in innovation (Chrisman et al, 2015; Duran et al, 2016), we contradict these findings for green innovation based the SEW aspirations present in all cases. Further, we introduce familiness as the key differentiating factors for family firms' heterogeneity in their

green innovation performance which has not been successfully linked in its entirety to green innovation in prior research. So far research has only searched for evidence between a single kind of resource and green innovation in family firms, e.g., firm size as a proxy for financial capital (Huang, Yang and Wong, 2016). The significance of this research is two-folded. First, we lay an important basis for further quantitative research to analyze the most relevant drivers. Second, our findings can guide family firm owners, practitioners, and policy makers in developing effective strategies and policies that foster green innovation in family firms as the most common form of business (La Porta, Lopez-De-Silanes and Shleifer, 1999).

The structure of the paper is as follows. The next section provides an overview on the current state of research, whereas the third section illustrates the methodology of this paper. The fourth section reports and discusses the main findings of the multiple case study, and the last one concludes, draws practical implications, and outlines avenues for future research.

2. Literature review

The topic of family firm innovation is of high strategic importance because innovation allows them to enhance their performance and create long-term value across generations (Eddleston, Kellermanns and Sarathy, 2008; Kellermanns et al, 2012). Research has shown that family firms follow a different innovation approach than non-family firms. In their conceptual paper, Li and Daspit (2016) propose four different innovation strategies by family firms, which depend on two factors, i.e., the level of family involvement in management and the family's non-economic SEW goals. These reflections have also been backed up by empirical research. In a meta-analytical analysis of 108 primary studies, researchers prove that family firms' innovation input, output, and ratio depend on the family CEO generation, family CEO founder status, and country-level factors. In general, family firms display lower levels of innovation input but achieve a higher output than non-family firms due to a higher conversion rate (Duran et al, 2016). In line with these findings, Kammerlander et al (2020) find that the share of family versus non-family members in the top management team as well as the family CEO's non-economic goals significantly influence, respectively moderate the family firms' pursuit of exploratory and exploitative innovation based on survey data from 109 family and non-family firms.

However, insights on family firms' behavior regarding general innovation cannot be transferred to green innovation as previous research has confirmed that green innovation differs from general innovation (Holzner and Wagner, 2022; Horbach, Oltra and Belin, 2013; Rennings, 2000). Green innovation has been defined as the creation of new products, processes, or similar leading to environmental improvements (OECD, 2010). More specifically, green innovation inhibits an amplified societal interest (Horbach, Oltra and Belin, 2013; Rennings, 2000), has high levels of interdependencies and complexity (Fontoura and Coelho, 2022), and represents a risky high-stakes strategic choice (Holzner and Wagner, 2022; Roper and Tapinos, 2016). Due to the idiosyncrasies of green innovation firms face new challenges and opportunities regarding their performance and reputation. For example, Chiou et al (2011) find evidence that green innovation as a mean to improve the environmental performance suppliers lead to significant improvements in the focal firms' environmental performance and competitive advantage based on a sample of 124 Taiwanese firms.

Thus, little is known about how the idiosyncrasies of green innovation affects the investment decisions of family firms. Research has so far identified few external and internal drivers for green innovation performance of firms. First, regulatory and normative pressures drive the adoption of green innovation (Bendell, 2022; Berrone et al, 2013; Huang, Ding and Kao, 2009). Berrone et al (2013) analyze environmental patents from 326 US-American firms and find that both regulatory and normative pressures can foster green innovation as firms seek legitimacy and compliance. As one of the first, Huang, Ding and Kao (2009) consider the difference between family and non-family firms in Taiwan and show that family firms pay more attention to pressure from their internal stakeholders compared to regulatory and market pressures and their non-family counterparts. Additionally, Bendell (2022) finds a higher likelihood for family firms to invest in green innovation with a high perceived threat of stricter regulations in the future based on quantitative data from 121 US-American family and non-family firms. Second, internal factors impact firms' green innovation performance, too. Firm size is an important factor as larger firms have access to more financial resources which enables them to invest in risky green innovation processes as Huang et al (2016) shows in a sample of 640 Taiwanese family and non-family firms. Another key determinant is the availability of green knowledge (Aiello et al, 2021) and capabilities required for green innovation, e.g., green dynamic capabilities (Singh et al, 2022) or leadership skills (Begum et al, 2022; Singh et al, 2020), which firms can also acquire by collaborating with other firms across their supply chain (Ben Arfi, Hikkerova and Sahut, 2018). However, researchers are not agreed yet concerning the impact direction of (family) firm governance, i.e., whether higher levels of family control impacts green innovation positively due to their

long-term SEW goals and stakeholder orientation (e.g., Bammens and Hünermund, 2020; Bendell, 2022) or negatively due to their risk aversion (e.g., Aiello et al, 2021; Huang, Yang and Wong, 2016). In their study of 633 German firms, Doluca, Wagner and Block (2018) discover that family firms have started off with a more cautious approach compared to non-family firms, demonstrating a higher aversion to risk. However, as time progressed, they have caught up and adopted a strategy that is characterized by lower volatility and a stronger focus on long-term objectives. Based on survey data from 4,009 German family and non-family firms, Bammens and Hünermund (2020) show that both their reputation motive and transgenerational control intentions are important family goals differentiating family from non-family firms.

Hence, a significant gap in research remains regarding the heterogeneity of green innovation performance among family firms and the underlying factors that contribute to this heterogeneity (Calabrò et al, 2019). Our study seeks to address the research question, *“Why do family firms engage in green innovation and what determines their green innovation performance?”* We hope to advance green innovation and family firm research by examining the factors that facilitate or hinder family firms' successful engagement in green innovation.

3. Methodology

We conducted a multiple case study applying a polar type theoretical sampling logic to provide an in-depth real-world perspective and extend emergent theory (Eisenhardt, 1989; Yin, 2018).

Case selection. We followed a three-step selection process to select our cases. First, we set our focus on German family firms which represent the backbone of the German economy and have a rich history of innovation across industries (Bergfeld and Weber, 2011). A firm is considered to be a family firm if at least 50% of decision-making rights are in the possession of a family unit (Bammens and Hünermund, 2020; Chua, Chrisman and Sharma, 1999). Second, we assessed the green innovation performance of 84 non-listed family firms from an external perspective based on consultation with eight industry experts ex ante and contacted the top and bottom 10%. The cases were added to the study by a replication logic to ensure external validity reaching the theoretical saturation level after 13 cases (Yin, 2018). Our cases operate in different industries, but most of them are B2B firms (8 of 13) as opposed to B2C firms. They also differ regarding the level of family involvement in management as only two cases have a non-family versus a family CEO and the average share of family members in board are 52%. Our sample also displays a rather wide range of which generation runs the company, namely from the 1st to the 13th generation, so that results are not limited to a certain level of family involvement in management and age of family firm. However, the sample is comparable concerning the level of family ownership, since all cases exhibit more than 50% of family ownership. Further, firm size is similar as all cases except for one have less than 5,000 employees which is important to ensure comparability as relevant resources for green innovation depend on firm size (Hao, Zhang and Wei, 2022; Huang et al, 2016).

Third, we performed a final ex-post evaluation of the family firms' green innovation performance based on the criteria defined by Tseng et al (2013). We identified seven high-performing, i.e., above-average, and six low-performing, i.e., below-average, family firms.

Data collection and analysis. We relied on input data from two main sources to triangulate the collected data and to increase the construct validity. First, we collected information about the firm's management team, the owning family, the firm itself, the industry, and the firm's green innovation performance based on publicly available data. Second, we conducted semi-structured interviews with (non-)family CEOs and managers from the top management responsible for the firm's sustainability strategy in 2022. We used case study protocols and one case database to increase our study's reliability and ensure a structured analysis process (Yin, 2018). We employed a highly iterative process based on three stages of analysis (Eisenhardt, 1989; Yin, 2018). First, we conducted a within-case analysis by semi-openly coding all case data. Second, we searched for cross-case patterns as we compared the groups for within-group similarities, but also intergroup differences for each driver and verified our two-tail approach as the identified drivers manifested differently in the two groups (Tseng et al., 2013). Third, we consolidated our findings, compared them with previous literature, and shaped our propositions to maximize their explanatory power between low- and high-performing family firms as well as within these groups.

4. Findings

4.1 Family firm SEW aspirations

Based on our observations, the key factor why family firms engage in green innovation is their goal to develop and sustain their SEW. The characteristics of green innovation, i.e., amplified societal interest and high-stakes strategic choice, correspond to family firms' goal to preserve their SEW which differentiate family from non-family firms. Thereby, SEW comprises the families' emotional requirements that are fulfilled by the non-monetary aspects of the firm (Gómez-Mejía et al, 2007).

SEW aspiration. We identified two subsequent drivers of family firm SEW aspiration, i.e., transgenerational control intentions and local embeddedness. The families' desire to pass on their firm to subsequent generations (Berrone, Cruz and Gómez-Mejía, 2012; Zellweger et al, 2012) is a positive driver for green innovation as all cases acknowledge the importance of green innovation for their future success. They view environmental laws as a risk to their long-term survival and recognize the demand for green innovation from customers and employees. They agree that family firms with high ecological footprints will not survive in the long run and cannot be passed onto future generations. Further, we observed that family firms' local embeddedness, i.e., their ties and commitment to the local community (Niehm, Swinney and Miller, 2008), promote green innovation, since these allow them to maintain their positive reputation as a valuable member of this community. Since all cases are influenced by social values and norms of the community, they aim to meet the increasingly challenging sustainability requirements of political and civil stakeholders.

For instance, the CEO of a low-performing case describes the various pressures and their effects on his firm:

"I would say that the risk of doing nothing regarding green innovation is significantly higher than trying and failing – just think about the regulation. You can't reach certain customers and resources if you don't have a sustainable business. We can already see it now and this trend will continue to intensify."

Existing research has found that family firms tend to invest less in innovation in fear of losing their SEW (Block et al, 2013; Chrisman and Patel, 2012). However, this innovation reluctance dissolves if the long-term family firm survival is at stake (Bammens, Hünermund and Andries, 2022). Previous studies have also proven that family firms aim to form close ties to the local community as a key mechanism to protect their firm long-term (Bammens and Hünermund, 2020; Zellweger et al, 2012). First studies confirmed this effect for green innovation (Dangelico, Nastasi and Pisa, 2019).

Hence, we propose:

Proposition 1: Family firms engage in green innovation due to their transgenerational control intentions and local embeddedness.

4.2 Familiness

Our data suggests that the heterogeneity in green innovation performance of family firms can be attributed to their available resources and capabilities, also referred to as familiness, as these vary greatly between the family firms with high or low green innovation performance (Habbershon and Williams, 1999). Thereby, three specific resources of family firms determine their chances to successfully develop and implement green innovation owing to its highly complex, collaborative, and risky nature. Hence, the level of social, human, and financial capital are positive contributing factors for green innovation in family firms (see also Danes et al, 2009; De Massis et al, 2015; Dyer, 2010).

Social capital. We identified social capital as an important driver of family firms' engagement in green innovation. Social capital is defined as the networks and relationships from which resources can be accessed to create value that arise from internal as well as external sources (Adler and Kwon, 2002; Nahapiet and Ghoshal, 1998). Family firms with a high green innovation performance benefit their high levels of structural, relational, and cognitive social capital, i.e., which allow them to form trust-based collaborations based on formalized processes and dedicated sustainability strategies both internally across functions as well as externally with a large green network with a growing number of diverse partners from various industries. In contrast, low performing family firms are more reluctant to build those close partnerships within their firm and outside of their own industry due to a lack of willingness to share knowledge and lack clearly communicated strategy and governance for their green innovation. For example, the Head of Sustainability from a high-performing family firm describes it like that:

“We have been a member of different regional networks and the leading green association since the nineties. These are all cross-industry initiatives where you learn how others approach the topic of sustainability. We bring in practical contributions and get involved.”

Although family firms’ SEW goals can prohibit an effective use of their social capital (Ardito et al, 2019; Pucci et al, 2020), prior research mostly confirms a positive relationship between social capital and both general and green innovation as it fosters the acquisition and exchange of knowledge and necessary resources (e.g., Cuevas-Rodríguez, Cabello-Medina and Carmona-Lavado, 2014; Sanchez-Famoso, Maseda and Iturralde, 2014).

Human capital. Family firms’ human capital as their knowledge and capabilities embodied in family members as well as other people within the organization (Hatch and Dyer, 2004) and in our cases, the capabilities specifically required for green innovation, i.e., green dynamic capabilities, green transformational leadership, and green creativity drive family firms’ chances of success (Chen and Chang, 2013). We observed that cases with a strong green innovation performance systematically screen markets for new trends and quickly identify the need for action in relation to their own green skills. Their inspiring leaders drive the entire organization as well as key stakeholders toward a green innovation mindset to fulfil their environmental vision and are resilient in the face of obstacles and setbacks. However, low-performing cases lack an ambitious sustainability vision from their leaders as well as structured green capabilities processes and are unaware about which skills need to be built but depend more on obtainable market solutions leading to lower levels of green creativity and innovation. For example, the Head of Sustainability of a low-performing family firm had to admit:

“We were a bit slack when it came to post-consumer recycled materials. We lost perspective for a short time and that can be just enough to no longer be at the forefront of a new development.”

Extant literature has found evidence that the three dimensions of green capabilities described above are positive predictors of general or green innovation in firms in general, and to some extent in family firms, because firms with these capabilities can best leverage the knowledge and capabilities of their entire organization in the innovation process (e.g., Chen and Chang, 2013; Li et al, 2020; Singh et al, 2020; Singh et al, 2022)

Financial capital. We observed that the green innovation performance is determined by family firms’ financial capital (Danes et al, 2009). In the case of green innovation, we find that especially their financial flexibility (Gamba and Triantis, 2008) and long-term orientation (Anderson, Duru and Reeb, 2012; Lumpkin, Brigham and Moss, 2010) influence family firm success with regard to green innovation. More specifically, family firms’ financial capital leeway increased when managers faced lower levels of financial goal pressure that allowed for the consideration of green decision criteria as they believe that green innovation investments create non-financial and financial benefits for the firm in the long-term. Moreover, financial flexibility increases through a distinguished understanding of growth as indicated by the family CEO of a family firm with high green innovation performance:

“In terms of company philosophy, it's a question of how much profit I want to make. For me: slow, steady growth, 5% to a maximum of 8% per year. That would certainly have been faster if we had renounced some ecological products.”

In contrast, low-performing cases put financial goals and benefits in the foreground while allocating financial capital. They are more focused on fixed and short amortization periods or facing financial constraints which hinders their engagement in green innovation which require a longer amortization period.

Although there is no empirical research on these topics in relation to green innovation performance in family firms, previous research has confirmed the special approach of family firms concerning their financial decision making owing to their own financial dependency and long-term orientation (e.g., Dreux, 1990; Hao, Zhang and Wei, 2022; Koropp, Grichnik and Kellermanns, 2013; Sirmon and Hitt, 2003).

Thus, we propose:

Proposition 2: Family firms are more likely to achieve a high green innovation performance if their familiness in form of higher levels of social, human, and financial capital enable them to successfully develop and implement green innovation.

5. Discussion

Synthesis and contribution. Based on this multiple-case study of 13 German family firms, we found that family firms engagement in green innovation is mainly driven by their aspiration to maintain SEW (Berrone et al, 2010;

Gómez-Mejía et al, 2007). Differences in green innovation performance were attributed to the construct of familiness, namely the family firm's heterogeneity in social, human, and financial capital (Habbershon and Williams, 1999).

Our paper contributes to the literature on green innovation and family firm heterogeneity as we identify key drivers of green innovation in family firms and support that green innovation is a unique form of innovation (Horbach, Oltra and Belin, 2013; Rennings, 2000). We find that family control (Bammens and Hünermund, 2020; Bendell, 2022; Dangelico, Nastasi and Pisa, 2019) and especially familiness are essential variables to understand family firm heterogeneity (Habbershon, Williams and MacMillan, 2003). We contribute to family firm heterogeneity research in innovation (Calabrò et al, 2019), demonstrating that family firm heterogeneity can be traced back to both governance and goals instead of focusing on only one factor (Kammerlander et al, 2020; Li and Daspit, 2016).

Practical implications. This study has important implications for family firm owners and policy makers. Family firms should have a long-term green innovation strategy supported by measurable targets. Encouraging inter-firm and -industry exchange can help access external green knowledge and foster social and human capital development. Family firms can also benefit from cooperation with research institutions and specific subsidies or long-term loans from government and financing institutions for green innovation.

Limitations and future research. We reached the point of theoretical saturation with our sample size which is comparable to other family firm multiple-case studies (e.g., Dangelico, Nastasi and Pisa, 2019). We offered interviewees confidentiality and asked for honesty to counteract social desirability biases in our interviews (Randall and Fernandes, 1991). However, future research could benefit from a quantitative perspective based on larger samples and survey or secondary data with higher levels of respondents' anonymity and investigate the transferability of our results to other economic regions (Fan, Zhang and Zhu, 2021).

References

- Adler, P.S. and Kwon, S.-W. (2002) "Social capital: Prospects for a new concept", *Academy of Management Review*, Vol 27, No. 1, pp 17–40.
- Aiello, F. et al. (2021) "Does external R&D matter for family firm innovation? Evidence from the Italian manufacturing industry", *Small Business Economics*, Vol 57, No. 4, pp 1915–1930.
- Aldrich, H.E. and Cliff, J.E. (2003) "The pervasive effects of family on entrepreneurship: Toward a family embeddedness perspective", *Journal of Business Venturing*, Vol 18, No. 5, pp 573–596.
- Anderson, R.C., Duru, A. and Reeb, D.M. (2012) "Investment policy in family controlled firms", *Journal of Banking & Finance*, Vol 36, No. 6, pp 1744–1758.
- Ardito, L. et al. (2019) "Inter-firm R&D collaborations and green innovation value: The role of family firms' involvement and the moderating effects of proximity dimensions", *Business Strategy and the Environment*, Vol 28, No. 1, pp 185–197.
- Bammens, Y. and Hünermund, P. (2020) "Nonfinancial considerations in eco-innovation decisions: The role of family ownership and reputation concerns", *Journal of Product Innovation Management*, Vol 37, No. 5, pp 431–453.
- Bammens, Y., Hünermund, P. and Andries, P. (2022) "Pursuing gains or avoiding losses: The contingent effect of transgenerational intentions on innovation investments", *Journal of Management Studies*, Vol 59, No. 6, pp 1493–1530.
- Begum, S. et al. (2022) "Does green transformational leadership lead to green innovation? The role of green thinking and creative process engagement", *Business Strategy and the Environment*, Vol 31, No. 1, pp 580–597.
- Ben Arfi, W., Hikkerova, L. and Sahut, J.-M. (2018) "External knowledge sources, green innovation and performance", *Technological Forecasting and Social Change*, Vol 129, pp 210–220.
- Bendell, B.L. (2022) "Environmental investment decisions of family firms - An analysis of competitor and government influence", *Business Strategy and the Environment*, Vol 31, No. 1, pp 1–14.
- Bergfeld, M.M.H. and Weber, F.M. (2011) "Dynasties of innovation: Highly performing German family firms and the owners' role for innovation", *International Journal of Entrepreneurship and Innovation Management*, Vol 13, No. 1, pp 80–94.
- Berrone, P. et al. (2010) "Socioemotional wealth and corporate responses to institutional pressures: Do family-controlled firms pollute less?", *Administrative Science Quarterly*, Vol 55, No. 1, pp 82–113.
- Berrone, P. et al. (2013) "Necessity as the mother of 'green' inventions: Institutional pressures and environmental innovations", *Strategic Management Journal*, Vol 34, No. 8, pp 891–909.
- Berrone, P., Cruz, C. and Gómez-Mejía, L.R. (2012) "Socioemotional wealth in family firms", *Family Business Review*, Vol 25, No. 3, pp 258–279.
- Block, J.H. et al. (2013) "Economic and technological importance of innovations in large family and founder firms", *Family Business Review*, Vol 26, No. 2, pp 180–199.
- Calabrò, A. et al. (2019) "Innovation in family firms: A systematic literature review and guidance for future research", *International Journal of Management Reviews*, Vol 21, No. 3, pp 317–355.

- Chen, Y.-S. and Chang, C.-H. (2013) "The determinants of green product development performance: Green dynamic capabilities, green transformational leadership, and green creativity", *Journal of Business Ethics*, Vol 116, No. 1, pp 107–119.
- Chiou, T.-Y. et al. (2011) "The influence of greening the suppliers and green innovation on environmental performance and competitive advantage in Taiwan", *Transportation Research Part E: Logistics and Transportation Review*, Vol 47, No. 6, pp 822–836.
- Chrisman, J.J. et al. (2015) "The ability and willingness paradox in family firm innovation", *Journal of Product Innovation Management*, Vol 32, No. 3, pp 310–318.
- Chrisman, J.J. and Patel, P.C. (2012) "Variations in R&D investments of family and nonfamily firms: Behavioral agency and myopic loss aversion perspectives", *Academy of Management Journal*, Vol 55, No. 4, pp 976–997.
- Chua, J.H., Chrisman, J.J. and Sharma, P. (1999) "Defining the family business by behavior", *Entrepreneurship Theory and Practice*, Vol 23, No. 4, pp 19–39.
- Cuevas-Rodríguez, G., Cabello-Medina, C. and Carmona-Lavado, A. (2014) "Internal and external social capital for radical product innovation: Do they always work well together?", *British Journal of Management*, Vol 25, No. 2, pp 266–284.
- Danes, S.M. et al. (2009) "Family capital of family firms: Bridging human, social, and financial capital", *Family Business Review*, Vol 22, No. 3, pp 199–215.
- Dangelico, R.M., Nastasi, A. and Pisa, S. (2019) "A comparison of family and nonfamily small firms in their approach to green innovation: A study of Italian companies in the agri-food industry", *Business Strategy and the Environment*, Vol 28, No. 7, pp 1434–1448.
- De Massis, A. et al. (2015) "Product innovation in family versus nonfamily firms: An exploratory analysis", *Journal of Small Business Management*, Vol 53, No. 1, pp 1–36.
- Doluc, H., Wagner, M. and Block, J.H. (2018) "Sustainability and environmental behaviour in family firms: A longitudinal analysis of environment-related activities, innovation and performance", *Business Strategy and the Environment*, Vol 27, No. 1, pp 152–172.
- Dreux, D.R. (1990) "Financing family business: Alternatives to selling out or going public", *Family Business Review*, Vol 3, No. 3, pp 225–243.
- Duran, P. et al. (2016) "Doing more with less: Innovation input and output in family firms", *Academy of Management Journal*, Vol 59, No. 4, pp 1224–1264.
- Dyer, W.G. (2010) "Are you the right type of family business?", *Organizational Dynamics*, Vol 39, No. 3, pp 269–278.
- Eddleston, K.A., Kellermanns, F.W. and Sarathy, R. (2008) "Resource configuration in family firms: Linking resources, strategic planning and technological opportunities to performance", *Journal of Management Studies*, Vol 45, No. 1, pp 26–50.
- Eisenhardt, K.M. (1989) "Building theories from case study research", *Academy of Management Review*, Vol 14, No. 4, pp 532–550.
- Fan, Y., Zhang, F. and Zhu, L. (2021) "Do family firms invest more in pollution prevention strategy than non-family firms? An integration of agency and institutional theories", *Journal of Cleaner Production*, Vol 286, p 124988.
- Fontoura, P. and Coelho, A. (2022) "How to boost green innovation and performance through collaboration in the supply chain: Insights into a more sustainable economy", *Journal of Cleaner Production*, Vol 359, p 132005.
- Gamba, A. and Triantis, A. (2008) "The value of financial flexibility", *The Journal of Finance*, Vol 63, No. 5, pp 2263–2296.
- Gómez-Mejía, L.R. et al. (2007) "Socioemotional wealth and business risks in family-controlled firms: Evidence from Spanish olive oil mills", *Administrative Science Quarterly*, Vol 52, No. 1, pp 106–137.
- Gómez-Mejía, L.R. et al. (2011) "The bind that ties: Socioemotional wealth preservation in family firms", *Academy of Management Annals*, Vol 5, No. 1, pp 653–707.
- Habbershon, T.G. and Williams, M.L. (1999) "A resource-based framework for assessing the strategic advantages of family firms", *Family Business Review*, Vol 12, No. 1, pp 1–25.
- Habbershon, T.G., Williams, M.L. and MacMillan, I.C. (2003) "A unified systems perspective of family firm performance", *Journal of Business Venturing*, Vol 18, No. 4, pp 451–465.
- Hao, Z., Zhang, X. and Wei, J. (2022) "Research on the effect of enterprise financial flexibility on sustainable innovation", *Journal of Innovation & Knowledge*, Vol 7, No. 2, p 100184.
- Hatch, N.W. and Dyer, J.H. (2004) "Human capital and learning as a source of sustainable competitive advantage", *Strategic Management Journal*, Vol 25, No. 12, pp 1155–1178.
- Holzner, B. and Wagner, M. (2022) "Linking levels of green innovation with profitability under environmental uncertainty: An empirical study", *Journal of Cleaner Production*, Vol 378, p 134438.
- Horbach, J., Oltra, V. and Belin, J. (2013) "Determinants and specificities of eco-innovations compared to other innovations - An econometric analysis for the French and German industry based on the community innovation survey", *Industry & Innovation*, Vol 20, No. 6, pp 523–543.
- Huang, X. et al. (2016) "The relationships between regulatory and customer pressure, green organizational responses, and green innovation performance", *Journal of Cleaner Production*, Vol 112, pp 3423–3433.
- Huang, Y.-C., Ding, H.-B. and Kao, M.-R. (2009) "Salient stakeholder voices: Family business and green innovation adoption", *Journal of Management & Organization*, Vol 15, No. 3, pp 309–326.
- Huang, Y.-C., Yang, M.-L. and Wong, Y.-J. (2016) "The effect of internal factors and family influence on firms' adoption of green product innovation", *Management Research Review*, Vol 39, No. 10, pp 1167–1198.

- Kammerlander, N. et al. (2020) "Organizational ambidexterity in family-managed firms: The role of family involvement in top management", *Family Business Review*, Vol 33, No. 4, pp 393–423.
- Kellermanns, F.W. et al. (2012) "Innovativeness in family firms: A family influence perspective", *Small Business Economics*, Vol 38, No. 1, pp 85–101.
- Koropp, C., Grichnik, D. and Kellermanns, F. (2013) "Financial attitudes in family firms: The moderating role of family commitment", *Journal of Small Business Management*, Vol 51, No. 1, pp 114–137.
- La Porta, R., Lopez-De-Silanes, F. and Shleifer, A. (1999) "Corporate ownership around the world", *The Journal of Finance*, Vol 54, No. 2, pp 471–517.
- Li, W. et al. (2020) "Unlocking employees' green creativity: The effects of green transformational leadership, green intrinsic, and extrinsic motivation", *Journal of Cleaner Production*, Vol 255, p 120229.
- Li, Z. and Daspit, J.J. (2016) "Understanding family firm innovation heterogeneity", *Journal of Family Business Management*, Vol 6, No. 2, pp 103–121.
- Lumpkin, G.T., Brigham, K.H. and Moss, T.W. (2010) "Long-term orientation: Implications for the entrepreneurial orientation and performance of family businesses", *Entrepreneurship & Regional Development*, Vol 22, 3-4, pp 241–264.
- Nahapiet, J. and Ghoshal, S. (1998) "Social capital, intellectual capital, and the organizational advantage", *Academy of Management Review*, Vol 23, No. 2, pp 242–266.
- Niehm, L.S., Swinney, J. and Miller, N.J. (2008) "Community social responsibility and its consequences for family business performance", *Journal of Small Business Management*, Vol 46, No. 3, pp 331–350.
- OECD (2010) *Eco-innovation in industry: Enabling green growth*. Paris: OECD Publishing.
- Pucci, T. et al. (2020) "Social capital and innovation in a life science cluster: The role of proximity and family involvement", *The Journal of Technology Transfer*, Vol 45, No. 1, pp 205–227.
- Randall, D.M. and Fernandes, M.F. (1991) "The social desirability response bias in ethics research", *Journal of Business Ethics*, Vol 10, No. 11, pp 805–817.
- Rennings, K. (2000) "Redefining innovation — eco-innovation research and the contribution from ecological economics", *Ecological Economics*, Vol 32, No. 2, pp 319–332.
- Roper, S. and Tapinos, E. (2016) "Taking risks in the face of uncertainty: An exploratory analysis of green innovation", *Technological Forecasting and Social Change*, Vol 112, pp 357–363.
- Sanchez-Famoso, V., Maseda, A. and Iturralde, T. (2014) "The role of internal social capital in organisational innovation. An empirical study of family firms", *European Management Journal*, Vol 32, No. 6, pp 950–962.
- Singh, S.K. et al. (2020) "Green innovation and environmental performance: The role of green transformational leadership and green human resource management", *Technological Forecasting and Social Change*, Vol 150, p 119762.
- Singh, S.K. et al. (2022) "Stakeholder pressure, green innovation, and performance in small and medium-sized enterprises: The role of green dynamic capabilities", *Business Strategy and the Environment*, Vol 31, No. 1, pp 500–514.
- Sirmon, D.G. and Hitt, M.A. (2003) "Managing resources: Linking unique resources, management, and wealth creation in family firms", *Entrepreneurship Theory and Practice*, Vol 27, No. 4, pp 339–358.
- Tseng, M.-L. et al. (2013) "Improving performance of green innovation practices under uncertainty", *Journal of Cleaner Production*, Vol 40, pp 71–82.
- Yin, R.K. (2018) *Case study research and applications: Design and methods*. 6th edn. Beverly Hills, CA.: SAGE Publications.
- Zellweger, T.M. et al. (2012) "Family control and family firm valuation by family CEOs: The importance of intentions for transgenerational control", *Organization Science*, Vol 23, No. 3, pp 851–868.

Exploring the Drivers of Business Model Innovation: Insights From a Single-Case Study in Agribusiness

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Abstract: Business model innovation has become a crucial factor for firms to remain competitive and achieve sustained success in today's rapidly changing business environment. The concept of business model innovation involves fundamentally changing the way a firm creates, delivers, and captures value, with the aim of creating value for the customer and capturing value for the company. However, despite its importance, the factors that drive firms to innovate their business models are not well understood and often assumed to be driven solely by profit. To address this gap in understanding, this research aims to examine the drivers of business model innovation in firms. Through a review of existing literature and a single case study, the study will explore the motivations and pressures that lead firms to seek new business models, as well as the internal and external factors that influence their ability to successfully implement these innovations. The case study will provide a deeper insight into the real-world complexities of business model innovation and will shed light on the practical considerations and challenges that firm faced in this process. The findings of this study will contribute to a deeper understanding of the drivers of business model innovation. By exploring the strategic, organizational, and external factors that influence the decision to innovate, this study will provide a more nuanced view of the complex process of business model innovation. In conclusion, this research will provide valuable insights for both practitioners and scholars on the factors that drive firms to innovate their business models and the factors that may influence their ability to successfully implement these innovations. By exploring the complexities of business model innovation through a single case study, this research will contribute to the existing literature and provide a practical example of a firm looking to stay ahead of the curve and maintain a competitive advantage.

Key-words Business Model Innovation; Case-study; Agroindustry; Drivers; Strategic innovation; Value creation

1. Introduction

In the rapidly changing business environment, business model innovation has become crucial for businesses to maintain their competitiveness and achieve long-term success (Carayannis, et al, 2015; Chang and Matsumoto, 2022; Foss and Saebi, 2017; Santa-Maria, 2022). In an environment where technology, customer expectations, and market conditions are always changing, businesses must adjust their strategies and develop new methods to create and capture value (Hanelt et al, 2021; Schoemaker, 2018; Shams et al, 2021). To generate value for the consumer and capture value for the business, business model innovation entails fundamentally altering how firms create, deliver, and capture value (Teece, 2010; Amit and Zott, 2001; Zott et al, 2011).

Business model innovation is becoming increasingly important (Amit and Zott, 2001, 2012; Foss and Saebi, 2017), yet its driving elements are little understood (Bock, 2012; Schoemaker et al, 2018). While profit is frequently regarded as the primary motivator, there are other factors that inspire businesses to pursue new business models.

According to the literature on business model innovation, it may be viewed as an architecture for creating, distributing, and capture value (Teece, 2010). However, the process of business model innovation is complex, and many companies encounter difficulties while attempting to innovate.

Previous research has identified motivations of business model innovation, such as the need to enter new markets, boost productivity, or benefit from new technologies. Businesses are also motivated to create new business models by organizational factors like shifts in leadership or corporate culture as well as external reasons like market conditions or client demands.

To successfully implement new business models and reap their advantages, companies must, however, get through both internal and external obstacles. Employee resistance to change, a lack of resources or knowledge, or the difficulty of unifying diverse organizational parts under a new model are a few examples of internal difficulties. Competition, governmental constraints, or a lack of customer demand are examples of external problems.

The purpose of this study is to investigate the motivations and forces that drive businesses to create novel business models, as well as the internal and external factors that affect these organizations' capacity to put these innovations into practice. It will examine prior research and present a case study that suggests the real-world

difficulties and worries that companies have while trying to reinvent their business models. Through an analysis of the strategic, internal, external and network factors (Ujwary-Gil and Potoczek, 2020) that influence the decision to innovate, this study will offer a more nuanced understanding of the complex process of business model innovation.

The results of this study will be helpful to managers and executives who wish to comprehend the factors that lead to the development of new business models as well as to academics and researchers who wish to investigate the complexities of this quickly evolving area of business strategy.

2. Literature review

Although the origin of the business model concept is believed to stem from corporate practice (George and Bock, 2011; Lecocq et al, 2010), the business model concept only gained traction in recent years, as noted by Spieth et al (2014), Chang and Matsumoto (2022) and Pitelis (2022). In the 1990s, researchers in Strategy and Entrepreneurship began constructing and applying a more comprehensive description of a corporation's business processes and how they link to create value (Zott et al, 2011).

Several factors have been identified by the literature on business model innovation that drive firms to explore new business models.

2.1 Strategic drivers

Among the strategic drivers are the desire to expand into new markets, the need to increase efficiency or the opportunity to leverage new technologies. Business model innovation can assist companies in breaking into new markets by creating fresh value propositions and revenue sources (Chesbrough, 2010), by focusing on underdeveloped markets or developing new client groups, business model innovation can be utilized to break into new markets (Johnson et al, 2008), and can aid companies in breaking into new markets by creating distribution channels or establishing powerful alliances (Osterwalder et al, 2005; Ujwary-Gil and Potoczek, 2020). Business model innovation, according to Zott and Amit (2010), can assist companies in expanding into new markets by utilizing their resources and competencies to develop new goods and services. Since businesses are driven to improve operations, save costs, and satisfy changing client needs in a constantly shifting business environment, increased efficiency has previously been cited as one of the drivers of business model innovation (Chesbrough, 2010; Foss and Saebi, 2017; Zhang et al 2021). In this situation, businesses can optimize resource allocation and enhance procedures to cut costs and boost productivity (Teece, 2010). The potential to use new technologies is cited as a key driver of business model innovation (Chesbrough, 2010; Teece, 2010). While Zott et al (2011) contend that new technologies can present chances for businesses to construct new business models, Foss and Saebi (2017) point out that they can help businesses develop new value propositions or access new markets.

2.2 Organizational drivers

Organizational drivers include shifts in leadership, corporate culture, or the adoption of new procedures and systems (Kafetzopoulos, 2021; Oliveira-Dias et al, 2022; Zhao et al, 2019). Changes in leadership can be a significant catalyst for the development of new business models. Strong leaders may help to drive change and make sure that their firms remain competitive in a fast-changing business environment by introducing new insights, developing a vision for the future, and encouraging an innovation culture. According to Foss and Saebi (2017), leadership is a key factor in business model innovation. Overall, these studies indicate that alterations in leadership can be a significant driver for new business model development. Strong leaders may help to drive change and make sure that their firms remain competitive in a fast-changing business environment by introducing new insights, developing a vision for the future, and encouraging an innovation culture.

2.3 External drivers

Finally, external drivers include modifications to the economy, governmental policies, or consumer demands and expectations. These factors are crucial for motivating businesses to investigate new business models and innovate in ways that can keep them competitive in the fast-paced business world of today.

According to several authors (Gassmann et al, 2014; Chesbrough, 2010; Zott et al 2011; Foss and Saebi, 2017; Teece, 2010; Zhang, 2023), modifications in the state of the market can be a significant driver for business model innovation. According to these sources, businesses may be compelled to innovate their business models to stay

competitive as market conditions change due to things like shifting customer preferences or the introduction of new technology. For instance, Gassmann et al (2014) stated how market upheavals might make businesses rethink their company strategies and Chesbrough (2010) points out that when businesses are confronted with fresh difficulties, shifting market conditions might present possibilities for business model innovation. They contend that as enterprises must navigate a complex legal environment in order to access outside knowledge and resources, government restrictions can significantly influence business models for open innovation. Businesses attempt to adjust to new regulatory requirements and abide by evolving standards, governmental regulations may serve as a catalyst for business model innovation. In their 2010 article, Zott and Amit underline the significance of taking regulatory considerations into account while developing new business models, particularly in highly regulated sectors like the healthcare and telecoms. Legislative reforms can foster innovation and open up new market opportunities. However, laws may also prevent businesses from testing out novel business strategies or upending the status quo. Government laws, according to Amit and Zott (2012), can both present difficulties and possibilities for business model innovation since they need businesses to negotiate complicated regulatory frameworks in order to develop new value propositions and revenue streams.

3. Methodology

A Single-case study was selected as a valid research method as the focus is on a single unit of analysis, in this situation, a multinational corporation acting in agroindustry and food sector. The aim is to understand in-depth the phenomenon under investigation. The case under investigation was based on theoretical selection rather than statistical reasons (Glaser and Strauss, 1967, Pettigrew, 1988).

A case study in agribusiness is a particularly interesting case to study drivers for business model innovation because the industry is often characterized by a high level of complexity and a wide range of interrelated factors. Agribusiness companies are subject to a variety of external pressures, including changing market conditions, environmental factors, and regulatory changes, as well as internal pressures such as the need to optimize production processes and increase efficiencies. Furthermore, agribusiness firms are often involved in complex supply chains that require close coordination with other actors, including suppliers, distributors, and retailers. Given the multifaceted nature of agribusiness, studying drivers for business model innovation in this industry can provide valuable insights into the challenges and opportunities that firms face when attempting to innovate their business models. Additionally, we found a highly dynamic and technological sector, in which innovation is sparsely investigated and misperception of general population and a sector with a rich trail of history and maturity. The decision to select this specific sector and corporation for our case study was driven by the primary factor of needing to achieve a rapid product-market fit.

Acknowledging limitations on a single case study as (1) generalization (2) subjectivity (3) external validity (4) significant resources and (5) limited scope, a single-case method was selected as allows in-depth examination of this case, which can lead to a rich understanding of the phenomenon. The method allowed researchers to collect detailed and comprehensive data, which provides a holistic view of the case. The case can contribute to the development of theories in the business model innovation field, as it provides rich and detailed data to support or challenge existing theories.

3.1 Case sampling and data collection

Following the single case study strategy (Ozcan et al, 2017; Yin, 2018), we employed a variety of data sources to obtain detailed and nuanced insights, which supported the development of empirical theory from field data. To explore and discover new information, we employed multiple stages of data collection, building on initial insights and interpretations to improve our understanding of the data and emerging theories (Corbin and Strauss, 2015). To conduct this case study, we employed a qualitative research approach that included multiple data collection methods. From June 2022 to March 2023, a total of 10 months were spent doing the study. Fieldwork, archival research, and interviews were the approaches used to obtain the data. To collect information, we mainly used qualitative interviews (Kvale and Brinkmann, 2009). With the help of this method, we were able to collect extensive and detailed data for analysis. We conducted a total of 16 hours of interviews with key stakeholders: 2 interviews with the CEO, 1 with the Marketing Director, 2 with the New Products Manager and 1 with the Production Responsible. The interviews were conducted in-person or through Zoom platform and were transcribed for analysis. More than 20 internal and external company documents, such as product lists, company presentations (including a report from June 2022), annual reports for the firm (2005-2022) and the RAR group (2019-2022), and other pertinent files, like e-mails, were gathered. For insights, these documents were read

through and examined. To better understand their operations and manufacturing procedures, we conducted a field visit to the company's warehouse and factory. An in-depth grasp of the business's operations and innovative processes was made possible thanks in large part to this visit.

Thematic analysis was used to examine the information gathered from the interviews, document analysis, and field visit. In order to acquire insights into the company's operations, difficulties, and strategies, we found recurring themes and patterns across the data. All participants were made aware of the study's goal and given the opportunity to give their consent in order to uphold ethical standards.

3.2 Data analysis

We used thematic analysis, a technique for extracting patterns and themes from qualitative data. As advised by Braun and Clarke (2006), we used an iterative and methodical strategy to make sure that our analysis was rigorous and reliable. To ensure accuracy and consistency in our interpretation of the data, we went through several steps of data coding and theme identification.

Open coding was the first step in our data analysis, during which we looked at each item of data (interview transcripts and archival documents) to find the initial codes and themes. We later went over and improved these early codes to create more conceptual and abstract themes that could be used throughout the full dataset.

Triangulation and reflexivity were two of the procedures we used to assure the validity and reliability of our findings. These actions aided in raising the reliability of our conclusions and raising the overall standard of our study.

This led to the development of a preliminary framework that revealed different drivers, both internal and external, that have influenced the company's innovation over several years. In the subsequent rounds of interviews, we aimed to expand and clarify the emerging concepts while also identifying any interrelationships between categories and constructs. As the interviews progressed, we compared and contrasted the preliminary findings with the existing literature on business model innovation drivers, which helped to complement and validate our emerging interpretations. Additionally, we drew on secondary data to verify, validate, and complement the interview findings. Finally, we integrated the emerging categories into an overarching theoretical framework and conducted a final round of focused coding to ensure that we had explored all the emerging categories and achieved data saturation (Saldaña, 2021). The resulting framework is presented in Figure 1.

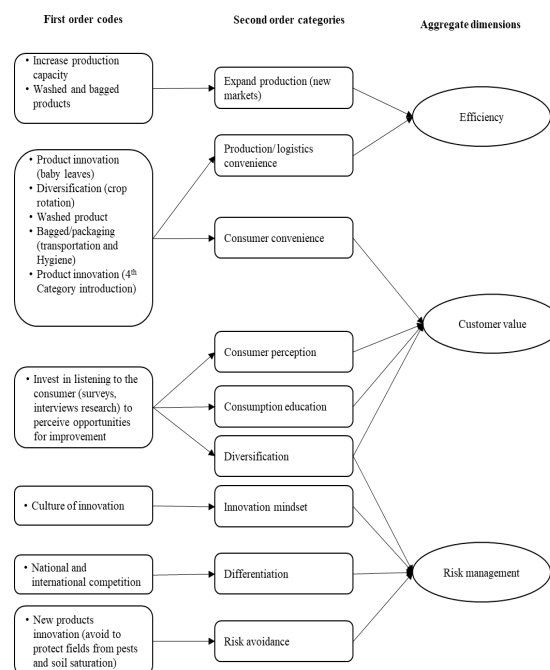


Figure 1: Coding structure

3.3 The case

3.3.1 Group history

Vitacress, is an European fresh produce supplier, specialized in watercress, salads, and fresh herbs. It was established in Hampshire, UK in 1951 by Malcolm Isaac, who started growing freshwater watercress in the UK in the 1970s. However, due to limited production capacity, and after a visit to Algarve in 1981, it started to experiment watercress production in this Portuguese region. Algarve's fertile soils and unique climate proved to be ideal also for baby leaf production, and it started to be a complement to the English production. Vitacress started its operation in Portugal in 1981, with a 15-hectare production site in Almancil, Quinta do Lago. The business in Algarve was successful, and they quickly began exporting to England. In few years they started to package products which facilitated the hygiene and transportation. Then the package was seen as a differentiating factor. Besides hygiene and convenience, it was possible to differentiate a product that was a commodity before. In 2003, they established new facilities, including a washing warehouse, which further improved hygiene and transportation processes.

3.3.2 The market and competition

Most of the competitors operate under white label branding (supermarket/distribution brands originally imitating existing products). Some other players operate under brand products. The business model of the competitors revolves around fulfilling the customer's demands, which is something that Vitacress has invested in and experimented with extensively. As a result, the internal perception is that the competition was originally merely imitating and following Vitacress's lead (nowadays is also innovating). The Spanish market is five times larger than the Portuguese market, which encourages the brand to innovate and expand into Spain. Presently, Vitacress holds 15% of the market share, and it is a relevant supplier for the supermarket brands. The differentiation from competitors comes in multiple ways: expertise on baby leaf products (vs. cut vegetables - perish faster); service provided; quality and innovation. Other competitors, known for their innovation, however, there is the client perception that their products may be of lower quality.

3.3.3 Innovation

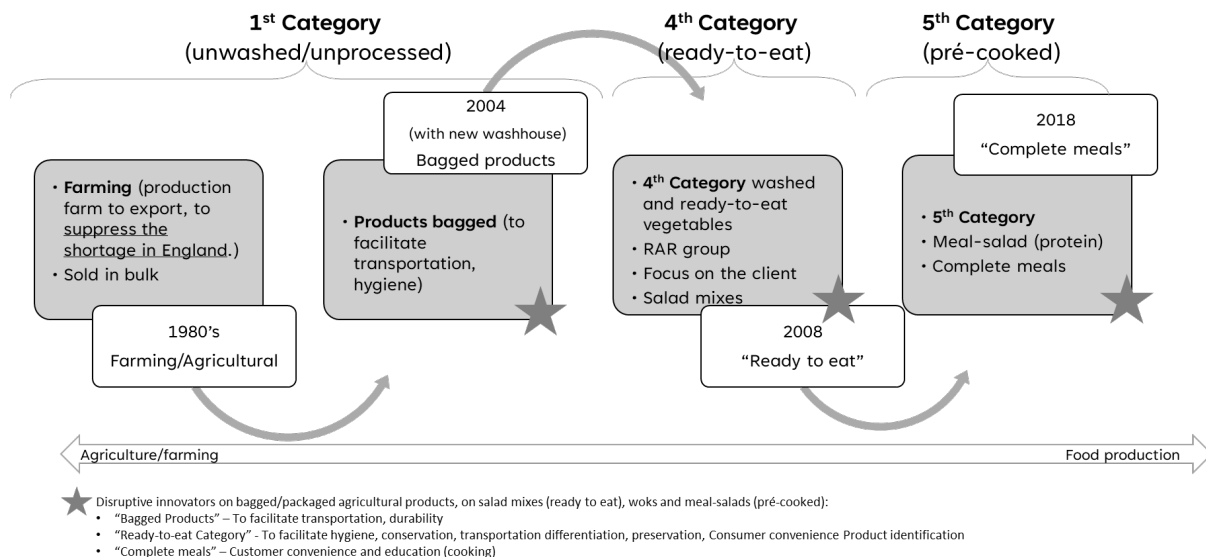


Figure 2: Business Model Innovation throughout the history of the company

From a purely agricultural company to one that stands out from the competition - become a branded company, client driven and focused on the market needs. It has a commitment to continue to improve and find solutions for daily life and differentiate itself in the offer of vegetables, make salads easier to use - increase salad consumption and increase convenience.

The company embodies an innovative mindset, with a customer focus and a commitment to best practices in their fields. They strive to be responsible innovators, continuously testing new products. In 2008 it is launched

the “ready-to-eat” category (washed salads, washed vegetables and Wok meals) and the “Complete meals” category (ready to serve meal - salads with protein) is launched in 2018.

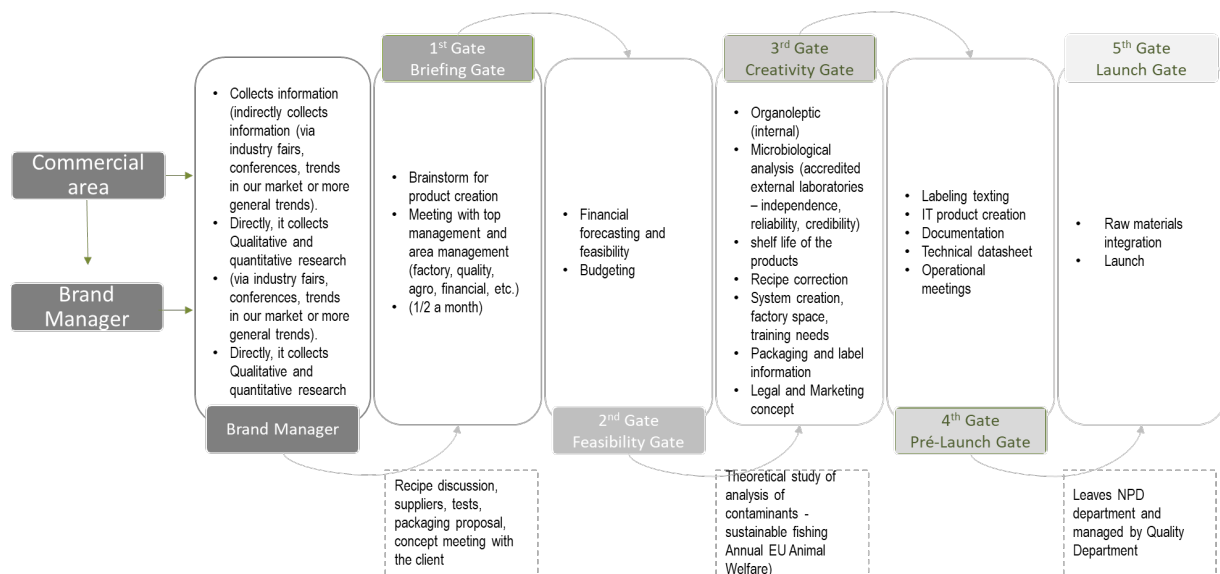


Figure 3: New product creation process

In 2022, they introduced 447 new or modified references (for new or existing products). Introducing new product categories is crucial for building trust with their B2B customers, which requires new packaging and branding to accompany the product launch. Overall, the company's commitment to innovation seems evident in their various initiatives, partnerships, and product offerings.

Their unique European climate provides an advantage in producing the freshest, tastiest, and healthiest product possible. The company's washed and packaged product offers several advantages, including hygiene, ease of transport, product differentiation, and preservation. Ultimately, their main goal is to provide consumers with a convenient, identifiable, and high-quality product that meets their needs and exceeds their expectations.

Vitacress operates with agility in their daily activities, given that the product has a limited shelf life. They face a tight window of 4 to 5 days to harvest the product, which leaves them with only 1-2 days to wash, pack, and deliver to customers. With such a short operating chain, they need to be agile and respond promptly to unexpected situations, such as weather variations, other challenges that affect crop in the field.

Fortunately, the company seem to have the support of their customers, such as supermarket chains, who are willing to take risks and invest in new products and solutions. Moreover, customers are open to testing these new products in the market.

4. Findings/analysis

Business model innovation is a critical aspect of organizational strategy and growth. The case of Vitacress, an agribusiness corporation, several key themes and patterns emerged in the analysis of their business model innovation (Figure 1).

Our empirical analysis focused on exploring and capturing the process that complex environment firm undertakes when it innovates its business model in a moderate dynamic environment (Ghezzi and Cavallo, 2020). According to our findings, this business innovation process is driven by Efficiency needs, Customer value, and Risk management. In this section, we provide a detailed description of our findings.

4.1 Efficiency

Agribusiness company Vitacress innovated its business model to boost production and organizational effectiveness. The business was able to discover and eliminate inefficiencies, minimize waste, and maximize resource allocation by implementing novel packaging and streamlining operations. This made transportation easier and reduced costs, which increased convenience for the business and its customers. Additionally, the company's goods and services were delivered faster and with higher quality, which increased customer

satisfaction and loyalty as well as sales and profits. The company's pursuit of nimble and adaptive practices contributed to its ability to maintain competitiveness in a business climate that was changing quickly. According to the research, efficiency is a key component in the creation of new business models since it enables companies to reduce costs, boost productivity, and react swiftly to market and customer demand changes. In order to keep ahead of the competition, it stressed how crucial it is to give priority to efficiency and adopt flexible and responsive processes.

4.2 Customer value

Vitacress' dedication to enhancing internal efficiency on a constant basis fuels innovation, expansion, and the delivery of value to stakeholders and customers. The company did this by introducing less perishable goods like baby leaves, expanding its product lines through crop rotation, and providing cleaned and bagged goods for the convenience and hygiene of its customers. In order to comprehend consumer needs and assess potential product concepts, Vitacress also placed a strong emphasis on direct client interaction and market research. This aided the business in encouraging customer education, diversity, and innovation. For instance, the demand for quick and wholesome meal options led to the creation of the ready-to-eat line. In summary, sustained internal efficiency improvement can promote innovation, business expansion, and deliver benefits to stakeholders and customers. Vitacress did it by creating new products, retaining customer engagement, and introducing new product lines that satisfy consumer wants while still being competitive in the market.

4.3 Risk management

Managing risk is a key internal driver of business model innovation, as corporations continuously prioritize risk management, including market risk and operational risk such as crop, handling, and transportation risks. Businesses can lessen the likelihood of mistakes, defects, and other issues that could result in monetary losses or reputational damage by prioritizing efficiency and finding and removing inefficiencies in their processes.

Product diversification is a technique that can satisfy customer needs, boost sales, and manage operational risk by reducing risk. Introducing new products allowed Vitacress to implement crop rotation, which allowed, for instance, decreased the likelihood that crops would fail due to weather, pests, or mildew.

A continuous and everyday innovation attitude was ingrained throughout the company as a result of its innovation culture, which was used to both foster innovation and control risks. The company differentiated itself through product innovation, which assisted it in standing out in both domestic and foreign markets, to manage market risk and deal with competition that frequently copies inventive items.

In summary, organizations prioritize risk management through efficiency, product diversification, and innovation. Risk management is a fundamental internal driver of business model innovation. The company Vitacress serves as an illustration of how to use these internal impulses to reduce operational risks and set apart through product innovation. Corporations may manage risks and maintain competitiveness in dynamic and competitive marketplaces by fostering an innovation culture and continuously enhancing operations and goods.

5. Conclusion

Efficiency, customer value, and risk management have all been discussed as drivers of business model innovation in this study. Because it enables businesses to save costs, boost productivity, and boost their competitiveness in the market, improving internal efficiency is a major factor in business model innovation. Another key factor is increasing customer value, which enables businesses to add value for their clients, foster client loyalty, and spur revenue development. A major force behind business model innovation, risk management enables organizations to avoid losses in revenue, harm to their reputations, and other undesirable outcomes.

Overall, the drivers of business model innovation are closely interrelated, as improving internal efficiency can help corporations to increase customer value and manage risk, while creating value for the customer can help corporations to improve efficiency and manage risk. Therefore, it is important for corporations to focus on these drivers in order to drive innovation and growth, while delivering value to their customers and stakeholders.

Moving forward, further research is needed to explore the specific strategies and approaches that corporations can use to effectively leverage these drivers of business model innovation. By doing so, corporations can continue to drive innovation, remain competitive, and create value for all stakeholders.

References

- Amit, R. and Zott, C. (2001) "Value creation in e-business", *Strategic management journal*, 22(6-7), 493-520.
- Amit, R. and Zott, C. (2012) "Creating value through business model innovation", *MIT Sloan management review*.
- Bock, A. J., Opsahl, T., George, G. and Gann, D. M. (2012) "The effects of culture and structure on strategic flexibility during business model innovation", *Journal of Management studies*, 49(2), 279-305.
- Braun, V. and Clarke, V. (2006) "Using thematic analysis in psychology" *Qualitative research in psychology*, 3(2), 77-101.
- Carayannis, E. G., Sindakis, S. and Walter, C. (2015) "Business model innovation as lever of organizational sustainability", *The Journal of Technology Transfer*, 40, 85-104.
- Chang, S. J. and Matsumoto, Y. (2022) "Dynamic resource redeployment in global semiconductor firms", *Strategic Management Journal*, 43(2), 237-265.
- Chesbrough, H. (2010) "Business model innovation: opportunities and barriers", *Long range planning*, 43(2-3), 354-363.
- Corbin, J. and Strauss, A. (2015) *Basics of qualitative research: Techniques and procedures for developing theory*. Sage.
- Foss, N. J. and Saebi, T. (2017) "Fifteen years of research on business model innovation: How far have we come, and where should we go?", *Journal of management*, 43(1), 200-227.
- Foss, N. J. and Saebi, T. (2018) "Business models and business model innovation: Between wicked and paradigmatic problems", *Long range planning*, 51(1), 9-21.
- Gassmann, O., Frankenberger, K. and Csik, M. (2014) *The business model navigator: 55 models that will revolutionise your business*. Pearson UK.
- George, G. and Bock, A. J. (2011) "The business model in practice and its implications for entrepreneurship research", *Entrepreneurship theory and practice*, 35(1), 83-111.
- Ghezzi, A. and Cavallo, A. (2020) "Agile business model innovation in digital entrepreneurship: Lean startup approaches", *Journal of Business Research*, 110, 519-537.
- Glaser, B. G. and Strauss, A. L. (2017) *The discovery of grounded theory: Strategies for qualitative research*. Routledge.
- Hanelt, A., Bohnsack, R., Marz, D. and Antunes Marante, C. (2021) "A systematic review of the literature on digital transformation: Insights and implications for strategy and organizational change", *Journal of Management Studies*, 58(5), 1159-1197.
- Johnson, M. W., Christensen, C. M. and Kagermann, H. (2008) "Reinventing your business model", *Harvard business review*, 86(12), 50-59.
- Kafetzopoulos, D. and Gotzamani, K. (2021) "Effect Of Leadership On Bmi And Competitive Advantage Of Smes", *International Journal of Innovation Management*, 25(09), 2150101.
- Kvale, S. and Brinkmann, S. (2009) *Interviews: Learning the craft of qualitative research interviewing*. sage.
- Lecocq, X., Demil, B. and Ventura, J. (2010) "Business models as a research program in strategic management: An appraisal based on Lakatos", *M@n@gement*, (4), 214-225.
- Oliveira-Dias, D., Kneipp, J. M., Bichueti, R. S. and Gomes, C. M. (2022) "Fostering business model innovation for sustainability: a dynamic capabilities perspective", *Management Decision*, 60(13), 105-129.
- Osterwalder, A., Pigneur, Y. and Tucci, C. L. (2005) "Clarifying business models: Origins, present, and future of the concept", *Communications of the association for Information Systems*, 16(1), 1.
- Ozcan, P., Han, S. and Graebner, M. E. (2017) "Single cases: The what, why, and how", *The Routledge companion to qualitative research in organization studies*, 92, 112.
- Pettigrew, A. (1988) "Longitudinal field research on change Theory and practice Paper presented at the National Science Foundation Conference on Longitudinal Research Methods in Organizations", Austin, TX.
- Pitelis, C. N. (2022) "Dynamic capabilities, the new multinational enterprise and business model innovation: A de/re-constructive commentary", *Journal of International Business Studies*, 53(4), 741-753.
- Saldaña, J. (2021) "The coding manual for qualitative researchers", *The coding manual for qualitative researchers*, 1-440.
- Santa-Maria, T., Vermeulen, W. J. and Baumgartner, R. J. (2022) "How do incumbent firms innovate their business models for the circular economy? Identifying micro-foundations of dynamic capabilities", *Business Strategy and the Environment*, 31(4), 1308-133
- Schoemaker, P. J., Heaton, S. and Teece, D. (2018) "Innovation, dynamic capabilities, and leadership", *California management review*, 61(1), 15-42.
- Shams, R., Vrontis, D., Belyaeva, Z., Ferraris, A. and Czinkota, M. R. (2021) "Strategic agility in international business: A conceptual framework for "agile" multinationals", *Journal of International Management*, 27(1), 100737.
- Spieth, P., Schneckenberg, D. and Ricart, J. E. (2014) "Business model innovation—state of the art and future challenges for the field", *R&D Management*, 44(3), 237-247.
- Teece, D. J. (2010) "Business models, business strategy and innovation", *Long range planning*, 43(2-3), 172-194.
- Teece, D. J. (2018) "Business models and dynamic capabilities", *Long range planning*, 51(1), 40-49.
- Ujwary-Gil, A. and Potoczek, N. R. (2020) "A dynamic, network and resource-based approach to the sustainable business model", *Electronic Markets*, 30(4), 717-733.
- Yin, R. K. (2018) *Case study research and applications: Design and methods*. Sage Books.
- Zhang, H., Xiao, H., Wang, Y., Shareef, M. A., Akram, M. S. and Goraya, M. A. S. (2021) "An integration of antecedents and outcomes of business model innovation: A meta-analytic review", *Journal of Business Research*, 131, 803-814.
- Zhang, L., Yang, X., Zhu, S. and Xia, Z. (2023) "Business Model Innovation and Performance of Startups: The Moderating Role of External Legitimacy", *Sustainability*, 15(6), 5351.

- Zhao, J., Wei, Z. and Yang, D. (2019) "Organizational search, dynamic capability, and business model innovation", *IEEE Transactions on Engineering Management*, 68(3), 785-796.
- Zott, C. and Amit, R. (2010) "Business model design: An activity system perspective", *Long range planning*, 43(2-3), 216-226.
- Zott, C., Amit, R. and Massa, L. (2011) "The business model: recent developments and future research", *Journal of management*, 37(4), 1019-1042.

Tracking the Effects of Groundswell Communication on the Attitudinal and Purchasing Behaviour of Consumers of Eco-Friendly Products

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Abstract: The expansion of the dialogue and individual customer values due to active development of digital communication, which is related to innovation of digital communication and its integration into all areas of marketing communication, requires examination of emotions and emotional responses in the "business - online community - customer" communication process. Globalization but also the development of digital technologies have led to the integration of traditional and digital presentation of business entities into a unified whole, contributing to the emergence of the currently popular phenomenon of the groundswell. The presence of new forms of social interaction, particularly in the realm of social media, supports the creation and dissemination of so-called community communication about businesses and their products, often without their knowledge. As a result of this phenomenon and the possibility of quickly obtaining information and comparing companies across various online channels, there is a change in consumer behaviour. The groundswell defines a new trend in communication between organizations and unofficial institutions (fans, customers, consumers), which has a significant impact on business in any industry. The popularity of environmental issues, negative news about global warming, and the occurrence of increasingly frequent earthquakes and stormy tornadoes, force consumers to become educated in the environmental field. However, the spread of hoaxes and false information about eco-products can be a problem. Social media users become victims of community opinion, and their belief in the need for eco-friendly behaviour in the purchasing process often has a decreasing tendency. Uncoordinated management of the groundswell indicates a societal issue, which is why the authors of the research article aimed to investigate and systematically describe the impact of groundswell activities on previously environmentally conscious customers, as well as on customers who were unaware of eco-products. In their scientific study, the authors present the findings of theoretical research aimed at ecological brands, products and users who have been exposed to the effect of groundswell as well as the potential of neuromarketing usage in the given field. The authors also provide general recommendations for ecologically oriented brands in the field of managing groundswell communication.

Keywords: Attitude Change, Consumer Behaviour, Ecoproducts, Groundswell, Neuromarketing.

1. Introduction

In recent years, the growing concern regarding environmental sustainability has resulted in a significant surge in consumer demand for environmentally friendly products (Dangelico and Vocalelli, 2017). Simultaneously, the emergence and widespread adoption of social media platforms, online forums, blogs, and consumer review websites have facilitated the exchange of information and opinions among consumers, leading to a phenomenon known as groundswell communication (Zaušková and Ščepková, 2022). This form of communication possesses the potential to influence consumer attitudes and purchasing behaviour, particularly in relation to environmentally friendly products. The purpose of this article is to examine and monitor the impacts of groundswell communication on consumer attitudes and purchasing behaviour concerning environmentally friendly products.

Groundswell communication is characterized by interactions among peers, content generated by users, and online communities. Through these channels, consumers have the opportunity to share their experiences, recommendations, and concerns regarding environmentally friendly products. The influence of groundswell communication on consumer attitudes is rooted in psychological factors such as social influence, trust, and credibility (Hennig-Thurau et al., 2004). When individuals observe their peers expressing positive attitudes and engaging in sustainable purchasing behaviour, they are more inclined to adopt similar attitudes and behaviours themselves, and vice-versa, negative attitudes may cause a relevant response.

The impact of groundswell communication on consumer purchasing behaviour can be viewed from two perspectives. Firstly, it can directly affect the decision-making process by providing consumers with pertinent information, product recommendations, and comparisons (Chevalier & Mayzlin, 2006). The availability of online reviews, ratings, and testimonials empowers consumers to make well-informed choices when selecting environmentally friendly products. Secondly, groundswell communication can influence brand loyalty and repeat purchases. Favourable online discussions and shared experiences contribute to the establishment of trust

and emotional connections between consumers and environmentally friendly brands (Herbes, Beuthner and Ramme, 2018). The monitoring of the effects of groundswell communication on consumer attitudes and purchasing behaviour holds great significance for businesses and marketers operating in the environmentally friendly product sector. By comprehending the mechanisms through which groundswell communication operates, companies can effectively engage with their target audience, raise brand awareness, and promote sustainable consumer behaviour. This research aims to offer valuable insights and recommendations for businesses aiming to utilize groundswell communication strategies in order to better fulfil the expectations and preferences of environmentally conscious consumers.

2. Theoretical background

In our paper, several key terminologies will be employed to examine the ramifications of groundswell communication on the attitudes and purchasing conduct of consumers in relation to eco-friendly products. It is imperative to elucidate these terms in order to ensure clarity and comprehension among readers.

- **Groundswell communication:** First things first, we need to state what is groundswell communication. Groundswell communication denotes the interactive dissemination of information, opinions, and experiences among consumers through diverse online platforms, including social media outlets, online forums, blogs, and consumer review websites (Shabana and Firoz, 2019). It represents the collective voice of consumers, providing them with a forum to exchange and deliberate upon their perspectives and encounters pertaining to specific products or subjects.
- **Attitudinal behaviour:** Attitudinal behaviour encompasses the cognitive, affective, and evaluative responses manifested by individuals towards specific entities, such as eco-friendly products (Ajzen, 2005). It encompasses the attitudes, beliefs, and intentions that shape an individual's decision-making process and subsequent actions with regard to the adoption or rejection of a product or conduct.
- **Purchasing behaviour:** Purchasing behaviour refers to the actions and choices made by consumers when acquiring products or services (Schiffman and Wisenblit, 2018). It encompasses factors such as purchase frequency, brand loyalty, product preferences, and the influence of external factors, such as advertising or recommendations from acquaintances.

In our paper we are focusing on eco-friendly products and their consumers, so some background on the chosen segment is also appropriate. One of the principal catalysts driving the demand for eco-friendly products is the growing recognition of environmental issues and the imperative to mitigate the adverse consequences of human activities on the planet (Fraccascia, Ceccarelli and Dangelico, 2023). Consumers are acknowledging the significance of embracing more sustainable consumption patterns to curb pollution, conserve natural resources, and diminish carbon emissions. Consumers are progressively apprehensive about the potentially detrimental effects of conventional products containing toxic chemicals and pollutants (De Canio et al., 2021). Eco-friendly alternatives, such as organic food, natural skincare products, and non-toxic cleaning agents, are perceived as safer options that promote personal well-being.

Ethical concerns also impel the demand for eco-friendly products (Chi, 2022). They endeavor to align their purchasing behavior with their values, favoring products that champion social responsibility and contribute to the welfare of communities and the environment. The significance of eco-friendly products transcends individual consumer preferences as it resonates with governmental and regulatory bodies, which have instituted policies and incentives aimed at promoting sustainability and mitigating the environmental impact of industries (Ready and Truelove, 2011). Businesses that embrace eco-friendly practices and offer sustainable products stand to benefit from favorable regulations, access to new markets, and the enhancement of brand reputation.

Groundswell communication can be shared by users through various channels on the web. Among them are:

- **Social media platforms**, such as Facebook, Instagram, YouTube and Twitter, are among the most used ones (Statista, 2023). Only on Facebook, for example, more than half a million comments are being posted every minute (Kohout et al., 2023). They have emerged as prominent conduits for groundswell communication. Users can share their experiences with eco-friendly products, proffer product recommendations, and engage in discussions with like-minded individuals (Zaušková et al., 2022). Social media platforms furnish a space for consumers to voice their opinions, raise awareness about sustainability concerns, and cultivate a sense of community among individuals committed to environmental consciousness.

- **Online forums and discussion boards** provide dedicated venues for consumers to pose queries, seek guidance, and share insights pertaining to eco-friendly products (Gretzel et al., 2015). These forums bring together individuals who share a common interest in sustainable lifestyles and provide a platform for in-depth exchanges. Consumers can deliberate on product attributes, dispense recommendations, and share personal encounters, thus contributing to the collective knowledge base of eco-friendly products.
- **Blogs** penned by eco-conscious individuals, influencers, and subject matter experts also serve as significant channels for groundswell communication (Kozinets, 2010). Bloggers can furnish detailed product reviews, dispense sustainability tips, and recount personal narratives related to eco-friendly living. Readers can engage with blog content by commenting, expressing their perspectives, and seeking further elucidation. Blogs facilitate a more narrative-driven and personalized approach to groundswell communication, engendering trust and credibility among readers.
- **Consumer review websites**, such as Amazon, TripAdvisor, and Yelp, wield substantial influence as channels for groundswell communication. In recent years, those websites are constantly growing (Fe, 2023). It emphasizes why we should not forget about them when talking about groundswell communication. These platforms afford prospective buyers a wealth of information that enables informed decision-making based on the experiences of others. Positive reviews engender trust and reliability, thereby shaping consumer attitudes and purchase intentions.

3. Groundswell's influence on consumer attitudes and purchasing behaviour

Groundswell communication exerts a notable influence on consumer attitudes towards eco-friendly products. By means of peer endorsements, user-generated content, and virtual communities, consumers encounter a plethora of information and experiences that mold their perceptions, trust, and credibility in regard to eco-friendly products.

Peer recommendations play a pivotal role in exerting influence on consumer attitudes. Observing their peers' positive attitudes and engagement in sustainable purchasing behaviour through groundswell communication channels, individuals are more likely to adopt similar attitudes and behaviours themselves (De Vries et al., 2012). Positive peer recommendations serve as **social proof**, enhancing the perceived value and desirability of eco-friendly products. The significance of social proof in propelling sales of eco-friendly products through groundswell communication cannot be overstated. Consumers often rely on the experiences and opinions of others to shape their decision-making processes, particularly when personal experiences are lacking (Helversen et al., 2018). By witnessing that others have encountered positive experiences with these products, consumers manifest an increased inclination to make purchases and embrace sustainable consumption practices.

User-generated content, including reviews, ratings, and testimonials, also plays a significant role in shaping consumer attitudes (Dong et al., 2023). The consumption of others' experiences can influence consumer perceptions of product quality, performance, and overall satisfaction. Positive user-generated content not only imparts valuable information but also contributes to the cultivation of trust and credibility in eco-friendly brands and their products (Chen & Xie, 2013). Moreover, consumers gain access to a diverse array of product attributes, advantages, and performance evaluations through user-generated content, discussions, and recommendations (Helversen et al., 2018). This wealth of information empowers consumers to make well-informed choices tailored to their specific needs and preferences. By comprehending the distinctive selling points of eco-friendly products, consumers can evaluate their alignment with personal values and sustainability objectives.

Online communities fostered by groundswell communication platforms further impact consumer attitudes. These communities bring together individuals with a shared interest in eco-friendly products, creating spaces for discourse, support, and information exchange. By actively engaging in these communities, consumers gain access to a diverse array of perspectives, insights, and recommendations (Hajli, 2014). Interaction with like-minded individuals who prioritize sustainability reinforces and strengthens consumer attitudes towards eco-friendly products, fostering a sense of belonging and underscoring the significance of sustainable choices. Groundswell communication may also influence consumer brand loyalty. Positive experiences shared by consumers on groundswell communication platforms contribute to the development of trust and loyalty towards eco-friendly brands (Wang et al., 2022). When consumers perceive a brand to be trustworthy, dedicated to sustainability, and responsive to customer feedback, their propensity to become loyal advocates and repeat customers is heightened (Fe, 2023). The sense of community fostered by groundswell communication platforms

further fortifies brand loyalty, as consumers feel a sense of connection with like-minded individuals who share similar values and preferences.

To support our statements above, let's take a look at some statistics gathered in external publications and agencies' surveys.

- The findings of a survey conducted by BrightLocal (2023) demonstrate that a substantial majority of consumers, specifically 87%, engage in the practice of reading online reviews for local businesses. Moreover, the survey reveals that the purchasing decisions of 93% of consumers are influenced by online reviews.
- In alignment with these results, a survey conducted by Podium (2017) affirms that 93% of consumers perceive online reviews as impactful on their purchasing decisions, while 82% assert that the quality of a company's reviews directly shapes their trust in said company.
- Supporting the significance of reviews, Bazaarvoice's study (2022) reveals that products boasting average ratings of 4 stars or higher exhibit a nearly fourfold increase in the likelihood of being purchased when compared to products with ratings below 4 stars.
- Insights provided by Nielsen (2015) indicate that a notable 66% of consumers are willing to allocate additional financial resources towards products and services offered by companies that espouse positive social and environmental impacts.
- Expanding the scope of influence, various articles (Cheng et al., 2020) reveals that consumers who actively engage with online communities centered around eco-friendly products demonstrate a higher propensity for brand loyalty and recurrent purchase behavior.
- The older research conducted by McKnight and Chervany (2002) substantiates the notion that consumers are more inclined to trust and be influenced by recommendations originating from individuals they perceive as similar to themselves.

These statistics underscore the considerable impact of groundswell communication, notably through online reviews, ratings, and peer recommendations, on consumer purchasing behavior and show the paramount significance of social proof, and thus groundswell communication and marketing in driving sales of eco-friendly products.

From the information above we may summarize, that groundswell communication enables consumers to develop trust and credibility in eco-friendly brands. The transparent and authentic nature of user-generated content allows consumers to evaluate others' experiences and opinions (Yang et al., 2023). Consistent positive reviews and recommendations from multiple sources increase the likelihood of individuals trusting the brand and perceiving it as credible. This trust and credibility have an impact on consumer attitudes by shaping a positive brand image, enhancing perceptions of the brand's commitment to sustainability, and instilling confidence in the eco-friendliness of its products.

4. Usage of neuromarketing for tracking the effects of groundswell communication

Neuromarketing techniques offer a unique perspective for tracking and understanding the effects of groundswell communication on consumer attitudes and purchasing behaviour. This can be especially relevant related to eco-friendly products, since their communication usually includes focus on the features those products have or include. By examining neural responses, emotional engagement, and subconscious associations, neuromarketing provides valuable insights into the underlying processes that drive consumer decision-making. The field of neuromarketing is vast and in this part of our paper we want to mention some neuromarketing tools and techniques which neuromarketing can be utilized to track the effects of groundswell communication:

1. **EEG (Electroencephalography):** EEG measures electrical brain activity and can track attention, engagement, and emotional responses. By analyzing EEG data, researchers can identify changes in brainwave patterns associated with groundswell communication exposure.
2. **Eye Tracking:** Eye tracking technology enables the measurement and analysis of consumers' visual attention and gaze patterns. It helps determine which elements of groundswell communication draw the most attention and guide subsequent actions.
3. **Implicit Association Testing (IAT):** IAT measures consumers' automatic associations and attitudes towards eco-friendly products influenced by groundswell communication. By measuring response times to stimulus pairs, researchers can determine the strength of unconscious associations.

4. **Facial Expression Analysis:** Facial expression analysis software tracks and analyzes micro-expressions to gauge consumers' emotional responses to groundswell communication. By identifying specific emotions, such as happiness or surprise, researchers can assess the effectiveness of the communication in eliciting desired emotional reactions.
5. **Neuroimaging (fMRI):** Functional Magnetic Resonance Imaging (fMRI) (Bozek et al., 2023) measures brain activity by detecting changes in blood flow. It can provide insights into consumers' cognitive and emotional responses to groundswell communication.
6. **Galvanic Skin Response (GSR):** GSR measures changes in skin conductance, reflecting participants' emotional arousal and engagement. By monitoring GSR during exposure to groundswell communication, researchers can assess emotional reactions and identify content that elicits stronger responses.
7. **Biometric Wearables:** Biometric wearables, such as heart rate monitors and skin temperature sensors, provide real-time physiological data related to consumers' emotional and physical responses. By collecting biometric data during groundswell communication exposure, researchers can assess the impact on consumers' physiological arousal levels and overall engagement.
8. **Implicit Priming:** Implicit priming techniques (Morgan et al., 2022) involve presenting subtle environmental cues to influence subsequent attitudes and behaviour. In the context of groundswell communication, implicit priming can be used to assess the impact of exposure to eco-friendly content on consumers' subsequent attitudes and choices.

The usage of certain techniques should always be decided based on a specific need of the brand and the product. As we can see, there are many ways in which consumers' emotions may be researched, and the selection of the most appropriate may result in the best outcome for the brand and the product. For the purpose of this article, we were not able to find a complex study that researches tracking the effects of neuromarketing communication using neuromarketing techniques. However, we think that neuromarketing may help to understand insights of customers' groundswell communication, and the information provided can serve as a starting point for further research in this field.

5. Case Studies

In this part of our paper, we want to demonstrate examples of real case studies of how groundswell communication can influence consumer behaviour in the eco-friendly product sector. By researching real experiences from the market, other brands may get valuable insight into why and how they should approach groundswell communication. Here are a few notable examples:

5.1 Patagonia's Worn Wear Campaign

Patagonia's Worn Wear campaign was an innovative initiative that aimed to promote sustainability and reduce environmental impact by encouraging customers to repair and reuse their Patagonia products rather than purchasing new ones. The campaign focused on engaging customers through groundswell communication channels, such as social media platforms, online forums, and the Patagonia website. The Worn Wear campaign effectively utilized groundswell communication by creating a community of environmentally-conscious consumers who shared their stories and experiences. Customers were encouraged to upload photos, videos, and personal narratives showcasing their repaired and well-loved Patagonia gear. The campaign went beyond mere advertising and connected customers on a personal level, fostering a sense of pride and loyalty among Patagonia enthusiasts.



Figure 1: Patagonia “Worn Wear” campaign creative

Source: Ottman, J. (2017) "WeHateToWaste Salutes Patagonia Worn Wear", [online], WeHateToWaste, <https://www.wehatetowaste.com/patagonia-worn-wear/>.

But what impact, if any, did this campaign have? The Patagonia's Worn Wear Surf Tour advertisements, which were a part of the campaign in 2018, were exposed to a considerable audience of 4,694,206 individuals throughout Europe through Facebook and Instagram advertising. The engagement with these advertisements amounted to 256,574 interactions, and a total of 16,863 users were motivated to click through and access the surf-related content on the Patagonia website. Notably, the utilization of Facebook as a promotional platform proved highly effective, as social advertisements accounted for 66% of all event responses in France, Spain, and the UK (Native, 2018). According to Batten (2020), Patagonia has reportedly sold approximately 120,000 repurposed items during the campaign. It has been suggested by some estimations that opting to purchase used garments instead of new ones has the potential to reduce an individual's carbon footprint related to apparel by as much as 60%. Additionally, a 10% increase in second-hand sales, resulting in a 50% extension of garment life, could lead to a 3% reduction in carbon emissions per tonne of clothing and a 4% decrease in water usage (WRAP, 2017). However, it is important to note that these figures may vary depending on the duration of the product's extended lifespan and the patterns of its use, including frequency of washing (Circular X, 2020). The overall engagement surrounding these events contributed to the expansion of the Patagonia Surf audience, thereby enhancing the potential for future campaigns. As we may see from the numbers above, campaigns that engage users' groundswell communication concerning eco topics have a vast potential on the market. Based on the numbers from above, the engagement rate was almost 5,5%. Considering the type of distribution and topic of the campaign, we consider it to be good, once again showing the prominence of groundswell communication in the field. Another conclusion we may state is that social advertisements are also a good way of engaging users in groundswell communication with the brand since in researched campaign around two-thirds of all responses came from ads.

5.2 Method's People Against Dirty Campaign

Method, a household cleaning product brand, launched the People Against Dirty campaign, leveraging groundswell communication to raise awareness about the harmful chemicals found in traditional cleaning products. The campaign aimed to position Method as a socially responsible and eco-friendly alternative in the cleaning product market. The People Against Dirty campaign utilized various groundswell communication channels, including social media platforms, online forums, and user-generated content. Method engaged consumers by encouraging them to share their experiences, concerns, and preferences regarding cleaning products and their impact on the environment and personal health. People Against Dirty adeptly stimulated individuals to reevaluate their perception of cleanliness, educated them about the effectiveness of green chemistry, and even encouraged them to clean in the nude using non-petroleum-based products. The strategic implementation of a single magazine insert effectively showcased the essence, products, philosophy, and mission of Method, leading to a remarkable 20% increase in sales. Impressively, this boost in sales was sustained at a 15% increment (Odysseus Arms), underscoring the profound impact of the campaign on revolutionizing a conventional yet flawed commodity.



Figure 2: Method's people against dirty campaign creative

Source: Odysseus Arms. "METHOD. People Against Dirty", [online], ODYSSEUS ARMS, <https://www.o-arms.com/vault-method>.

The success of Method's People Against Dirty campaign can be attributed to their strategic use of groundswell communication. By tapping into the growing consumer concern for the environment and health, Method created a dialogue that resonated with their target audience. Through the campaign, Method not only educated consumers about the potential harms of traditional cleaning products but also positioned themselves as a viable and sustainable alternative. Method's campaign is a great example of how a brand may increase sales while creating a good public image of the brand without breaking the bank completely. By using groundswell communication, Method was able to create better connections with the customers, building trust in their relationship due to the helpful information they were sharing, while also gaining a remarkable increase in their sales. This campaign shows us the giant potential that groundswell communication brings with itself in the field of eco products if used correctly and appropriately by the brand.

6. Implications and recommendations

The findings regarding the effects of groundswell communication on consumer attitudes and purchasing behaviour in the eco-friendly product sector have significant implications for businesses, marketers, and eco-friendly product manufacturers. Understanding these implications can help companies effectively leverage groundswell communication to engage with consumers, build trust, and drive sustainable consumer behaviour. Based on the information we were able to collect in our paper, the following recommendations for businesses, both small and big, can be made:

- **Embrace and Leverage Groundswell Communication:** Actively engaging with consumers on these channels provides the potential to create meaningful connections, encourage discussions, and share relevant information about eco-friendly products. By embracing and leveraging groundswell communication, businesses can tap into the collective knowledge and experiences of consumers, building brand loyalty and advocacy.
- **Foster Online Communities and Influencer Partnerships:** Companies can create and nurture online communities centered around eco-friendly products, where consumers can connect, share insights, and support each other. Additionally, partnering with influencers who align with the brand's values and have a strong presence on social media can amplify the reach and impact of groundswell communication. Influencers can serve as authentic advocates, providing personal experiences and recommendations that resonate with their followers.
- **Monitor and Respond to Consumer Feedback:** As we described earlier, customer feedback and reviews play a giant role in the purchasing decision-making of other consumers. Actively monitoring consumer conversations and feedback on social media platforms, online reviews on platforms like Yelp or Google, and other groundswell communication channels, while may seem insignificant, brings a lot of potential for attracting new customers. It is also important to respond promptly and transparently, both to positive and negative reactions, to address any concerns, provide clarifications, and demonstrate a commitment to customer satisfaction to show that the company values consumer opinions and fosters a sense of trust and credibility.
- **Encourage User-Generated Content:** Companies should encourage consumers to create and share user-generated content related to their eco-friendly products. This can include testimonials, reviews, photos, videos, and success stories. User-generated content serves as powerful social proof and can influence the attitudes and purchasing decisions of others.
- **Incorporate Neuromarketing Research:** Utilizing neuromarketing research techniques may help brands to gain deeper insights into consumer behavior and emotional responses. This can involve studying consumer reactions to eco-friendly product messaging, packaging, and branding through neuroimaging, eye-tracking, and physiological measurements. Understanding the subconscious triggers and emotional drivers behind consumer behavior can help companies tailor their marketing efforts more effectively.

7. In conclusion

Groundswell communication has emerged as a powerful force in shaping consumer attitudes and purchasing behaviour in the eco-friendly product sector. Through various channels such as social media platforms, online forums, user-generated content, and influencer marketing, consumers are actively engaging in discussions, sharing experiences, and influencing the opinions of others. In our article we have explored the effects of

groundswell communication on consumer attitudes and purchasing behaviour, highlighting its significance in driving sustainable consumer behaviour and the success of eco-friendly product brands.

By actively participating in conversations, fostering online communities, partnering with influencers, and encouraging user-generated content, companies can effectively engage with consumers, build trust, and drive positive brand perceptions. The impact of groundswell communication on consumer attitudes is evident through the role of peer recommendations, user-generated content, and online communities in shaping perceptions, trust, and credibility. Consumers rely on the experiences and opinions of others to make informed decisions, and groundswell communication provides a platform for sharing and accessing this valuable information. Moreover, the influence of groundswell communication extends to consumer purchasing behaviour, with online reviews, ratings, and social proof playing a significant role in driving sales of eco-friendly products.

We also provided information on how neuromarketing can be used while working with groundswell marketing and communication. By utilizing tools such as EEG, eye tracking, implicit association testing, facial expression analysis, neuroimaging (fMRI), galvanic skin response (GSR), biometric wearables, and implicit priming, researchers can track neural responses, emotional engagement, and subconscious associations, providing a deeper understanding of consumer decision-making processes. This approach provides a unique perspective and enables brands to optimize their groundswell communication strategies, resulting in more effective and impactful campaigns. By leveraging the power of neuromarketing, brands can enhance their understanding of consumers and tailor their communication efforts to drive positive attitudes and behaviours. Examples such as the Patagonia Common Threads Initiative and Method's People Against Dirty campaign marketing have showcased how companies can successfully leverage groundswell communication to drive positive attitudes and increased sales.

To conclude, groundswell communication has become a vital tool for businesses and marketers seeking to engage with consumers and drive sustainable consumer behaviour in the eco-friendly product sector. By understanding the implications and recommendations outlined in this article, companies can harness the power of groundswell communication to better connect with their target audience, build trust, increase sales and ultimately contribute to a more sustainable future.

Acknowledgements

The scientific paper is one of the partial outputs under the scientific research grant VEGA No. 1/0458/21 under the title "Management of the "groundswell" concept by business entities in promotion of environmentally-friendly products in times of technology interference".

References

- Ajzen, I. (2005) *Attitudes, Personality, and Behavior*, Open University Press.
- Batten, C. (2020) "Patagonia's Worn Wear Collection Is Saving the Planet", [online], The Manual, <https://www.themanual.com/outdoors/patagonia-worn-wear-collection-recycled-recommerce/>.
- Bozek, J et al. (2023) "Normative models for neuroimaging markers: Impact of model selection, sample size and evaluation criteria", *NeuroImage*, Vol. 268, pp 1-13.
- Bridge, K. (2022) "How to get more reviews for your business", [online], The Bazaar Voice, <https://www.bazaarvoice.com/blog/how-to-get-more-reviews-for-your-business/>.
- BrightLocal. (2023) "Local Consumer Review Survey", [online], BrightLocal, <https://www.brightlocal.com/research/local-consumer-review-survey/>.
- Cheng, F-F., Wu, C-S. and Chen, Y-C. (2020) "Creating customer loyalty in online brand communities", *Computers in Human Behavior*, Vol. 107, pp 1-9.
- Chi, N. T. K. (2022) "Ethical consumption behavior towards eco-friendly plastic products: Implication for cleaner production", *Cleaner and Responsible Consumption*, Vol. 5, pp 1-9.
- Circular X. (2020) "Patagonia - Worn Wear Program", [online], Circular X, <https://www.circularx.eu/en/cases/34/patagonia-worn-wear-program>.
- Dangelico, R. M. and Vocalelli, D. (2017) "'Green Marketing': An analysis of definitions, strategy steps, and tools through a systematic review of the literature", *Journal of Cleaner Production*, Vol. 165, pp 1263-1279.
- De Canio, F., Martinelli, E. and Endrighi, E. (2021) "Enhancing consumers' pro-environmental purchase intentions: the moderating role of environmental concern", *International Journal of Retail & Distribution Management*, Vol. 49, No. 9, pp 1312-1329.
- De Vries, L., Gensler, S. and Leeflang, P. S. (2012) "Popularity of brand posts on brand fan pages: An investigation of the effects of social media marketing", *Journal of Interactive Marketing*, Vol. 26, Issue 2, pp 83-91.

- Dong, Y. et al. (2023) "Identification and evaluation of competitive products based on online user-generated content", *Expert Systems with Applications*, Vol. 225, pp 1-17.
- Fe, H. (2023) "Social networks and consumer behavior: Evidence from Yelp", *Journal of Economic Behavior & Organization*, Vol. 209, pp 1-14.
- Fraccascia, L., Ceccarelli, G. and Dangelico, R. M. (2023) "Green products from industrial symbiosis: Are consumers ready for them?", *Technological Forecasting and Social Change*, Vol. 189, pp 1-13.
- Gretzel, U. et al. (2015) "Smart tourism: Foundations and developments", *Electronic Markets*, Vol. 25, pp 179-188.
- Hajli, N. (2014) "A study of the impact of social media on consumers", *International Journal of Market Research*, Vol. 56, Issue 3, pp 387-404.
- Helversen, B. et al. (2018) "Influence of consumer reviews on online purchasing decisions in older and younger adults", *Decision Support Systems*, Vol. 113, pp 1-10.
- Hennig-Thurau, T. et al. (2004) "Electronic word-of-mouth via consumer-opinion platforms: What motivates consumers to articulate themselves on the Internet?", *Journal of Interactive Marketing*, Vol. 18, Issue 1, pp 38-52.
- Herbes, C., Beuthner, C. and Ramme, I. (2018) "Consumer attitudes towards biobased packaging – A cross-cultural comparative study", *Journal of Cleaner Production*, Vol. 194, pp 203-218.
- Kohout, S., Kruikemeier, S. and Bakker, B. N. (2023) "May I have your Attention, please? An eye tracking study on emotional social media comments", *Computers in Human Behavior*, Vol. 139, pp 1-9.
- Kozinets, R. V. (2010) *Netnography: Doing ethnographic research online*. Sage Publications, London.
- McKnight, D. H. and Chervany, N. L. (2002) "What trust means in e-commerce customer relationships: An interdisciplinary conceptual typology", *International Journal of Electronic Commerce*, Vol. 6, No. 2, pp 35-59.
- Morgan, P. L. et al. (2022) "Reducing risk to security and privacy in the selection of trigger-action rules: Implicit vs. explicit priming for domestic smart devices", *International Journal of Human-Computer Studies*, Vol. 168, pp 1-16.
- Nativeve. (2018) "Patagonia's Worn Wear Surf Tour: Social Media Case Study", [online], Nativeve, <https://www.nativeve.com/work/patagonia-worn-wear-surf-tour-social-media-case-study/>.
- Nielsen. (2015) "Global sustainability report: Consumers increasingly focused on social and environmental impact", [online], Nielsen, https://www.supplychain247.com/images/pdfs/nielsen_global-sustainability-report-oct-2015.pdf.
- Odysseus Arms. "METHOD. People Against Dirty", [online], ODYSSEUS ARMS, <https://www.o-arms.com/vault-method>.
- Ottman, J. (2017) "WeHateToWaste Salutes Patagonia Worn Wear", [online], WeHateToWaste, <https://www.wehatetowaste.com/patagonia-worn-wear/>.
- Podium. (2017) "State of Online Reviews", [online], Podium, <https://www.podium.com/resources/podium-state-of-online-reviews>.
- Ready, D. A. and Truelove, E. (2011) The Power of Collective Ambition, *Harvard Business Review*, Dec. 2011.
- Schiffman, L. G. and Wisenblit, J. (2018) *Consumer Behavior (What's New in Marketing)*, 12th ed., Pearson Education, New York.
- Shabana, A. and Firoz, M. (2019) "Review of Literature – Social media & its strategic importance for businesses.", *International Journal of Business and Management Invention (IJBMI)*, Vol. 8, Issue 10, Series 1, pp 54-61.
- Statista. (2023) "Most popular social networks worldwide as of January 2023, ranked by number of monthly active users", [online], Statista, <https://www.statista.com/statistics/272014/global-social-networks-ranked-by-number-of-users/>.
- Wang, Z., Huang, W.-J. and Liu-Lastres, B. (2022) "Impact of user-generated travel posts on travel decisions: A comparative study on Weibo and Xiaohongshu", *Annals of Tourism Research Empirical Insights*, Vol. 3, Issue 2, pp 1-11.
- Wrap. (2017) "Valuing our clothes: The cost of UK fashion", [online], Wrap, <https://wrap.org.uk/resources/report/valuing-our-clothes-cost-uk-fashion>.
- Yang, Y. et al. (2023) "Exploring users' content creation and information dissemination behavior in social media: The moderating effect of social presence", *Acta Psychologica*, Vol. 233, pp 1-10.
- Zaušková, A., Ščepková, S. and Kubovics, M. (2022) "Communication of Slovak Eco-innovation Companies with Social Media Users", *Proceedings of the 9th European Conference on Social Media*, Vol. 1, pp 219-227.
- Zaušková, A. and Ščepková, S. (2022) *Groundswell: The Cornerstone of Interactive Communication on Social Media*, Wolters Kluwer Hungary Kft., Budapest.

Navigating the New Product Development Process: A Case Study of a Startup's Journey from Ideation to Commercialization

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Abstract: New Product Development (NPD) is a critical yet challenging aspect of business development, with failure rates ranging from 40% to 80%. This challenge is particularly pronounced in startups, which form the backbone of most developed economies. Despite their importance, startups often struggle with NPD, with some studies suggesting a failure rate as high as 90%. This research paper contributes to the existing literature by examining the NPD journey of a technology startup, Plugable. Plugable, an Irish enterprise in the mobility sector, aims to create a platform similar to Airbnb for private Electrical Vehicle (EV) chargers. The paper traces the journey of two products the company attempted to launch. The first product did not reach the launch stage, leading the business to revise its strategy and develop Plugable. At the time of writing, Plugable is at the prototype stage, having secured €50,000 in external funding and won several national business awards. The case study provides several key learnings for entrepreneurs in the NPD space. It underscores the importance of accurately defining the problem statement, the critical role of validation, and the significance of assembling the right team to develop an effective go-to-market strategy. These findings contribute to the emerging body of knowledge on NPD within the startup context, providing practical insights into the application of established NPD models. Furthermore, the study offers valuable insights into technology startups' unique challenges during the NPD process.

Keywords New product development (NPD), Entrepreneurship, Technology startups, Design thinking, Stage gate process, Electric cars Ireland

1. Introduction

New Product Development (NPD) has long been recognized as one of the most challenging yet critical aspects of business development and success. This process typically involves a series of stages that require a range of skills, such as strategic planning, creative thinking, and effective execution (Holmstrom & Roberts, 1998). Despite the abundance of research papers and proposed models aimed at assisting entrepreneurs and businesses in managing the NPD process, (for example, Cooper, R. G., & Kleinschmidt, E. J. (2017), Montoya-Weiss, M. M., & Calantone, R. J. (1994)), there is a noticeable gap in the literature when it comes to the practical application of these models within the context of startups (Lüthje & Franke, 2004).

Startups face unique challenges when implementing an effective New Product Development (NPD) process. Indeed, an emerging area of research, studies widely recognize that startups encounter several distinct challenges in NPD. These include challenges in terms of limited resources, high risk and uncertainty, and the constant need for rapid adaptation to changing market conditions. For instance, Tung and Lin (2020) argue that in comparison to larger firms, startups have "limited resources and R&D scale" (p. 322), which ultimately hinders their innovation capacity and leads to high failure rates. The Failure rate among new products or services is reportedly in the region of 40%, as per the findings from Lee and Markham (2016). However, in the case of start-ups, research suggests that the failure rate among start-ups globally can be as high as 90%.

By way of adding to the current research, this paper aims to contribute to the existing body of research by presenting a snapshot of a single case study, tracing the journey of a new technology business as they navigate the New Product Development (NPD) process. The subject of this study is a new product, Plugable, which is working on creating an Airbnb for private EV chargers.

The primary objective of this study is to understand how a technology-based startup navigates the NPD process within the context of existing NPD literature. Within this aim, the paper seeks to address several specific research questions:

1. Review the literature to Assess the applicability of existing NPD models, such as design thinking, stage-gate, and agile approach, to startup situations.

2. Map and trace the NPD process adopted by the startup technology company, and glean insights from understanding this process, along with the challenges it presents.
3. Evaluate to what extent the various NPD processes proposed within the literature are appropriate in a real-life situation.

The findings of this study will contribute to the academic literature on NPD in technology startups, providing valuable insights to inform the practices of startups, policymakers, and other stakeholders involved in innovation and entrepreneurship in Ireland.

2. Literature review

2.1 Innovation, NPD and Entrepreneurship and Firm Success

The premise that innovation and new product development (NPD) is a key driver of economic growth and firm competitiveness was initially established by Schumpeter as far back 1934. In his work, "The Theory of Economic Development", published in 1934. Schumpeter introduced the concept of "creative destruction," in which he argued that entrepreneurship and the process of industrial mutation revolutionizes economic structures from within. In many respects, this theory has been foundational in explaining the role of innovation and new product development in driving economic growth and firm competitiveness.

Built on this foundation, other scholars such as Porter, M.E. and van der Linde, C., (1995), Foyolle (2007) and Saberi and Hamdan (2019) firmly placed the creation of new products and ideas as central to the creation of economic and social development. Indeed, the most recent Global Entrepreneurship Monitor Report (2022) argues that "starting and running new businesses is a vital process in any dynamic economy" and discusses how carefully crafted environmental standards can trigger innovation, allowing companies to improve their resource productivity.

In the NPD literature's context, scholars such as Romer (1990) and more recently Bricken et al (2014) put forward the economic and business case for NPD. In these study, successful NPD can lead to higher firm revenues (Bocken et al., 2014), increased market share (Spigel, 2017), and higher profits (Jacobides, Cennamo, & Gawer, 2018), thereby supporting job creation and economic growth (Doherty, Haugh, & Lyon, 2014).

2.2 A review of the NPD literature in the context of a start-up situation

A review of the existing literature, it is clear that the study of new product development (NPD) in the context of startups is both crucial and challenging for several reasons. Firstly, startups and new firm development are critical in modern economic and business ecosystems. In many developed and developing economies, small and medium-sized businesses form a significant portion of the economy, often accounting for 80-90% of businesses within the European Union (European Commission, 2020). As such, SMEs are often recognized at the forefront of innovation, frequently seen as the driving force behind introducing new products and ideas to markets (Audretsch, 2001) and in emerging economies like Sri Lanka, The SME sector is recognized as the largest business establishment sector which accelerates economic growth by managing unemployment, mitigating inequities of the income distribution and underpinning regional imbalance. (HMJCB Heenkenda, 2022).

Secondly, studies consistently show that the application of the NPD models proposed within the existing literature, in the context of startups, is problematic. Table 1 presents a brief overview of six of the main NPD models proposed within the literature. One of the main critiques of many of these models, suggests that for the most part, many of the early models were developed in the context of medium to large organizations. For example, in both its original and revised versions, the Stage-Gate model, often considered the industry standard, is a highly "structured, sequential approach to new product development, which typically encompasses a series of discrete stages" (Cooper, 2017). While alternative approaches such as Agile and Lean NPD have been proposed that prioritize flexibility and responsiveness, making them more suitable for startups. However, there may be challenges, in terms of intellectual property issues and the ability to manage relationships with external partners, which can be complex and time-consuming for start-ups (Chesbrough & Brunswicker, 2013).

The second concern centers on the application of these models given the lack of resources in a start-up situation, Croll and Yoskovitz (2013) for example, suggest that entrepreneurs in a start-up situation rarely have access to vital research reports and data on market potential to assess feasibility, critical to stage gate. Keir (2019) highlight the problems in accessing the necessary human and personnel resources, as such start-up are unable to adopt many of

the structures proposed by traditional NPD models (Giardino et al., 2017) and particularly in retaining and accessing high skilled employees needed (Mukul and Saini 2021). There is also the issue of accessing the necessary financial funding to successfully bring a new product or idea to market (Hendratmi, Ryandono and Sukmaningrum 2020). There is also the enduring problem of the high failure rates among NPD.

In summary, the existing discussion underscores the complexities and challenges of NPD in the context of startups. By way of bridging this gap, this case study aims to add to the existing literature by examining the process of NPD in a real-life application of NPD in a technology startup.

NPD Model	Description	Companies who used them	Year created	Reference
Stage-gate	A process model that describes the development process as a sequence of stages separated by decision points (gates).		Proposed by Robert G. Cooper in the 1980s.	Cooper (1988)
Agile	A flexible and interactive system of product development that emphasizes interaction, customer collaboration, and ability to respond to change.		Emergenced in the 1990s and formalized in the Agile Manifesto in 2001.	Highsmith and Cockburn (2001)
Lean NPD	An approach that focuses on eliminating waste in the product development process, improving speed and efficiency.		Originated from Lean Manufacturing principles, applied to NPD in the late 1990s.	Womack and Jones (1996)
Design Thinking	A human-centered approach to innovation that integrates the needs of people, the possibilities of technology, and the requirements for business success.			Brown (2008)
Open Innovation model	A paradigm that assumes that firms can and should use external ideas as well as internal ideas to advance their technology.		Proposed by Henry Chesbrough in 2003.	Chesbrough (2003)

3. Research Methodology

A qualitative case study approach involving in-depth interviews and journal logs was adopted for data collection for this study. A qualitative approach was deemed appropriate given the aim of this study which was to explore and understand how a start-up entrepreneur and business undertook and approached NPD. In this paper, a number of interviews with the founders and a review of journal logs were the primary sources of data collection, which was supplemented with non-participant observation of the company documentation and information from website and online platforms. However, the in-depth interviews formed the primary data collection method.

As noted by Kumar (2014) interviews are among the most flexible and widely used methods for gaining qualitative information in social science research. The justification for interviews is well-proven and is particularly useful for exploring a subject in considerable depth with selected participants (Zihmund et al 2013). As noted by Norton (2009) interviews give the researcher a first order perspective by allowing interviewees to provide their experiences, views and feelings. A such as noted by Kumar (2014), “interviewing is a commonly used method of collecting information” (p. 176). Over a series of several months, interviews were conducted to explore the decision-making process and the learning. In addition to interviews, journal logs were kept by the founders at key stages, and these were also used to provide a record of relevant events. Interviews were conducted both face-to-face and online.

3.1 About the business

Plugable is a technology startup in the mobility space based in Ireland. It started as a college project by Dundalk Institute of Technology and Queens University Belfast students. Currently in its prototype stage, the business has two founders who spent more than 12 months taking the business from an idea to the prototype stage. One of the

entrepreneurs was introduced to the concepts of NPD during his Master's course, which was put into practice during the journey of this business venture.

Plugable looks to create a community powered EV charging network by connecting private EV chargers into a peer-to-peer network. By doing this it aims to become the largest EV charger network that the world has seen.

3.2 IDEA #1: EV Switcher.com – a DESIGN THINKING APPROACH

Earlier models of NPD have increasingly emphasized the use of Design Thinking as a process for startups to successfully manage NPD. In discussing the NPD process with the founders of Plugable, they mentioned their first product launch, EV Switcher, and the process they adopted. One of the founders, an EV driver himself, was passionate about EV adoption and the global movement that was happening. He acknowledged that he empathized with this new segment of people switching to electric cars and was keen to contribute or play a pivotal role in the global rollout of electric mobility. He said, 'I was very aware of the challenges faced by potential EV adopters. The buying experience to the level of awareness was exceptionally low, and finding information was a broken process.' At the time of the idea's conception, the founder was a student at Dundalk Institute of Technology (DKIT) and having studied NPD and Innovation; he knew that he needed to see if this was a real problem and that Design Thinking and being user-centric was critical. Looking to identify the problem statement, he decided to speak with the end user - existing and potential EV drivers - to try and understand their circumstances and challenges to identify opportunities. He said, 'From one-to-one discussions, I joined the Irish EV owners' group on Facebook, spoke 1:1 to potential buyers in my social network and also spoke to new EV owners when hunkering down to charge in a public charger point' These initial discussions with the users clearly identified a problem. 'After having many interactions with EV users, I identified a problem around the way electric cars were sold in the market and the level of information and education a prospective EV buyer has available in the market'.

From this initial discussion, he decided to venture into space by offering a unique service to consumers considering buying an electric car. This service, an 'extended test drive service for electric cars' coupled with education about electric cars, was designed to fill a gap in the market. With a background in digital marketing, he took the plunge, bought a domain, and used a no-code platform to build a prototype, which he named 'EV Switcher'. After building the prototype, he decided to get the website up and running. However, upon consulting with industry experts, the founder realized that the concept was not viable due to insurance-related issues. "We build an incredibly good product, and automobile dealers were ready to bite the bullet, but the tricky question that kept hitting us with no possible solution was, who or how will we cover the insurance for this service? There were no solutions available, and insurance brokers weren't willing to even start a conversation to create a product for this activity. I realized how not bringing customers and industry at my early research stages was a mistake." quoted the founder. Key learnings from this stage were the importance of bringing customer and industry validation at the initial stages of NPD.

3.3 IDEA #2: Plugable: Stage-gate approach

Around May 2022, the founder realized that the business model had viability issues around securing an adequate legal framework. The team concluded that while the problem was "essential and sizeable, it could not be solved now". So, the team moved on to another problem within the space - the lack of EV charging infrastructure. "With EV Switcher, we only got the customer and industry involved towards the last stage, which was a mistake. If we are going to spend time and resources in building something, we need to get the business validated by people who are going to pay for the service.", the founder quoted.

The first step was identifying the problem statement. The team recognized that this problem was too wide and deep to solve, so the team decided to narrow it down to the problem of not having access to a home charger, which incidentally was a problem faced by the founder himself. "As someone living in a rented house, I did not have access to a home charger which meant he had to use a granny charger which would take 1-2 days to charge an electric car Vs 4-10 hours using a home charger".

3.4 Customer engagement and understanding the market

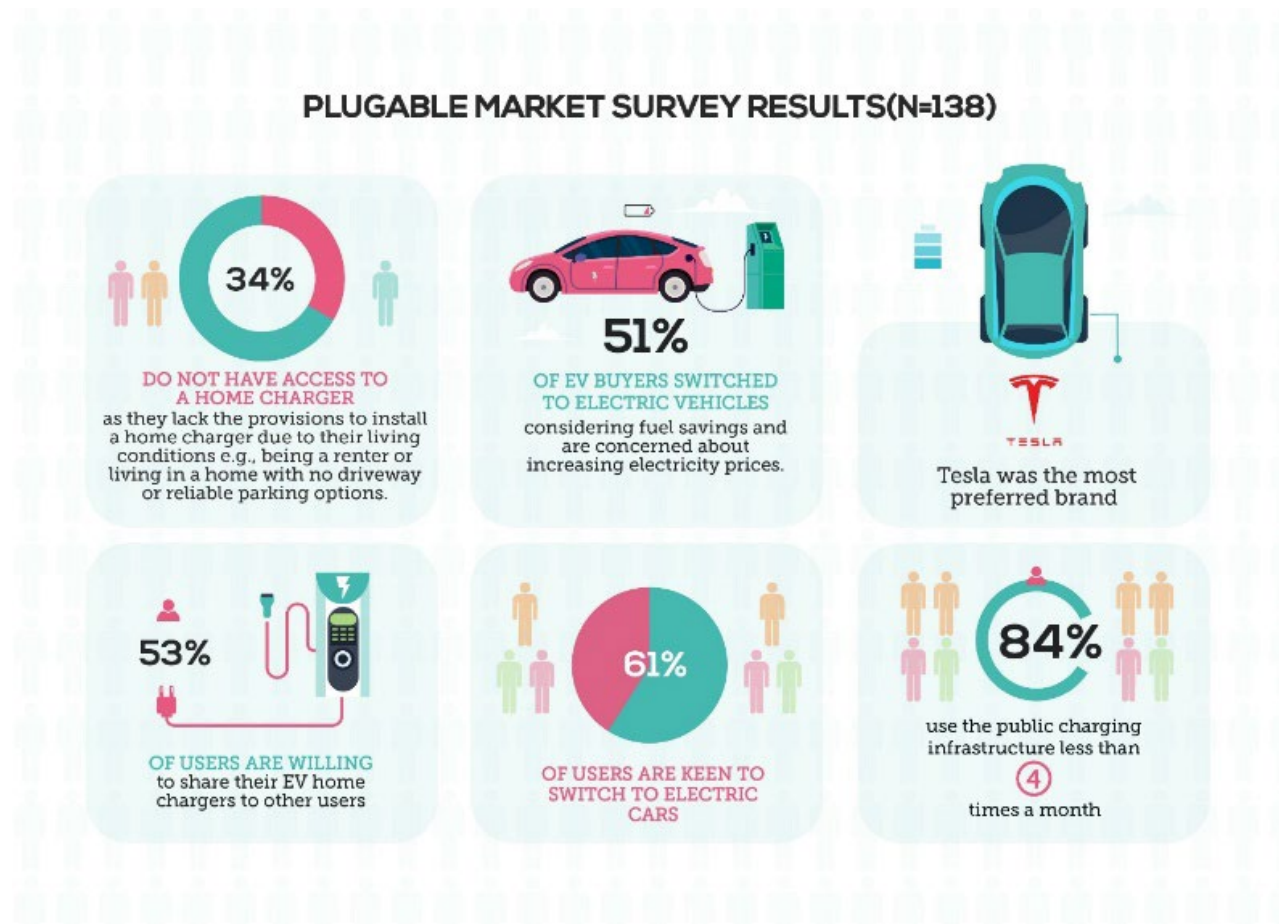
At early stage, the founder engaged with customers and market experts by testing the concept's viability. Number of stages in customer and stakeholder engagement process. He went on to interview other EV users who had similar problems. The first set of research showed that this problem called for an urgency and was a sizeable problem, but this time the founder decided to validate the opportunity as much as possible before getting into prototyping. At

first, he conducted 1:1 interview with EV users and spoke to industry members key agencies that regulate and monitor the sector including Zero emissions vehicles Ireland (ZEVl), the Sustainable energy authority of Ireland (SEAI), and EV owners' associations in Ireland and Northern Ireland. Everyone gave constructive feedback and supported to the idea, "This gave me the confidence to apply for grants and business plan competitions further to validate the viability and commercial potential of the idea. I applied for the feasibility grant from the Local enterprise office in Louth. While we had high expectations, we got rejected the first time but went back the following month with answers to their questions and finally landed our first grant". Realizing that "The idea started to grow hands and legs". At this stage, a second member soon joined as a co-founder.

After winning the first grant from Local enterprise, the team had started working on building a prototype or a minimal viable product (MVP) and hoping to get live by late August.

The duo team went on to win Queens University Dragons Den competition, New Frontiers @ Dkit by Enterprise Ireland, Student Entrepreneur awards, FIA startup competition, and Invent 23 by Catalyst. The team also conducted a survey(n=138) (table 2.0), sent this survey out on Facebook groups, and LinkedIn users, wherein 35% of new EV owners were found to not have access to a home charger and 51% of the existing EV owners were willing to share or rent their home chargers to others. So, by this stage, the team had done early market research, had a first-level business plan ready and secured money for funding the concept via grants that helped the team raise €50,000 towards building a Minimal viable product (MVP). The team has set a target of raising €100,000 via grants and government funding alone which will help them launch the MVP, acquire initial customers and validate the business idea before scaling it up to whole of EU.

Table 2.0: Plugable survey



4. Key learnings



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5. Interpretation of Findings in the context of existing literature

The case study findings provide valuable insights into the New Product Development (NPD) process in the context of a technology startup.

5.1 Iterative Nature of NPD

The iterative nature of the NPD process, as demonstrated in the case study, aligns with the principles of Design Thinking (Brown, 2008). This is consistent with the broader literature on entrepreneurship, which emphasizes the importance of flexibility, experimentation, and learning from failures (Zahra & Wright, 2016).

The initial idea, EVSwitcher.com, was prototyped but later found non-viable after market research. This led the team to pivot to a new solution, Plugable, which was validated through market research before progressing to the prototyping stage. "The secret is one of a fail fast approach; there is no value in having an idea. It all comes down to execution and the only way to get there is by constantly iterating your idea.", said the founder in this context. This iterative process, where ideas are tested, refined, or discarded based on market research and feedback, aligns with the principles of Design Thinking (Brown, 2008).

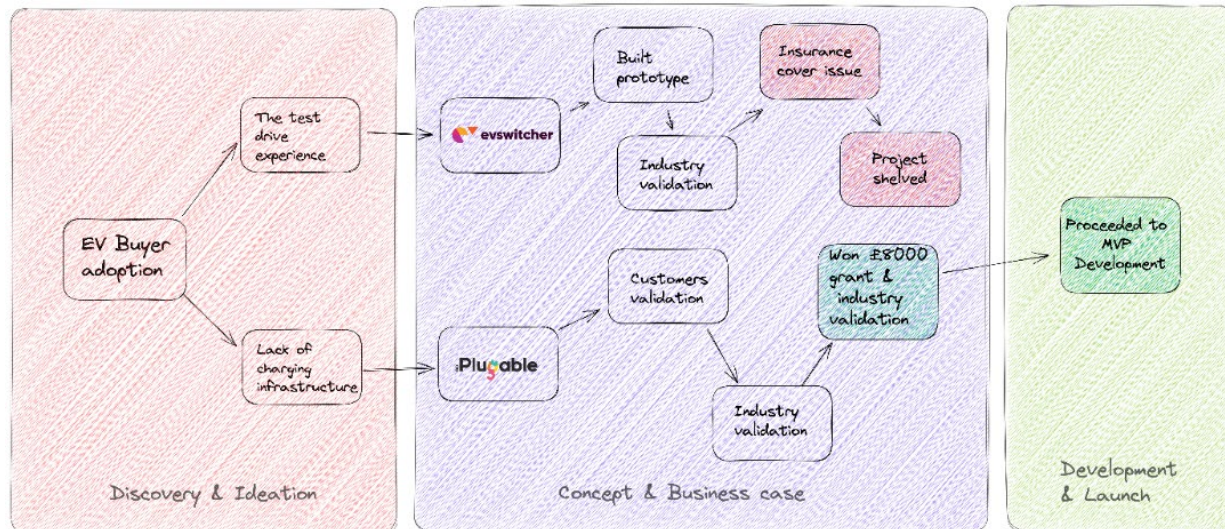
5.2 Importance of Market Research and User Feedback

The importance of market research and user feedback in the NPD process is a well-established theme in the literature on both Design Thinking and the Stage-Gate model (Cooper, 1990). This research provides further empirical evidence of the value of these practices in the context of a technology startup.

"The first thing we did was to validate the idea with customers and industry. From 1-to-1 interviews to mass surveys to winning business plan competitions, we bought in the customer inputs at the initial stages of NPD", quoted the founder. The survey findings further validate the importance of market research and user feedback in the NPD process. The fact that a considerable proportion of respondents did not have access to an EV home charger and were

willing to share access to their home chargers supports the market need for a solution like Plugable. This demonstrates the value of market research in validating product ideas and ensuring they meet user needs, as emphasized in both Design Thinking and the Stage-Gate model (Cooper, 1990).

5.3 Hybrid Approach to NPD



Hybrid NPD Process: Design thinking+ Stage gate

The effectiveness of a hybrid approach to NPD, combining elements of Design Thinking and the Stage-Gate model, contributes to the emerging literature on hybrid NPD approaches. While the existing literature has begun to explore the potential benefits of such approaches (Zahra & Wright, 2016), this research provides a concrete example of how a hybrid approach can be implemented in practice. Various models have been proposed throughout the literature to guide businesses through the New Product Development (NPD) process. These models are often presented as standalone solutions. However, evidence from this case study suggests that a more practical approach for startups might be to combine elements from several models.

The findings from the case study indicate that a hybrid approach to NPD, integrating elements of Design Thinking and the Stage-Gate model, can be practical within the context of a technology startup. This suggests that flexibility and adaptability in applying established NPD models may be crucial for startups navigating the complex and dynamic process of new product development.

In conclusion, the findings from this research provide valuable insights into the NPD process in the context of a technology startup. They highlight the importance of an iterative approach, market research, user feedback, and a hybrid NPD approach. These insights can inform future research and practice in entrepreneurship and NPD.

6. Limitations

While this research provides valuable insights into the New Product Development (NPD) process in the context of a technology startup, it is essential to acknowledge its limitations.

Single Case Study: The research is based on a single case study of one start-up entrepreneur's journey in the EV market in Ireland. While this provides a detailed and in-depth view of the NPD process in this context, the findings may need to be more generalizable to other contexts or industries. Further research involving multiple case studies across different industries and geographical locations would be beneficial to validate and extend the findings.

Self-Reported Data: The case study findings are based on the entrepreneur's self-reported experiences and perceptions. While this provides a unique and personal perspective on the NPD process, it may also introduce biases or subjectivity to the findings. Future research could incorporate multiple perspectives, such as those of team members, investors, or customers, to provide a more comprehensive view of the NPD process.

Survey Limitations: The survey findings are based on a relatively small sample of 137 respondents from the Republic of Ireland and Northern Ireland. While the survey provides valuable insights into the potential market for the Plugable service, the findings may represent something other than the broader population of EV users or potential users. Additionally, the survey relied on self-reported data, which may be subject to response biases.

Hybrid NPD Approach: The research explores a hybrid approach to NPD, combining elements of Design Thinking and the Stage-Gate model. While the findings suggest that this approach was effective in this context, further research is needed to understand the conditions under which such a hybrid approach is most beneficial and how it can be best implemented in practice.

7. Conclusion

This research explored the New Product Development (NPD) process in the context of a technology startup, focusing on the journey of Plugable, a technology startup based in Ireland from ideation to product launch. The findings provide valuable insights into the iterative and dynamic nature of the NPD process, highlighting the importance of flexibility, market research, and user feedback.

The case study demonstrated how an initial idea was tested, refined, and ultimately discarded based on market research, leading to the development of a new solution. This iterative process aligns with the principles of Design Thinking, emphasizing the importance of empathy, experimentation, and learning from failures.

The survey findings further validated the approach to developing the new solution, Plugable, demonstrating a clear market need and potential user acceptance of the proposed service. This underscores the value of market research and user feedback in the NPD process, as emphasized in both Design Thinking and the Stage-Gate model.

The hybrid approach to NPD, combining elements of Design Thinking and the Stage-Gate model, can be effective in the context of a technology startup. This contributes to the emerging literature on hybrid NPD approaches, suggesting that such approaches may offer a promising way forward for entrepreneurs and startups.

While the research has limitations, including the reliance on a single case study and self-reported data, it contributes valuable insights to the current understanding of the NPD process in the context of a technology startup. It provides a foundation for future research, with potential implications for entrepreneurs, researchers, and policymakers.

In conclusion, the journey of Plugable and its team in navigating the NPD process from ideation to product launch underscores the complexities and challenges involved in entrepreneurship. It highlights the importance of a clear problem statement, thorough market research, and an effective NPD process in the successful development and launch of a new product. It also emphasizes the potential benefits of a hybrid approach to NPD, combining the flexibility and user-centered focus of Design Thinking with the structured, stage-based approach of the Stage-Gate model.

Appendix

Exhibit A



Exhibit B

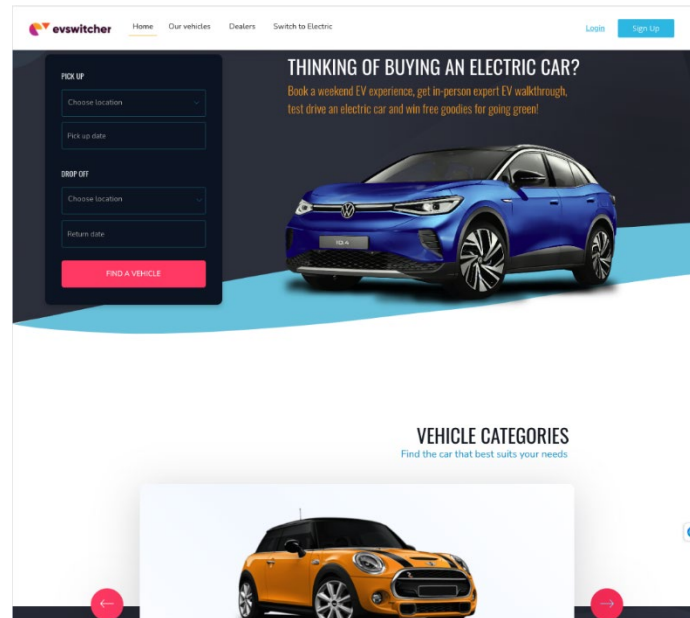


Exhibit c

V1



Reference

- Rodriguez-Sanchez, I., Williams, A. F., & Brotons, M. (2019). The innovation journey of new-to-tourism entrepreneurs. Retrieved from <https://doi.org/10.1080/13683500.2017.1334763>
- Holmstrom, B., & Roberts, J. D. (1998). The Boundaries of the Firm Revisited. Retrieved from <https://doi.org/10.1257/jep.12.4.73>
- Lüthje, C., & Franke, N. (2004). Entrepreneurial Intentions of Business Students — A Benchmarking Study. Retrieved from <https://doi.org/10.1142/s0219877004000209>
- Stam, E., & Wennberg, K. (2009). The role of R&D in new firm growth. Retrieved from <https://doi.org/10.1007/s11187-009-9183-9>
- Brem, A., & Wolfram, P. (2014). Research and development from the bottom up - introduction of terminologies for new product development in emerging markets. Journal of Innovation and Entrepreneurship, 3(1), 9. <https://doi.org/10.1186/2192-5372-3-9>
- Cefis, E., & Marsili, O. (2015). Crossing the innovation threshold through mergers and acquisitions. Research Policy, 44(3), 698-710. <https://doi.org/10.1016/j.respol.2014.10.011>

- Chesbrough, H. (2003). *Open Innovation: The New Imperative for Creating and Profiting from Technology*. Harvard Business School Press.
- Cooper, R. G. (2011). *Winning at New Products: Creating Value Through Innovation*. Basic Books.
- Cooper, R. G. (2017). Agile–Stage–Gate Hybrids. *Research-Technology Management*, 60(1), 21-29.
<https://doi.org/10.1080/08956308.2017.1255056>
- Cooper, R. G. (2019). The drivers of success in new-product development. *Industrial Marketing Management*, 76, 36-47.
<https://doi.org/10.1016/j.indmarman.2018.07.011>
- Cunningham, J. A., Menter, M., & Young, C. (2016). A review of qualitative case methods trends and themes used in technology transfer research. *The Journal of Technology Transfer*, 42(4), 923-956. <https://doi.org/10.1007/s10961-016-9481-7>
- Davila, A., Foster, G., & Jia, N. (2019). *The Art of Startup Fundraising*. John Wiley & Sons.
- Fuentes-Moraleda, L., González-Rodríguez, M. R., & Muñoz-Mazón, A. (2020). Innovation and entrepreneurship in the academic setting: a systematic literature review. *International Entrepreneurship and Management Journal*, 16(1), 343-378.
<https://doi.org/10.1007/s11365-018-0528-4>
- Gundgaard, G., & Ritter, T. (2013). The Innovation Value Chain. In: Dodgson, M., Gann, D. M., & Phillips, N. (eds) *The Oxford Handbook of Innovation Management*. Oxford University Press.
<https://doi.org/10.1093/oxfordhb/9780199694945.013.0002>
- Holmstrom, B., & Roberts, J. D. (1998). The Boundaries of the Firm Revisited. *The Journal of Economic Perspectives*, 12(4), 73-94. <https://doi.org/10.1257/jep.12.4.73>
- Lüthje, C., & Franke, N. (2004). Entrepreneurial Intentions of Business Students — A Benchmarking Study. *International Journal of Innovation and Technology Management*, 01(03), 269-288. <https://doi.org/10.1142/s0219877004000209>
- OECD (2010). *The OECD Innovation Strategy: Getting a Head Start Tomorrow*. OECD Publishing.
<https://doi.org/10.1787/9789264083479-en>
- Ries, E. (2011). *The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses*. Crown Business.
- Schumpeter, J. A. (1934). *The Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest, and the Business Cycle*. Harvard University Press.
- Stam, E., & Wennberg, K. (2009). The roles of R&D in new firm growth. *Small Business Economics*, 33(1), 77-89.
<https://doi.org/10.1007/s11187-009-9183-9>
- Statt, N. (2017). Juicero, maker of the doomed \$400 internet-connected juicer, is shutting down. *The Verge*. Retrieved from <https://www.theverge.com/2017/9/1/16243356/juicero-shutting-down-layoffs-refunds>
- Sutherland, J. (2015). Quirky files for bankruptcy and plans to sell off its Wink smart home platform. *The Verge*. Retrieved from <https://www.theverge.com/2015/9/22/9372689/quirky-bankruptcy-wink-smart-home-platform-sale>
- Davidsson, P., & McKelvie, A. (2009). From Resource Base to Dynamic Capabilities: An Investigation of New Firms. *British Journal of Management*, 20, S63-S80. DOI: [10.1111/j.1467-8551.2008.00613.x](https://doi.org/10.1111/j.1467-8551.2008.00613.x)
- Fowler, F. J. (2013). *Survey Research Methods*. Sage Publications.
- Laursen, K., & Salter, A. (2014). The paradox of openness: Appropriability, external search and collaboration. *Research Policy*, 43(5), 867-878. DOI: [10.1016/j.respol.2013.10.004](https://doi.org/10.1016/j.respol.2013.10.004)
- Lüthje, C., & Franke, N. (2004). Entrepreneurial Intentions of Business Students — A Benchmarking Study. *International Journal of Innovation and Technology Management*, 01(03), 269-288. DOI: [10.1142/s0219877004000209](https://doi.org/10.1142/s0219877004000209)
- Yin, R. K. (2014). *Case Study Research: Design and Methods*. Sage Publications.
- Brown, T. (2008). Design thinking. *Harvard Business Review*, 86(6), 84-92.
- Cooper, R. G. (1990). Stage-gate systems: A new tool for managing new products. *Business Horizons*, 33(3), 44-54.
- Zahra, S. A., & Wright, M. (2016). Understanding the social role of entrepreneurship. *Journal of Management Studies*.
- Schumpeter, J. (1934). *The theory of economic development: An inquiry into profits, capital, credit, interest, and the business cycle*. Harvard University Press.
- Romer, P. M. (1990). *Endogenous Technological Change*. Link
- Knight, G., & Cavusgil, S. T. (2004). Innovation, organizational capabilities, and the born-global firm. *Journal of International Business Studies*.
- Holmstrom, J., & Roberts, J. (1998). Creating and implementing winning strategies in the construction industry. *Construction Management and Economics*, 16(6), 737-748.
- Lüthje, C., & Franke, N. (2004). Entrepreneurial intentions of business students: A benchmarking study. *International Journal of Innovation and Technology Management*, 1(03), 269-288.
- Gonthier, J., & Chirita, G. (2019). The role of corporate incubators as invigorators of innovation capabilities in parent companies. *Journal of Innovation and Entrepreneurship*. [Link](https://doi.org/10.1007/s11187-019-00000-0)
- Cooper, R. G. (2019). The drivers of success in new-product development. *Industrial Marketing Management*.
- Cefis, E., & Marsili, O. (2015). Crossing the innovation threshold through mergers and acquisitions. *Research Policy*, 44(3), 698-710.
- Cunningham, J. A., Menter, M., & Young, C. (2016). A review of qualitative case methods trends and themes used in technology transfer research. *The Journal of Technology Transfer*, 42(4), 923-956.

- Song, X. M., & Parry, M. E. (1997). A cross-national comparative study of new product development processes: Japan and the United States. *Journal of Marketing*, 61(2), 1-18.
- Nightingale, P., & Coad, A. (2014). Muppets and gazelles: political and methodological biases in entrepreneurship research. *Industrial and Corporate Change*, 23(1), 113-143.
- Acs, Z. J., Desai, S., & Hessels, J. (2008). Entrepreneurship, economic development and institutions. *Small business economics*, 31(3), 219-234.
- Audretsch, D. B. (2001). The role of small firms in U.S. biotechnology clusters. *Small Business Economics*, 17(1-2), 3-15.
- European Commission. (2020). Annual report on European SMEs 2019/2020: SMEs as main drivers of digital transformation. Publications Office of the European Union.
- Giardino, C., Wang, X., & Abrahamsson, P. (2017). Why Early-Stage Software Startups Fail: A Behavioral Framework. In *International Conference on Agile Software Development* (p. 27-41). Springer, Cham.
- Statt, N. (2017). Juicero, maker of the doomed \$400 internet-connected juicer, is shutting down. *The Verge*.
- Sutherland, M. (2015). Quirky files for bankruptcy and plans to sell off its Wink smart home platform. *The Verge*.

Industry 4.0 and Technological Evolution in CNC Machines

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Abstract: This work, entirely based on a documental research strategy, consists of an analysis of the technological evolution of the machining processes with Computer Numerical Control machines regarding the new concept of Industry 4.0. This concept involves integration of cyber-physical systems with the manufacturing processes, the use of the Internet of Things in industrial processes and the development of complex virtual systems. An attempt was made to understand how current processes can be adapted or changed to the concept under study when analyzing the evolution of machining tools for CNC machines. A thorough study was done to adopt the distinguishing features of the Industry 4.0 concept, applying it to machining processes in CNC machines. The use of virtual technology in machining tools is still a subject in development, and it was one of the main focus of this work. The main factors that can influence directly or indirectly the production processes of a factory with CNC machines were analyzed. The types of machining processes for CNC machines and the types of machining tools developed with virtual technology possibilities were studied and explored. Following the analysis, suggestions for future applications and for improvements in production structures are proposed.

Keywords: CNC tools; computer numerical control; computer aided manufacturing; cyber-physical systems; internet of things; virtual technology; industry 4.0

1. Introduction

The work related to this research consisted of an analysis of the technological evolution of the machining processes with CNC (Computer Numerical Control) machines regarding the new concept of Industry 4.0. The concept fits into the current transformation process for the so-called fourth industrial revolution, which involves the integration of cyber-physical systems (CPS) with the manufacturing processes and the use of the Internet of Things (IoT) in industrial processes, among other characteristics (Kagermann et al, 2013). The main objectives of this work were:

1. To adopt the distinguishing features of Industry 4.0 by applying it to the machining processes in CNC Machines.
2. To study the issues related to the technological evolution of the tools used in CNC machines with virtual technology.
3. To study and analyse the integration factors for production systems that include a CAM (Computer Aided Manufacturing) software, a tool with virtual technology and a CNC machine.
4. To develop proposals for future applications and enhancements on the studied topics.

In order to carry out this project, a detailed analysis of numerous primary, secondary and tertiary literary sources was carried out in relation to the proposed topic of Industry 4.0 and to the principles it approaches, correlating it with the machining processes in CNC machines and with production tools with virtual technology possibilities, which are currently under development. All the relevant information was synthesised so that it was possible to develop a complete and detailed knowledge and understanding regarding the proposed research.

Simultaneously and in parallel, and in order to reach the first objective of this work, a thorough study was done in an attempt to adopt the features of Industry 4.0 by applying them to the machining processes in CNC Machines. With the knowledge acquired, a framework was established relating the features of Industry 4.0 and the machining processes, in order to present suggestions for an improved operational condition for machining processes with CNC machines.

One of the main factors that influences the development of machining processes in CNC machines are the tools used in CNC machining processes for the production of parts, components or similar artefacts (Fountas et al, 2016). Therefore, for the development of the second objective, it was necessary a thorough study of the issues related to the technological evolution of the tools used in CNC machines with virtual technology. The use of virtual technology possibilities in machining tools is still a subject in development (Chen et al, 2015). It was analysed the main factors that can influence directly or indirectly the production processes of a factory with CNC machines (Shneor, 2018).

When virtual technology is considered, the need for software is inevitably addressed. In CNC machining operations, a CAM software performs machining simulations for CNC machines. Often, it is made in a not very efficient way, because there is a considerable need for the programmer's knowledge, because it depends on the

type of CNC machine, on the tools that are used, on the kind of workpiece material and on production data (cutting speed, RPM, cutting feed, etc.)(Liu et al, 2007). The programmer transmits all this information to the software. If there is any incorrect information, or if it is not according to the type of material, or if there is non-ideal machining data, there will be a direct impact on the execution of the machining process. The third objective of this work is related to this situation. As such, it was studied and analysed the information flows of a production system that includes a CAM software, a tool with virtual technology possibilities and a CNC machine. The aim was to verify how this set can jointly work, and what changes are necessary to improve this production process, so that the communication system can work more efficiently without being so dependent on the need of the programmer's knowledge. That objective was integrated with the concept of Industry 4.0 to achieve the main objective, as mentioned above. In the sequence of this work, a framework for an improved production model will be proposed, which involves an alternative architecture for the structure of the model. It will also provide the basis for better understanding the possibilities for application in the future, having in mind the concept of Industry 4.0 (Deng et al, 2018). The last objective of this work is to propose future applications concerning the mentioned topics.

2. Methodology

The methodology used during the development of this work was based on a documental research strategy. The bibliographic research was based in scientific publications and on searches made on several databases, including SCOPUS, Web of Science and Science Direct. The search strings were related to the machining area, and included machining processes, CNC machines, CAM and CAD software, machine tools, Industry 4.0, cyber-physical technology, Internet of Things, smart factory, social networks. The criteria for article selection was based on the direct relevance to the main research object of the study, which was CNC machines, CNC machine tools and industry 4.0 concept. The methodology of this work also has been based on one of the author's experience of programming and operation of CNC machines with machining processes engineering, and from data derived from direct observation and experimentation with these production processes.

3. Exploring the literature and articulating new possibilities

3.1 The Concept of Industry 4.0

The definition of the term Industry 4.0 was first presented in 2011 in an edition of the Hannover Fair as a project in the High-Tech Strategy of German Industry (Hermann et al, 2015). Shortly thereafter, in the year 2013, the German working group presented a report about Industry 4.0 (Hermann et al, 2015). The report defined the environment for Industry 4.0, which included a strong customization of the products obtained with high flexibility of mass production, presenting an introduction of systems with own organization (own automation, own configuration, own diagnosis, etc.) to obtain an adequate connection between the real world (people and machines) and the virtual world (Devezas et al, 2017). This new approach to industrial processes is centered on the intensive use of advanced Information and Communication Technology (ICT) resources in order to ensure greater flexibility in production systems and processes, as a consequence of the increasing complexity of products and supply chains (Faller et al, 2015). The concept has been caught up by many stakeholders and currently many agents around the world are initiating projects and programs to ensure competitive enhancement through adaptation to digital transformation (Kagermann et al, 2013).

The main purpose of Industry 4.0, enabled by the convergence and integration of existing, emergent and new technologies, is the creation of smart factories. These are capable of managing process complexity, operate with less disruption, and more efficiently. The interaction between humans, machines and resources resembles a social network (Kagermann et al, 2013). In these installations, cyber-physical systems monitor physical plant processes and make decentralized decisions. Physical systems are converted into objects of the Internet of things, communicating and collaborating with each other and with humans in real time through wired and wireless networks connected to the Web (Marr, 2016).

3.2 CNC tools with CPS capabilities and CNC machines

A new tool with cyber-physical technology potential has emerged in the CNC machining area. The technology is a combination of sensors, algorithms, the cloud, data analysis, and connectivity with Internet of Things (Sandvik-Coromant, 2018). The traditional tools do not have the capacity to collect and transmit in real time operational information during the process execution. The new tool raises up the opportunity to analyze the implications for future production when used on CNC machines, and in this research it will be used as a way to do that. Digitalization of manufacturing opens new opportunities to improve productivity and effectiveness (Botkina et al, 2018)

This new tool provides cyber-physical technological potential. Cyber-physical systems correspond to the physical and the virtual systems integrated in a network that brings together physical resources and processes (Gorecky et al, 2014). In these networks, multiple information circulates from different sources, which is monitored and synchronized between the factory and the cyberspace (Lee et al, 2015). The tool with CPS potential has two main dimensions or implications, one regarding the CPS and the other IoT, both related to the concept of Industry 4.0.

3.3 Cyber-Physical Systems and CNC Tools

The emerging concept\approach of cyber-physical systems focus on the integration of computational applications with physical devices and it is designed as a network of interactive physical and cybernetic elements (Leitão et al, 2016) The CPS controls and monitors real-world physical infrastructures and have a high impact on industrial automation.

On CNC machine tools, the manufacturing resources are the parts of the physical system which are required in order to perform machining tasks. Manufacturing resources are the tools and materials, such as cutting tools, machine tools, fixture and parts, and also the machining environment, like vibration and temperature. The CNC machine tool makes a specific work task with given manufacturing resources. Through the operation status data, the resulting work, quality and productivity of the CNC machine can be expressed by the characteristic parameters in the work process (Sandvik-Coromant, 2018).

The CPS model of a CNC machine tool work process includes a model input, which consists of two parts, the work task and the manufacturing resources, while the output is the corresponding operation status data when the machine tool performs a task (Chen et al, 2015). The CPS model of a CNC machine tool work process can be defined in association with the work task, manufacturing resources and operation in the cyber system in parallel with the physical system.

In CNC tools, the cyber-physical system works by taking the application data through connected software and hardware, with sensor-equipped tools that are adjusted to control and monitor machining performance in real time (Villalba-Diez et al, 2021). The CNC machine is controlled via accurate on-site data dashboards, through the cloud and via integration with the user's software and machine environment. The tool with CPS potential connects into existing software, offering two-way connectivity and accurate data quality. In these networks, multiple information circulates from different sources that is monitored and synchronized between the factory and cyber space (Lee et al, 2015)

The information captured by the tool is informed to the CNC machine and manager\operator through CPS connected software and hardware, where the data could be managed and monitored to get a better precision and quality on production in real time. The tool gives the information in real time execution, and if some problem happens, the tool can detect it and a reliable solution can help avoid or minimize machine tool and workpiece damage. The operator can monitor the machining process in real-time and interact with the machine tool when the tool detects, e.g., overload forces. These can help the operator on time execution, where other actions are programmed if some problem occurs.

3.4 Internet of Things and CNC Tools

The Internet of Things is an extension of the current Internet, which provides to the objects the possibility to connect to the Internet, but with computing and communication capabilities (Jang et al, 2018). CNC tools connected via Internet of Things can monitor the machining performance and make decisions about how to optimize the processes based on accurate information. Cloud-based analytics and local systems enable the use of all the data collected on machining operations.

The design of cyber-physical systems and the implementation of their applications need to rely on IoT enabled architecture and protocols, to be able to manage and process large datasets, and to support complex processes to manage and control those systems at different scales. The large-scale nature of IoT based CPS can be effectively and efficiently supported by cloud computing infrastructures and platforms, which can provide flexible computing power, resource virtualization and high-capacity storage for data flows and ensure security, protection and privacy. The IoT is a key domain in which data streams are generated, and the volume of this data is expected to increase (Jang et al, 2018).

The Internet of Things is responsible for sensing the physical world, and for networked and interconnected objects that are exclusively addressable, like the sensors on a CNC tool. So, they take the information flow of the abstraction process through sensors and transfer it to the Internet with world connectivity, where it is transferred to the cloud computing infrastructures and platforms, which can provide flexible computing power, resource virtualization and high-capacity storage for data flows and ensure security, protection and privacy.

3.5 Communication between CAM software, tools with cyber physical capabilities and CNC machines

New tools with cyber physical systems potential in CNC machining raise the opportunity to know how it could work integrated with a CAM software and a CNC machine (Moor et al, 2021). The main aim of this chapter is to study how a CAM software works in communication between a tool with CPS capabilities and a CNC machine.

The introduction of computer graphics allows the creation of virtual workpieces on the computer, and to handle and study them. The universal application of computer aided systems brings substantial benefits to the manufacturing area. CAM involves a software associated with functions in manufacturing engineering, process planning and CNC programming (Dubovska et al, 2014).

We could say that for most of the steps from the manufacturing model (CAM) to the CNC program creation, the work is being executed in the cyber world. There is the possibility that the CAM software does the simulation in the cyber world and then, if the process has no problems there, it could be executed in the real world, following two procedures: first, the simulation on CAM is done, and then it follows the process execution on the CNC machine. The two procedures are not simultaneous.

With CNC tools with CPS, complemented with software packages, it will be pertinent to know what the implications of this procedure and what changes could be done on CAM. In the case of the tool developed by Sandvik Coromant (2018), which is mentioned in this work as a mean to explore the concepts mentioned before, the tool with CPS potential provides a Toolguide software that communicates with CAM software, and there is a facility to choose the ideal tool and parameters to do the simulation on CAM before going to the machine. This facility uses an open API (Application Programming Interface) and the possibility to connect with the tool library and tool management systems on CAM. While programming on CAM, the programmer does not create a tool to execute the simulation on software, because it is already provided by the Toolguide. So, the communication between the CAM software, the CNC machine and the software of the CNC tool are still not working in an integrated way and on real time when machining the physical workpiece. It nevertheless contributes to decrease the time on process simulation on CAM software, giving the information about the process executed from the data and suggesting parameters to use in certain materials. The information executed in real time could then be transferred to the software for future applications on CAM simulation. As the data could be saved on the Cloud during the process execution, the software with API connected with CAM could help the programmer when he is programming, facilitating with information about what is the ideal tool to be used in the process and the right parameters that could be used for specific materials.

3.6 Integrated production involving tools with CPS capabilities, CNC machines and CAM software within the concept of Industry 4.0

This section aims to show how a tool with CPS and the CNC machines communicating with CAM could work integrated through a communication architecture. The technology combination of CNC tool with CPS capabilities, CNC machine and CAM software helps to transform the actual production processes on Industry 4.0 environment through the IoT and CPS, the interface of the physical world and cyber world (Trstenjak et al, 2017).

This combination of the technology with a CNC tool with CPS capabilities, CNC machine and CAM software, could transform the actual production processes on Industry 4.0 environment. With the CNC tool there is the capacity to transfer the information in real-time to the cyber world, and the process, the human and the machine could have a virtual and real interaction, helping to increase the productivity and reduce the waste time (Siddharta et al, 2021).

The main purpose of Industry 4.0 is the creation of the so-called smart factory, which is capable of managing process complexity, operate with less disruption, and more efficiently, through the interaction between humans, machines and resources, resembling a social network (Kagermann et al, 2013). The smart factory environment consists of a new integrative real-time intercommunication between every manufacturing resource that could help increase the manufacturing efficiency (Pereira et al, 2017). The smart factory environment of the Industry 4.0 concept, the CNC machine and CAM software, and the sensors and software combination provided by the CNC tool with CPS potential allow an intercommunication between the real world and the cyber world, giving the information to the operator\manager about what is happening in real time manufacturing. Thereby, this change could improve the traditional manufacturing process, upscaling to a smart manufacturing process the machining area. The main adaptations\transformations are:

1. CNC tool with CPS capability gives the information on process execution in real-time: On traditional processes execution using the traditional CNC tools, there is no capacity to give information about what is going on during the machining execution (cutting temperature, roughness, vibration, etc.). A CNC tool

with CPS enables the capacity to transfer this information and transmit it to the software through the sensors, and the operator\manager has the possibility to verify the crucial points to manage or alter if necessary. Thereby, it creates an Industry 4.0 cyber virtual and real interaction (Villalba-Diez et al, 2021).

2. CNC tool with CPS capability gives the information about CNC machine: Similarly, to the previous point, in the traditional process execution using the traditional CNC tools, there is no capacity to give information about machine health. Although other ancillary technologies may provide this information, they will not do it through the CNC tool. The CNC tool with CPS capability creates the ability to transfer the information about the machine health, enabling the detection of some problem during the process execution on CNC machines, and triggering alterations or maintenance. This is another aspect of the concept of Industry 4.0, where multiple information from different sources that are monitored and synchronized between the factory and cyberspace (Lee et al, 2015; Ahmad et al, 2020).
3. Human interaction on the process in real-time: In the traditional process execution on CNC machine: There is no human interaction when the machine is working during the machining process. If some problem occurs on the machine or in the tool during the process execution, the implementation of a CNC tool with CPS potential enables the possibility for the software to give information to the operator and machine about what it is happening in real-time and changes to correct the problem can be made.
4. Cutting tool information saved on a cloud: In traditional mechanical CNC tools, there is no capacity to save the cutting information on the cloud. By using the CNC tool with CPS capability during the process execution, it is possible to save the information on the cloud in real-time, and there is the possibility to save the actual information of the process and to use it later in future production processes with similar characteristics. Intelligent processing will support IoT applications by collecting data from databases and Network service providers can process a large volume of messages instantly through cloud computing.
5. CAM Software supported by CNC tool software on virtual world: The software from the tool with CPS capability could be connected to the CAM with the API (Application Programming Interface), giving the possibility to use the virtual library of tools with CPS on virtual process execution for simulation. All information filed by the operator on CAM is transferred to the program when generated on a post-processor. The interaction between systems based on high-performance software and dedicated user interfaces, integrated with digital networks, create a new universe of functionalities for systems on Industry 4.0 (Longo et al, 2017).

4. Proposals for future process applications

4.1 Real time measurement

As it follows from the topics that were addressed in this study, CNC machines are working centred on a three-dimensional space (X, Y and Z axes)(de Souza et al, 2020). The feed movement is realized by individual or simultaneous axes movement (Bosetti et al, 2014). Thereby, the three-dimensional machines (machines for measurement) are based on a three-dimensional space as well. Some of them are called CNC Coordinate Measuring Machine, and are specifically designed for measuring components on the production line while keeping pace with modern machine tools.

The software from the tool with CPS capability could provide in the future similar information about measurement, just like the measurement machines provide nowadays (Koleva et al, 2015). The most common process to make a measurement on a workpiece on a three-dimensional machine is collecting the point through the sensors by the probe.

We suggest that the measurement will not be based on point collection using a probe as a sensor to collect the dimensions but, alternatively, it will be done by the CNC tool with CPS during the process execution. Following the path of the axes previously programmed, the CNC tool could collect measurement information and transfer it to the CNC machine. The process measurement is a very sensitive process, and it needs a sensor (probe or CNC tool with CPS capability) to collect the information. We suggest that the measurement with the CNC tool is done by using the tool for finishing on process machining (tool used to remove small material and give the finishing on the surface). As the tool follows its path, the information is transferred to the CNC machine. If the CNC software has the capacity to do an automatic correction, the movements of the machine could compensate the variations of measurements transferred by the tool. In consequence, there will be no human intervention to make the measurement and no waste with machine stoppages.

Until nowadays, the measurement on CNC machines was not done because there were no CNC tools with capacity to transfer the measurement information during the process execution. The measurement information is done only by probe (sensor measurement) on physical contact. Since the new CNC tool with CPS capability has

been implemented in the machining area with capacity to transfer the information during the process execution, this procedure could be now done.

4.2 Flow information model

In the process execution of CNC machines using a CNC tool with CPS capability, the tool has the capacity to send the information about roughness, vibration, cutting and temperature. Thus, we suggest that the improvements to process architecture implies the implementation of two main dimensions, the tool enabled measurement and the communication with social networks through the tool with CPS capability (Figure 1).

The proposal for tool measurement on CNC machines is to use the CNC tool with CPS capability giving the information about the measurement on process execution through the sensors, where the workpiece could be measured during the process execution and, when the process is done, the workpiece would be already measured, and no time would be lost with machine interruptions. The tool would follow the programmed axes path during the measurement, collecting measurement information and transferring it to the CNC machine through the software and hardware.

The process measurement is a sensitive process that needs a sensor to collect the information. The idea is to do the measurement with the CNC tool using the tool for finishing operation. This option implies less removal of material on process machining. The tool software will send the information collected by the tool sensors to the software and hardware of the CNC machine as shown in Figure 1. Thereby, the software of the CNC machine has to be modified compared to the actual software on CNC machines. The machine software has to be able to collect the information on real-time and make the changes automatically. This is one of the most important steps for the development of this proposal. The software will communicate with the tool making the automatic compensation. CNC machines are working centred on a three-dimensional space (X, Y and Z axes) and the three-dimensional machines work in three-dimensional space as well to make the measurements. This possibility is viable for development, it will be a technology combination between the software from CNC machines and three-dimensional machines. The software from the tool and the machine will work in articulation with each other, exchanging information about measurement during the process execution. We know that during the process execution there are numerous parameters to be considered, such as material, RPM, speed, insert, among other aspects that could influence the process execution. Thereby, the initial step to implement the proposal is to do the measurement of the basic process execution on CNC lathe machines for finishing surfaces, as a first implementation, test and analysis of the proposed idea.

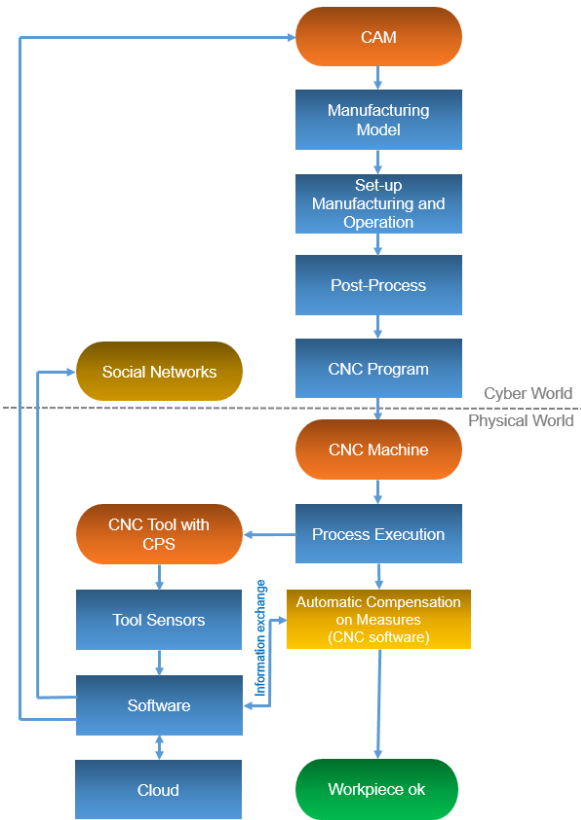


Figure 1: An information flow model between CNC tool with CPS capability, CNC machine and CAM

The software of the CNC machine will have the capacity to interpret the measurement as the three-dimensional machine works, answering automatically to the changes during the process execution (finishing with measurement). This process will consist on the adaptation of the actual software on CNC machine software, because the actual software is not able to do the automatic corrections, because there is not a CNC tool with the capacity to do the measurement during the process execution. Thereby, on the process simulation using a CAM software in the cyber world, it could be created a new operation function, the operation of measurement, where the programmer could select this function to do the simulation on the virtual world.

In general terms, the information flow proposed in the model of Figure 1 is as follows. First, it starts with the communication flow with the CAM on the cyber world, and the process simulation using the CNC tool with CPS capability is keeping the same steps of the currently used processes, until the creation of a CNC program. However, there are some new possibilities. The information processed in real time (by the CNC tool with CPS capability) could be transferred to the software for future applications on CAM simulation. As the data could be saved on the cloud during the process execution, the software with API (Application Programming Interface) connected with CAM could help the programmer when he is programming, facilitating and providing information about what is the ideal tool to be used in the process and the right parameters to be used for specific materials.

Then, the CNC program is received by the CNC machine for process execution in the physical world. New possibilities also emerged at this stage. As the machine is already prepared for process execution, the CNC tool with CPS capability and the CNC machine start to work together. The sensors from the CNC tool collect the information during the process execution, keeping it on the cloud and then, through the software, the information is transferred to CAM for future simulations, and to the social network, and is keeping the communication integrated with the CNC machine for information exchange.

The new feature of communication with a social network embodies communication possibilities of a CNC tool with CPS capability with the Internet of Things. The CNC tool could communicate with social networks (e.g. dedicated, professional, social networks), where groups can discuss the problem in real time or post as a discussion. The yellowish brown fields in Figure 1 show the main differences of the process compared to actual ones

5. Conclusions

The work related to this research consisted of an analysis of the technological evolution of the machining processes with CNC machines, having in mind the new concept of Industry 4.0. In order to reach it, a thorough study has been done to adopt the features of Industry 4.0 applying it to the machining processes in CNC Machines.

One of the main factors that influence the development of machining processes in CNC machines are the tools used in CNC machining processes for production. Issues related to the technological evolution of the tools used in CNC machines with virtual technology capability were considered. A better understanding of how the virtual technology works with machining tools on CNC machines was done. It was possible to analyse the main factors that can influence directly or indirectly the production processes of a factory with CNC machines.

This study enabled a better understanding about virtual technology addressed by software on machinability. We used a new tool with cyber-physical capability that has emerged in the CNC machining area as way to demonstrate how this kind of tool technology could work on CNC machines. It provided the opportunity to study how a CAM software works in communication between the tool with CPS capability and the CNC machine, presenting the CAM connection possibilities and its implications. A study and analysis of how a production system can work in an integrated way between the tool with CPS capability, the CNC machine and the CAM software within the concept of Industry 4.0 has been done, providing a better understanding of how this recent technology implementation of machining processes could be adapted under the concept of Industry 4.0.

Finally, following the original proposals presented regarding the integration of CNC tools and machines, a general proposal for an improved production system in the machining area was made. This proposal showed how this new production model could work, integrating a tool with CPS capability, the CNC machine and the CAM software, giving a new idea of communication and interaction between them.

Acknowledgements

This work has been supported by FCT – Fundação para a Ciência e Tecnologia within the R&D Units Project Scope: UIDB/00319/2020.

References

- Ahmad, M. I., Yusof, Y., Daud, M. E., Latiff, K., Kadir, A. Z. A., & Sair, Y. (2020). Machine monitoring system: a decade in review [Review]. *International Journal of Advanced Manufacturing Technology*, 108(11-12), 3645-3659. <https://doi.org/10.1007/s00170-020-05620-3>
- Bosetti, P., & Bertolazzi, E. (2014). Feed-rate and trajectory optimization for CNC machine tools. *Robotics and Computer-Integrated Manufacturing*, 30(6), 667-677. doi: 10.1016/j.rcim.2014.03.009
- Botkina, D., Hedlind, M., Olsson, B., Henser, J., & Lundholm, T. (2018). Digital Twin of a Cutting Tool. *Procedia CIRP*, 72, 215-218. doi: 10.1016/j.procir.2018.03.178
- Chen, J., Yang, J., Zhou, H., Xiang, H., Zhu, Z., Li, Y., & Xu, G. (2015). CPS Modeling of CNC Machine Tool Work Processes Using an Instruction-Domain Based Approach. *Engineering*, 1(2), 247-260. doi: 10.15302/J-ENG-2015054
- Deng, C., Guo, R., Zheng, P., Liu, C., Xu, X., & Zhong, R. Y. (2018). From Open CNC Systems to Cyber-Physical Machine Tools: A Case Study. *Procedia CIRP*, 72, 1270-1276. doi: 10.1016/j.procir.2018.03.110
- de Souza, A. F., Martins, J., Maiocchi, H., Juliani, A. D. P., & Jaskowiak, P. A. (2020). Development of a mobile application for monitoring and controlling a CNC machine using Industry 4.0 concepts [Article]. *International Journal of Advanced Manufacturing Technology*, 111(9-10), 2545-2552. <https://doi.org/10.1007/s00170-020-06245-2>
- Devezas, T., Leitão, J., & Sarygulov, A. (2017). *Industry 4.0: Entrepreneurship and Structural Change in the New Digital Landscape*. Switzerland: Springer International Publishing AG.
- Dubovska, R., Jambor, J., & Majerik, J. (2014). Implementation of CAD/CAM system CATIA V5 in simulation of CNC machining process. *Procedia Engineering*, 69, 638-645. doi: 10.1016/j.proeng.2014.03.037
- Faller, C., & Feldmüller, D. (2015). Industry 4.0 Learning Factory for regional SMEs. *Procedia CIRP*, 32, 88-91. doi: <https://doi.org/10.1016/j.procir.2015.02.117>
- Fountas, N. A., Stergiou, C. I., Majstorović, V. D., & Vaxevanidis, N. M. (2016). Intelligent Optimization for Sculptured Surface CNC Tool-paths. *Procedia CIRP*, 55, 140-145. doi: 10.1016/j.procir.2016.08.033
- Gorecky, D., Schmitt, M., Loskyll, M., & Zühlke, D. (2014). Human-machine-interaction in the industry 4.0 era. *12th IEEE International Conference on Industrial Informatics (INDIN)*, 27-30 July.
- Hermann, M., Pentek, T., & Otto, B. (2015). Design Principles for Industrie 4.0 Scenarios: A Literature Review. *Working Paper No. 01 / 2015*. Technische Universität Dortmund, Fakultät Maschinenbau.
- Jang, J., Jung, I. Y., & Park, J. H. (2018). An effective handling of secure data stream in IoT. *Applied Soft Computing Journal*, 68, 811-820. doi: 10.1016/j.asoc.2017.05.020
- 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*. Frankfurt, Germany: Acatech - National Academy of Science and Engineering.
- Koleva, S., Enchev, M., & Szecsi, T. (2015). Automatic dimension measurement on CNC lathes using the cutting tool. *Procedia CIRP*, 33, 568-575. doi: 10.1016/j.procir.2015.06.080
- Lee, J., Bagheri, B., & Kao, H.-A. (2015). A Cyber-Physical Systems architecture for Industry 4.0-based manufacturing systems. *Manufacturing Letters*, 3, 18-23. doi: <https://doi.org/10.1016/j.mfglet.2014.12.001>
- Leitão, P., Colombo, A. W., & Karnouskos, S. (2016). Industrial automation based on cyber-physical systems technologies: Prototype implementations and challenges. *Computers in Industry*, 81, 11-25. doi: 10.1016/j.compind.2015.08.004
- Liu, Y., Guo, X., Li, W., Yamazaki, K., Kashihara, K., & Fujishima, M. (2007). An intelligent NC program processor for CNC system of machine tool. *Robotics and Computer-Integrated Manufacturing*, 23(2), 160-169. doi: 10.1016/j.rcim.2006.04.003
- Longo, F., Nicoletti, L., & Padovano, A. (2017). Smart operators in industry 4.0: A human-centered approach to enhance operators' capabilities and competencies within the new smart factory context. *Computers and Industrial Engineering*, 113, 144-159. doi: 10.1016/j.cie.2017.09.016
- Marr, B. (2016). *What everyone must know about industry 4.0*. Tech. Forbes Contributors,. from <http://www.forbes.com/sites/bernardmarr/2016/06/20/what-everyone-must-know-about-industry-4-0/#327956184e3b>
- Moor, M., Vaher, K., Riives, J., Kangru, T., & Otto, T. (2021). Modern robot-integrated manufacturing cell according to the needs of Industry 4.0 [Article]. *Proceedings of the Estonian Academy of Sciences*, 70(4), 407-412. <https://doi.org/10.3176/proc.2021.4.06>
- Pereira, A. C., & Romero, F. (2017). A review of the meanings and the implications of the Industry 4.0 concept. *Procedia Manufacturing*, 13, 1206-1214. doi: 10.1016/j.promfg.2017.09.032
- Sandvik-Coromant. (2017). *Metal Cutting Knowledge*. from <https://www.sandvik.coromant.com/en-gb/knowledge/Pages/default.aspx?Country=pt>
- Sandvik-Coromant. (2018). We're ready for Industry 4.0. Are you? , from <https://www.sandvik.coromant.com/en-us/campaigns/pages/coroplus.aspx?Country=pt>
- Shneor, Y. (2018). Reconfigurable machine tool: CNC machine for milling, grinding and polishing. *Procedia Manufacturing*, 21(2017), 221-227. doi: 10.1016/j.promfg.2018.02.114
- Siddhartha, B., Chavan, A. P., Hd, G. K., Subramanya, K. N., & leee. (2021, Jan 27-28). IoT Enabled Real-Time Availability and Condition Monitoring of CNC Machines. *IEEE International Conference on Internet of Things and Intelligence System (IoTIS)*, Electr Network.
- Trstenjak, M., & Cosic, P. (2017). Process Planning in Industry 4.0 Environment. *Procedia Manufacturing*, 11, 1744-1750. doi: 10.1016/j.promfg.2017.07.303

Villalba-Diez, J., Gutierrez, M., Martin, M. G., Sterkenburgh, T., Losada, J. C., & Benito, R. M. (2021). Quantum JIDOKA. Integration of Quantum Simulation on a CNC Machine for In-Process Control Visualization [Article]. *Sensors*, 21(15), 14, Article 5031. <https://doi.org/10.3390/s21155031>

The Technopreneurial Hub: An Innovative Entrepreneurial Approach to Minimise Clothing and Textile Waste

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Abstract: The clothing and textile industry contribute over all 4% share of global greenhouse gas emissions that starts from initial raw material extraction up until the end-of-use disposal. The root cause being mass-produced fast fashion that is easily and cheaply replaced thus resulting in very large volumes of unwanted clothing that has to be dealt with effectively including the leftover fabrics and offcuts. The "Sustainability Clothing and Textile Project" took shape in 2019 where the students from a University of Technology based in South Africa were tasked to use off cut (leftover fabric edges and trims) fabrics from finished garments in the laboratory that would have otherwise been thrown away as waste and ended on the landfill sites. The project objectives were for the learners to 'think out of the box', be innovative and use critical thinking skills to create meaningful products while introducing the concept of sustainability and technopreneurial skills. Technopreneurship refers to the practice of combining technology and entrepreneurship, where individuals or organizations leverage technological innovations and advancements to create, develop, and manage new ventures or business opportunities. Technopreneurs are individuals who identify and capitalize on technology-based business ideas, utilizing their entrepreneurial skills to bring these ideas to fruition. Through this research we focus on providing an entrepreneurial support, addressing job creation and curriculum development. The research will also address the societal challenges in South Africa for the vulnerable sections of the society for whom these opportunities are limited and at the same time generating new entrepreneurs or increasing accessibility to the job market, creating hope for the future.

Keywords: entrepreneurship, technopreneurship, engineering education, waste management, curriculum delivery

1. Introduction

The COVID-19 pandemic had a detrimental effect on developing countries around the globe, with many facing critical challenges such as unemployment, and jobless. The impact on societies around the globe and more specifically on a socioeconomic level became worse. In 2020, global economic output saw a decline of 3.4%, while economic growth was expected to decrease by 5.6% in 2021 (Organisation for Economic Co-operation and Development [OECD], 2021). According to Liñán and Jaén (2020), the recession caused by the pandemic is possibly the most serious among all recessions since World War II. According to the World Bank (2021), COVID-19 initiated a severe contraction of economic activities with a related contraction in GDP growth. In these critical times, securing employment can be a big challenge for fresh graduates (Koe et al., 2021). Maritz et al. (2020) claims that entrepreneurship can be a catalyst to growth and transformation in this uncertain era. As the young generation has both passion and novel ideas, the critical need is to introduce them to the concept of entrepreneurship. Based on these ideas entrepreneurship can serve as a platform over which technology, society, science and industry can grow for the economic benefit of the community and country at large. Although entrepreneurial concepts have gained attention and popularity amongst policymakers, researchers and theorists, however actual entrepreneurial activities have somehow not gained popularity in the field of clothing and textiles in South Africa. It is also one of the industries that emits a lot of pollutants to the environment and waste to landfills.

One of the sub-types of entrepreneurship is 'technopreneurship', which is known as the "new breed of entrepreneurship" (Koe et al., 2021). Technopreneurship encompasses technology for the creation of business products. It is a process of blending technological skills with entrepreneurial competence (Selvarani & Venusamy, 2015). In brief, technopreneurship is about identifying the latest technology and employing it for creative purposes. With the world transforming into a virtual realm, technopreneurship remains intensely connected with entrepreneurship (Okorie et al., 2014). Also, due to the COVID-19 scenario, a lot of businesses have moved towards technology adoption in their operations to meet the unprecedented challenges (Sallomi, 2020). According to Muhib and Khan (2018), business skills (without technological skills) are out of date. Hence, educational institutions should focus on technopreneurial skills to train the youth so that they can seek opportunities, think strategically, and manage risks. Technopreneurship has evolved as a new approach to help rebuild shattered economies. With the onset of the pandemic came increased unemployment and stagnant growth, technopreneurship proves to be rewarding by addressing societal challenges i.e. job creation and unemployment. Those countries affected by these economic challenges it becomes vital that they jump on to the entrepreneurship bandwagon in order to overcome the disruption caused by the pandemic. Hence as

academics there is an effort to improve the educational approaches, curriculum delivery, launch technology incubators and offer support to start-up businesses.

Post the COVID-19 pandemic there is a high potential for groups and individuals to flourish as technopreneurs as the world has adopted the digital transformation on a higher scale. The current research aims to identify the role the academics plays in a department in the Faculty of Engineering at a University of Technology. The aim was achieved by allocating students' projects promoting entrepreneurship and at the same time involving SMMEs in these projects. The study also highlights existing literature by focusing on the need and importance of technopreneurship, as earlier studies have examined the traditional concept of entrepreneurship, leaving technopreneurship under researched (Sussan & Acs, 2017; Koe et al., 2021). In terms of the South African perspective the current study can be considered novel as there is limited research that discusses the development of technopreneurship. It also highlights the need for technopreneurship inclusion in the curriculum post COVID-19.

1.1 Aim and objectives of the research

The research aims to offer solutions for societal challenges such as job creation, unemployment, and economic disruptions, along with focusing on curriculum development, content delivery, and preparing students for the future.

To achieve these aims the following objectives were kept in mind:

- Provide a platform for students to learn, develop problem solving competencies, apply and enhance their skills through the Technology Station Clothing and Textiles (TSCT) enabling job creation.
- Support local entrepreneurs and businesses by providing training, mentorship, business upskill and post-completion follow-up service
- Teaching entrepreneurship in the curriculum empowers students to become more proactive and innovative by equipping them with tools and mindset to succeed to not only become job seekers but job creators.

2. Literature review

Technopreneurship is defined as the combination of technological competence and entrepreneurial expertise (Selvarani & Venusamy, 2015). It is an offspring of entrepreneurship which includes technology. The intention is to create a combination of scientific and technical skills, technological expertise, and individuals' intelligence who work together to form a digital and smart society (Abbas, 2018). In academic world, technopreneurship integrates the world of technology with academic entrepreneurship. Businesses are shifting to the digital mode in addition to their traditional presence. To fight unemployment and other social challenges, increasing technopreneurial potential among the young can be the most effective mitigation tool (Masenya, 2021).

Technopreneurship involves a multidisciplinary approach, integrating technological knowledge, business acumen, and innovative thinking. It requires the ability to identify market opportunities, develop technology-driven solutions, manage risks, secure funding, and navigate the dynamic landscape of technology-driven industries. Technopreneurs often focus on disruptive technologies, such as artificial intelligence, blockchain, biotechnology, internet of things (IoT), and others, aiming to create innovative products, services, or business models that bring significant value to the market.

Successful technopreneurs possess a combination of technical expertise, entrepreneurial mindset, leadership skills, and a willingness to take calculated risks. They embrace the rapid pace of technological change, adapt to market dynamics, and continuously seek opportunities to create and deliver value through technology-driven ventures.

2.1 Educational Entrepreneurship

Education in the current world is an investment as it not only educates but enhances various lifelong skills, entrepreneurship being one of them. It rewards students with boosted earnings, capabilities, and success. Acquiring entrepreneurial skill successfully relies on various factors, but the Theory of Planned Behaviour (TPB) considers the most critical one to be quality education via successful curriculum delivery (Underwood, 2012).

The TPB also supports the notion that a curriculum on entrepreneurship is very important and that curriculum is key among all factors of entrepreneurial education (Yang, 2013; Kim and Lim, 2019).

Education has two main objectives: knowledge transfer and skills development. Entrepreneurship has captured the attention of academicians and educationists (Ndou et al., 2019, Iqbal et. al., 2022). It is recognized as a key skill of the 21st century and is one of those disciplines that can be learnt easily by anyone (Grivokostopoulou et al., 2019). The concept of entrepreneurship started to emerge in late 1980s and early 1990s (Audretsch, 2021) however it was already initiated in 1971 at the University of Southern California in the postgraduate program and later in the undergraduate program (Muhib & Khan, 2010). Entrepreneurial education has a profound effect on students' behaviour by assisting them to attain the required competencies (Grivokostopoulou et al., 2019).

Taking a holistic perspective, entrepreneurial activities are influenced by institutions, education, stakeholders, and the entrepreneurs themselves (Palmer et al., 2021). Fowosire & Idris (2017) highlighted the need for universities to train young individuals as strategic players capable of excelling in a dynamic digital world. With the global repercussions of COVID-19 making job opportunities scarce, education can shift students' mindset from traditional job hunting to setting up successful enterprises. Practical-oriented entrepreneurship education has proven to be more effective than theory-based teaching (Fiore et al., 2019), and including role models' success stories can enhance students' motivation (Zozimo et al., 2017). Graduates equipped with practical entrepreneurship skills can contribute to economic development in society (Feliu & Rodriguez, 2017).

Since the COVID-19 pandemic, businesses have increasingly adopted technology, creating demand for apps and software supporting remote operations. Educational institutions can engage tech-savvy students in technopreneurship by offering relevant curriculum. The Triple Helix theory emphasizes the integration of academic institutions, industry, and government to convert knowledge and technology into economic resources (Mêgnigbêto, 2018). Entrepreneurial education is a key pathway to transfer knowledge to the industry and introduce new technology to the market (Giuri et al., 2019). Technopreneurship, rooted in the Triple Helix theory, plays a vital role in addressing changing market needs, especially in light of the COVID-19 pandemic's relevance to technological infrastructure. The current study focuses on the role of educational institutions in technopreneurial development, examining university education and community entrepreneurs' perspectives. This research is unique as it delves into the realm of technopreneurship in the clothing and textiles context, filling a noticeable gap in existing literature that mainly centers around "traditional entrepreneurship" (Koe et al., 2021) in South Africa.

Hence, understanding the necessity of establishing an educational hub is crucial. The purpose of such a technopreneurial hub is to identify and engage with local, viable stakeholders and interested parties directly at the location. The main goal is to foster networking opportunities and cultivate collaborations with student graduates. This hub aims to accommodate various entities, including individual entrepreneurs, cooperatives, active NGOs, and other economic actors, who can seek support and assistance for their initiatives.

In this case the Technopreneurial Hub is a unit based in the Department of Clothing and Textile Technology at the University of Technology that provides technology support to students/alumni, technopreneur start-ups as well as existing SMMEs who want to grow their businesses.

The following support is offered through this Technopreneurial Hub viz:

- Product development: CAD, pattern making, grading (sizing), marker making (optimize material utilization), 3D simulation.
- Product testing and analysis: a range of textile performance testing and analytical instruments used for e.g. fabric composition, wash test, tensile tests, abrasion resistance, fibre analysis etc.
- Training and mentorship: a range of focused short learning programmes e.g. product costing, production, textile application etc.
- Network facilitation: connecting within the university to specialized research areas, linking to support organisations outside the university viz. business support, marketing, start-up loan financing etc.
- Building linkages with potential customers
- Technology and equipment access. High end specialised equipment available on a booking system e.g. 3D body scanner, ultrasonic welding machine, buttonhole machine etc.

The figure 1 below shows how the TSCT is conducting knowledge transfer to our students and stakeholders where it has two major dimensions, one for the SMMEs and the other being the institution (dept).

Whereas in Figure 2, the incorporation of the technopreneurial hub will serve mutually beneficial to stakeholders involved. Students are provided a platform to learn, develop and gain support from experts. SMMEs are able to collaborate and upskill themselves to meet current market trends. They can also engage with students and be part of youth trends, learn and build new skills. Through their organisations, irrespective of their size or infrastructure receive necessary support, feedback and gain industry linkages and network. As TSCT has a good industry rapport it will be possible to support small and local businesses via future projects or orders. All this generates a lot of data for research purposes as well as influences the Universities teaching and learning.

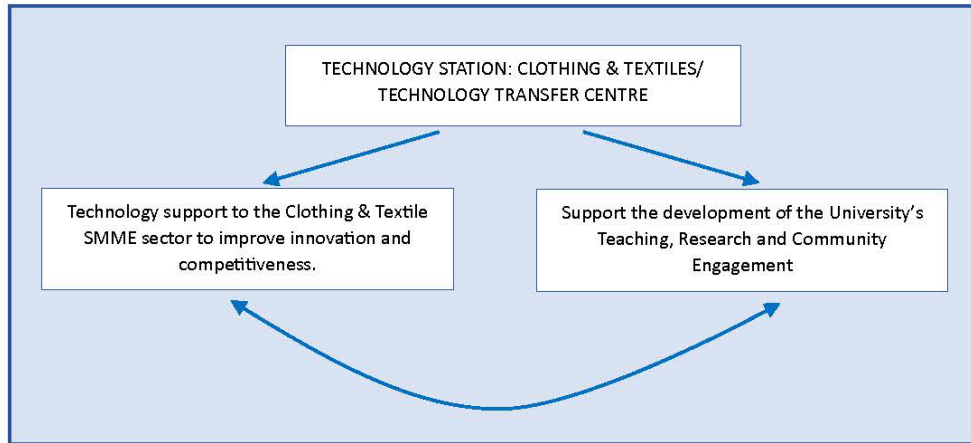


Figure 1: TECHNOLOGY STATION CLOTHING AND TEXTILES (TSCT) SMME SUPPORT (CURRENT)

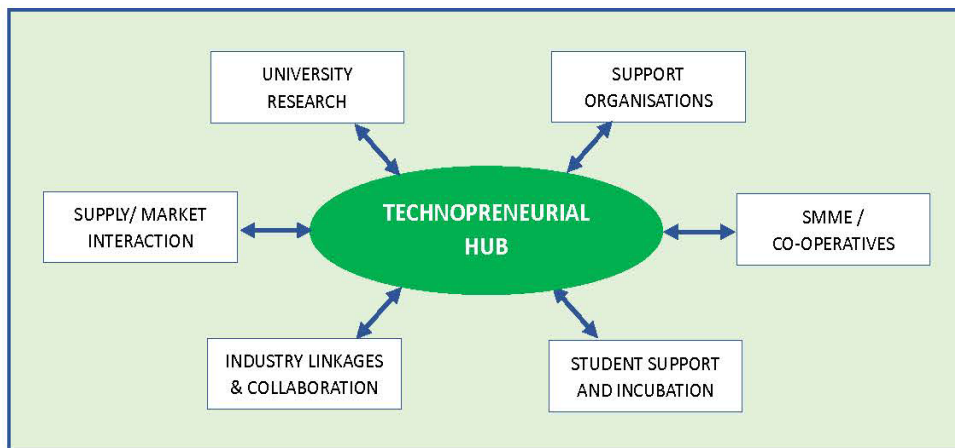


Figure 2: TECHNOPENREURIAL HUB IN DEVELOPMENT

3. Research Methodology

3.1 Participants

This research commenced with the involvement of students, and later, Small, Medium, and Micro Enterprises (SMMEs) were added, making them the initial focus of the study. As the project was about nurturing an entrepreneurial mindset, fostering creativity and innovation, adaptability to the evolving job market and be a lifelong learner it was important that student feedback was collected at the end of the project to understand what they had learnt, what worked best and what more could be done differently. The research was conducted at a research-intensive institution in Cape Town, South Africa, involving approximately 40 participants enrolled in the Clothing and Textile Technology qualification within the Faculty of Engineering and the Built Environment. The course requires students to possess foundational knowledge of entrepreneurship and supply chain management. The curriculum encompasses topics such as supply chain management, processes, technology, and performance, while the entrepreneurship module covers product and operation strategy, product costing, technical drawing, and financial planning.

3.2 Study design

During the 15-week teaching and learning intervention, participants had valuable learning experiences. The initial weeks focused on introductions, with students engaging in repetitive Marketing sessions to reinforce product saleability concepts. They were grouped together and tasked with pitching 3-5 innovative ideas aimed at addressing real-life gaps or challenges. Throughout the process, low-stakes formative assessments were conducted before the project's completion. The theoretical aspects of the modules were covered during lectures, after which students commenced group work on the selected project idea, which received approval from the academics due to its feasibility and relevance. To start the project, students conducted market surveys targeting their intended audience to understand the need for their waste-based products, created from leftover off-cut fabrics provided generously by retailers.

Two academics, who were subject lecturers, were directly involved in the project, and occasionally, students sought expert input from other academics regarding patterns, garments, or textile testing. The timeline of the project consisted of different phases: Weeks 1-3 focused on idea pitching, finalization, and market surveys. Weeks 4-6 involved theoretical concepts and approaching willing SMMEs to discuss project ideas. During Week 7, students collected waste fabrics based on their product requirements. From Weeks 8-12, students dedicated their time to work on product creation within allocated time slots. In Weeks 13-14, they produced a digital storytelling video documenting their project journey, compiled a report based on market findings, product reviews by SMMEs, the final product, and the lessons learned, which served as their final module assignment. Finally, academics provided feedback forms for students to offer their input on the entrepreneurship project.

3.3 Data collection

For data collection, academics shared a survey form with the project participants, specifically the students involved. The survey comprised a mix of open and close-ended questions, aiming to gather information about their project exposure and the lessons they learned. The study adopted a qualitative approach, and the data collected were analyzed using Atlas.ti for coding and thematic analysis for quantitative analysis. Following the process outlined by Braun and Clark (2006), the academics familiarized themselves with the data to allocate appropriate codes. They then conducted multiple reviews and analyses to refine the coding process. From the coded data, themes emerged, which were further revised and compiled into the final report.

Given the qualitative nature of the research, the analysis aimed to explore potential themes within the data. The researchers considered the strengths and weaknesses of conceptualizing themes strictly without quotes versus using quotes to provide readers with evidence. They opted to include quotes from the data to allow readers to independently assess the credibility, accuracy, and fairness of the findings (Corden and Sainsbury, 2006).

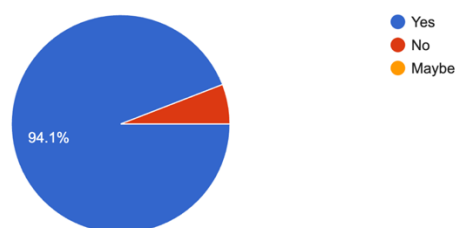
4. Results and discussion

The academics completed the analysis for each question and have provided results under this section for each question. The responses were via google forms therefore some of the responses are screenshots from the student responses.

4.1 Intention and interest in the project

94.1 % of students highlighted their interest towards the project as they felt like working towards their own start-up enterprise. The responses are that of groups and not of individuals hence the number.

Did it generate interest at that stage?
17 responses



Few responses of coded question above are as follows:-

"There was uncertainty on whether we should make a garment or a product that is just made from textile, our first idea was to make a tote bag or a. Convertible backpack tote bag. I found creative ideas that I didn't know about before. I came to know what entrepreneurship is really about."

"To be honest, I didn't know that one can make a product or a garment out of offcuts, so I had no idea on what to do. Later I through lectures learnt we are producing sustainable products. Creating something that is more attractive to township people, which is where I live. I am already planning to start my own business."

4.2 Project highlights

The students initially were unsure of where the project is taking them or what their learnings will be at the end. As this was their first exposure to a technopreneurship project in the department they were unsure what the final outcomes hold. They had some lovely comments as extracted from quotes.

"The concept of actually making something from offcuts and it ending up being visually appealing and functional. Having to use fabrics that were not fit for the product to produce a product out of it."

"We wanted to create something that people needed but did not know that they needed it. Something that's important but taken for granted. To get more knowledge on how to develop or make something out of nothing, also how to draft a plan on how to start a business. Travelers always lose their important belongings. So we wanted to eliminate that and make something cost effective for them."

"Connecting with my partner to brainstorm innovative ideas as well as being able to develop and make my own tote bag as a lover of totes. Tote bags are popular, and I also used it and they're also easier to introduce to the market."

4.3 Learnings from technopreneurship project

As the project aims to connect to the real-world be it skill development, addressing a real issue, or technopreneurial skills it is important for the academics to understand how the project contributed to student learning and development.

"One can make products from offcut material and start a business that can generate profit provided that the products that are being made are worth purchasing. I can take do things for myself using unwanted fabrics. That I can create something valuable from trash."

"I've learnt that customer preferences change as time goes so which is why companies should adapt to the change. That it is not a child's play to open a company. And all the department's which companies have are necessary for it to be a success or for it to succeed."

"Get more knowledge about how to start a business and gain more information about how to think out of the box. how to be a business owner and entrepreneur one day. I have acknowledged that instead of being unemployed I can use the skill to produce products and sell them using any off-cuts."

"Considering means of selling a product to the correct market and analysing the final product to assess whether is suitable for mass production."

6. What kind of learning do you think has taken place in the course of this project? (making sense of the subjects, grasping the knowledge, etc)

12 responses

Learning to work as a team and the importance of meeting deadlines

Sustainability

Where by we thought to make something out of nothing

That helped us a lot in way that we come up with ideas to make product keeping in mind of the waste materials we should choose from

Understanding the course at a broader level, being exposed to problem solving and working under pressure as well as with different team mates.

It opened my eyes to be able to understand the relationship between a business and consumers and how they influence each other

I have learnt some sewing skills from the project because it was not as easy as sewing garments. I now know I can do anything I can think of with the right resources. The project encouraged us to go out there and make connections with small businesses which I believe could be resourceful in future.

i loved the subject because it made me realize that i can archive and create anything once i set my mind to it. and i will never find my self with no employment in future because i can be my own employer.

4.4 Honing a lifelong learning or technopreneurial skill

Students in the current digital world are considered advanced in the field of technological adoption. Hence when asked to post their work on social media, get surveys done online or create digital storytelling videos, they were eager to learn and incorporate it into their products and their projects. They considered all this as a learning which they otherwise wouldn't have cared enough to learn. It isn't surprising that students at the Diploma level have a good circle of influence from various sources on social media.

"The technopreneurship project has made me more aware of power that lies in recycling as well as producing something that can be viewed as sustainable to the environment. I was able to install smartness into my products. It has improved my outlook in a way that I take waste into consideration when making clothing."

"I thought all this was a lie just for the media. But now that I had produced a sustainable garment from off-cuts and old garments. It think this is really a way forward for our clothing industry and it's possible. I've learnt a lot from doing the project by to think about many ways of how to generate an ideas and also to plan before doing something."

"I got motivation to be more entrepreneurial and use social media for education. Technopreneurship is the way forward. It can help minimize cost and Waste while maximizing profits. "

9. After this project we all can now relook at clothing waste differently. How do you intend to collect waste if you want to have your own start-up at a later stage?

12 responses

Working closely with my community by making sure everyone is aware of sustainability.

Approach sewing sites or factories and ask for offcut donations

By asking companies to please supply us with their waste and tell them what is it that we going to use it for

Sourcing it from small businesses, in our department, and just storing up left over fabric or garment I no longer wear.

Yes

I am going to start small by asking family members and close friends to give me waste textile materials that they so not use, and I will then do something out of it each time and give it to the needy.

i will create a social media profile where i will elaborate my ideas and the reason i want those waste to motivate people to engage in my vision. and i can contact few CMT for they off cut or reject which i could buy in less cost..

4.5 Knowledge transfer

Students were asked if they after being part of the project have earned some skills and knowledge to transfer it at a later stage. They felt quite confident about it and share it with communities. Some of them felt they could share and build on this knowledge to start their own business. Some responses have been shown as below.

8. Now that you have ached/mastered making a product out of waste do you think you can transfer this knowledge to other? Please elaborate

12 responses

Yes, whatever old clothes you have at home instead of throwing them away Design something
Instead of getting rid of bottles or old clothes one can use those combination to make different shapes vase or even different type of lamp Structure. We can utilise this material and turn them into useful household items. Turn old clothes into fleece, mats cushion cover by doing patch work or doodlage of various pieces together.
Yes I do, I've been thinking of starting a small business using offcuts to make and sell fashionable bags
Of course it since it the second time going through this learning process, I can definitely transfer it to anyone.
Yes, it will also benefit us to transfer the knowledge we have to others in a way, because the more we interact with people the more we also gain knowledge from them.
Yes we're going to back to SMME to present our innovative ideas and to the community at large
Yes, but so this is a very challenging thing to do and requires alot of patience

The image below is the final response that students gave when been asked what their final thoughts were around their learning and understanding of the subject. The responses highlight the relevance of the subject and its contribution towards student learning and support towards the project. Some have responded stressing the fact that they have found it beneficial.

12. Final thoughts about the subjects, learning and assessments modalities that you want to highlight, please do so.

7 responses

Both subject taught me how to do a proper business plan, how to generate meaningful, functional and innovative ideas, and with the knowledge and experience I gained from both lectures these can help me in future if I decide to venture into business. Also those many presentation we had helped me overcome my anxieties of talking infront of people compared to when I started. I know know how to develop a product and market it.
I'm not sure if understand the question but As a whole it was a great experience however we learned in a short time frame.
This project was challenging, but I learnt a lot within a short period of time. Thinking out of the box and coming up with solutions.
Overall both the lectures gave enough study material and insight on what is needed for the duration of the subject. It was great doing assessments based on som9we developed on our own
I like the learning(theoretical) and the practical work which is done after learning And it equips us to broaden our minds

So it was observed from the feedback, student presentations and some face to face feedback post oral presentations that the learning nurtures creativity, encouraging students to come up with new and original ideas, products, or services, which are essential for driving progress and success in various fields. Students gained a better understanding of technical concepts that further assist in innovative ideas, financial concepts, budgeting, funding, and managing resources, which are crucial skills for personal and professional financial success. Teaching it in the curriculum can inspire students to create businesses with a focus on social and environmental impact, promoting sustainable practices and responsible entrepreneurship. As the job market continually evolves, entrepreneurial skills equip students with the ability to adapt, innovate, and pivot their careers in response to changing circumstances and industries.

5. Conclusion

The primary objective of this study was to investigate whether the learning environments in technopreneurship-related activities adequately supported all types of learners in the department. In the context of technopreneurship advancement, each student activity and SMME assessment and interaction carried a strong

element of social responsibility. When making decisions about student interaction with SMMEs, academics had to consider student demographics, which were closely related to the background of the SMMEs. This connection allowed for easily identifiable market gaps and creating relevant products to fill those gaps. The connection with existing SMMEs was important in that both SMMEs and students benefitted by the experience. From an academic standpoint, it was crucial for a majority of students to comprehend and apply their soft skills and theoretical content learned in the module to real-world work settings. Teaching entrepreneurship in the curriculum offers several benefits to students: nurturing an entrepreneurial mindset, encouraging students to think creatively, take initiative, and identify opportunities for problem-solving and value creation. It fosters the development of critical skills such as decision-making, communication, leadership, and adaptability, which are valuable not only in business but also in various aspects of life. Students learn to embrace calculated risks and become more resilient in the face of challenges and failures, as entrepreneurship often involves uncertainty and setbacks. Entrepreneurship education empowers students to consider self-employment and create their own job opportunities, contributing to economic growth and job creation in the long run.

Overall, teaching entrepreneurship in the curriculum empowers students to become more proactive, innovative, and adaptable individuals, equipping them with the tools and mindset to succeed in a dynamic and ever-changing world. It can boost students' confidence in their abilities, encouraging them to believe in their potential to bring about meaningful change and make a difference in the world. The study's findings also hold promising implications for curriculum officers and developers. They can use these findings to enhance the quality of future modules by refining the curriculum design and delivery methods to offer more effective and engaging learning experiences.

6. Limitations and future research

The current research exhibits several strengths, but it is also subject to certain limitations that could impact the findings. Firstly, the participants were drawn from a single developing country, introducing economic and cultural bias, which may hinder the generalizability of the results. Additionally, the data source only included Diploma students and excluded postgraduate students, suggesting the need for future research to explore their perspectives and examine potential differences in outcomes.

The findings and limitations highlight the necessity for further investigation. Future studies should consider additional factors, such as the university's teaching and learning environment, the role of curriculum officers or developers within the institution, and students' interests in specific job roles or industries. A longitudinal study in the future could offer new insights into how educational institutions influence students' entrepreneurial skills over time.

References

- Abbas, A. (2018). The bright future of technopreneurship. *International Journal of Scientific and Engineering Research*, 9, 563-566.
- Acs, Z. J., Braunerhjelm, P., Audretsch, D. B., & Carlsson, B. (2009). The knowledge spillover theory of entrepreneurship. *Small Business Economics*, 32(1), 15-30. <https://doi.org/10.1007/s11187-008-9157-3>
- Audretsch, D. B. (2021). Have we oversold the Silicon Valley model of entrepreneurship? *Small Business Economics*, 56(2), 849-856. <https://doi.org/10.1007/s11187-019-00272-4>
- Boldureanu, G., Ionescu, A. M., Bercu, A. M., Bedrule-Grigoruță, M. V., & Boldureanu, D. (2020). Entrepreneurship education through successful entrepreneurial models in higher education institutions. *Sustainability*, 12(3), 1267. <https://doi.org/10.3390/su12031267>
- V. Braun and V. Clarke, (2006) "Using thematic analysis in psychology," *Qualitative research in psychology*, vol. 3, pp. 77-101.
- A. Corden and R. Sainsbury, (2006) Using verbatim quotations in reporting qualitative social research: researchers' views: University of York York.
- Feliu, V. R., & Rodriguez, A. D. (2017). Knowledge transfer and university-business relations: current trends in research. *Intangible Capital*, 13(4), 697- 719. <https://doi.org/10.3926/ic.990>
- Fiore, E., Sansone, G., & Paolucci, E. (2019). Entrepreneurship education in a multidisciplinary environment: evidence from an entrepreneurship programme held in Turin. *Administrative Sciences*, 9(1), 28. <https://doi.org/10.3390/admsci9010028>
- Fowosire, R. A., Idris, O. Y., & Elijah, O. (2017). Technopreneurship: A view of technology, innovations and entrepreneurship. *Global Journal of Research in Engineering*, 17(7), Article e290903.

- Giuri, P., Munari, F., Scandura, A., & Toschi, L. (2019). The strategic orientation of universities in knowledge transfer activities. *Technological Forecasting and Social Change*, 138, 261-278. <https://doi.org/10.1016/j.techfore.2018.09.030>
- Grivokostopoulou, F., Kostas, K., & Perikos, I. (2019). Examining the impact of a gamified entrepreneurship education framework in higher education. *Sustainability*, 11(20), 5623. <https://doi.org/10.3390/su11205623>
- Iqbal J, Yi X, Ashraf MA, Chen R, Ning J, Perveen S, et al. (2022) How curriculum delivery translates into entrepreneurial skills: The mediating role of knowledge of information and communication technology. *PLoS ONE* 17(5):e0265880. <https://doi.org/10.1371/journal.pone.0265880>
- Kim YJ, Lim JY. Factors influencing entrepreneurial intention of nursing students based on theory of planned behavior. (2019) *Journal of Korean Academy of Nursing Administration*. 25(3):175–185.
- Koe, W. L., Mahphoth, M. H., Alias, N. E., Krishnan, R., & Arham, A. F. (2021). Factors influencing intention towards technopreneurship among university students. *Journal of Educational and Social Research*, 11(1), 162-162. <https://doi.org/10.36941/jesr-2021-0016>
- Liñán, F., & Jaén, I. (2020). The Covid-19 pandemic and entrepreneurship: some reflections. *International Journal of Emerging Markets*, 17(5), 1165-1174. <https://doi.org/10.1108/IJOEM-05-2020-0491>
- Maritz, A., Perenyi, A., de Waal, G., & Buck, C. (2020). Entrepreneurship as the unsung hero during the current COVID-19 economic crisis: Australian perspectives. *Sustainability*, 12(11), 4612. <https://doi.org/10.3390/su12114612>
- Masanya, T. M. (2021). Technopreneurship development: Digital strategy for youth self-employment in the digital economy. In k. Sandhu (Ed.), *Handbook of Research on Management and Strategies for Digital Enterprise Transformation* (pp. 196-218). IGI Global. <https://doi.org/10.4018/978-1-7998-5015-1.ch010>
- Ménigbêto, E. (2018). Modelling the Triple Helix of university-industry-government relationships with game theory: core, shapley value and nucleolus as indicators of synergy within an innovation system. *Journal of Informetrics*, 12(4), 1118-1132. <https://doi.org/10.1016/j.joi.2018.09.005>
- Muhib, Y., & Khan, N. (2010). The prospects of entrepreneurial education in Pakistan: an economic perspective. *Journal of Independent Studies and Research Management, Social Sciences and Economics*, 8(2), 1-10.
- Ndou, V., Mele, G., & Del Vecchio, P. (2019). Entrepreneurship education in tourism: an investigation among European Universities. *Journal of Hospitality, Leisure, Sport & Tourism Education*, 25, 100175. <https://doi.org/10.1016/j.jhlste.2018.10.003>
- OECD (2021). *OECD Economic Outlook*. OECD I Library. https://www.oecd-ilibrary.org/economics/oecd-economic-outlook_16097408
- Okorie, N., Kwa, D., Olusunle, S., Akinyanmi, A., & Momoh, I. (2014). Technopreneurship: an urgent need in the material world for sustainability in Nigeria. *European Scientific Journal*, 10(30), 59-73
- Palmer, C., Kraus, S., Kailer, N., Huber, L., & Öner, Z. H. (2021). Entrepreneurial burnout: A systematic review and research map. *International Journal of Entrepreneurship and Small Business*, 43(3), 438-461.
- Qasim, Y & Mahmood, Z (2022), Technopreneurship Education: The way to rebuild COVID-19 affected economy. *Journal of Management and Research*, 9(1), 1 – 22.
- Sallomi, P. (2020). *Understanding the sector impact of COVID-19: technology sector*. Deloitte. https://www2.deloitte.com/content/dam/Deloitte/pl/Documents/Reports/pl_COVID_19_Impact_Technology_Sector.pdf
- Selvarani, A., & Venusamy, K. (2015). A study of technopreneurship in small and medium industry. Technopreneurship as a firm strategy: links to innovation, creation and performance. *Journal Impact Factor*, 6(1), 401-408.
- Sussan, F., & Acs, Z. J. (2017). The digital entrepreneurial ecosystem. *Small Business Economics*, 49(1), 55-73. <https://doi.org/10.1007/s11187-017-9867-5>
- The World Bank. (2021). *The World Bank in Pakistan*. The World Bank. <https://www.worldbank.org/en/country/pakistan/overview>
- Underwood PR. (2012) Teacher beliefs and intentions regarding the instruction of English grammar under national curriculum reforms: A Theory of Planned Behaviour perspective. *Teaching and Teacher Education*. 28(6):911–925.
- Yang J. (2013) The theory of planned behavior and prediction of entrepreneurial intention among Chinese undergraduates. *Social Behavior and Personality*. 41(3):367–376.
- Yildiz, O. (2021). Changing paradigms in the digital age and entrepreneurial universities. In D. Günay, T. Asunakutlu, & O. Yildiz (Eds.), *University- Industry Collaboration Strategies in the Digital Era* (pp. 1-21). IGI Global.
- Zozimo, R., Jack, S., & Hamilton, E. (2017). Entrepreneurial learning from observing role models. *Entrepreneurship & Regional Development*, 29(9-10), 889-911. <https://doi.org/10.1080/08985626.2017.1376518>

A Conceptual Study of TOE and Organisational performance

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Abstract: The COVID-19 pandemic has changed everything and created a big challenge for all the enterprises including the SME's. The use of technology becomes crucial for the survival of the business activities because the mode of payment and receiving mostly shifted towards the digital method. However, the SME's sector still facing the challenge of technology adoption particularly in the native areas. The basic motive of this research is to examine previous studies to find the role of technology, organisation and environment (TOE) in organisational performance. This study analysed various theories of technological innovation while focusing the theory of TOE. The main factors studied in this research are the Technological, environmental and organisational variables. This research study will follow the qualitative research method. In this research study we have followed the systematic "Meta-narrative" of literature review method introduced by Kuhn. To study and find the relevant article we have used the key words of SMEs, TOE, technology and adoption. Moreover, the study period covered in this research was from 2011 to 2023. This study highlights the important aspect of TOE and its application in SMEs. Moreover, this research contributes in the theoretical understanding of SMEs success factors while critically studying the theory of TOE.

Key words: SMEs, TOE, Technology & Digitalisation

1. Introduction

A study of the World Bank (2022) acknowledged the importance role of Small and Medium Enterprises (SMEs) in all over the world, particularly in the developing and emerging countries. SMEs has a dual role in the economic development, on the one side it creates business opportunities and in the other side it creates new jobs openings. Moreover, it has a vital role in fostering domestic economies and emerged as the main contributor of local businesses. According to Cahyono et al., (2022) the SMEs sector contribution in the national economy is approximately 37% of the total gross domestic product (GDP). As suggested by Muhammad et al., (2021), the local SMEs can further accelerate and advance their business while applying the new technological advancement like online business, mobile payment and industry 4.0 technology. However, "Technological-Organisational Environmental" (TOE) research identified that adoption of Industry 4.0 suggest SMEs must be better prepared and need to consider the practical challenge of the implications. This advance readiness is necessary to move the economy to the next structural cycle of the economy (Prasanna, 2019).

Research on the relationship between Technological-Organisational Environmental (TOE) influences the adoption of Industry 4.0, which has increased in developing expertise and continuously pushed businesses to upgrade to new technology in recent years (Nguyen & Luu, 2020). Another study primarily focused the SMEs sector, revealed that most of the technological adaptation decisions are centralised and mainly in the hand of the business owners (Jayashree et al., 2020). According to Trotta & Garengo, (2018) the benefits of technological adoption is recognised everywhere however, there is still lack of industry 4.0 technological implementation due to insufficient theoretical understanding. Currently SMEs are having to face many challenges and barriers when they try to adopt the advanced technological innovations. Hence, the SMEs sector faced some specific challenge as compared to the big industries (Muhamad et al., 2021).

The adaptation of Technological-Organisational Environmental (TOE) framework continuously becoming a challenge for small enterprises particularly in suburbs and rural areas in Malaysia Tien et al., 2020). Small and Medium-sized Enterprises (SMEs) in Malaysia still need to develop competitive advantages based on the adequate and intensive use of information systems (IS) which are essential sources of innovation and success in today's market (Erind, 2015). The success of the SMEs heavily dependent on the smart and timely adoption of new technologies in their business activities. During the covid-19 every organisation realised the true need and importance of technological usage. SMEs must adopt the infusion of automation and digital practices embedded in Industry 4.0 to remain competitive and innovative in the market. Benefits of SMEs adopting TOE are increased productivity, increased efficiency of internal business operations, and more easily and cheap connection to external contacts (Thaha et al., 2022). Various researchers also listed benefits such as

increased complexity, compatibility, information technology capabilities, and technological competencies, business competitiveness, vertical integration with other related businesses, stakeholders, and institutions, improved networking with other parties, and support from the government and environmental dynamics (Sugandini et al., 2020). The Technology Organisation Environment (TOE) is a general framework that identifies various factors that influence organisational technology adoption (Chong & Olesen, 2017).

Previous research was mainly carried out in the domain of quantitative research; however, this research studied the important aspect of qualitative research as suggested by (Trotta & Garengo, 2018). Moreover, Salimon et al, (2023) further suggested to conducted a qualitative and mix-method research on the SMEs performance with respect to TOE. Hence, this research conducted a comprehensive review of the relevant literature on the TOE and SMEs performance in viewing the rural setting of Malaysia.

2. Literature review

Electronic business, or e-business, has the power to completely restructure organisations, their organisational structure and their business processes (Zhu et al., 2006). The connections with clients, suppliers, and other business partners are also impacted by e-business (Ulas, 2019 & Ifinedo, 2011). According to Simpson and Doherty (2004) and Turban et al. (2004), e-business is the integration of communication (internet) technology, management practices and business processes. According to Ulas, (2019), web technologies help businesses in better understand the needs of their customers (marketing capability), personalise their goods and services (improving customer satisfaction), adopt product-market solutions (responding quickly to changes in the exogenous environmental elements), and accept customer orders (improv delivery speed, enhances global approach, declines cost and provide and improved satisfaction of the customers).

Sindakis & Aggarwal, (2022) also examined the drivers and barriers to e-business adoption in small businesses, discovered that adoption is influenced by the unique characteristics of each business setting as well as the social backdrop. They also emphasised to develop a complete framework to support the adoption of e-business. This comprehensive framework assured to understand the underlying factors of e-business success strategies. A model created by Bertschek and Fryges (2002), examined the elements that influence a company's decision to use B2B e-commerce in Germany. The findings of the study suggested that business size plays an influential role while adopting B2B e-commerce strategy. Therefore, it would seem that a large firm accepts e-business more readily, largely due to the managerial staff's professional knowledge and skill.

Similarly, Aceto et al., (2019) also conducted a similar research in the SMEs business of Italy and identified the information and communication technology (ICT) adoption. The findings of the study confirmed that technological adoption in SMEs vary from business to business and the environment of the organisation. Like the supportive and technological cultural of the organisation further enhance the use of E-business activities. Harindranath et al. (2008) also tried to find the reason of limited adoption of digital and mobile technology in the SMEs sector of United Kingdom. Their findings revealed that the British managers feel fear due to the possibility of restricted usage and obsolescence of an IT system that would also necessitate frequent updates.

Additionally, the Covid-19 pandemic further uncovered the importance and need of digital transformation in all over the world including Malaysia. After post-Covid there is, in particular, a lack of understanding of how capabilities, skills, and knowledge may be developed internally or acquired from outside sources. While policymakers are currently seeking to promote SMEs' digital transformation as the key focus point for SME growth in 2022 and beyond (June, 2022), little is known about the efficacy of individual measures. Asean SME Transformation Study 2022 by UOB has identify although there is renewed ambition towards business recovery, a significant proportion of SMEs (45%) in the region remain concerned about the need to transform their business models, particularly in the areas of digitalisation and sustainability (Malik et al., 2022). This is especially true for SMEs that may struggle to priorities tech upgrades among their other budgetary considerations.

Several analysts compare the effects of digitisation to the industrial revolution. According to TM, scalability and flexibility of the cloud reduce complexities and prohibitive costs around info-tech infrastructure, enabling SMEs to transform how they work without over-committing financially (TM One, 2021). Covid-19 has spurred necessary digital transformations that had previously been slow in many sectors. Digital News Asia reported the study conducted by SAP identify having managed significant challenges over the past two years, SMEs across Asia Pacific and Japan are looking beyond a focus on resilience (Digital News Asia, 2022). demonstrate how existing businesses must rethink entire industries to cope with the influence of technology improvements. Meier et al. (2022) study also affirm on how existing businesses must rethink entire industries to cope with the

influence of technology improvements.

2.1 Technology, organisation and environmental (TOE)

Tornatzky and Fleischer (1990) introduced the TOE framework to study the technological innovation and implementation through technological, organisational and environmental context as shown in the figure 1 below. The technological context describes that how technology availability is important for the firm perceived benefits. Similarly, the organisational context focuses on the firm types, size, scope, managerial level and other concern issues. The environmental context talks about the external climate in which the firm operates like the Govt. agencies, industrial obligations and business competitors (Mahakittikun et al., 2020).

As documented by Oliveira and Martins (2011), TOE framework provided strong empirical and theoretical foundation which is proved by previous research scholars to predict and explain the technological adaptation at firm level. Moreover, Kuan and Chau (2001) also confirmed the suitability of TOE framework for assessing the technological innovation.

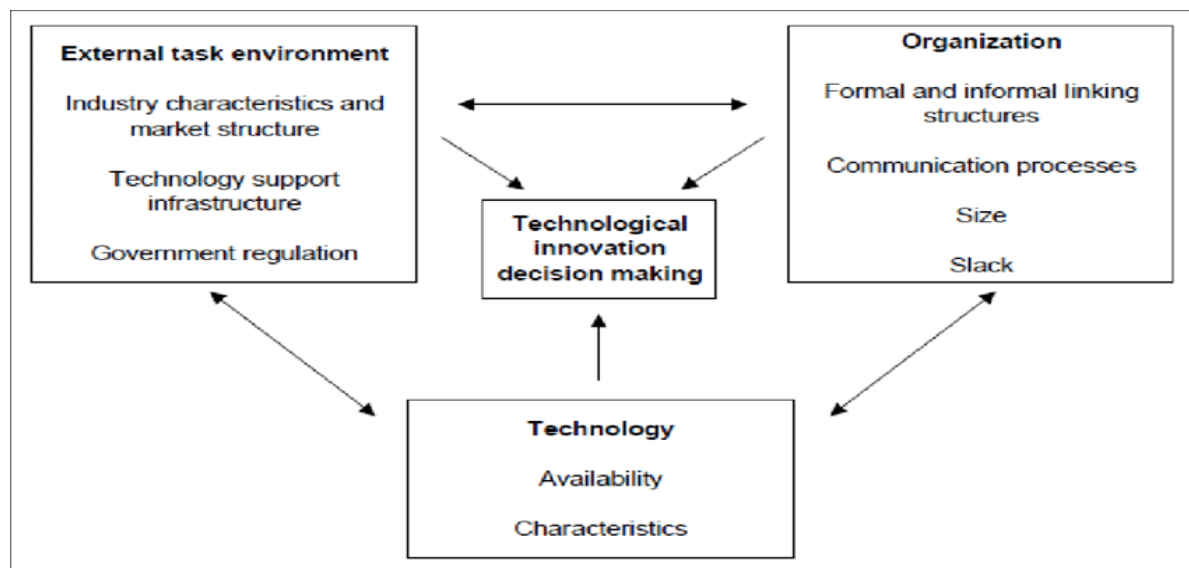


Figure: 1 TOE framework developed by Tornatzky & Fleischer (1990)

Similarly, the TOE framework is applied in elucidating the application, utilisation and execution of innovations. For example Zhu et al., (2004) found a connection between TOE elements and organisation performance. These factors included the technological readiness, financial resources, global scope, and regulatory environment, identified as significant contributors. Later on Zhu and Kraemer (2005) combined TOE with the theory of resource based view to investigate the collective effect on e-business. They observed that regulatory support plays an important role in developing countries. Additionally, Picoto et al. (2014) studied the collective effect of TOE, diffusion of innovation theory resource-based theory to examine the prevailing vales connected with mobile business and found that the TOE factors has a predictive power in the adaptation of mobile business.

Additionally, a comprehensive review of the relevant literature also performed to vouch the trend of the adoption of TOE in the SMEs sector. The systematic review of the literature was followed the method of "Meta-narrative" introduced by (Kuhn, 1970) and suggested (Xiao & Watson, 2019). Meta-narrative review represents a novel analytical and synthetic approach tailored for subjects that have been approached and studied from diverse epistemic communities, each with its unique perspectives. The method was pioneered by Greenhalgh et al. (2005) and draws inspiration from Kuhn's concept of scientific paradigm competition (Kuhn, 1970). Metanarrative review centers on tracing the development of specific social concerns and research traditions pertaining to a particular issue over time. By examining this evolution, it aims to understand how the unfolding of these concerns and traditions influences the formulation of research questions and the adoption of methodologies to address them. All the reviewed research papers were published in the leading research journal. To identify and study the relevant paper the key words, such as SMEs, TOE, technology and adoption were used. All the research papers were published in the leading research journals and international conference proceeding. The main source of theses research articles was the google scholar and ProQuest online data base. The articles which were selected and analysed are presented in the following table in year wise order.

Table 1: Review of SMEs technological adoption studies

Author and Year	Type of study	IS/IT adoption	Focus area of the study	Google citation
Hanafiah et al., 2023	Qualitative	E-commerce adoption	"Does E-commerce adoption create SME performance: A Literature Review".	02
Alraja et al., 2022	Quantitative	TOE & RBU	"Technological Innovation, Sustainable Green Practices and SMEs Sustainable Performance".	49
Ramdani et al., 2021	Qualitative	Digital innovation	"Digital innovation in SMEs: a systematic review, synthesis and research agenda".	67
Ali et al., 2020.	Quantitative	IT adoption and usage	"Examining the factors affecting SME performance: the mediating role of social media adoption".	15
Lutfi et al., 2020	Quantitative	Social media adoption	"The impact of AIS usage on AIS effectiveness among Jordanian SMEs: A multi-group analysis of the role of firm size".	42
Sandu & Gide, 2018	Quantitative	adoption of Cloud based service	"TOE factors that influence the adoption of Cloud based service SMEs in India".	26
Mahmod et al., 2018	Qualitative	Enterprise Risk Management	"A Conceptual Framework of ERM Practices among SMEs IN Malaysia".	11
Soto et al., 2016	Quantitative	e-business & organisational innovation	"E-business, organisational innovation and firm performance in manufacturing SMEs".	382
Chatzoglou & Chatzoudes 2016	Quantitative	e-business adoption	"Factors affecting e-business adoption in SMEs: an empirical research".	182
Amini & Bakri 2015	Quantitative	Cloud computing	"Cloud Computing Adoption by SMEs in the Malaysia: A Multi-Perspective Framework based on DOI Theory and TOE Framework".	93
(Alshamaila, 2013	Qualitative	Cloud computing adoption	"Contribute to a growing body of research on cloud computing, by studying the small to medium -sized enterprise (SME) adoption process".	984
Chao & Chandra, 2012	Quantitative	IT adoption and strategic alignment	"Impact of owner's knowledge of IT on business, IT strategic alignment and use in the small firm context. Resource-based view as a theoretical foundation".	124
(Haug et. al. 2011	Qualitative	IT readiness/IT adoption	"IT readiness in small and medium-sized enterprises. <i>Industrial Management & Data Systems</i> ".	110

The above literature review shows that most of the research studies were conducted in the domain of the quantitative research. Similarly, majority of the research studies focused on the framework of the TOE and "Diffusion of Innovation" DOI for the technological adoption in SMEs. The relative importance of each model is undeniable; however, the holistic application produces more superior understanding and application. According to Oliveira and Martins, (2011) the TOE model provides a comprehensive theoretical understanding and has the potential of solid application in SMEs. The research of Hanafiah et al., (2023) disclosed the importance of the theory of diffusion of innovation. This theory provides the fundamental approach to study the primary factors of technological diffusion. It further confirmed that the adoption of technological innovation depends mainly on the innovative behaviour and nature of the organisation. Similarly, the study of Alraja et al., (2022) investigated the challenged technological adoption faced during the covid-19 pandemic. The finding of the research revealed that a holistic approach is needed to compact these types of mass pandemic. Like the integration of the TOE and resource-based view. By applying these integrations, the SMEs businesses can be able to proactively grab the future pandemic challenge. Previous research study of Lutfi et al., (2020) also suggested for an integrated model TOE and RBV to address the technological changes for the SMEs.

However, few studies also recommended the cloud computing for the SMEs to scale-up their business activities. According to Amini & Bakri, (2015) cloud computing become more practicable, as it can be used with low budget and less human resources. Although, there is some security concerns which need to be considered. The application of information technologies gives competitive advantages and enable them to compete with the larger firm. Moreover, the study of Alshamaila, (2013) identified various factors which affect cloud computing application such as, compatibility, scope & nature of the business, comparative advantage, employee's capabilities, stakeholder support and organisational culture. All of the given factors collectively influence the adoption of cloud computing in the SMEs business sector.

3. Conclusion

Before adopting new technologies and methods, it's crucial to comprehend the dimensions and characteristics of organisational adoption of technological innovation as it is a necessary element in understanding the process. Researchers and practitioners with an interest in this subject can benefit from the insights offered by the TOE framework developed by Tornatzky and Fleischer (1990) which explains three key parameters which influence the organisational adoption; Technology, Organisation and Environment. The enterprise's technological, organisational, and environmental settings all have an impact on how quickly IS advances are adopted. A variety of inventions and circumstances have been examined using the TOE framework by the researchers. The majority of research in the area of small- and medium-sized business adoption of IS innovations is focused on the adoption of technologies like ERP, E-commerce, and E-business, as well as on determining how prepared SMEs are for IT. However, over the study period (2011 to 2023), we came across a growing body of research that concentrated on how SME's adopted new technologies like cloud computing, social networking and other Web 2.0 tools that are gaining popularity.

Various elements that affect how SMEs adopt technological innovation might be found throughout the literature review and illustrated through summary table 1. The expected relative advantage, IS knowledge, top management support, innovativeness and organisational readiness are some of the topics that are frequently mentioned in research articles analysed during literature. In SMEs, mostly CEO makes majority of critical decisions due to the lack of managerial human resource. In addition to "characteristics of the technological innovation," "characteristics of the organisation," and "characteristics of the environment," Thong (1999) emphasises the significance of "characteristics of the organisational decision makers" (including the CEO's IS knowledge and CEO's innovativeness) as a fourth element of context.

In conclusion, our study highlights the missing research on SME adoption of the new Web 2.0 technologies and how well their patterns of adoption do fit in the already established frameworks of technological innovation adaptation, such as the TOE framework, as a research gap for the time period taken in consideration for literature review. Continuous empirical research work and framework validation are required during these dynamic technological advancements. The study's findings may have repercussions for the SME managers, research community and information and communication technology providers in terms of illustrating the state of the field's research and developing better frameworks and strategies for the adoption of new IS among Small and Medium Enterprises.

References:

- Bakar, M.F.A., Talukder, M., Quazi, A. and Khan, I., 2020. Adoption of sustainable technology in the Malaysian SMEs sector: does the role of government matter? *Information*, 11(4), p.215.
- Aceto, G., Persico, V. and Pescapé, A., 2019. A survey on information and communication technologies for industry 4.0: State-of-the-art, taxonomies, perspectives, and challenges. *IEEE Communications Surveys & Tutorials*, 21(4), pp.3467-3501.
- Ali Qalati, S., Li, W., Ahmed, N., Ali Mirani, M., & Khan, A. 2020. Examining the factors affecting SME performance: the mediating role of social media adoption. *Sustainability*, 13(1), pp.75.
- Alshamaila, Y., Papagiannidis, S., & Li, F. 2013. Cloud computing adoption by SMEs in the north east of England: A multi-perspective framework. *Journal of enterprise information management*.
- Amini, M., & Bakri, A. 2015. Cloud computing adoption by SMEs in the Malaysia: A multi-perspective framework based on DOI theory and TOE framework. *Journal of Information Technology & Information Systems Research (JITISR)*, 9(2), pp.121-135.
- Alraja, M. N., Imran, R., Khashab, B. M., & Shah, M. 2022. Technological innovation, sustainable green practices and SMEs sustainable performance in times of crisis (COVID-19 pandemic). *Information Systems Frontiers*, pp.1-25.
- Bertschek, I. and Fryges, H., 2002. The adoption of business-to-business e-commerce: empirical evidence for German companies.
- Cahyono, B., Nurcholis, L. and Nugroho, M., 2022. Information Technology Implementation in SMEs: A Comparison of Indonesia and Malaysia. *Jurnal Manajemen Teori Dan Terapan | Journal of Theory and Applied Management*, 15(1), pp.25-37.
- Chao, C. A., & Chandra, A. 2012. Impact of owner's knowledge of information technology (IT) on strategic alignment and IT adoption in US small firms. *Journal of Small Business and Enterprise Development*, 19(1), pp.114-131.
- Chatzoglou, P., & Chatzoudes, D. 2016. Factors affecting e-business adoption in SMEs: an empirical research. *Journal of Enterprise Information Management*.
- Chao, C. A., & Chandra, A. 2012. Impact of owner's knowledge of information technology (IT) on strategic alignment and IT adoption in US small firms. *Journal of Small Business and Enterprise Development*, 19(1), pp.114-131.

- Chung, K. C. 2020. Green marketing orientation: Achieving sustainable development in green hotel management. *Journal of Hospitality Marketing and Management*, 29(6), pp.722–738
- Digital News Asia 2022. The 'Great Resignation' hits Asian SMEs digital transformation plans. Retrieved from [Digital News Asia](#).
- ESOMAR European Society for Opinion and Marketing Research 2018. Global Market Research 2018. Available online at: <http://www.esomar.org> (accessed Dec12, 2021).
- Greenhalgh, T., Robert, G., Macfarlane, F., Bate, P., Kyriakidou, O., & Peacock, R. (2005). Storylines of research in diffusion of innovation: a meta-narrative approach to systematic review. *Social science & medicine*, 61(2), 417-430.
- Hanafiah, A., Sandi, K. and Aina, A.N., 2023. Does E-commerce adoption create SME performance: A Literature Review. *International Journal of Artificial Intelligence Research*, 6(1.2).
- Haug, A., Graungaard Pedersen, S., & Stentoft Arlbjørn, J. 2011. IT readiness in small and medium-sized enterprises. *Industrial Management & Data Systems*, 111(4), pp.490-508.
- Ifinedo, P., 2012. Internet/E-Business technologies acceptance in Canada's SMEs: Focus on organizational and environmental factors. *E-Business-Applications and Global Acceptance*, pp.3-19.
- Jayashree, Sreenivasan, Mohammad N. Hassan Reza, Chinnasamy A.N. Malarvizhi, Hesti Maheswari, Zohre Hosseini, and Azilah Kasim 2021. "The Impact of Technological Innovation on Industry 4.0 Implementation and Sustainability: An Empirical Study on Malaysian Small and Medium Sized Enterprises" *Sustainability* 13 (18) pp.10115.
- Kuan, K. K., & Chau, P. Y. (2001). A perception-based model for EDI adoption in small businesses using a technology–organization–environment framework. *Information & management*, 38(8), 507-521.
- Kuhn, T. S. (1970). *The Structure of Scientific Revolutions*. Chicago, IL: University of Chicago Press
- Kuhn, T. S. 2012. *The structure of scientific revolutions*. University of Chicago press.
- Kumar, A., Syed, D. A. A. & Pandey, D. A., 2020. How Adoption of Online Resources Can Help Indian SMEs in Improving Performance during COVID-19 Pandemic. *Test Engineering and Management*, Volume 83, pp. 3394-3400.
- Lutfi, A., Al-Okaily, M., Alsayouf, A., Alsaad, A., & Taamneh, A. 2020. The impact of AIS usage on AIS effectiveness among Jordanian SMEs: A multi-group analysis of the role of firm size. *Global Business Review*, p.0972150920965079.
- Meier-Kolthoff, J.P., Carbasse, J.S., Peinado-Olarte, R.L. and Göker, M., 2022. TYGS and LPSN: a database tandem for fast and reliable genome-based classification and nomenclature of prokaryotes. *Nucleic Acids Research*, 50(D1), pp.801-807.
- Malik, A., Sharma, P., Vinu, A., Karakoti, A., Kaur, K., Gujral, H.S., Munjal, S. and Laker, B., 2022. Circular economy adoption by SMEs in emerging markets: Towards a multilevel conceptual framework. *Journal of business research*, 142, pp.605-619.
- Muhamad, M.Q.B et al., 2020. Technological-Organisational-Environmental (TOE) Framework in Industry 4.0 Adoption among SMEs in Malaysia: An Early Outlook pg. 14 *ASEAN Entrepreneurship Journal* Vol. 7 (1), pp.13-19
- Mahakittikun, T., Suntrayuth, S., & Bhatiasavi, V. (2020). The impact of technological-organizational-environmental (TOE) factors on firm performance: Merchant's perspective of mobile payment from Thailand's retail and service firms. *Journal of Asia Business Studies*, 15(2), 359-383.
- Mahmod, M. S., Aziz, K., Yazid, A. S., Rasid, N., Salleh, F., Ghazali, P. L., & Mahmood, S. 2018. A Conceptual Framework of ERM Practices among SMEs IN Malaysia. *International Journal of Academic Research in Business and Social Sciences*, 8(11), pp.1209-1221.
- Nguyen, X. T., & Luu, Q. K. 2020. Factors affecting adoption of industry 4.0 by small- and medium-sized enterprises: A case in ho chi minh city, Vietnam. *Journal of Asian Finance, Economics and Business*, 7(6), pp.255-264.
- Oliveira, T., & Martins, M. F. 2011. Literature review of information technology adoption models at firm level. *Electronic journal of information systems evaluation*, 14(1), pp110-121.
- Research Industry. *Frontiers in psychology*, 11, 288. <https://doi.org/10.3389/fpsyg.2020.00288>
- Parker, C.M. and Castleman, T., 2009. Small firm e-business adoption: a critical analysis of theory. *Journal of enterprise information management*.
- Picoto, W. N., Bélanger, F., & Palma-dos-Reis, A. (2014). A technology–organisation–environment (TOE)-based m-business value instrument. *International Journal of Mobile Communications*, 12(1), 78-101.
- Prasanna, RPIR, et al (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) pp.100.
- Ramdani, B., Raja, S., & Kayumova, M. 2022. Digital innovation in SMEs: a systematic review, synthesis and research agenda. *Information Technology for Development*, 28(1), pp.56-80.
- Sandu, R., & Gide, E. 2018. Technological, organisational and environmental (TOE) factors that influence the adoption of cloud based service SMEs in India. In *2018 IEEE 11th International Conference on Cloud Computing (CLOUD)* (pp. 866-870).
- Sindakis, S. and Aggarwal, S., 2022. E-business Adoption by Small Businesses: Benefits and Drawbacks. In *Small Business Management and Control of the Uncertain External Environment*. Emerald Publishing Limited.
- Soto-Acosta, P., Popa, S., & Palacios-Marqués, D. 2016. E-business, organizational innovation and firm performance in manufacturing SMEs: an empirical study in Spain. *Technological and Economic Development of Economy*, 22(6), pp.885-904.
- Sugandini, D., Irhas Effendi, M., Istanto, Y., 2020. The Resistance of SMEs in Adopting Social Media: TOE Model. In Ljupka Naumovska (Ed.), *COVID-19 – Reshaping Marketing and Communications* pp.44-53.

- Thong, J.Y., 1999. An integrated model of information systems adoption in small businesses. *Journal of management information systems*, 15(4), pp.187-214.
- TM, A., Singh, S., Khan, S.J., Ul Akram, M. and Chauhan, C., 2021. Just one more episode: exploring consumer motivations for adoption of streaming services. *Asia Pacific Journal of Information Systems*, 3(1), pp.17-42.
- Tornatzky, L. G., Fleischer, M., & Chakrabarti, A. K. (1990). *Processes of technological innovation*. Lexington books.
- Ulas, D., 2019. Digital transformation process and SMEs. *Procedia Computer Science*, 158, pp.662-671.
- Word bank group: Digitalizing SMEs to Boost Competitiveness October 2022.
<https://documents1.worldbank.org/curated/en/099515009292224182/pdf/P17608901a9db608909f5b02980d48c4e28.pdf>
- Xiao, Y., & Watson, M. 2019. Guidance on conducting a systematic literature review. *Journal of planning education and research*, 39(1), pp.93-112.
- Zhu, K., Kraemer, K.L. and Xu, S., 2006. The process of innovation assimilation by firms in different countries: a technology diffusion perspective on e-business. *Management science*, 52(10), pp.1557-1576.

The Third Digital Divide: Digital Identity and Start-up Success

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Abstract: The digital divide concept recognizes that with the rapid pace of technological advancement, actors who lack access to digital infrastructure and the necessary knowledge may not have the opportunity to benefit from the opportunity that digital entrepreneurship offers. Online-exclusive ventures now constitute a growing proportion within the gross population of new ventures started up, especially in China. Digital entrepreneurship is viewed as the new vista where aspiring entrepreneurs are able to rapidly setup and test new business ideas, significantly reducing startup costs and the costs associated with startup failure. A key question for new entrepreneurs, therefore, is: what drives “success” in digital-only entrepreneurship, and are these drivers significantly different when compared to conventional or online-offline hybrid entrepreneurship? Here it is alleged that ‘digital identity’ plays a significant role in determining online-only start-up “success”. Our aim in this paper is to identify the overlaps between ‘identity’ and ‘digital entrepreneurship’ literature to highlight how scholars in the area explain the *digital identity* formation process, and the manner in which it contributes to start-up success. We situate our paper in the Chinese national context; which represents a unique digital start-up ecosystem, with well-developed routes to business startup. Presented are outcomes from a systematic literature review encompassing 48 publications, including 12 pieces of indigenous Mandarin literature. We identify overarching themes, and how concepts in identity and digital entrepreneurship literature overlap, with a view to explaining the drivers of digital start-up “success”, and as to how these might be further investigated using novel methodology.

Keywords: Digital Identity, Digital entrepreneurship, Digital Divide, New Venture Creation, Systematic Literature Review

1. Introduction

Digital entrepreneurship relies on digital technology as an enabler for opportunities brought by innovative digital products (Curley and Formica, 2013). Digital ecosystems have made it easier than ever for entrepreneurs to set up online ventures and reach a global audience (Wang, Liu and Qu, 2023). The digital entrepreneurship landscape or eco-system is now fast evolving: a mature e-entrepreneurship model is more than simply online trading; it encompasses innovation, communication, collaboration, management, and social networking (Lai and To, 2020). In fact, digital or e-entrepreneurship leverages digital technology which entrepreneurs can leverage to reduce capital expenditures and operating costs, effectively shortening the New Venture Creation (NVC) process (Laurell, Achtenhagen and Andersson, 2016). Digitization of the entrepreneurial process helps to break down the boundaries between different startup stages and introduces a greater degree of uncertainty and nonlinearity to their development (Satish Nambisan, 2017). This then raises a significant set of new research problems related to digital entrepreneurship; researchers contend that we need a careful assessment of digital technologies and their features that impact entrepreneurs' increasing endeavours. Alongside scholarly contributions, new research in the area will enable eco-system actors to fine tune features of digital spaces and mechanisms to promote the rapid growth of e-entrepreneurship (Elia, Margherita and Passiante, 2020).

Whereas in the past, digitalisation was limited due to functional processes and access to digital infrastructure, now though in the web 2.0 and 3.0 era, digital networks and devices are ubiquitous and end users exercise a high degree of control over digital resources (Guo and Yang, 2021). The openness, generativity and ability of digitalisation to bring about spontaneous change opens up many possibilities for digital start-ups to create new value. For example, online ventures can interact with customers and stakeholders through new channels, connect multivariate needs and highly personalized products, and use social media for collective intelligence innovation (Elia, Margherita and Passiante, 2020). Studies have shown that digital technologies have reduced boundaries encountered during business startup – where these have gone from discrete, impermeable, and stable to increasingly more dimensional and fluid (Satish Nambisan, 2017). This notion presents a challenge: as a growing number of organisations, including start-ups, now operate solely on online web 2.0 platforms, we are beginning to witness a two-fold digital divide (Reuschke, 2021). The first digital divide refers to the physical asymmetry of access to ICTs and the second digital divide is the social/effectiveness/digital skills aspect of ICTs. These divisions are one of the key factors that distinguish successful or failed entrepreneurship (Zhang, 2022). A further dimension in entrepreneurial success, in addition to the above two digital divides, is the significance of effective *digital identity* management as a means for regulating relationships between businesses and their audiences in an interactive web 2.0 context. In essence, a poor perception of a new venture's digital identity is

a strong predictor for its failure. Entrepreneurs must consistently consider their initiatives' perception from others' perspective, incorporate new features and make rapid adjustments with customers' input and use rapid prototyping to create learning loops. This is where identity, strategy, and branding all converge, where digital identity becomes co-created through digital media (Horst and Hitters, 2020). However, what remains to be better understood is the process through which a *viable* new venture 'identity' is created and sustained.

It is contended that digital entrepreneurship has the potential to transform the socio-economic landscapes of developing and emerging economies. Li, Du and Yin (2017) argued that in China and elsewhere around the developing and emerging world, there has been an explosion of start-ups transforming their business models using digital technology and doing business exclusively online. However, many such start-ups lack a systematic framework for interacting with and leveraging the digital ecosystem to create and maintain a viable digital presence via a 'digital identity'. In other words, in the developing and emerging world especially, there is a lack of understanding within both practitioners and researchers on what *digital identity* is and its significance in e-entrepreneurship success. To illustrate, as the Chinese context is used as the backdrop for this paper, we find that there is a considerable lack of data on China's exclusively online start-up scene in western academic literature. This may be owing to the lack of Mandarin language proficiency, and the lack of access to the Chinese National Knowledge Infrastructure (CKNI). Hence, following on from the above, this article analyses the current research themes in digital entrepreneurship, digital media practise, and digital identity work, as well as the characteristics of the stage-dependent development of digital identities that lead to the success of small and micro-online firms during their NVC process (Frederik von Briel, Per Davidsson and Recker, 2018). Our aim is to identify the overlaps between digital identity and digital entrepreneurship literature to highlight how scholars in the area explain the digital identity formation process, and the manner in which it contributes to start-up success, especially in the Chinese digital eco-system context. The adopted theoretical lens emerges from the 'corporate identity' literature, where we emphasize explain how and why the "same" access to underlying digital technologies (such as ICTs) can produce different entrepreneurial outcomes in different contexts. We adopt the *Systematic Literature Review* (SLR) methodology to identify potential research questions and propositions to test in further research on digital entrepreneurship and digital identity. 48 peer-reviewed papers have been included, including 12 publications from reputable Chinese sources.

2. Research Background

A new generation of entrepreneurs is emerging as a result of the seamless integration of entrepreneurship and digital technology, who conduct most start-up activities online with the aid of digital technology. The availability of digital technologies has changed our understanding of the new venture creation (NVC) and digital identity formation processes (Curley and Formica, 2013; von Briel, Davidsson and Recker, 2018). But the existence of digital divides leads to an inequitable distribution of entrepreneurial capabilities as well as entrepreneurial performance, especially within the already maturing digital ecosystem of entrepreneurship. China presents a unique national context showing digital startup innovation (Yitshaki and Kropp, 2016). In 2016, China's Ministry of Science and Technology supported 115 university science and technology parks and over 1,600 technology business incubators to provide startup support, legal advice, and workspaces for aspiring entrepreneurs (Wang, Liu and Qu, 2023). This is taking into account the vast array of prevalent business models, interactive web 2.0 and 3.0 platforms and the sophistication and participation rates of its populace in ecommerce (Guo and Yang, 2021). In China, the rapid growth in the digitalisation of a vast array of services and institutions, including those that are government sponsored or led, is breaking down entry barriers for e-entrepreneurship. Although the importance and positive impact of digital identity on start-up performance has been largely documented, we still lack understanding of the dynamics of its emergence and other factors related to the composition of digital entrepreneurial ecosystems. Numerous studies reported that digital identities and the effective management of overcoming the digital divide can have a positive impact on business success (Wilson and Elliot, 2016; Flint, Signori and Golcic, 2018). It is now widely acknowledged that owing to the ease of starting up a new digital enterprise, there is an urgent need to develop the theoretical perspective of digital divide to solve the staged dynamic formation of digital identity in the ecosystem for Chinese entrepreneurs.

3. Review Approach

We propose that a new "digital identity perspective" is needed to bear on entrepreneurial process research, which will require a careful re-examination of theoretical foundations in the area; in other words, an exploration of "how" and "why" type questions (Fan et al., 2022). A systematic literature review (SLR) is, therefore, preferable in this paper because the 'phenomena' of digital entrepreneurship and digital identity formation

cannot be separated from its specific ‘context’ – in our case the Chinese national digital startup ecosystem (Li, Du and Yin, 2017). The SLR method is typical for exploring research questions in a complex context and helps to reveal aspects of a problem through multiple data sources (Fan et al., 2022). The next two sections highlight the planning and execution of the adopted SLR methodology.

3.1 Planning

To prepare this review, we adopted the protocol developed especially for the field of Entrepreneurship by Kraus, Breier and Dasí-Rodríguez (2020). By concentrating on strings searches via mainly online databases, a preliminary cross reading through article cover page was conducted to identify any missing key strings. Conference reports, academic books and scientific journals were selected as sources. Pertinent articles hosted by key academic journal databases including ScienceDirect, Scopus, Chinese National Knowledge Infrastructure (CNKI), Google Scholar, IEEE, Springer and ResearchGate were searched for using a set of key words. Reference lists of the shortlisted articles were also used to discover further relevant papers published during 2010-2022 period. A novel aspect of this review is that it includes for the first time, peer-reviewed publications exclusively focussed on the Chinese digital start-up ecosystem published in the Mandarin language. The ambition behind including CNKI’s outputs in this SLR is to increase relevance and to gather more direct evidence on the Chinese online entrepreneurial eco-system, information on which is not widely published in non-Chinese research outlets. The columns in Table 1 show the sources included and the total numbers of relevant publications for each database.

Table 1: Number of papers and database source

Database [↵]	Digital Entrepreneurship Success Factors, with a special emphasis on China [↵]	Digital Identity – its significance, emergence and evolution [↵]	Total [↵]
ScienceDirect [↵]	28 [↵]	35 [↵]	63 [↵]
IEEE [↵]	16 [↵]	3 [↵]	19 [↵]
Google Scholar [↵]	33 [↵]	30 [↵]	63 [↵]
Springer [↵]	19 [↵]	15 [↵]	34 [↵]
CNKI [↵]	9 [↵]	12 [↵]	21 [↵]
ResearchGate [↵]	5 [↵]	6 [↵]	11 [↵]
Total [↵]	110 [↵]	101 [↵]	221 [↵]

A strict selection criterion was applied: shortlisted papers needed to include ‘digital entrepreneurship’ and ‘identity’ as primary themes. The search was expanded using the "*" symbol to include word derivatives (e.g., "venture" and "venturing"). The following Table 2 shows key words and their combinations (along with their derivatives) in both English and Chinese were employed for search:

Table 2: Key words used for literature search

Key words in English [↵]	Key words in Chinese [↵]
<‘digital divide’, ‘digital entrepreneur*’, ‘E-entrepreneur*’ ‘digital eco*’, ‘digital identity*’, ‘online identity’, ‘start-up identity’, ‘new venture creation’, ‘business ventur*’, ‘online start-up*’> [↵]	<‘数字鸿沟 (shu zi hong gou)’, 数字创业 (shu zi chuang ye) ‘数字生态 (shu zi sheng tai), 在线身份 (zai xian shen fen)’, ‘企业身份 qi ye shen fen)’, ‘身份形成 (shen fen xing cheng)’, ‘创建新企业 (chuang jian xin qi ye)’, ‘企业创新 (qi ye chuang xin)’, ‘在线企业 (zai xian qi ye)’> [↵]

Specific exclusion criteria adopted were as follows:

a) Our selection of journals was based on rating system developed by *Chartered Association of Business Schools (CABS) Academic Journal Guide (AJG)* (2021). To ensure that this review demonstrated transparency and reproductivity, only articles from highly ranked (rating greater than 2) journals such as *Journal of Business Research* and *Journal of Business Venturing*. The average rating of our selections is 2.8, where the journal with highest rating of 4* is contributed by “*Strategic Entrepreneurship Journal*” and the lowest ranked journal is “*International Entrepreneurship and Management Journal*” with AJG rating of 1.

b) Studies unrelated to the research topic, or opinion-based publications, and duplicate studies with low impact factors were rejected. After excluding studies that did not meet criterion a), we read through the titles of the remaining pieces of literature. In most cases the title itself revealed whether a study proved to be a good fit with the review's aim. After the preliminary reading of the title, another round of exclusions was made based on the abstract and the targeted research questions.

3.2 Execution

The execution stage included the selection of research themes and the extraction of data. After narrowing down the number of articles that did not meet the designed quality criteria, a total of 112 articles were excluded. Among the remaining publications, 18 papers were presented in the form of systematic literature reviews or research overviews, and we focused on these articles to identify current developments in the area as well as emerging research trends. We first extracted key data from these 18 papers and selected the remaining valid papers according to their coverage (Table 3). After the main themes were identified, we found that secondary themes such as identity formation, identity co-creation and entrepreneurial journey were prominent in the reviewed literature.

Table 3: Coverage of research themes

Research overviews that took 'Entrepreneurship' as a primary theme [↵]		
No. [↵]	Sub-theme [↵]	Articles [↵]
1 [↵]	Entrepreneurial process; Entrepreneurial journey; [↵]	(Zaheer et al., 2022), (Kraus, Breier and Dasi-Rodríguez , 2020) [↵]
2 [↵]	Media Entrepreneurship; Media Management; [↵]	(Horst and Murschetz , 2018) [↵]
3 [↵]	Digital ecosystem; Digital Entrepreneurial ecosystem [↵]	(Autio et al., 2018), (Guo and Yang, 2021), (Zhu and Yang, 2022) [↵]
4 [↵]	Entrepreneurial identity; Entrepreneurship [↵] Founders; Identity formation; Identity work; [↵]	(Horst, Järventie-Thesleff and Perez-Latre , 2020) [↵]
5 [↵]	Role identity; Social identity; Venture identity; Organizational identity; [↵]	(Mmbaga et al., 2020), (Leitch and Harrison, 2016) [↵]
Research overviews that took 'Identity' as primary theme [↵]		
1 [↵]	Brand community; Netnography [↵]	(Laroche, Habibi and Richard, 2013) [↵]
2 [↵]	Organizational identity [↵]	(Balmer, 2017), (Di Lauro et al., 2020) [↵]
3 [↵]	Identity co-creation; Corporate performances; [↵]	(Devereux, Melewar and Foroudi , 2017), (Iglesias et al., 2020), (Upendra Kumar Maurya et al., 2015) [↵]
4 [↵]	Social media strategy; media entrepreneurship [↵]	(Arendt and Brettel , 2010), [↵] (Hassan , Nadzim and Shiratuuddin , 2015) [↵]
6 [↵]	Entrepreneurial Identity; social identity; [↵]	(Wang et al., 2022) [↵]

By screening out irrelevant articles based on defined themes, 49 publications were further excluded. In the following chapter we will undertake a standardised procedure to analyse data from the remaining 52 publications with identified themes. The thematic intersections led credence to this SLR and helped identify important gaps in knowledge. These intersectional pieces of literature were grouped together into a separate third theme: Interplay between Start-up Success & Digital Identity – and included 42 of articles in English and 10 in Mandarin.

4. Research themes

The digital divide refers to the unequal access to digital technology, where not only geographical factors but knowledge, skills and connectivity within the ecosystem could deepen the gap of digital divide. Specifically, prior study has shown that digital identity is becoming one of the emerging factors that causing division hence the success/failure of digital entrepreneurship (Zhang, 2022). Taking the theoretical lens of the NVC process, our aim is to identify the overlaps between digital identity and digital divide literature to highlight how scholars in the area explain the digital identity formation process, and the manner in which it contributes to start-up success. Specifically, we wish to present new understanding on the role of digital identity in start-up success within the Chinese online entrepreneurial eco-system (Zaheer et al., 2022).

4.1 Digital Divide and New Venture Creation Process

The development of digital technology over the past decade, particularly the growth of the Internet, has provided an efficient and effective way to launch businesses online exclusively (Elia, 2020). Darja Reuschke, Mason and Syrett (2021) assert that new business concepts based on Information and Communication Technology (ICT) have simplified the process of entrepreneurship. Researchers have focussed on analysing what enabling mechanisms of digital technologies come into play during the entrepreneurial process and develop stage-specific claims for the impact of enabling digital technologies on start-up activity. The NVC process of start-ups is characterized by flexibility, experimentation, learning, and interactivity owing to digital technologies, reducing the risk associated with the start-up development process (Kraus et al., 2019). Digital infrastructures, digital artifacts and digital ecosystems form part of new entrepreneurial ideas and act as external enablers, with specificity and relationality as two prominent properties (Frederik von Briel, Per Davidsson and Recker, 2018). While low specificity digital technology has significant scalability and editing (input and output are not rigorously constrained), rigid digital technology has high professionalism and access threshold (such as digital twining). This will lead to a new digital divide paradigm when ventures lose their digital edge due to barriers to access. The change in the entrepreneurial landscape is so fundamental that Nambisan (2017) proposes that the use of a "digital identity lens" to examine the phenomena of entrepreneurship is now fundamental. Such a lens will help us recognise important extant changes in entrepreneurial processes and outcomes driven by the distinctive features of digital technology. For example, we can determine whether digital identities make some start-ups more successful than others, how affordability of digital technologies in different configurations induces start-up activity in certain industries, and at what stage of the entrepreneurial process, which features of digital identities provide maximum value. Therefore, the support provided by specific digital technologies is associated with specific stages of firm development. This observation warrants a deeper investigation at the impact of digital technologies on start-up activity depending on the stage being initiated (Li, Du and Yin, 2017).

It has been shown that digital affordances can accelerate the traditional NVC process, which is seen as consisting of the following stages: 1. conceptualising 2. resourcing 3. developing 4. scaling (Zaheer *et al.*, 2022). E-entrepreneurs negotiate these stages using digital media. Such media exists in a plethora of forms, and enables the building of connections with external audiences and customers through diverse channels and modes of communication, as well as to facilitate internal communication, decision-making and organisational development (Hassan, Nadzim and Shiratuddin, 2015; Devereux, Melewar and Foroudi, 2017).

4.2 Digital Identity as Mediator to Digital Divide

Based on data from the 2018 China Household Tracking Survey (CFPS), the study found that the digital divide significantly inhibits the probability of starting a venture with the household as the smallest unit (Zhang, 2022). Research based on the Chinese context shows that Micro-SMEs can reap digital information dividends by actively interacting with digital ecosystems such as the Internet and other digital information technologies (Ma, Lin and Xiao, 2022). The connection between entrepreneurship and identity becomes apparent in the work that entrepreneurs do, which has implications for the image, perception and identity of the organisation (Leitch and Harrison, 2016). This means that identity work may be seen as an element of strategizing. A clear and legitimate identity helps entrepreneurs achieve consistency, uniqueness and authenticity that eliminate digital divide within the digital entrepreneurial ecosystem (Flint, Signori and Golobic, 2018). It is a complex and dynamic process, and entrepreneurs should adapt their identity in response to changes in the entrepreneurial environment and market demands (Di Lauro et al., 2020).

Micro and small business entrepreneurs expand their social capital ties by enhancing their digital information technology application capabilities, and the prevalence and low barriers to digital technology provide easier and more diverse channels for using the internet for identity building (Zhou and Que, 2022). Entrepreneurs need to communicate their core values and characteristics in order to facilitate the digital identity formation process (Newbery et al., 2018), and digital ecosystems are considered the ideal environment for stakeholder interaction and co-creation of identity due to their unique features which facilitate scale collaboration (Wang, Liu and Qu, 2023). We find that the rise of digital business challenges the resource-based view of the firm and the division and definition of the firm's resources themselves, instead emphasizing the role of social, cultural and spatial aspects of entrepreneurial processes and outcomes (Zhang, 2022).

Overall, within the literature, there is still limited discussion of how digital ecosystem and the collaborative dynamics enabled by such technology can change and transform the entire entrepreneurial process (Elia, 2020). Entrepreneurial identity is seen as a transitory phenomenon which is co-constructed through interactions within

digital ecosystem with an ever-changing audience (Wang, Liu and Qu, 2023). Therefore, constructing coherence and receiving attention are core aspects that entrepreneurs need to sustain in creating their entrepreneurial identities.

4.3 Identity: Old versus New Identity Archetypes

According to Yitshaki and Kropp (2016), identity is composed of concrete elements that interact with each other and more diffuse features (such as emotions or beliefs) that are abstract and difficult to capture and measure. The term is often used interchangeably with corporate reputation, corporate portraits, and corporate branding (Devereux et al., 2017). Numerous studies report that identity has become an important strategic concept because its effective management has a positive impact on corporate performance (Arendt and Brettel, 2010). Nguyen et al. (2018) argued that Chinese high-tech companies in the early stages of development that do not have a cohesive strategy and the requisite experience in developing a robust corporate identity, limit their potential to communicate their value and offerings.

Identity work helps build credibility and creates more favourable business relationships with potential customers (Di Lauro et al., 2020). Staub et al. (2016) examined the relationship between innovation ability, sustainability and identity under the classifications of soft and hard endogenous drivers. Hard drivers included corporate culture, attitude and philosophy, while soft drivers included corporate image, communication, and design. According to the identity co-creation performances model described by Devereux et al. (2020), scholars are leaning towards the idea that the concept of identity is dynamic because in practice it can evolve in-between four core status (communication, internalisation, contest, elucidation) over time. Stakeholders constantly reflect, validate and reconcile their subjective perceptions of differences in identity through interactive channels (Essamri, McKechnie and Winklhofer, 2019). In this co-creation process, stakeholders simultaneously give multiple meanings to the intended identity and may resonate with other stakeholders within the digital ecosystem (Iglesias et al., 2020).

Off-late the understanding of digital identity has shifted from a perspective that is solely nurtured by its founders to a dynamic concept in the digital arena, where it is co-created by multiple stakeholders (Iglesias *et al.*, 2020). Research on the concept of identity can be divided into several temporal stages, with the early stages revolving around corporate marketing and marketing communications, the middle stages formally establishing the concept and focusing on corporate strategy, and the later stages refining the dimensions and classifying themes (He, 2012). The differences in features between the old and new archetypes of identity are compared in Table 4.

Table 4: Features Comparison: Physical identity vs. Digital identity

Features [↙]	Old identity archetype [↙]	New identity archetype [↙]
Form of communication [↙]	One-way: one to many [↙]	Two-way: one to one [↙]
Contents [↙]	Single content, created by venture itself [↙]	Rich content, co-created by stakeholders [↙]
Mode of perception [↙]	Passively accepted by the audiences [↙]	Interactively constructed [↙]
Effectiveness of identification [↙]	Propagation delay [↙]	Instantaneity [↙]
Limitation [↙]	Constrained by channels [↙]	Unlimited size, <u>time</u> or space [↙]
Formation process [↙]	Unexpected time or cost consumption [↙]	Low cost and low threshold [↙]

4.4 Identity Work and Digital Entrepreneurship Eco-systems

Entrepreneurial ecosystems are clusters of industries influenced by spatial proximity and availability of digital technologies (Autio et al., 2018). In order to deepen the understanding of digital entrepreneurship in the emerging phase of the field's development, it is desirable to delve into the processes and outcomes of various entrepreneurial actions interacting with the external environment (Zaheer, 2022). The multiple interrelated elements, resources, and networks that aid in the development and expansion of digital startups are collectively defined as the "digital entrepreneurial ecosystem". It includes a variety of stakeholders, such as entrepreneurs, investors, customers, government and academic institutions. The key components of a digital entrepreneurial ecosystem typically include access to funding and investment; preservation of talent and skills; availability of

supportive infrastructure, such as incubators, accelerators, and coworking spaces; and bondage between research institutions (Autio et al., 2018; Guo et al., 2021).

A major challenge digital entrepreneurs face in business development is building trust among ecosystem participants (Kraus et al., 2019). This happens by, for example, sharing of new ideas, publishing updates on prototypes and receiving feedback from followers, enabling entrepreneurs to leverage their knowledge (Liu, Lin and Xing, 2021) and openly co-create products with customers (Essamri, McKechnie and Winklhofer, 2019). It is agreed that digital technology is changing how organizations do business, and associated digital technology has made it easier for online-only start-ups to conduct user preference analyses based on consumption and other data, thereby providing targeted products to specific segment needs (Hassan, Nadzim and Shiratuddin, 2015). There is a need, therefore, for digital start-ups to proactively explore customer participation opportunities, extend contextual feedback and inspire customers to participate in the value creation process (Guo et al., 2021).

Overall, a digital entrepreneurial ecosystem is critical for the growth and success of startups and digital businesses, as it provides the necessary support and resources to help them navigate the challenges of launching and scaling a new venture in the digital age. However, to properly comprehend the digital nature of these new forms of entrepreneurship, we need to further address the potential of digital technologies as entrepreneurship enablers via the theoretical lens of strategy-as-practices (Frederik von Briel, Per Davidsson and Recker, 2018). This is important because strategic actions become more complex in start-ups using digital media, as the location of meaning production shifts from within the organization to ongoing engagement with audiences (Elia, Margherita, and Passiante, 2020).

5. Potential for Further Research

One of the essential purposes behind conducting this SLR was to identify key themes for future research on the topic. We have highlight two well-developed themes in the area: ‘digital entrepreneurial ecosystem’ and ‘digital identity’, showing that a consistent digital identity can significantly shorten the NVC process and overcome the startup success gap caused by the digital divide. The assumption that digital identities are dynamic is now reaching the level of consensus in scholarship in the area and that it changes with interaction with digital entrepreneurial ecosystem. Specifically, prior research has shown that identities can be modified based on corresponding internal and external radical events, and that these aspects could be negatively or positively affected by the existence of digital divide. There is a distinct lack of novel research on digital identity formation in emerging economies such as China. A large number of young digital entrepreneurs are engaging with the Chinese national digital eco-system with undergone significant development under Chinese government policies. Interactions in the digital entrepreneurial ecosystem can act as a form of virtual social capital that translates into real-life social networks and contributes to the accumulation of social capital. Thus, a digital identity management construct is urgently needed for these micro and small businesses for better differentiation strategies. Although many authors have highlighted the importance of developing a digital representation, a study of how digital identity evolves with changes in the internal and external environment and such changes’ link to start-up success will be an important contribution to current scholarship. Since entrepreneurs often see their ventures as an integral part of their own personal identity, radical changes such as innovative disruption or business failure can be critical to prompt such identity changes (Zhu and Yang, 2023).

6. Conclusion and Limitations

The research overlapping digital entrepreneurship and digital identity is still in its infancy. We now recognize that “success” in the start-up phase depends largely on the support generated by the digital society. If the digital divide is widespread, the accumulation of social capital through digital information tools cannot be achieved. Although the importance and positive impact of digital identity on start-up performance has been largely proven, so far we lack understanding on the dynamics of that emerge, amongst other factors related to the make-up of digital entrepreneurship eco-systems, as a response to *digital divide*. Incorporating concepts that draw on digital identity within entrepreneurship research can allow us to examine how the infusion of fluidity or volatility impacts the entrepreneurial process. Ultimately, what we urgently need is a robust identity-theory perspective to explain how entrepreneurship promotion mechanisms and institutions, enabled and supported by digital entrepreneurial ecosystem, shape stage-dependent entrepreneurial processes and outcomes.

Two challenges and limitations of this SLR can be stated. Firstly, since we have conducted key term search procedures for international publications in both English and Chinese databases, we were unable to include all variants of key terms related to digital identity and e-entrepreneurship. Another limitation is that the scope of

our work can potentially be restrained by our selection of the 18 extant literature reviews by previous researchers – these extant literature reviews were published in earlier years with different research foci which could have potentially biased our selection of themes.

References

- Arendt, S. and Malte Brettel (2010). Understanding the influence of corporate social responsibility on corporate identity, image, and firm performance. *Management Decision*, 48(10), pp.1469–1492.
- Autio, E., Nambisan, S., Thomas, L.D.W. and Wright, M. (2018). Digital affordances, spatial affordances, and the genesis of entrepreneurial ecosystems. *Strategic Entrepreneurship Journal*, 12(1), pp.72–95
- Azzouz Essamri, McKechnie, S. and Winklhofer, H. (2019). Co-creating Corporate Brand Identity with Online Brand communities: a Managerial Perspective. *Journal of Business Research*, 96, pp.366–375.
- Chartered Association of Business Schools. (2021). *Academic Journal Guide 2021*. [online] Available at: <https://charteredabs.org/academic-journal-guide-2021-view/>.
- China Internet Network Information Center (2022). *The 50th Statistical Report on China's Internet Development*. [online] Available at: <https://www.cnnic.com.cn/IDR/ReportDownloads/202212>
- Curley, M.G. and Piero Formica (2013). The Experimental Nature of New Venture Creation: Capitalizing on Open Innovation 2.0. Cham; New York: *Springer Verlag*, Cop, pp.23–57.
- Darja Reuschke, Mason, C. and Syrett, S. (2021). Digital Futures of Small Businesses and Entrepreneurial Opportunity. *Futures*, 128.
- Devereux, L., Melewar, T.C., Dinnie, K. and Lange, T. (2020). Corporate identity orientation and disorientation: A complexity theory perspective. *Journal of Business Research*, 109, pp.413–424.
- Devereux, L., Melewar, T.C. and Pantea Foroudi (2017). Corporate identity and social media: Existence and extension of the organization. *International Studies of Management and Organization*, 47(2), pp.110–134.
- Di Lauro, S., Tursunbayeva, A., Antonelli, G. and Martinez, M. (2020). Organizational and Corporate Identity on Social Media: A Literature Review. *International Journal of Business and Management*, 15(4), p.53.
- Elia, G., Margherita, A. and Passiante, G. (2020). Digital entrepreneurship ecosystem: How digital technologies and collective intelligence are reshaping the entrepreneurial process. *Technological Forecasting and Social Change*, 150, p.119791.
- Fan, D., Breslin, D., Callahan, J.L. and Iszatt-White, M. (2022). Advancing Literature Review Methodology through Rigour, Generativity, Scope and Transparency. *International Journal of Management Reviews*, 24(2), pp.171–180.
- Flint, D.J., Signori, P. and Golcic, S.L. (2018). Corporate Identity Congruence: A Meanings-based Analysis. *Journal of Business Research*, 86, pp.68–82.
- Frederik von Briel, Per Davidsson and Recker, J. (2018). Digital Technologies as External Enablers of New Venture Creation in the IT Hardware Sector. *Entrepreneurship: Theory and Practice*, 42(1), pp.47–69.
- Guo, H. and Yang, Z. (2021). “从数字技术到数字创业：内涵、特征与内在联系”，From Digital Technology to Digital Entrepreneurship: Connotation, Characteristics and Internal Connection. *Foreign Economics & Management*, [CNKI], 43(9), pp.3-23
- Guo, R., Han, M., Shao, T. and Feng, Z. (2021). “生态视角下数字化转型企业的机会开发机理”，Opportunity Development Mechanism of Enterprises in Digital Transformation from an Ecosystem Perspective: Based on the Case Studies of Haier and Suning. *Foreign Economics & Management*, [CNKI], 43(9), pp.43-67
- Hassan, S., Nadzim, S.Z.A. and Shiratuddin, N. (2015). Strategic Use of Social Media for Small Business Based on the AIDA Model. *Procedia - Social and Behavioral Sciences*, 172(172), pp.262–269.
- He, H. (2012). Corporate Identity Anchors: A Managerial Cognition Perspective. *European Journal of Marketing*, 46(5), pp.609–625.
- Horst, S.-O. and Hitters, E. (2020). Digital Media Entrepreneurship: Implications for Strategic Identity Work and Knowledge Sharing of Beginning Entrepreneurs. *Nordic Journal of Media Management*, 1(1), pp.23–44.
- Iglesias, O., Landgraf, P., Ind, N., Markovic, S. and Nikolina Koporcic (2020). Corporate Brand Identity Co-creation in Business-to-Business Contexts. *Industrial Marketing Management*, 85, pp.32–43.
- John M.T. Balmer (2017). The Corporate Identity, Total Corporate Communications, Stakeholders' Attributed Identities, Identifications and Behaviours Continuum. *European Journal of Marketing*, 51(9-10), pp.1472–1502.
- Kraus, S., Breier, M. and Dasí-Rodríguez, S. (2020). The Art of Crafting a Systematic Literature Review in Entrepreneurship Research. *International Entrepreneurship and Management Journal*, 16(3), pp.1023–1042.
- Kraus, S., Palmer, C., Kailer, N., Kallinger, F.L. and Spitzer, J. (2019). Digital Entrepreneurship: A Research Agenda on New Business Models for the Twenty-first Century. *International Journal of Entrepreneurial Behaviour & Research*. 25(2), pp. 353-375.
- Kraus, S., Palmer, C., Kailer, N., Kallinger, F.L. and Spitzer, J. (2019). (PDF) Digital entrepreneurship: A research agenda on new business models for the twenty-first century.
- Lai, L.S.L. and To, W.M. (2020). E-Entrepreneurial Intention Among Young Chinese Adults. *Asian Journal of Technology Innovation*, 28(1), pp.119–137.
- Laroche, M., Habibi, M.R. and Richard, M.-O. (2013). To Be or Not to Be in Social media: How Brand Loyalty Is Affected by Social media? *International Journal of Information Management*, 33(1), pp.76–82.

- Laurell, H., Achtenhagen, L. and Andersson, S. (2016). The Changing Role of Network Ties and Critical Capabilities in an International New Venture's Early Development. *International Entrepreneurship and Management Journal*, 13(1), pp.113–140.
- Leitch, C.M. and Harrison, R.T. (2016). Identity, Identity Formation and Identity Work in entrepreneurship: Conceptual Developments and Empirical Applications. *Entrepreneurship & Regional Development*, 28(3-4), pp.177–190.
- Li, W., Du, W. and Yin, J. (2017). Digital Entrepreneurship Ecosystem as a New Form of Organizing: the Case of Zhongguancun. *Frontiers of Business Research in China*, [CNKI], 11(1), pp.1–21.
- Liu, Z., Lin, S. and Xing, X. (2021). “数字创新创业：研究新范式与新进展”, Digital Innovation and Digital Entrepreneurship: New Paradigm and Research Advance. *R&D Management*, [CNKI], 33(1), pp.1-11
- Ma, H., Lin, Y. and Xiao, B. (2022). “数字创业生态系统中多主体互动对数字创业绩效的影响”, Impact of Multi-Agent Interaction in Digital Entrepreneurial Ecosystem on Digital Entrepreneurial Performance — A Study Based on fsQCA Method. *R&D Management*, [CNKI], 34(3), pp.41-53
- Mmbaga, N.A., Mathias, B.D., Williams, D.W. and Cardon, M.S. (2020). A Review of and Future Agenda for Research on Identity in Entrepreneurship. *Journal of Business Venturing*, 35(6): 106049.
- Newbery, R., Lean, J., Moizer, J. and Haddoud, M. (2018). Entrepreneurial identity formation during the initial entrepreneurial experience: The influence of simulation feedback and existing identity. *Journal of Business Research*, 85, pp.51–59.
- Nguyen, B., Melewar, T.C., Japutra, A., Sung Ho Han, Chen, S. and Yu, X. (2018). An Investigation of the Corporate Identity Construct in China: Managerial Evidence from the High Technology Industry. *Journal of Marketing Communications*, 24(8), pp.779–800.
- Satish Nambisan (2017). Digital entrepreneurship: toward a Digital Technology Perspective of Entrepreneurship. *Entrepreneurship: Theory and Practice*, 41(6), pp.1029–1055.
- Staub, S., Kaynak, R. and Gok, T. (2016). What Affects Sustainability and Innovation — Hard or Soft Corporate identity? *Technological Forecasting and Social Change*, 102, pp.72–79.
- Horst, S.O., Järventie-Thesleff, R. and Perez-Latre, F.J. (2020). Entrepreneurial Identity Development through Digital Media. *Journal of Media Business Studies*, 17(2), pp.87–112.
- Maurya, U.K., Mishra, P., Anand, S. and Kumar, N. (2015). Corporate identity, Customer Orientation and Performance of SMEs: Exploring the Linkages. *IIMB Management Review*, 27(3), pp.159–174.
- Wang, J., Liu, S. and Qu, Q. (2023). “数字平台生态系统中的创业企业成长研究：现状、框架与展望”, Research on the Growth of Entrepreneurial Enterprises in Digital Platform Ecosystem: Current Situation, Framework and Prospects. *R&D Management*, [CNKI], 35(1), pp. 72-88
- Yitshaki, R. and Kropp, F. (2016). Entrepreneurial Passions and Identities in Different contexts: a Comparison between high-tech and Social Entrepreneurs. *Entrepreneurship & Regional Development*, 28(3-4), pp.206–233.
- Zaheer, H., Breyer, Y., Dumay, J. and Enjeti, M. (2022). The Entrepreneurial Journeys of Digital start-up Founders. *Technological Forecasting and Social Change*, 179(6-7):121638
- Zhang, Y. (2022). “数字鸿沟与农户家庭创业”, Digital Divide and Rural Household Entrepreneurship. *Journal of Shanxi University of Finance and Economics*, [CNKI], 44(2), pp.103-114
- Zhu, X. and Yang, S. (2022). “数字创业生态系统研究述评与展望”, A Review and Prospects of Digital Entrepreneurial Ecosystem. *Foreign Economics & Management*, [CNKI], 44(5), pp.48-63
- Zhu, X. and Yang, S. (2023). “数字创业生态系统多主体协同机制研究”, Multi-Agent Synergy Mechanism of Digital Entrepreneurial Ecosystem. *Chinese Journal of Management*, [CNKI], 20(1), pp.86-95

Technology Complexity and Firm Performance: The Moderating Effect of Design Innovation

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Abstract: In today's highly competitive markets, firms can no longer ensure competitive advantage through the development of highly complex technologies or differentiation based solely on technological and functional factors. Simultaneously, there is growing recognition that design and aesthetic factors can contribute to firms' competitive advantage and profitability. Hence, this study examines the effects of design innovation, captured by formal design registration, on firms' financial performance. We investigated the relationship between technology complexity, design innovation, and firm performance to unveil design innovation's role in exploiting complex technologies. Our main hypothesis is that design innovation positively moderates the negative effect that technology complexity yields on firm performance. We used a unique dataset that aggregates all patent data published by US-headquartered publicly-traded firms to the parent company level. We combined this with firms' financial information and design patent data from the Computat and PATSTAT databases based on their matching firm identifier. Focusing on 1,765 US firms from 1980 to 2015, we calculated firm-level technology complexity based on the structural diversity of technologies. The results confirmed our hypotheses. This study contributes to firms' resource-based view by recognizing design as a strategic resource that firms can utilize to gain a competitive advantage and by discovering design innovation's role in generating economic profits.

Keywords: Design innovation, Technology complexity, Structural diversity, Patent analysis, Resource-based theory

1. Introduction

In today's highly competitive markets, firms constantly seek new ways to innovate and gain a competitive advantage. While technological and functional factors have traditionally been the focus of such efforts, there is growing recognition that design and aesthetic factors can also be crucial in driving financial success. Technological innovations are often complex and require significant research and development (R&D) investments, with high risks and uncertainties associated with the development of new products or processes. In contrast, design innovations, including redesigning an existing product, often in combination with minor technical improvements, tend to be more incremental and involve far less R&D efforts and uncertainty (Walsh et al., 1992). In fact, most firms rely on incremental innovations and design improvements as their primary approach to new product development. Subsequently, new products are increasingly similar in functional features, and competition is shifting towards unique designs (Talke et al., 2009).

While several studies have highlighted the effects of design innovation on firms' financial performance (Bloch, 2011; Candi and Saemundsson, 2011; Filippetti, 2011; Roper et al., 2016; Rosenfeld, 2018; Rubera and Droge, 2013), most of these studies have relied on estimations of firms' design activities based on factors such as the expenditures (Chiva and Alegre, 2009; Vinodrai et al., 2007), centrality (Galindo-Rueda and Millot, 2015; Montresor and Vezzani, 2020), and internal management of design (Filippetti, 2011; Filippetti and D'Ippolito, 2017). However, these measures do not fully capture the functional dimensions of design innovation. Alternately, design patents offer legal protections for a product's aesthetic and functional features, including its style, usability, and modularization (Filippetti and D'Ippolito, 2017). Accordingly, this study explores the role of design patents in enhancing firms' financial performance.

A growing body of research has considered the various mechanisms of how design innovation contributes to firm performance, such as in relation to the emotional and symbolic value embedded in design (Creusen and Schoormans, 2005; Hoegg and Alba, 2011), and the strategic use of design for product differentiation (Filitz and Henkel, 2016; Gemser and Leenders, 2001). While researchers have some understanding of how design contributes to firm performance, it remains unclear how design may contribute to a firm's ability to exploit and commercialize complex technologies. To address this gap in the literature, we examine the moderating effects of design innovation on the financial performance of firms, specifically in the context of complex technologies. Specifically, we argue that design innovation can act as an alternative source of profit for firms investing in complex technologies that are often associated with high levels of R&D efforts as well as market and technical uncertainty (Fleming, 2001; Fleming and Sorenson, 2001).

To test our hypotheses, we used a unique dataset from Arora et al. (2021) that aggregates all patent data published by US-headquartered publicly-traded firms to the parent company level. We combined this with firms' financial information and design patent data from the Computat and PATSTAT databases based on their matching firm identifier, i.e., the global company key (GVKEY) and the PATSTAT standardized assignee identifiers, respectively. The empirical analysis focused on 1,765 US-headquartered public firms from 1980 to 2015, for which we calculated a parent firm-level technology complexity based on the recently developed measure of structural diversity (Broekel, 2019). The results of panel generalized least square (GLS) regressions confirm our hypotheses on the direct effect of design innovation on the financial performance of firms and its moderating effect on the relationship between technology complexity and firm performance, suggesting that firms operating in technology-intensive industries need to be particularly attuned to the role of design in exploiting and commoditizing complex technologies.

The present study aims to contribute to the resource-based view of the firm by recognizing design as a strategic resource that firms can leverage to gain a competitive advantage (Barney, 1991). Additionally, our findings shed light on the potential benefits of design innovation in the context of complex technologies. Our findings offer insights that can inform firm strategies and innovation management practices by highlighting the importance of design innovation in complex technology environments.

2. Literature review and hypotheses

2.1 Technology complexity and firm performance

2.1.1 The two-sided effects of technological complexity at the firm level

Complex knowledge is more challenging to invent and learn, which, in turn, requires greater economic efforts to enter those domains (Mewes and Broekel, 2022). Hence, complex knowledge is less likely to diffuse (Ganco, 2013), making it more exclusive and valuable in economic terms (Broekel, 2019). Researchers investigating this topic have typically relied on the resource-based theory of the firm as their framework. This theory proposes that complex knowledge is not easily diffused nor imitable and therefore provides firms with a significant potential for competitive advantage (Juhász et al., 2021), and greater returns from innovations (Mewes and Broekel, 2022).

While complex knowledge is often characterized by greater economic value, it also poses challenges in terms of understanding and (re-)combining. The recombination of diverse knowledge components results in a complex knowledge base, which affects the understandability and transferability of knowledge within and outside firm boundaries (Hou et al., 2022). This argument is supported by various empirical studies observed at the firm level of analysis, which demonstrate that complex technologies are negatively associated with knowledge transfer between actors within firms (Ganco, 2013), use of external knowledge (Lane et al., 2006), and knowledge generation (Hou et al., 2022).

2.1.2 Research gap and hypothesis

Based on the preceding arguments and the conflicting evidence in the literature, we reckon that further insights could be gained by examining the impact of technology complexity on firms' financial performance. Specifically, we hypothesize that the effect of complexity on firms' financial performance will be negative. This is based on the idea that while complex technologies may offer significant potential for competitive advantage and long-term economic value due to their difficulty in imitation (Juhász et al., 2021), they may not be as effective in exploiting their knowledge base and generating short-term profitability. Complex technologies may limit a firm's options for commoditization, as they may require specific complementary assets, skills, and capabilities (e.g., skilled labor, specialized production processes, and equipment) to fully exploit and commercialize their knowledge base.

In contrast, firms with simpler technologies may have greater flexibility and ease in commoditizing their products or services, as they can leverage more widely available and transferable knowledge components. Furthermore, the complexity of a firm's knowledge limits the benefits of extensibility mechanisms, as greater complexity reduces the portion of output on which each knowledge component can be applied, thereby increasing the average cost of knowledge (Antonelli et al., 2022). Hence, the following hypothesis is proposed:

Hypothesis 1. Technology complexity is negatively associated with firms' financial performance.

2.2 Design innovation

2.2.1 *The impact of design*

Scholars have recently devoted increasing attention to understanding how design contributes to firms' innovative performance (Montresor and Vezzani, 2020; Roper et al., 2016), financial performance (Roper et al., 2016; Rosenfeld, 2018), and organizational strategies (Micheli et al., 2018).

There is sufficient theoretical and empirical evidence supporting a positive relationship between design and the financial performance of firms (Filitz and Henkel, 2016; Hoegg and Alba, 2011). Several scholars have investigated the different roles that design and designers can play in the new product development (NPD) process and their contributions to NPD performance (Goffin and Micheli, 2010; Perks et al., 2005; Ravasi and Stigiani, 2012; Roper et al., 2016). Their findings generally confirm that design positively contributes to the novelty and success of NPD, regardless of its role (e.g., design as a functional specialization or a bridging role in NPD, and continuous involvement of design in the NPD process). The role of design in promoting the marketability of innovations is also evident in studies that assess the impact of design on firm performance based on the probability of having high shares of innovative turnover (Bloch and Graversen, 2008; Galindo-Rueda and Millot, 2015; Roper et al., 2016). Specifically, Montresor and Vezzani (2020) found that the probability of having over 50 percent of turnover from innovative offerings is 3.3 percent higher in firms where design plays a central role than in firms that do not value design.

2.2.2 *Design patents as a proxy for design innovation*

The majority of studies that examine the effects of design innovation estimate firms' design activities based on the expenditure (Chiva and Alegre, 2009; Vinodrai et al., 2007), centrality (Candi and Saemundsson, 2011; Montresor and Vezzani, 2020), and internal management of design (Czarnitzki and Thorwarth, 2012; Filippetti and D'Ippolito, 2017).

Design patents, however, can be a more suitable indicator for assessing a firm's emphasis and devotion to design innovation for the following reasons (Dan et al., 2018). First, like patents provide patent holders the exclusive right to produce, sell, and use the invention for a certain period, design registration provides legal protection against imitation and infringement by competitors, which can lead to a competitive advantage in the market. Second, design patents are cheaper and have a shorter approval period than utility patents. Given the lower overall cost and potential benefits in reducing competition, a rational firm should prioritize pursuing design patents. Finally, design patents provide legal protection for both the aesthetic and functional features of a product, including the style, usability, and modularization of a product (Filippetti and D'Ippolito, 2017). Although there is no uniform definition nor measurement for design innovation, it is widely accepted that design is not merely the physical form of a product but is closely interlinked with the functional and technological aspects, as well as some manufacturing aspects of a product such as ease of manufacturing and efficient use of materials (Gemser and Leenders, 2001).

2.2.3 *Research gap and hypothesis*

Overall, theoretical and empirical support exists for a positive relationship between design innovation and firms' financial performance. However, to date, this relationship has not been empirically tested on design patents across multiple industries. Thus, it remains unclear whether firms' engagement in design innovation, as measured by legal registration of design that captures both the aesthetic and functional dimensions of a product, affects the profitability of their innovations. We thus state and test the following hypothesis:

Hypothesis 2. Design innovation is positively associated with firms' financial performance.

2.3 Technology complexity and design innovation

2.3.1 *Increased marketability and exploitation of complex technologies*

The relationship between design innovation and the marketability of innovations finds wide theoretical support in the literature (Galindo-Rueda and Millot, 2015; Montresor and Vezzani, 2020). The literature proposes that firms can enhance their capability to handle the challenges of introducing innovative products through design innovation. This enables them to gain a better understanding of consumer responses, shape their needs and preferences, and respond with innovative solutions that incorporate technological and non-technological

advancements. In this respect, design innovation may improve the marketability of complex technologies that are often characterized by higher levels of market uncertainty (Valle and Vázquez-Bustelo, 2009) by introducing products that are not just technologically advanced but also better suited to the needs and preferences of the market. Additionally, considering that complex technologies are also characterized by higher levels of R&D risks, firms can build on their existing knowledge to (re-)design products or services that are more tailored to the needs and preferences of specific customer segments such as those in niche markets or with specific functional or aesthetic needs (Gilal et al., 2022; Hemonnet-Goujot and Valette-Florence, 2022; Verganti, 2018). Hence, firms that invest in design capabilities are more likely to successfully commercialize complex technologies and achieve greater profits from their innovations.

Technology-driven radical innovations built upon a complex knowledge base are associated with greater R&D efforts, difficulties, as well as market and technical uncertainties (Valle and Vázquez-Bustelo, 2009). Conversely, design innovations, including redesigning an existing product, often coupled with minor technical improvements, involve far less R&D effort and uncertainty (Walsh et al., 1992). On this basis, firms pursuing radical innovation can reduce the uncertainty and risks associated with technological development by investing in design capabilities. In other words, design innovation may act as an alternative source of profit for firms investing their R&D efforts in complex technologies (Verganti, 2009).

2.3.2 Research gap and hypothesis

Based on the literature discussed so far, we argue that design innovation can assist firms in better utilizing their complex knowledge by transforming it into more valuable and marketable products or services. By combining their existing knowledge with design thinking, firms can develop products or services that cater to the unique requirements of different customer groups while reducing the uncertainty and risks associated with developing complex technologies. Consistent with Hypothesis 1, we contend that the negative impact that technology complexity has on firms' financial performance can be mitigated through design innovation, which helps firms leverage their existing knowledge and even successfully commercialize complex technologies. Thus, we propose the following hypothesis:

Hypothesis 3. Design innovation positively moderates the relationship between complexity and firms' financial performance.

3. Data and methods

3.1 Data

3.1.1 Data and sources

Figure 1 illustrates the data collection method. Using Arora et al.'s (2021) set of patent applications from PATSTAT matched to Compustat firms for the period 1980–2015 as a reference dataset, we combined data from three main sources: (i) company and financial information from the Compustat North American Database, (ii) design patent applications and additional information related to Arora et al.'s (2021) patent dataset (i.e., the Cooperative Patent Classification (CPC) and citation information) from the EPO's PATSTAT Database, and (iii) structural diversity values from Broekel (2019).

Arora et al. (2021) aggregated all patent data published by US-headquartered publicly-traded firms with active records and positive R&D expenses for at least one year from 1980 through 2015 to the parent company level, accounting for both private and publicly-traded subsidiaries. Consequently, we linked Arora et al.'s (2021) dataset with the Compustat and PATSTAT datasets based on their matching firm identifier, i.e. GVKEY and patent publication I.D.s, respectively.

Figure 1 provides a summary of all the variables and data sources. Using these data sources, we constructed a unique panel dataset comprising 16,888 firm-year-level observations for 1,765 firms. These observations were made over a 35-year period spanning from 1980 to 2015. It should be noted that the dataset is an unbalanced panel, as the data for each variable does not cover an identical time frame.

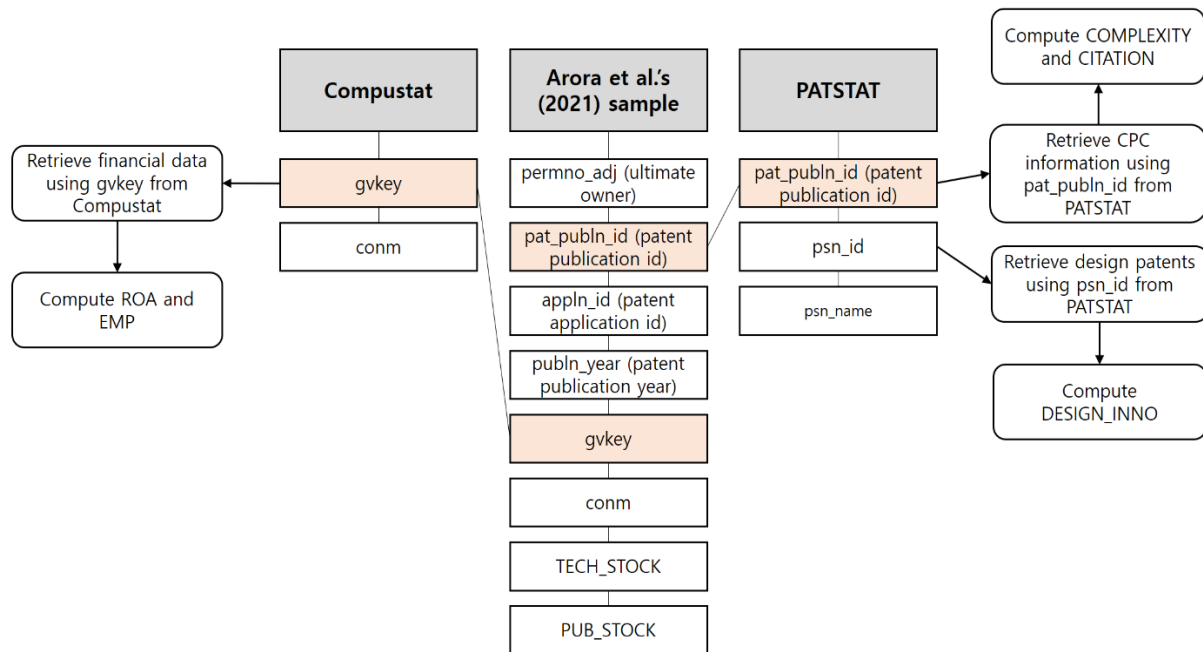


Figure 1: Framework of data collection for analysis

3.2 Variables

3.2.1 Financial performance (ROA)

We measured a firm's financial performance in a given year by its returns on assets (ROA). This is calculated by dividing the net income by the average total assets.

3.2.2 Technology complexity (COMPLEXITY)

Following Broekel (2019), we used a measure of a firm's technology complexity based on its patent portfolio. Specifically, the technology complexity of a firm in a given year was determined by multiplying the number of technology patents filed by the firm within a specific technology field (4-digit CPC) by the corresponding value of Broekel's (2019) structural diversity. This resulting value was then averaged by the number of technology fields specialized by the firm to compute the average technology complexity of the firm. To account for any delayed effects associated with patents, we lagged the measure by three years.

3.2.3 Design innovation (DESIGN)

We measured a firm's design innovation each year using the natural logarithm of the number of design patents. We also lagged this measure to account for delayed effects that could have led to endogeneity between the dependent and explanatory variables.

3.2.4 Control variables

Following the extant literature on the impact of patenting on firm performance, we included the following control variables that may be correlated with firms' financial performance, design innovation and technology complexity. First, we introduced an input measure of innovation—the stock of patents (TECH_STOCK)—to control for the impact of technology patents. Second, previous studies have empirically demonstrated the significance of firm size on technology development (Tyler and Steensma, 1998). Therefore, we included the number of employees (EMP) as a proxy for firm size to account for potential economies or diseconomies of scale. Third, to control for the importance or value of patents, we included the number of citations (CITATION) in our model. Finally, as scientific and technological discoveries are not always patented, we included the number of scientific journal publications (PUB_STOCK) to control for firms' innovation efforts that are not captured by patents. All control variables were lagged and log-transformed.

Table 1: Description of variables

Variables	Abbreviation	Description	Data source
Financial performance	ROA	The percentage of net income divided by the average total assets	PATSTAT
Technology complexity	COMPLEXITY	The average complexity of technologies possessed by firm <i>i</i> , computed with Broekel (2019)'s value of structural complexity	PATSTAT, Broekel (2019)
Design innovation	DESIGN_INNO	The number of design patents filed by firm <i>i</i> and its subsidiaries in time <i>t</i>	PATSTAT
Innovation quality	CITATION	The number of citations received for technology patents within 5 years after its publication	PATSTAT
Technology innovation	TECH_STOCK	The number of cumulative technology patents filed by firm <i>i</i> and its subsidiaries in time <i>t</i>	PATSTAT
Firm size	EMP	The number of employees	COMPUSTAT
Scientific paper publication intensity	PUB_STOCK	The number of cumulative scientific publications published by firm <i>i</i> and its subsidiaries	Arora et al. (2021)

3.3 Empirical model

The empirical model is estimated using panel data spanning 1,765 firms for 35 years from 1980 to 2015, which means the estimation method needs to account for both time-variant-effects and firm-specific variations. Therefore, we used cross-sectional time-series feasible generalized square (FGLS) regressions with panel-specific first-order autoregressive (AR(1)) autocorrelation, as suggested by Cameron and Trivedi (2005). The autoregressive model specifies that the dependent variable linearly depends on each firm's previous values. This means that the error structure is specified for each firm, allowing for a panel regression model that considers heterogeneity among firms. By doing so, we can avoid issues related to time-variant and cross-sectional endogeneity (Baltagi, 2021).

4. Results

4.1 Regression analysis

Table 3 presents the regression results for design innovation. The first model contains only the control variables, while the second model presents the baseline model with only DESIGN_INNO as an independent variable. All control variables included in the estimation models are statistically significant at the 0.01 level. The number of employees (EMP), often used as a proxy for firm size, is positive and statistically significant. The number of publications (PUB_STOCK), considered a proxy for the quantity of knowledge output, also shows the expected positive sign and is statistically significant. In other words, the more scientific papers published, the higher the financial performance of the firms. The coefficients of CITATION and PATENT_STOCK are also statistically significant and positive, indicating that both the quality and quantity of patenting matter for the financial performance of firms.

As for the explanatory variables, there is a significant positive effect of DESIGN on firms' financial performance in Model 2 to 4. This supports hypothesis 1, which states that design innovation positively affects a firm's financial performance. Consistent with prior literature, these findings suggest that firms that invest in design innovation are likely to achieve better financial performance, thus highlighting the importance of considering design innovation as a critical factor in firms' innovation strategies, alongside technology innovation. By investing in both technology and design innovation, firms can enhance their competitiveness and achieve sustainable long-term growth.

Model 3 includes DESIGN_INNO and COMPLEXITY together. The coefficient of COMPLEXITY is negative and significant, supporting our hypothesis that technology complexity has a negative impact on firms' financial performance. Theoretically, this result suggests that knowledge complexity may hinder a firm's effective utilization of its knowledge resources to achieve superior financial performance.

Finally, Model 4 includes the interaction term between DESIGN_INNO and COMPLEXITY. The results are consistent with those discussed so far, and the interaction term has the expected positive impact ($\beta = 0.058$) and is significant at the 0.05 level. The coefficient of technology complexity is -0.305 ($p < 0.01$) in this model, indicating that the negative impact of technology complexity on financial performance is alleviated as design innovation increases. This implies that Hypothesis 3, suggesting that design innovation can positively moderate the negative effect of technology complexity on firms' financial performance, is supported. These findings indicate that design innovation can play a crucial role in enhancing firms' financial performance, especially in the presence of high technology complexity.

Table 2: Generalized least square regression model for design innovation

		Dependent variable: logROA			
		Model 1	Model 2	Model 3	Model 4
Control variables	EMP	1.164*** (0.014)	1.230*** (0.011)	1.335*** (0.009)	1.347*** (0.009)
	PUB_STOCK	0.331*** (0.011)	0.344*** (0.010)	0.321*** (0.009)	0.315*** (0.008)
	CITATION	0.045*** (0.006)	0.080*** (0.006)	0.152*** (0.007)	0.169*** (0.007)
	PATENT_STOCK	0.204*** (0.013)	0.229*** (0.012)	0.301*** (0.013)	0.315*** (0.013)
Independent variables	DESIGN_INNO		0.032*** (0.011)	0.034*** (0.012)	0.039*** (0.013)
	COMPLEXITY			-0.284*** (0.021)	-0.305*** (0.021)
	DESIGN_INNO*COMPLEXITY				0.058** (0.024)
	Constant	12.858*** (0.038)	12.583*** (0.033)	12.336*** (0.030)	12.269*** (0.030)
N (group)		16,888 (1,765)	16,888 (1,765)	16,888 (1,765)	16,888 (1,765)
Wald χ^2		14904.60***	29089.36***	46983.53***	50033.95***
BP (χ^2)		455.26***	455.42***	397.46***	405.41***

Notes: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors are in parentheses below the coefficients.

Figure 2 presents an interaction plot that visualizes the moderating effect of design innovation. The figure plots the relationship between technology complexity and firm performance for low, medium, and high levels of design innovation. It shows that the lower the level of design innovation, the steeper the line, suggesting that the negative impact of technology complexity on firm performance is more severe for firms with lower levels of design innovation. In other words, the negative impact of technology complexity is gradually reduced as firms engage in more design innovation activities.

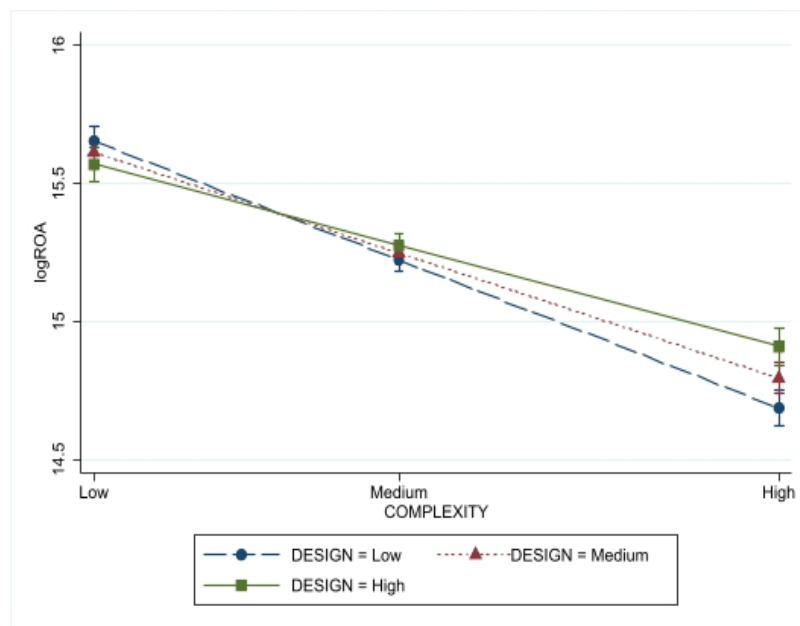


Figure 2: Impact of technology complexity on logROA at different levels of design innovation

5. Discussion and implications

5.1 Interrelationship of design innovation, technology complexity, and firm performance

The results of the present study suggest that design innovation plays a crucial role in enhancing the firms' financial performance. Specifically, we found that design innovation positively affects firm performance and moderates the negative relationship between technology complexity and firm performance. In other words, design innovation improves the negative effects of technology complexity on the exploitation or commoditization of knowledge stock. These findings are consistent with prior research illustrating the importance of design innovation in achieving competitive advantage and improving firm performance.

As argued by Antonelli et al. (2022), technology complexity can have both positive effects (e.g., an increase in the exploration of knowledge) and negative effects (e.g., a decrease in the exploitation of knowledge). The present study supports this view by highlighting the negative effects of technology complexity on firms' financial performance. Our results suggest that firms with higher levels of technology complexity face greater challenges in translating their technological knowledge into practical solutions that can create value for their customers. This could be due to the increased costs associated with developing complex technologies or the greater risks and uncertainties associated with the commercialization of such technologies. Consequently, firms with high levels of technology complexity may struggle to fully exploit their technological knowledge, leading to lower financial performance. Therefore, firms should balance their investment in complex technologies with efforts to effectively manage and exploit their knowledge to ensure sustained financial performance.

5.2 Implications

The study contributes to the resource-based view of the firm by highlighting the importance of design innovation as an important factor in driving firms' financial performance. In addition, the study offers insights into the interplay between technology complexity and design innovation, suggesting that firms operating in technology-intensive industries need to be particularly attuned to the role of design in exploiting complex knowledge and in different stages of the life cycle of a product or technology. This finding aligns with the dynamic capabilities perspective, which emphasizes the importance of firms' ability to adapt and respond to changes in their environment, such as a shift of emphasis in products from functions to forms or from technology-oriented innovation towards design-oriented innovation. From a managerial perspective, firms should invest in developing design capabilities and integrate design thinking into the product development process, particularly in technology-intensive industries. This can help firms to better exploit and commoditize their knowledge base and achieve a sustained competitive advantage.

5.3 Limitations and future research

There are some limitations to this study. First, it focuses on US-headquartered publicly-traded firms, which may limit the generalizability of the findings to smaller private firms and firms operating in other countries with different legal systems (i.e., intellectual property right), and market characteristics. Second, the study does not consider other factors that may influence the relationship between design innovation, technology complexity, and firm performance, such as market conditions, industry dynamics, and managerial capabilities.

A future research direction could be to explore the specific design capabilities and processes that are most effective in enhancing financial performance in the context of complex technologies. For example, researchers could investigate which types of design activities (e.g., product and brand design) are effective in improving the exploitation and marketability of technologies, and what approaches are effective in integrating design and technology development to create innovative and commercially successful products.

References

- Antonelli, C., Crespi, F., Quatraro, F., 2022. Knowledge complexity and the mechanisms of knowledge generation and exploitation: The European evidence. *Research Policy*, Special Issue on Economic Complexity 51, 104081. <https://doi.org/10.1016/j.respol.2020.104081>
- Arora, A., Belenzon, S., Sheer, L., 2021. Matching patents to compustat firms, 1980–2015: Dynamic reassignment, name changes, and ownership structures. *Research Policy* 50, 104217. <https://doi.org/10.1016/j.respol.2021.104217>
- Baltagi, B.H., 2021. *Econometric Analysis of Panel Data*, Springer Texts in Business and Economics. Springer International Publishing, Cham. <https://doi.org/10.1007/978-3-030-53953-5>
- Barney, J., 1991. Firm Resources and Sustained Competitive Advantage. *Journal of Management* 17, 99.

- Bloch, C., Graversen, E., 2008. Innovativeness—an examination of innovative sales as a measure of innovation output. *Journal of Product Innovation Management* 28, 378–380. <https://doi.org/10.1111/j.1540-5885.2011.00805.x>
- Broekel, T., 2019. Using structural diversity to measure the complexity of technologies. *PLoS ONE* 14. <https://doi.org/10.1371/journal.pone.0216856>
- Cameron, A.C., Trivedi, P.K., 2005. *Microeconometrics: Methods and Applications*. Cambridge University Press.
- Candi, M., Saemundsson, R.J., 2011. Exploring the Relationship Between Aesthetic Design as an Element of New Service Development and Performance*. *Journal of Product Innovation Management* 28, 536–557. <https://doi.org/10.1111/j.1540-5885.2011.00827.x>
- Chiva, R., Alegre, J., 2009. Investment in Design and Firm Performance: The Mediating Role of Design Management. *Journal of Product Innovation Management* 26, 424–440. <https://doi.org/10.1111/j.1540-5885.2009.00669.x>
- Creusen, M.E.H., Schoormans, J.P.L., 2005. The Different Roles of Product Appearance in Consumer Choice*. *Journal of Product Innovation Management* 22, 63–81. <https://doi.org/10.1111/j.0737-6782.2005.00103.x>
- Czarnitzki, D., Thorwarth, S., 2012. The Contribution of In-house and External Design Activities to Product Market Performance. *Journal of Product Innovation Management* 29, 878–895. <https://doi.org/10.1111/j.1540-5885.2012.00935.x>
- Dan, S.M., Spaid, B.I., Noble, C.H., 2018. Exploring the sources of design innovations: Insights from the computer, communications and audio equipment industries. *Research Policy* 47, 1495–1504. <https://doi.org/10.1016/j.respol.2018.05.004>
- Filippetti, A., 2011. Innovation modes and design as a source of innovation: a firm-level analysis. *European Journal of Innovation Management* 14, 5–26. <https://doi.org/10.1108/14601061111104670>
- Filippetti, A., D'Ippolito, B., 2017. Appropriability of design innovation across organisational boundaries: exploring collaborative relationships between manufacturing firms and designers in Italy. *Industry and Innovation* 24, 613–632. <https://doi.org/10.1080/13662716.2016.1263888>
- Filitz, R., Henkel, J., 2016. Competing in Design: Differentiation, Imitation, and Value Capture. <https://doi.org/10.2139/ssrn.2826391>
- Fleming, L., 2001. Recombinant Uncertainty in Technological Search. *Management Science* 47, 117–132.
- Fleming, L., Sorenson, O., 2001. Technology as a complex adaptive system: evidence from patent data. *Research Policy* 30, 1019–1039. [https://doi.org/10.1016/S0048-7333\(00\)00135-9](https://doi.org/10.1016/S0048-7333(00)00135-9)
- Galindo-Rueda, F., Millot, V., 2015. *Measuring Design and its Role in Innovation*. OECD, Paris. <https://doi.org/10.1787/5js7p6lj6zq6-en>
- Ganco, M., 2013. Cutting the Gordian knot: The effect of knowledge complexity on employee mobility and entrepreneurship. *Strategic Management Journal* 34, 666–686. <https://doi.org/10.1002/smj.2044>
- Gemser, G., Leenders, M.A.A.M., 2001. How integrating industrial design in the product development process impacts on company performance. *Journal of Product Innovation Management* 18, 28–38. <https://doi.org/10.1111/1540-5885.1810028>
- Gilal, F.G., Gilal, N.G., Shahid, S., Gilal, R.G., Shah, S.M.M., 2022. The role of product design in shaping masstige brand passion: A masstige theory perspective. *Journal of Business Research* 152, 487–504. <https://doi.org/10.1016/j.jbusres.2022.08.008>
- Goffin, K., Micheli, P., 2010. Maximizing the Value of Industrial Design in New Product Development. *Research-Technology Management* 53, 29–37. <https://doi.org/10.1080/08956308.2010.11657648>
- Hemonnet-Goujot, A., Valette-Florence, P., 2022. “All you need is love” from product design value perception to luxury brand love: An integrated framework. *Journal of Business Research* 139, 1463–1475. <https://doi.org/10.1016/j.jbusres.2021.10.066>
- Hoegg, J., Alba, J.W., 2011. Seeing Is Believing (Too Much): The Influence of Product Form on Perceptions of Functional Performance. *Journal of Product Innovation Management* 28, 346–359. <https://doi.org/10.1111/j.1540-5885.2011.00802.x>
- Hou, T., Li, J.J., Lin, J., 2022. Linking knowledge search to knowledge creation: the intermediate role of knowledge complexity. *Management Decision* ahead-of-print. <https://doi.org/10.1108/MD-01-2022-0025>
- Juhász, S., Broekel, T., Boschma, R., 2021. Explaining the dynamics of relatedness: The role of co-location and complexity. *Papers in Regional Science* 100, 3–21. <https://doi.org/10.1111/pirs.12567>
- Lane, P.J., Koka, B.R., Pathak, S., 2006. The Reification of Absorptive Capacity: A Critical Review and Rejuvenation of the Construct. *The Academy of Management Review* 31, 833–863.
- Mewes, L., Broekel, T., 2022. Technological complexity and economic growth of regions. *Research Policy, Special Issue on Economic Complexity* 51, 104156. <https://doi.org/10.1016/j.respol.2020.104156>
- Micheli, P., Perks, H., Beverland, M.B., 2018. Elevating Design in the Organization. *Journal of Product Innovation Management* 35, 629–651. <https://doi.org/10.1111/jpim.12434>
- Montresor, S., Vezzani, A., 2020. Design centrality, design investments and innovation performance: an empirical analysis of European firms. *Industrial and Corporate Change* 29, 351–374. <https://doi.org/10.1093/icc/dt046>
- Perks, H., Cooper, R., Jones, C., 2005. Characterizing the Role of Design in New Product Development: An Empirically Derived Taxonomy*. *Journal of Product Innovation Management* 22, 111–127. <https://doi.org/10.1111/j.0737-6782.2005.00109.x>

- Ravasi, D., Stigliani, I., 2012. Product Design: a Review and Research Agenda for Management Studies. *International Journal of Management Reviews* 14, 464–488. <https://doi.org/10.1111/j.1468-2370.2012.00330.x>
- Roper, S., Micheli, P., Love, J.H., Vahter, P., 2016. The roles and effectiveness of design in new product development: A study of Irish manufacturers. *Research Policy* 45, 319–329. <https://doi.org/10.1016/j.respol.2015.10.003>
- Rosenfeld, S.A., 2018. Manufacturing by Design. *Economic Development Quarterly* 32, 313–325. <https://doi.org/10.1177/0891242418798052>
- Rubera, G., Droge, C., 2013. Technology versus Design Innovation's Effects on Sales and Tobin's Q: The Moderating Role of Branding Strategy. *Journal of Product Innovation Management* 30, 448–464. <https://doi.org/10.1111/jpim.12012>
- Tyler, B.B., Steensma, H.K., 1998. The Effects of Executives' Experiences and Perceptions on Their Assessment of Potential Technological Alliances. *Strategic Management Journal* 19, 939–965.
- Valle, S., Vázquez-Bustelo, D., 2009. Concurrent engineering performance: Incremental versus radical innovation. *International Journal of Production Economics* 119, 136–148. <https://doi.org/10.1016/j.ijpe.2009.02.002>
- Verganti, R., 2018. Overcrowded : Designing Meaningful Products in a World Awash with Ideas. *Overcrowded : Designing Meaningful Products in a World Awash with Ideas* 48–48. <https://doi.org/10.3280/PM2018-034012>
- Vinodrai, T., Gertler, M., Lambert, R., 2007. Capturing design: Lessons from the United Kingdom and Canada. pp. 65–86.

European Academic Spin-Offs: Exploring the Barriers to Long-Term Success

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Abstract: An academic spin-off (ASO) is an enterprise that is founded by researchers or students associated with a university or research institution. ASOs typically commercialize new technologies, products, or services that are based on results of academic research. However, ASOs often face barriers to long-term success. These barriers severely limit the economic and social impact of the research and innovation from ASOs, as well as discourage future researchers from starting their own ASOs. Furthermore, barriers can vary depending on the region and the industry and increase the complexity of this issue. So far very little research has been done to examine the barriers to ASOs in general or in specific industries and regions. Thus, the research question emerges as to what the general barriers to long-term success for ASOs in Europe are. To increase the understanding of the spin-off creation process, we conduct a systematic literature review of existing literature about ASOs and their barriers in general. Previous approaches already classify barriers into micro, meso, and macro levels. Other models exist that examine the spinning-off process with respect to a temporal level. In order to combine both dimensions, the frameworks mentioned above were merged in the first step and expanded with current research in the second step with a particular focus on barriers to long term success. Barriers for ASOs need to be addressed more in depth in order to fully realize their potential and to expand upon the existing literature of the general barriers of ASOs in Europe. Exploring these barriers yielded first results which include a limited access to funding and resources, lack of understanding of the creation of a business model, furthermore a lack of infrastructure and difficulty in establishing and sustaining a network with industry partners. Addressing these barriers will require targeted policies, funding, and training programs that enhance entrepreneurial skills and promote collaboration between ASOs and industry partners. Our findings provide insights that can help to improve the success rate of ASOs in Europe and encourage the development of innovative solutions to address societal challenges.

Keywords: Academic Spin-Off, Europe, Innovation, Entrepreneurship, Literature Review

1. Introduction

Universities are undergoing a transformation from being purely research and educational institutions to becoming "Entrepreneurial Universities". This phenomenon is also referred to as the "third mission," which means that universities are dedicating themselves to the transfer of knowledge to the productive sector and industry (F. Visintin und D. Pittino 2014). To accomplish this task, various forms of transferring knowledge have emerged over the years. Knowledge in form of technology can be transferred by licensing processes, publications, and industry research and development agreements and also in form of academic spin-offs (ASOs), also known as university spin-offs (USO) (Mihali et al. 2022). An ASO is a new company established through the exploitation of a core technology or technology-based idea generated within a university, where the founding member(s) may or may not be affiliated with the academic institution (Smilor et al. 1990; Nicos Nicolaou und Birley 2003).

ASOs are seen as drivers of innovation, which have a positive impact on the economy (Block et al. 2017; F. Visintin und D. Pittino 2014; Berbegal-Mirabent et al. 2015). Benneworth und Charles (2005) have summarized additional valuable impacts of spin-offs, including the promotion of entrepreneurship, network building, regional economic development, the creation of technology clusters, and job creation. In general there is still a lack in research about specific survival factors (Mihali et al. 2022), despite the fact that research on ASOs continues to grow, and literature reviews have already been conducted to cluster specific topics such as barriers, drivers, and success factors (Hossinger et al. 2020) or to categorize them into different levels (F. Miranda et al. 2018). Hossinger et al. (2020) also noted in his literature review, that the results have been somewhat controversial and fragmented. This is due to the nature of certain samples, timeframes, or contexts. Different research designs and definitions have also undermined the consistency of the results, thereby affecting the fulfilment of their objectives.

Until yet research does not consider both, a temporal and a contextual dimension, and it has been repeatedly suggested that further research is needed to better understand ASOs. Therefore, this paper will primarily focus on the barriers of ASOs by consolidating existing research findings and identifying opportunities for future research areas. Existing theoretical frameworks in the area of contextual dimensions and in the area of temporal dimensions were combined to a new framework. Currently, the SCOPUS database has been reviewed, and

relevant articles have been analysed within this new framework. The search query yielded 92 articles, of which 26 were deemed relevant.

2. Theoretical Framework

2.1 Definition Academic Spin-off

The concept of academic entrepreneurship refers to the establishment of new ventures that aim to commercialize knowledge, technology, or research outcomes developed within a university setting. According to Pirnay et al. (2003) academic entrepreneurship involves utilizing internal and external opportunities innovatively to generate economic resources for personal profit or to support academic units and institutions. Additionally, it aims to create platforms for social and political change within academia. (van Looy et al. 2011, S. 554) defines it as "Entrepreneurial universities are institutions which are characterized by greater involvement in economic and social development, more intense commercialization of research results, patent and licensing activities, the institutionalization of spin-off activities, and managerial and attitudinal changes among academics with respect to collaborative projects with industry (van Looy et al. 2011, S. 554).

Motivated academics play a crucial role in the development of academic entrepreneurship. These individuals go beyond their traditional roles in teaching and research to pursue entrepreneurial activities. Understanding the motivations driving academics to become academic entrepreneurs is essential for government officials and university administrators to develop effective policies that provide sufficient incentives for academics to engage in entrepreneurial activities (Hossinger et al. 2020).

Etzkowitz und Viale (2010) define academic entrepreneurs as experts in specific scientific fields who possess a divergent awareness of the commercial potential of both fundamental research and business problems. University spin-off (USO) companies emerge from this process and are characterized by their utilization of the founders' research outcomes while maintaining a connection to the originating academic institution.

Academic entrepreneurship represents a fusion of academic expertise and entrepreneurial activities, aiming to commercialize research outcomes and generate societal impact. Understanding not only the success factors but also what hinders ASOs are critical for fostering a culture of innovation and knowledge transfer within universities.

2.2 Dimensions and Stages

Many authors have recently been engaged in identifying the influences that have positive or negative effects on ASOs aspects (Hossinger et al. 2020).

F. Miranda et al. (2018) identified three main research areas in the field of academic entrepreneurship: individual characteristics, organizations, and institutional context, depending on the unit of analysis. When the analysis focuses on the individual faculty member, the main area is referred to as "individual"; when the emphasis is on the university spin-off (USO) itself, the area is labeled as "organization"; and in cases where the analysis pertains to the national or regional context in which the USO is situated, and the economic and social impacts that the USO could have on them, the area is referred to as "institutional context". These areas also relate to the framework of Hossinger et al. (2020).

Hossinger et al. (2020) summarized success factors, drivers, and barriers of ASO creation in a literature review. In their framework three dimensions or levels to categorize every influence and to easily identify patterns and recurring themes are used. The micro-level refers to individual aspects of the ASO founding process, such as the behaviour and decisions of individual founders or their interactions with other actors. The meso-level looks at the founding process from an organizational perspective by analysing the interactions and dynamics between different organizations, groups or communities involved in the formation of ASOs. The macro-level, on the other hand, focuses on the overall social framework and structures that influence the ASOs founding process, such as political or economic legal.

With particular focus on barriers, they list the following:

Micro (Individual academic)	Meso (University)	Macro (Regional and national contexts)

Lack of entrepreneurial capabilities, knowledge and resources	Lack of entrepreneurial culture	Limited availability of federal and private funding sources
Lack of applicability of knowledge	Bureaucracy	Complicated and time-consuming application and granting processes for state subsidies
Team or governance conflicts	Management style	Country- and regional-specific differences
Fear of failure	Lack of incubation services	
Aversion to risk and stress		
Attitude towards science: 'Publish or perish'		

Hossinger et al. (2020) Conceptual framework

In the context of a temporal dimension, Ndonzuau et al. (2002) investigated successful spin-offs to better understand the process of academic spin-offs. Their study revealed four phases:

- Stage 1: to generate business ideas from research.
- Stage 2: to finalize new venture projects out of ideas.
- Stage 3: to launch spin-off firms from projects.
- Stage 4: to strengthen the creation of economic value by spin-off firms.

Each of the four stages within this spin-off process fulfils a distinct functional role. In the initial phase, ideas are generated and evaluated in terms of their potential for commercialization. The subsequent phase involves rigorous examination of these ideas, leading to the transformation of the most promising ones into tangible entrepreneurial projects. In the third phase, the superior projects materialize through the establishment of new spin-off companies. Finally, in the fourth phase, the economic value generated by these nascent firms is consolidated and enhanced. Every phase can be seen as a selection process. Not every idea funnel into a successful spin-off creation and commercialisation.

3. Method

To answer our research question and gain deeper insights into the barriers facing ASOs in Europe, we conducted a systematic literature review. This methodological approach enabled us to identify, analyse and synthesize relevant research papers addressing this topic.

A literature review is essential for scientific research as it shows the current state of knowledge, identifies research gaps, and develops new hypotheses or theories. It enables relevant literature to be analysed and summarized to reveal weaknesses and inconsistencies (Xiao und Watson 2019).

3.1 Article research

Our literature search includes two scholarly databases, namely “Scopus” and “EBSCO Business Source Premier”, whereas this actual work in progress paper includes only first results from Scopus. By using a systematic search strategy based on keywords and search terms, we were able to generate an extensive list of potentially relevant articles. For Scopus we used the following keywords and search terms:

(Academic OR university) AND (spin-off OR spinout* OR spinoff* OR spin-in* OR spinin* OR startup* OR start-up*) AND europe* AND (barrier* OR obstacle* OR challenge* OR success* OR driver*)*

With this initial input, we received a total of 179 results. We then further narrowed the results by focusing on English-language articles and book chapters published between the years 2000 and 2023. After the refinement, we were left with 92 results from the Scopus database. For the systematic literature review, we also used EBSCO Business Source Premier in addition to the previous database. By including this additional database, we were able to expand our access to relevant literature and identify potentially new articles. Combining the results from both databases allowed us to get a comprehensive overview of the existing literature and to identify the most relevant sources for our research question. For the EBSCO Business Source Premier database, we used the following keywords and search terms:

(Academic OR university) AND (spin-off* OR spinout* OR spinoff* OR spin-in* OR spinin* OR startup* OR start-up*) AND (barrier* OR obstacle* OR challenge* OR success* OR driver*)

This initial input does not include the term “AND Europe” since we received a lot of results unrelated to our research question. To limit the results to Europe, we used the geographical filters provided by EBSCO. Furthermore, we used the advanced search options from EBSCO:

- Peer Reviewed
- Published Date: 2000-2023
- Publication Type: Academic Journal
- Publication: Article

After the refinements, we got a total of 153 results. Together with the 92 results from the Scopus database, we found a total of 245 results for our literature review. This body of literature should be sufficient to conduct a systematic literature review and examine the barriers for ASOs in Europe.

3.2 Paper selection

For the selection of the relevant papers, careful paper selection was carried out using certain criteria. These criteria were developed to ensure that the selected papers meet the requirements of our research question and provide high-quality information on the barriers facing academic spin-offs (ASOs) in Europe.

The following criteria were considered in the paper selection process:

- Timeliness: Do the title, abstract or keywords of the paper show that it is based on current research in academic spin-offs in Europe?
- Focus: Does the paper focus specifically on academic spin-offs in Europe, or is it too broad or too narrow for our research question?
- Relevance: Do the paper's title, abstract, and keywords suggest that it directly addresses our research question or is highly relevant to our topic?
- Approach: Does the paper use an appropriate approach or methodology for our research question based on the information in the title, abstract or keywords?
- Perspective: Does the paper offer a unique or valuable perspective on the research topic that offers new insights or a fresh perspective on our research question?

Our criteria were chronologically examined, beginning with an assessment based on the title, abstract, and keywords. In cases where further examination was necessary, the entire paper was thoroughly read to make a final decision, whether to include it into our shortlist. Papers failing to satisfy at least one criterion were excluded from the shortlist for the literature review. This thorough process guarantees the inclusion of solely high-quality and pertinent papers in the final literature review.

We applied our paper selection criteria to the 92 results that we received from the Scopus database. By doing so, 26 papers were identified that demonstrate relevance to our stated criteria of timeliness, focus, relevance, approach, and perspective. By doing so, we successfully identified 26 papers that demonstrated relevance to our predetermined criteria of timeliness, focus, relevance, approach, and perspective. These 26 selected papers will serve as a solid foundation for our systematic literature review. Afterwards, each of the identified papers underwent careful examination, enabling us to analyse and categorize the barriers faced by ASOs in Europe, using our established framework. This comprehensive analysis will provide valuable insights into the barriers encountered by ASOs, facilitating the grouping of similar barriers and organizing them into distinct categories for an organised presentation of the findings. The objective is to assemble a list of these barriers and explain the dimensions and stages of the spin-off creation process where these barriers may manifest. The content of each paper was audited to ascertain its potential contribution to addressing our research question.

3.3 Established theoretical framework

By integrating the three dimensions proposed by Hossinger et al. (2020) and the four stages outlined by Ndonzuau et al. (2002), we can enhance the structure and analysis of our research findings. The inclusion of micro, meso, and macro levels enables a comprehensive examination of the barriers encountered by European academic spin-offs (ASOs) from multiple perspectives, considering the interactions among actors, organizations, and the broader ecosystem. Furthermore, the incorporation of the four phases of the spin-off formation process provides insights into the specific stages where barriers may arise. This novel framework facilitates the

identification of patterns and recurring themes within our results, thereby offering a comprehensive understanding of the barriers faced by European ASOs.

4. Results

4.1 Stage 1: generate business ideas from research

According to (Ndonzuau et al. 2002) the first stage aims to generate business ideas, proposals and offers for commercial exploitation within the scientific community. For most universities, commercial exploitation of their research requires radical changes in the traditional way they have exploited their results. Commercial exploitation implies the convergence of two opposing concepts of science. The scientific concept, which sees science as an end in itself, and the economic concept, which sees science more as a means to achieve other ends, particularly financial gain. The challenge is to reconcile these two opposing concepts (Ndonzuau et al. 2002).

4.1.1 Mikro-Level

Generating business ideas from research can be challenging due to various barriers on an individual level. (Toledano et al. 2022) state that academic entrepreneurs may experience ethical dilemmas in the commercialization of knowledge and technology through ASOs without clear guidance. Academic entrepreneurs' attachment to academia and university life can at times conflict with their entrepreneurial activities, particularly when research and business interests diverge. Serving the public interest, a typical goal of academic activity, can collide with the commercialization of knowledge and technology through ASOs, leaving academic entrepreneurs with ethical dilemmas without clear guidance. The current literature also points to the pressure that academic entrepreneurs can face to reconcile scientific knowledge with commercially viable knowledge (Toledano et al. 2022).

Researchers in Eastern Europe, particularly Poland, show different patterns of academic entrepreneurship. Locally productive researchers are more likely to engage in academic entrepreneurship than cosmopolitan researchers who follow an international academic career because they have less time for entrepreneurial activities. Focusing on an academic career, especially on an international level, requires more time and reduces the likelihood of approaching an entrepreneurial career path (Luczaj 2022).

(Seguí-Mas et al. 2018) were able to identify management problems are a key obstacle to setting up academic spin-offs. Since academics do not automatically have strong management skills, knowledge transfer via spin-offs is more complex compared to licenses or patents, where management tasks can be delegated to the licensee or buyer. Therefore, (Seguí-Mas et al. 2018) recommend universities to specifically train potential academic entrepreneurs in management skills to promote successful knowledge transfer via ASOs. Furthermore, (Vega-Gomez et al. 2018) argues that individual characteristics such as academic experience, entrepreneurial personality, self-confidence, creativity, conscious benefit of entrepreneurship, promotion of the societal role of universities, gender and scientific productivity influence the possibility of founding an ASO and the entrepreneurial orientation of the researcher.

The results of a survey of academics from 50 universities and 16 out of 17 Spanish regions show that personal and economic benefit is the main motivator for Spanish academics to establish an ASO. This condition determines nearly 28% of a researcher's preference structure. Failure by academics to see the prospect of personal and financial benefits can hamper their motivation to start an ASO. The mikro level therefore plays a important role in overcoming this potential barrier to entrepreneurial motivation (Vega-Gomez et al. 2018).

In summary, various barriers at the mikro-level can complicate the establishment of ASOs in Europe. Management problems (Seguí-Mas et al. 2018), lack of time resources due to focusing on an academic career (Luczaj 2022), and ethical dilemmas related to the commercialization of knowledge and technology (Toledano et al. 2022) are some of the obstacles to be overcome. Individual factors such as academic seniority, entrepreneurial personality, and perceived benefits of entrepreneurship also play a role (Vega-Gomez et al. 2018).

4.1.2 Meso-Level

van Geenhuizen und Soetanto (2009) state that a constraining culture at the university can develop when universities do not provide sufficient resources and incentives for academics to balance the process of inception

and early growth. This constraining culture can create a barrier for employees to get fully involved in the spin-off (van Geenhuizen und Soetanto 2009). Organizational culture has been identified as a major barrier for starting ASOs. This includes different goals and timelines, as well as language and communication styles, which can negatively impact the formation of ASOs. Administrative problems such as bureaucracy and insufficient working time have also been identified as barriers to academic entrepreneurship. Furthermore, an organizational lack of knowledge about ASOs and their formation has been identified as a barrier. Especially academics with little to no experience are affected by this lack of knowledge from their organization or university (Davey und Galan-Muros 2020). In order for academics to be actively involved, particularly with regard to the important step of disclosing inventions, there must be a strong research system and appropriate incentives implemented by the universities (Heher 2006).

To support the development of ASOs, universities adopt strategies such as integration into the university's vision and mission and fostering an entrepreneurial culture. Resources and incentives are provided to facilitate implementation. However, the lack of provision of resources and incentives can be a barrier, as can the lack of integration into the university's vision and mission and the failure to promote entrepreneurial behavior among university stakeholders (Davey und Galan-Muros 2020). The support measures for entrepreneurial activities in academia strongly depend on the entrepreneurial culture of the university and ultimately the committed resources in form of university incubators or founding centers, as (Piontek und Wyrwich 2017) note. Both researchers and students are affected by the culture of universities and their commitment to promoting entrepreneurial activities. The more students participate in entrepreneurship courses, the greater the opportunity for new start-ups and academic spin-offs. Interview partners stated that students with compulsory courses are more likely to be found in the incubator than those with optional courses (Piontek und Wyrwich 2017).

4.1.3 Makro-Level

Although academic entrepreneurship in theory allows for the transfer of unique skills, academic engagement in entrepreneurial activities is rather limited in most countries. The European higher education system is largely based on Humboldt's idea of a university, which is opposed to a utilitarian approach. It is therefore not surprising that the level of academic entrepreneurship in Europe is comparatively low (Luczaj 2022).

In Ukraine, too little emphasis has been placed on strengthening innovative entrepreneurship at universities, especially in start-ups and ASOs. The commercialization of research results is crucial to transform theoretical knowledge into innovative products. However, social, economic and political conditions make it difficult to develop an environment for ASOs. Measures such as legal protection of research results and technology transfer are needed to address these barriers and increase innovation productivity. Bureaucratic hurdles and a lack of institutional management between science and business are further barriers that have to be overcome (Novikova et al. 2018).

Commercialization of scientific research results is not sufficiently supported by academic institutions in Poland and Slovakia, although higher education law in Poland and law in Slovakia encourage entrepreneurial activities. Institutions are not yet adequately prepared for commercialization pressures, and resources and programs to support researchers in this area are lacking. In addition, the government continues to focus mainly on funding basic research and less on application-oriented research that can be used by industry. These barriers hinder the development of business ideas from research and ultimately the formation of ASOs (Luczaj 2022).

4.2 Stage 2: to finalize new venture projects out of ideas

4.2.1 Mikro-Level

4.2.2 Meso-Level

4.2.3 Makro-Level

4.3 Stage 3: to launch spin-off firms from projects

4.3.1 Mikro-Level

4.3.2 Meso-Level

4.3.3 Makro-Level

4.4 Stage 4: to strengthen the creation of economic value by spin-off firms.

4.4.1 Mikro-Level

4.4.2 Meso-Level

4.4.3 Makro-Level

5. Discussion and Implementation

Our research, despite its extensive systematic literature review, has several limitations. First, the survey is limited to English-language literature, thereby excluding potentially relevant work in other languages. Second, the "Scopus" and "EBSCO Business Source Premier" databases used may not be complete and may have overlooked important studies. Third, we limited our search to the period between 2000 and 2023, potentially excluding previous significant work. Finally, our investigation relates exclusively to Europe and therefore cannot be generalized to ASOs in other regions of the world. Further research that overcomes these limitations could provide a more complete picture of the challenges facing ASOs.

6. Conclusion

Generating business ideas from research results is a significant challenge at the micro, meso and macro levels in Europe. At the micro level, individual factors such as managerial skills, time resources and ethical dilemmas influence the ability of scientists to set up ASOs. Scientists who dedicate themselves intensively to their academic careers, especially at an international level, often have less time for entrepreneurial activities. In addition, ethical dilemmas can arise when research interests and commercial interests diverge. At the meso level, institutional factors are proving to be substantial challenges. A restrictive university culture that lacks resources and incentives to set up ASOs can hamper the active participation of scholars. Administrative hurdles and a lack of knowledge about ASOs and their formation process can also limit the formation of spin-offs. To overcome these obstacles, universities should actively implement strategies to promote an entrepreneurial culture and provide sufficient resources and incentives. At the macro level, social, economic and political conditions pose an obstacle to the development of ASOs. In **eastern European** countries like Ukraine, too little emphasis is placed on strengthening innovative entrepreneurship at universities. Bureaucratic hurdles and a lack of institutional management between science and business represent additional barriers that need to be overcome. The commercialization of research results and the emergence of ASOs in Europe are therefore facing crucial challenges. However, these obstacles can be overcome through targeted action at all levels. It is important to provide strategies and resources that support both scientific research and entrepreneurship. In this way, research results can be effectively converted into practical business applications and contribute to economic development.

Bibliography

- Benneworth, Paul; Charles, David (2005): University spin-off policies and economic development in less successful regions: Learning from two decades of policy practice. In: *European Planning Studies* 13 (4), S. 537–557. DOI: 10.1080/09654310500107175.
- Berbegal-Mirabent, Jasmina; Ribeiro-Soriano, Domingo Enrique; Sánchez García, José Luis (2015): Can a magic recipe foster university spin-off creation? In: *Journal of Business Research* 68 (11), S. 2272–2278. DOI: 10.1016/j.jbusres.2015.06.010.
- Block, Joern H.; Fisch, Christian O.; van Praag, Mirjam (2017): The Schumpeterian entrepreneur: a review of the empirical evidence on the antecedents, behaviour and consequences of innovative entrepreneurship. In: *Industry and Innovation* 24 (1), S. 61–95. DOI: 10.1080/13662716.2016.1216397.

- Davey, Todd; Galan-Muros, Victoria (2020): Understanding entrepreneurial academics - how they perceive their environment differently. In: *Journal of Management Development* 39 (5), S. 599–617. DOI: 10.1108/JMD-09-2019-0392.
- Etzkowitz, Henry; Viale, Riccardo (2010): Polyvalent Knowledge and the Entrepreneurial University: A Third Academic Revolution? In: *Critical Sociology* 36 (4), S. 595–609. DOI: 10.1177/0896920510365921.
- F. Miranda; A. Chamorro; Sergio Rubio (2018): Re-thinking university spin-off: a critical literature review and a research agenda. DOI: 10.1007/S10961-017-9647-Z.
- F. Visintin; D. Pittino (2014): Founding team composition and early performance of university—Based spin-off companies. DOI: 10.1016/J.TECHNOVATION.2013.09.004.
- Heher, A. D. (2006): Return on investment in innovation: Implications for institutions and national agencies. In: *Journal of Technology Transfer* 31 (4), S. 403–414. DOI: 10.1007/s10961-006-0002-z.
- Hossinger, Stefan Marc; Chen, Xiangyu; Werner, Arndt (2020): Drivers, barriers and success factors of academic spin-offs: a systematic literature review. In: *Manag Rev Q* 70 (1), S. 97–134. DOI: 10.1007/s11301-019-00161-w.
- Luczaj, Kamil (2022): Foreign-Born Scholars and Academic Entrepreneurship in Eastern Europe. In: *Journal of the Knowledge Economy* 13 (1). DOI: 10.1007/s13132-020-00711-8.
- Mihali, Lavinia Maria; Potra, Sabina; Dungan, Luisa Izabel; Negrea, Romeo; Cioabla, Adrian (2022): Key Factors of AS Performance in Emerging Central and Eastern European Countries: Evidence from Romania. In: *Sustainability (Switzerland)* 14 (14). DOI: 10.3390/su14148328.
- Ndonzuau, Frédéric Nlemvo; Pirnay, Fabrice; Surlmont, Bernard (2002): A stage model of academic spin-off creation. In: *Technovation* 22 (5), S. 281–289. DOI: 10.1016/S0166-4972(01)00019-0.
- Nicos Nicolaou; Birley, Sue (2003): Social Networks in Organizational Emergence: The University Spinout Phenomenon. In: *Management Science* 49 (12), S. 1702–1725. Online verfügbar unter <http://www.jstor.org/stable/4133979>.
- Novikova, I. E.; Osetskiy, V. L.; Alekseieva, K. A. (2018): Startups and spinoffs as factors of the academic business development: The foreign experience and the ukrainian prospects. In: *Science and Innovation* 14 (5), S. 77–89. DOI: 10.15407/scine14.05.071.
- Piontek, Matthias; Wyrwich, Michael (2017): The emergence of entrepreneurial ideas at universities in times of demographic change: evidence from Germany; [Die Entstehung von Gründungsideen und neuen Unternehmen in Zeiten demografischen Wandels in ausgewählten deutschen Regionen]. In: *Review of Regional Research* 37 (1), S. 1–37. DOI: 10.1007/s10037-016-0111-6.
- Pirnay, Fabrice; Surlmont, Bernard; Nlemvo, Frédéric (2003): Toward a Typology of University Spin-offs. In: *Small Business Economics* 21 (4), S. 355–369. DOI: 10.1023/A:1026167105153.
- Seguí-Mas, Elies; Oltra, Víctor; Tormo-Carbó, Guillermina; Sarrión-Viñes, Faustino (2018): Rowing against the wind: how do times of austerity shape academic entrepreneurship in unfriendly environments? In: *International Entrepreneurship and Management Journal* 14 (3), S. 725–766. DOI: 10.1007/s11365-017-0478-z.
- Smilor, Raymond W.; Gibson, David V.; Dietrich, Glenn B. (1990): University spin-out companies: Technology start-ups from UT-Austin. In: *Journal of Business Venturing* 5 (1), S. 63–76. Online verfügbar unter <https://ideas.repec.org/a/eee/jbvent/v5y1990i1p63-76.html>.
- Toledano, Nuria; Gessa, Ana; Sanchez-Herrera, Reyes (2022): Rethinking the Resources and Responsibilities of University Spin-Offs: Critical Factors in Times of Global Crisis. In: *Sustainability (Switzerland)* 14 (19). DOI: 10.3390/su141912628.
- van Geenhuizen, Marina; Soetanto, Danny P. (2009): Academic spin-offs at different ages: A case study in search of key obstacles to growth. In: *Technovation* 29 (10), S. 671–681. DOI: 10.1016/j.technovation.2009.05.009.
- van Looy, Bart; Landoni, Paolo; Callaert, Julie; van Pottelsberghe, Bruno; Sapsalis, Eleftherios; Debackere, Koenraad (2011): Entrepreneurial effectiveness of European universities: An empirical assessment of antecedents and trade-offs. In: *Research Policy* 40 (4), S. 553–564. DOI: 10.1016/j.respol.2011.02.001.
- Vega-Gomez, Francisco-Isidoro; Miranda, F. Javier; Mera, Antonio Chamorro; Mayo, Jesús Pérez (2018): The spin-off as an instrument of sustainable development: Incentives for creating an academic USO. In: *Sustainability (Switzerland)* 10 (11). DOI: 10.3390/su10114266.

Prized Innovation Features of a Business Environment for Graduates

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Abstract: Innovation has proved to be a credible source for business development for various organisations, many organisations rely on their ability to innovate to produce impactful and disruptive products and services. Organisations are increasingly focusing on employing candidates or graduates with the ability to be innovative and improve business development. Higher Education Institutions (HEIs) hold the responsibility to produce graduates with the capability to produce innovation and adapt to the innovative cultures and structures created by organisations. This aim of this paper is to determine the most prized innovation features of a business environment suitable for business development, this is to aid HEIs to be informed of the curriculum relevant to produce graduates capable of innovation and business development. The quantitative approach aspect of this research paper enabled the researcher to collect data using an online survey questionnaire from 69 innovation experts from the South African Business Innovation Community (Innovation Summit), and the Innovation, Sustainability and Visionary Leadership Group. The quantitative data was then analysed through inferential statistical analysis. Based on the findings from this research paper, business leadership is deemed the most prized feature of an innovative environment, along with explorative culture and brand identity. Findings from the commercialisation units further support the above findings, as they indicated that most graduates and young entrepreneurs lack leadership skills. In conclusion, entrepreneurial Higher Education Institutions should align their curriculum to industry needs, through understanding the various activities that graduates are expected to engage with in industry to contribute to business innovation and business development.

Keywords: Innovation; Innovation features; Business environment; Business leadership; Entrepreneurship.

1. Introduction

The Business Council Australia (1993) defines innovation as the creation of improved processes and procedures to add value to an organisation. Innovation can further be defined as the process of conceiving and designing and adopting ideas through the creation of products, procedures, and services (Bansi, 2016; Rooke, 2017; Arnaut, 2019). Innovation has become one of the most essential components within various organisation to remain competitive and sustainable. Higher Education Institutions HEI's needs to understand the various features of innovation features withing organisations that promote business development to produce graduates capable of adapting and contributing to these organisational structures driven by innovation and business development. Innovation can be as the application of systems or processes that have existed before but where never paid attention to (Rowe, 2008:8). Selman (1999:2) states *"innovation means intentionally 'bringing into existence' something new that can be sustained and repeated, and which has some value or utility"*.

Moreover, innovation is concerned with real world services and products that add value to the world (Bansi, 2016). It is essentially the making of new products, systems, or tools with the intention to enable humans to benefit from what they have been struggling to achieve (Selman, 1999:2). A research gap further exists on the determinants for ensuring graduates with the capability to produce innovation. The Prize element in a signification framework focuses on valuing a specified thing as extremely highly valuable. The innovation features of a business environment in this research include Business leadership, Explorative culture, Brand identity, technical skill development, Structured systems, Community service, non-technical skill development, Business sales and profitability, Compensation and Financial literate employees. Hence, the aim of this paper is to determine the most Prized innovation features of a business environment, this is to aid HEIs to be informed of the curriculum relevant to produce graduates capable of innovation and business development.

2. Literature review

Innovation can be categorised into different types of innovations that are generally key to the strategy of a business for sustainable competitive advantage (Varadarajan, 2018:144). The different types of innovation are product innovation, marketing innovation, business model innovation, and strategic innovation (Coccia, 2006:9). Generally, innovation can be defined as the introduction or implementation of a new or improved product, service or process, and new business practice (Varadarajan, 2018:149). Innovation can further be defined as

knowledge that is used uniquely and differently, it could be a new way of thinking and innovation is normally the result of complex and dynamic interactions and learning processes by different stakeholders (Pellissier, 2012:4). Innovation plays a significant role in business growth and the creation of new businesses; hence it is important to nurture innovativeness (Chen & Yin, 2019:26). Innovativeness can be described as the capacity of an invention or innovation to disrupt the business industry or create a shift in the business paradigm, specifically in the market structure of a particular industry or in science and technology (Varadarajan, 2018:150). There are various definitions of innovation, namely: innovation can be defined as the process of successfully Commercialising an invention; or innovation can be defined as the successful process of Commercialising an idea, product, or practice (Varadarajan, 2018:152). It is important to identify the stage of the process of adopting innovation, as well as the types of information in each stage for input and output features of the system (Edwards-Schachter, 2018:66). Note that innovation and creativity is also driven by a culture of innovation, models, structured processes and infrastructure (Levitt, 2002:138).

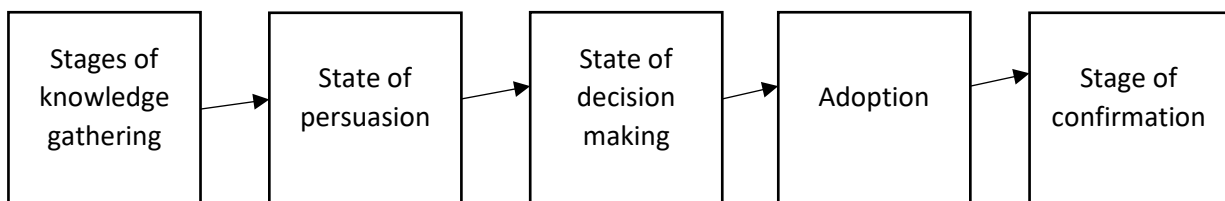


Figure 1: The stage of the process of adopting innovation

(Source: Popa et al., 2010:155)

Figure 2.1 notes the significance of innovation adoption, through the stages of the process of adopting innovation. The primary stage of innovation adoption is created to lead towards good and poor behaviours towards the persuasion stage, with the intention to move to the stage of decision making. While on the confirmation stage, the decision-maker implements a code of conduct that can be followed by the variations in the attitude that are caused by trying to decrease reasoning conflict due to adopting the innovation (Popa et al., 2010:155).

Innovation is the lifeblood for organisations, and the true value of innovation can be established through the results, such as ideas that are commercialised products (Datta, Reed & Jessup, 2013:147). The ability of organisations to commercialise their innovation can improve the economic state of an environment and market and create new markets. Regardless of the type of organisation, profit-driven or education-driven, entrepreneurial-related activities that pertain to commercialisation begin with the generation of an idea and its launch (Datta et al., 2013:147; Thani et al., 2021). Education-driven organisations may have an abundance of ideas, yet fail at launching (Thani et al., 2021). It is stated that one out of 3000 ideas and innovative inventions get the opportunity to be commercialised into prosperous products (Datta et al., 2013:148). On the other hand, Kakouris (2021:467), states that recently there are developments in entrepreneurial education that suggest that more critical stances are being adopted in the teaching and advocacy of reflective approaches to entrepreneurial education.

3. Methodology

This paper is part of a PhD study on the innovation and commercialisation dynamics of entrepreneurial universities, but for the purpose of this paper the focus is on prized innovation features of a business environment to inform and assist in improving university curriculum. The PhD study utilised a mixed-method complex approach but for the purpose of this paper the researcher reported on some aspects from the quantitative data collected. This paper utilised a Signification Framework as method for this research, Signification framework methodology refers to a structure that underlines a system, concepts and text representing the world perception and philosophies of a researcher, is further utilised to represent the meaning that is generally applied in sensemaking (Deprez & Hanchar, 2017; Magoma, 2018). A Signification Framework aims make sense of a phenomena through five elements namely; Presume, Predict, Prize, Perceive and Produce, which all have their research meaning and purpose. This paper only reports on the data from the Prize element, which focuses on valuing a specified thing as extremely highly valuable. This study was further strengthened and re-enforced using pragmatism as philosophical paradigm, this allowed the researcher to explore practical ways that can work in the real-world context and improve university curriculum.

Date was collected through a survey online questionnaire from 100 delegates from the Innovation, Sustainability and Visionary Leadership Group and the South African Business Innovation Community (Innovation Summit). A 69-response rate was obtained for the questionnaire distributed. This means the researcher got 69 responses out of the 100 participants the questionnaire was sent out to. The participants for this research varied from, government representatives, company representatives, Chief Executive Officers, Managing Directors, entrepreneurs, academics, company founders, business analyst chief of section, board member, Chief Operating Officer, creative director, learning manager, filmmaker and editor, lead consultant, mentor, mentor and Ambassadors from the Vice Chairperson in the Northern Lights Northern Conference of South Africa's Youth Committee, business development, marketing and sales. Descriptive and inferential statistical analysis technique was used to analyse the data with the aid from Statistical Package for Social Sciences (SPSS) software and Microsoft Excel for descriptive and inferential statistical analysis and visualisation, for example, stacked graphs. SPSS was only utilised to generate the data in Microsoft Excel and no further analysis was done regarding the variables e.g., reliability, validity, correlations, and regression.

4. Results and discussion

This research paper aimed to determine the most Prized innovation features of a business environment, this is to inform and assist HEIs with aspects and features of innovation to consider within their curriculum to produce graduates capable of innovation and business development Next figure 4.1, the question asked the participants to what extent they **PRIZED** (signification framework element) the innovation features of a business environment. The features would constitute an environment that is conducive for innovation to thrive.

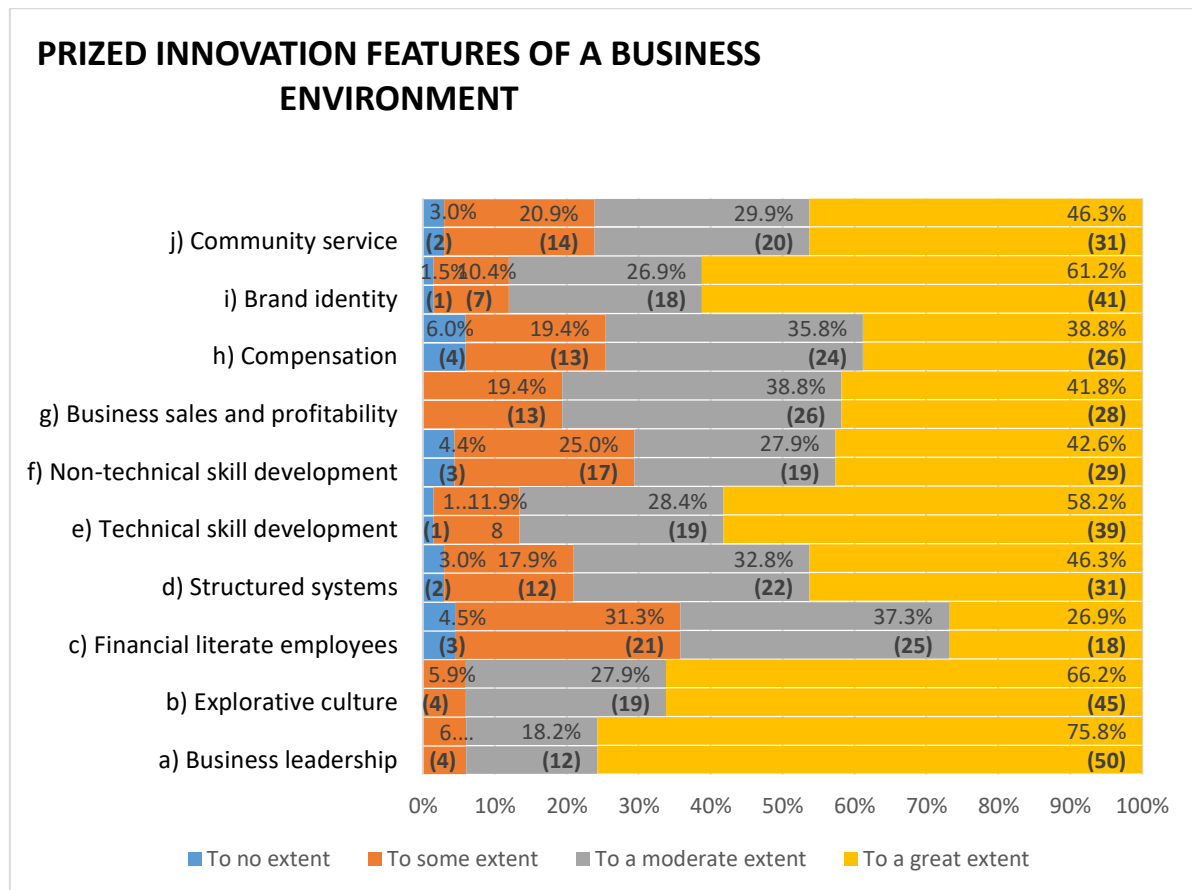


Figure 2: Prized innovation features of a business environment (own source developed for this study, 2021)

Figure 4.1 reports on the prized features of innovation within a business environment. On the business leadership feature, a) 0.0% participants prized to no extent, 6.1% participants prized to some extent, 18.2% prized to a moderate extent, and 75.8% prized to a great extent. On explorative culture, b) 0.0% participants prized to no extent, 5.9% participants prized to some extent, 27.9% prized to a moderate extent, and 66.2% prized to a great extent. On financial literate employees, c) 4.5% of the participants prized to no extent, 31.3% participants prized to some extent, 37.3% prized to a moderate extent, and 26.9% prized to a great extent. On

structured systems, d) 3.0% of the participants prized to no extent, 17.9% participants prized to some extent, 32.8% prized to a moderate extent, and 46.3% prized to a great extent. On technical skill development, e) 1.5% participants prized to no extent, 11.9% participants prized to some extent, 28.4% prized to a moderate extent, and 58.2% of the participants prized to a great extent.

On non-technical skill development, f) 4.4% of the participants prized to no extent, 25.0% participants prized to some extent, 27.9% prized to a moderate extent, and 42.6% prized to a great extent. On business sales and profitability, g) 0.0% participants prized to no extent, 19.4% participants prized to some extent, 38.8% prized to a moderate extent, and 41.8% prized to a great extent. On compensation, h) 6.0% participants prized to no extent, 19.4% of the participants prized to some extent, 35.8% prized to a moderate extent, and 38.8% prized to a great extent. On brand identity, i) 1.5% participants prized to no extent, 10.4% participants prized to some extent, 26.9% prized to a moderate extent, and 61.2% prized to a great extent. On community service, j) 3.0% of the participants prized to no extent, 20.9% prized to some extent, 29.9% prized to a moderate extent, and 46.3% prized to a great extent.

Noteworthy in figure 4.1, majority of the participants prized to a great extent business leadership, 75.8% of the participants which was the highest response. Business leadership is vital for business innovation, HEIs should invest more time skilling graduates on business leadership, amongst other vital skills. Furthermore, business leadership has a direct influence on organisational culture and for innovation to thrive an innovative culture is needed.

The results in figure 4.1 depict innovation features of a business environment that are most sought-after features; prized meaning, those features that bring with it the most value to the business environment. In this case this would assist the entrepreneurial institutions to understand the types of activities graduates are expected to engage in the industry and be able to contribute to business innovation and the types of skills required. Having knowledge of the types of skills required, the university will be able to decide on an appropriate intervention, for example, in the form of curriculum alignment to increase frequency of industry networking opportunities or community engagement to hone their innovation in community service. Based on the findings, the researcher was able to develop the **PRIZED** element of this study's signification framework (cf figure 5.1).

5. Intervention discussion

Next, figure 5.6 presents the **PRIZE** Intervention key.

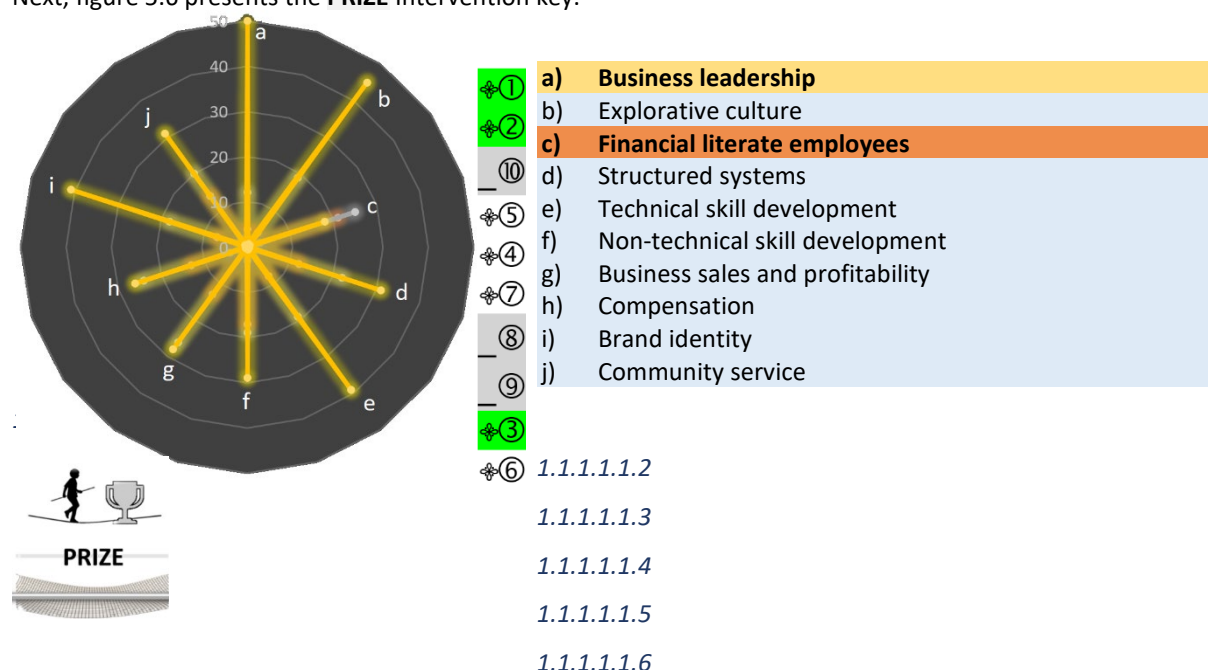


Figure 3: PRIZE Intervention key – Innovation features of a business environment (own source developed for this study, 2021)

Figure 5.1 presents the **PRIZE** Intervention key together with two examples of how it may be applied in terms of the innovation features of a business environment that are most sought after by business innovation experts.

Intervention application 1: Business innovation experts assign the most value to these features in this order to constitute an environment that is conducive for innovation to thrive:

1. Business leadership
2. Explorative culture
3. Brand identity
4. Technical skill development
5. Structured systems
6. Community service
7. Non-technical skill development
8. Business sales and profitability
9. Compensation
10. Financial literate employees

If innovators comprehend the prized innovation features of a business environment that is conducive to innovation, then innovators will be able to align their inventions accordingly. If not, an intervention is necessary.

Intervention application 2: If HEI admission requirements restrict innovators (scenario, Mathematics as prerequisite for entry in business management), yet financial literate employees are the least prized innovation feature, then an HEI programme review intervention is needed. This does not mean financial literate employees are not prized, it means that innovators are not necessarily actuaries. Instead, innovation features that are regarded as most significant are 1) business leadership, 2) explorative culture, and 3) brand identity.

6. Conclusion

HEIs and the business industry need to find a common environment that is conducive for graduates to thrive and innovate. It is significant for universities to determine and understand the most important aspects and features of innovation for innovation and business development. This will influence the improvement of the curriculum to suite the industry needs and innovation development. This paper aimed to determine the most Prized innovation features of a business environment, this is to aid HEIs to be informed of the curriculum relevant to produce graduates capable of innovation and business development. Findings revealed that business leadership, explorative culture and brand identify are the most prized innovation features for business development. Furthermore, findings indicate that financial literate employees are the least prized innovation feature for business development, this is important because most innovators are not that financially literate and yet university mathematics requirements may restrict innovators from entering the university due to the requirements.

In conclusion, it is significant to note that findings indicate HEI's need to focus mainly on leadership, brand identity and explorative culture within their curriculum to ensure that they produce graduates with the ability engage in these activities and to innovate and contribute to business development.

Acknowledgement

Permission to conduct research was obtained from the College of Business and Economics Research Committee CBEREC with a clearance code and was assigned the clearance number IKM2018_023. The research participants were given an informed consent form as part of the research process to obtain permission to conduct research ethically and to ensure that their identity remains anonymous.

References

- Arnaut, D. (2019) *Towards an entrepreneurial university*, University of Zenica, Zenica.
- Bansi, R. (2016) *Commercialization of university innovation in South Africa*, DTech Public Management dissertation, Faculty of Management, Durban University of Technology, Durban.
- Chen, J. & Yin, X. (2019) "Connotation and types of innovation", *The Routledge Companion to Innovation Management* Routledge, Vol 3, No. 20, pp 26-54.
- Coccia, M. (2006). *Classifications of Innovations Survey and Future Directions*, Ceris-Cnr, Moncalieri.
- Datta, A., Reed, R. & Jessup, L. (2013) "Commercialisation of innovations: An overarching framework and research agenda", *American Journal of Business*, Vol 28, No. 2, pp 147-191.
- Deprez, S. & Guijt, I. (2021) *Can voices at scale really be heard? Reflections from ten years of innovation with SenseMaker*. In, D. Burns, J. Howard & S.M. Ospina, (eds), *The SAGE handbook of participatory research and inquiry*. Sage publications, Los Angeles.

- Deprez, S. & Hanchar, A. (2017) *Working with micro-narratives for monitoring, evaluation, learning and decision-making in complex programmes: An introduction to the practice of SenseMaker*, Data Atelier, Washington DC.
- Edward-Schachter, M. (2018) "The nature and variety of innovation", *International Journal of Innovation Studies*, Vol 2, No. 2, pp 65-79.
- Kakouris, A. (2021) "Teaching creativity in entrepreneurship: Embolden or discourage?", *Industry and Higher Education*, Vol 35, No. 4, pp 465-470.
- Levitt, T. (2002) "Creativity Is Not Enough", *Harvard Business Review*, Vol 80, pp 137-145.
- Magoma, T.C. (2018) *Signification framework of a business intelligence tool for SME business decision-making*, MCom dissertation, University of Johannesburg, Department of Information and Knowledge Management.
- Pellissier, R. (2012) "Innovation in a complex environment", *South African Journal of Information Management*, Vol 14, No. 1, pp 1-14.
- Popa, I.L., Preda, G. & Boldea, M. (2010) *A theoretical approach of the concept of innovation*, West University of Timisoara, Timisoara.
- Rooke, M. (2017) *Research into issues around the commercialisation of university IP*, RMC PACEC, Cambridge.
- Rowe, R. (2008) *Innovation, and commercialisation-concepts, definition, and metrics*. Pathways to Innovation, Shediac Bridge.
- Selman, J. (1999) *Leadership and innovation: Relating to circumstances and change*, ParaComm Partners International, California.
- Thani, F.N., Mazari, E., Asadi, S. & Mashayekhikhi, M. (2021) "The impact of self-development on the tendency toward organizational innovation in higher education institutions with the mediating role of human resource agility", *Journal of Applied Research in Higher Education*, Vol 14, No. 2, pp 852-873.
- Varadarajan, R. (2018) "Innovation, innovation strategy, and strategic innovation", *Journal in Innovation and Strategy*, Vol 15, pp 143-166.

Barriers, Challenges, and Benefits: Gender Diversity in Technology-Based New Venture Team Innovation

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Abstract: This paper introduces the early phase of research designed to unpack the phenomenon of gender diversity in technology new venture teams including its barriers, potential benefits, and challenges. We present some preliminary case study findings from 13 interviews with team members from three technology new ventures in Indonesia. This research setting allows us to investigate a unique cultural context in a developing country. The present study addresses a significant research gap by elucidating various viewpoints of new ventures towards gender diversity within the same institutional context, thereby enabling a nuanced understanding of their ability to leverage the potential benefits of gender-diverse teams for innovation. Specifically, our findings reveal that new ventures have different abilities to navigate the barriers and challenges associated with gender diversity. This study identified three distinct barriers, namely the acquisition of gender-balanced applicants, the mitigation of gender-specific bias, and the effective management of dynamics team composition. In addition to the potential benefits of having a gender-diverse team, such as enhanced collaboration, balanced thinking, and inter-group competition, our research has identified three significant challenges. These include the need to overcome cultural and social norms that hinder gender diversity, effectively managing diversity management practices, and improving employee engagement and a sense of belonging. The initial results of our study offer some practical and theoretical implications for enhancing the potential of new ventures to leverage the advantages of gender-diverse teams to promote innovation. These we aim to study further as the doctoral investigation advances further through more extensive case study analysis.

Keywords: Gender Diversity, Innovation, Technology New Ventures Teams

1. Introduction

Previous studies on gender and innovation have focused on quantitative analysis and thereby lacked critical insights on how these concepts interplay with each other over time. As a result, the findings have been inconclusive, with some studies reporting positive effects (Dai, Ye et al., 2019; Ritter-Hayashi et al., 2019), negative (Cropley and Cropley, 2017; Schneid et al., 2015) and insignificant impact (Biga-Diambeidou et al., 2021; Roh and Koo, 2019). Such results lead to further unsolved research questions and problems on their relationship whether that can be found to be “positive” or “negative”.

It is a plausible assertion that certain companies may reap advantages from having a gender-diverse team, whereas others may encounter difficulties. Gender diversity in a team could increase innovation performance as the team would have access to different resource pools and networks that could impact the quality and quantity of idea generation in innovation (Schneid et al., 2015). On the other hand, it might raise the potential for a conflict (Der Foo et al., 2005; Chowdhury, 2005) which is detrimental to innovation.

With regards to the prior arguments, it is surprising that previous research did not fully address the issue of how gender diversity benefits firms and what challenges that firms should foresee to grasp the potential advantages of having “gender-diverse” teams. Moreover, the change in the demographic composition of women in the workforce increases the need for a more thorough understanding of the potential benefits and challenges of creating such a team. Abels (2012) argued “the failure to involve women in the innovation process could be perceived as an unacceptable waste of human resources” reducing the probability of innovation success.

As stated, understanding the potential benefits and challenges of having a gender diverse team might support firms to stimulate their innovation. Drawing from previous research which mostly focus on the established firm, the context of gender diversity in a new venture team has been neglected, while it is argued that small firms have greater difficulties capturing the benefit of a gender-diverse team (Teruel and Segarra, 2017). Therefore, by exploring new venture contexts, this research aims to explain the reason behind the results, specifically in the IT sector, where women are infrequently encountered.

Given those previous arguments, the research question then becomes, “How do new ventures understand the barriers, challenges, and potential benefits of having a gender-diverse team to support innovation?” To address this question, we have interviewed 13 new venture team members from three different start-ups to understand

their experience in a gender diverse team. These new ventures were purposefully selected to capture different gender compositions. Through these interviews, we were able to identify the barriers, challenges, and potential benefits of having a gender-diverse team.

There are several contributions made by our study. First, this research provides some preliminary empirical evidence, from an emerging country, of how new ventures have different approaches to creating gender diversity in their teams. Second, our study pinpoints the barriers, benefits, and challenges of maintaining gender diversity in a new venture team. Hence, this research aims to provide a practical contribution to help new ventures develop diversity management practices to support innovation.

In the forthcoming section, we provide a comprehensive exploration of the aforementioned unit of analysis, aiming to develop our knowledge and understanding. Subsequently, we outline the methodology adopted to conduct the research investigation, offering insight into the approach we have employed to gather and analyze the data collected. This includes details of the setting where the research was conducted. Then, we present the results, followed by a detailed discussion and interpretation of these findings. Finally, we conclude with a synthesis of the key findings and their implications, emphasizing the critical significance of this study.

2. Literature Review

According to social role theory, gender is an important factor mediating human behaviours (Eagly, Alice H et al., 2000). Gender-diverse teams will allow combinations of knowledge from individuals with different socialization histories (Ruiz-Jiménez et al., 2014). From an information-processing perspective, gender diversity will lead to a more diverse pool of resources that could impact the quality and quantity of idea generation in innovation (Schneid et al., 2015).

As previously mentioned, prior research provided a strand of evidence that gender diversity in a team could influence innovation performance. It is argued that optimal innovation occurs when there is an equal mix of men and women in a team (Okoń Horodyńska and Zachorowska-Mazurkiewicz, 2015). There is some evidence that suggests a significant and positive impact of gender diversity on innovation performance (Dai, Ye et al., 2019; Marinova et al., 2015; Ritter-Hayashi et al., 2019).

Nevertheless, alternative studies have presented conflicting results, suggesting that gender diversity does not have a substantial influence on innovation performance. (Biga-Diambeidou et al., 2021; Roh and Koo, 2019). Men and women show no differences in their innovativeness (Steyn and de Bruin, 2020; Nählinder et al., 2015), Cropley and Cropley (2017) and Schneid et al. (2015) found a significant negative impact of gender diversity on innovation performance. The caused of which is a social categorization process, amplified by national culture, whether it is collectivistic or individualistic societies. However, it is uncertain how new ventures within the same institutional context will follow this rationale. Therefore, there is a need to find an answer to a straightforward research problem: how does gender diversity improve innovation performance in new ventures within the same institutional context?

A new venture is relevant for this study since innovation is a crucial aspect for a new venture to survive when entering the industry. However, new ventures have to face complex challenges to maximise their limited resources in order to innovate. Teruel and Segarra (2017) argued that smaller firms have difficulties capturing the benefits of having a gender-diverse team. They argue that even though smaller firms have more flexible organisational structures, they are not equipped with specific tools and skills to optimise the potential of their human resources, nor can they cope with the potential problem caused by either creating or maintaining gender diversity in a team. This research provides a supportive argument that exploring new ventures is relevant since they are the ones that usually fail to benefit from gender diversity. Moreover, the focus on technology new ventures will give some valuable insight since the scarcity of female entrepreneurs in the IT industry renders their perspectives and knowledge highly valuable resources to firms, given the prevailing male dominance in this industry (Dai, Y. et al., 2019).

3. Methodology

To address our primary research question, we have undertaken a qualitative approach through multiple case studies. Multiple-case study research is appropriate as the nature of the research question is used to explore new topic areas that have not been extensively studied in the real-world context (Eisenhardt, 1989; Yin, 2018). More for our work the underdeveloped nature of gender diversity scholarship in an emerging economy context necessitated it. We are investigating five cases but two of these are not sufficiently developed enough to present

here therefore we are presenting the results from three of them. Case study is relevant to be used to answer a research question that requires an extensive and in-depth approach to a phenomenon (Yin, 2018). One of the key advantages of doing a case study is the ability to obtain plausible explanations of causal relationships from theoretical constructs that have been conceptually developed through the framework (Siggelkow, 2007).

3.1 Data Collection

In this research, a technology new venture team is the unit of analysis. By adopting multiple case studies, three cases were purposefully chosen to represent the variation in their gender composition. To gather rich and in-depth data to explore the phenomenon of gender diversity in a new venture team, in-depth interviewing was conducted using a semi-structured approach. The objective was to cover all different hierarchical levels in new ventures, and to disseminate their different views on their experience in a gender-diverse team. The researcher constructed the interview guide using open-ended questions, specifically to derive answers from the participants that might not be considered by the researcher as well as to reduce bias. During this stage, 13 interviews were conducted. Each interview took approximately 45 minutes to an hour.

3.2 Data Analysis

The data analysis was divided into two stages. In the first stage, within-case analysis was conducted for each case. Adapted from thematic analysis (Braun and Clarke, 2022), this stage involved six steps: familiarisation with the data, creation of initial codes, searching for themes, reviewing the themes, defining and naming themes, and producing the report. The analysis process was conducted using NVivo 12. In the second stage, cross-case analysis was conducted, and the narratives between the three cases were visualised using tables and figures to enable comparison. The outcome of this phase led to a better understanding of the barriers, challenges, and potential benefits that were being faced by the new venture.

3.3 Research Setting

To capture a unique situational context, this research was conducted in Indonesia. Indonesia provides a unique research setting as it represents an emerging country without any notable prior study of our research topic. Compared to developed countries such as the US, the UK, and the EU countries where the topic is mature and well researched. Indonesia provides a different socio-cultural context. For example, compared to those countries, Indonesia has a higher “power distance level” between male and female workers, meaning that workers and managers are members of organizations that expect and accept that power is distributed unequally.

Turning to other aspects, Indonesia also adopts a collectivistic culture. It means that there is a high preference for a strongly defined social framework in which individuals are expected to conform to the ideals of society and the in-groups to which they belong (Hofstede et al., 2010). Therefore, gender diversity in the IT sector is hard to achieve since it is a patriarchal structure that mainly operates in Indonesia. However, interestingly there is evidence that 26% of women are involved in entrepreneurship activities, whilst 60% of micro, small, and medium-sized firms in the country are women-owned (Agussani, 2020). Therefore this unusual context provides an interesting opportunity to build and inform theory on gender diversity in new ventures. As the institutional support seems lacking unlike in developed countries yes we are still seeing a relatively high level of woman in new venture activity.

4. Results

In the results we present some sample evidence from the initial investigation analysis. This highlights some of the salient key points quickly observed from initial coding and transcript interpretations.

4.1 Case Introduction

Case 1 – Milk.Co

Milk.Co is among the first of alumni of 1000 start-up digital, a program initiated by the government to enhance start-up growth in Indonesia. Milk.Co developed a mobile application which provided on-demand services for breastmilk donor and the recipient. It also functioned as a crowdfunding platform that enable member to support the recipients in need. However, following the resignation of team member who focused on IT development, Milk.co defined itself as a social enterprise and used less advanced technology. They decided to use foundation as their legal form to gain public trust. Consequently, they have difficulties broadening their

business model to gain profit. In the near future, they intend to establish a subsidiary in the form of a limited company with the aim of increasing profitability and enhancing operational flexibility. Their current activities are focused on recruiting donors, screening them, and distributing breastmilk to recipients through an Android-based mobile application. Initially, Milk.Co had a male-dominated team consisting of five men and one woman. However, following the resignation of a previous team member, the CEO then recruited more women, arguing that they represented their target market. Currently, the composition is reversed and becomes female-dominated, comprising nine women and three men.

Case 2 – Shrimp.Co

Shrimp.Co aims to develop an integrated application with a device to support farmers in increasing their crop yields through mitigation of failure risks and sustainable farming practices. As a limited company, they develop several revenue streams, not only selling devices and apps but also assisting farmers in cultivation, post-production and shrimp trading. Apart from profit-oriented activities, they are also active in promoting gender diversity in aquaculture by adopting Gender Active Learning System (GALS) to increase women's participation in the aquaculture sector. In addition, they consistently assess and monitor their impact through the establishment of a dedicated impact department. In its early stages, the team composition was predominantly male, with one female member and seven male members. However, with good diversity management practices, it could improve women's representation by up to 37% within two years. The policy that supports gender diversity is well-developed, and they constantly enhance their corporate culture to ensure that all team members are provided with an inclusive and supportive working environment.

Case 3 - Cop.Co

Cop.co is a start-up that focuses on developing Enterprise Resource Planning (ERP) to enable co-operatives to digitalize their business processes. Case 3 also supports their co-operative to connect to a larger co-operative ecosystem and strengthen their network to enhance the business. Cop.co has a strong relationship with the Ministry of Cooperatives and SMEs of the Republic of Indonesia, which have the same mission of digitising their Indonesian co-operative. In three years, they have helped digitise no less than 700 cooperatives across over 12 provinces. Their aim is to assist cooperative management to be more efficient, transparent, and accountable. Cop.Co was established by five people, consisting of one woman and three men. After receiving seed funding, they recruited more team members and are currently operating with 19 gender-balanced team members. The CEO believes in gender diversity, but he also acknowledges that the current composition is naturally formed.

4.2 Comparative Analysis Across the three cases

4.2.1 Barriers

Gender diversity is prioritised in some circumstances yet achieving it may be difficult. In fact, new ventures need to overcome some barriers such as the difficulties on increasing gender-balance applicant, getting reliable human resources, overcoming gender specific bias, and managing dynamic team composition.

Table 1: Barriers to have gender diversity in a technology new venture teams

Themes	Sub-Themes	Example Quote
Barriers	Increasing Gender-Balance Applicant	<i>"Even though in some cases, I mean that from the side who applied for the position, it's not like what I expected. It can be balanced, but mostly some positions are dominated by men, some others are dominated by women. It's something like that".</i>
	Getting Reliable Human Resources	<i>"It was just yesterday that we were recruiting. The qualifications of men are still much better than woman and even if there are woman when it comes to the offering, most of them applying are men [who accept the offer], right, because woman are usually constrained by their parents' blessing for moving to another region like that, so there are still more men there".</i>
	Overcoming Gender-Specific Bias	<i>"It's quite rare for girls to be in the field, so for example when we hire, in the end, the one that are capable of or the one who wants to go around are mostly male....it might be because they think it's a man's job".</i>

Themes	Sub-Themes	Example Quote
	Managing Dynamic Team Composition	<i>"When we talk about team composition. We cannot force them to stay. So the composition were five people, two of them were developers, one of them was a designer and the rest were Mrs. L and I. In 2018, three of them decided to resign".</i>

4.2.2 Potential Benefits

Although different cases have different views on gender diversity in a team based on their experience, each case describes some of the advantages of having a gender-diverse team. Those identified the advantages then categorised them into three different themes: achieving balanced thinking, collaboration, and inter-group competition.

Table 2: Potential Benefits of Having Gender Diverse Team

Themes	Sub-Themes	Example Quote
Potential Benefits	Balanced Thinking	<i>"Our approach is different and for example she is more like result oriented, She don't care about this and that as long as it leads to result but, I am more people oriented, I do care about whether the team members are comfortable or not. So the approach is different but both are needed."</i>
	Collaboration	<i>"So, we have a woman designer, so we pair them with person who, for example, are good at research. In pairs and so the combination of people doing a job is important".</i>
	Inter-group Competition	<i>"So if I built homogenous organization, whose member are mostly the same, people who are similar in shape, religion, skin colour, gender, they will feel that they are in a comfort zone, and that's not good, In my opinion, so I need a lot of minorities, so it suppresses the majority so that they can work well together. Women are the minority in here.. the speed of work also created by this competition".</i>

4.2.3 Challenges

All the benefits mentioned in the previous section would not come without any consequences. Some challenges might emerge from a gender-diverse team that needs to be considered to benefit from them. If it is ignored, instead of having the advantage, negative impacts might occur. These challenges include overcoming cultural and social-norm barriers, improving engagement and belonging, and managing diversity management practices.

Table 3: Challenges of Having Gender Diverse Team

Themes	Sub-Themes	Example Quote
Challenges	Overcoming Cultural, social-norm barriers	<i>"For friends who are in the field. Maybe the challenge is more from the farmer, sometimes they respond more to men than to woman".</i>
	Improving Engagement & Belonging	<i>"But here you know, some people come, and some people go, so I cannot really be who I really am".</i>
	Diversity Management Practices	<i>"Given those facilities, it doesn't mean that the women can relax more than men, they both should have the same performance standards and have the same performance considerations".</i>

5. Discussion

The analysis revealed that one of the barriers experienced by new ventures is difficulties in getting gender-balanced applicants due to the tendency of people to apply for a position in which the occupation's stereotype matches their gender. This phenomenon has been explained in Social Congruity Theory, an extension of the social role theory proposed by Eagly, Alice H. and Karau (2002). This theory argues that the incongruity of gender roles will have negative consequences, which individuals tend to prevent. Some occupations might activate gender stereotypes. It is imperative to utilise gender-neutral terminology when referring to occupations. Therefore, it is important to make vacancies advertisement that could counteract these stereotypes. By doing this, the number of applicant might increase which also can potentially overcome second barrier which is getting reliable human resources.

Moreover, the findings reveal other barriers such as gender-specific bias, and managing dynamic team composition. It means that team members need specific training programmes to increase gender awareness and dynamic within the team. The main focus is on identifying implicit biases and challenging stereotypical gender norms, which have the potential to mitigate gender biases in the hiring process and performance evaluations during the selection phase (Rice and Barth, 2016).

This study also reveals some potential benefits of having a gender-diverse team. One of the potential benefits includes balanced thinking, which is argued to be one of the key elements supporting innovation (Ettlie et al., 2014) concluding that new ventures team should be equipped with a balanced thinking style (Groves et al., 2011). Another benefit is collaboration. This finding confirms previous research, which indicates that the inclusion of women in a team significantly enhances its collaborative efforts (Bear and Woolley, 2011). Similarly, Nielsen et al. (2018) also argue that having a gender-diverse team has the potential to facilitate scientific discovery and innovation. This argument is supported by recent evidence that indicates that gender-diverse collaborative teams generate more significant scientific breakthroughs (Yang et al., 2022). Surprisingly, having a gender-diverse team also triggers intergroup competition (Bornstein et al., 2002), which can be managed to boost productivity.

Moving towards the challenges, gender biases, specifically in technology-related fields persist in Indonesia. When women encounter under-appreciation and limited opportunities to engage in decision-making processes, their capacity to improve performance may be neglected (Cropley and Cropley, 2017). Overcoming gender-specific bias in the workplace can be challenging, but it is important to ensure that a firm can utilise the resources provided by the entire team members and realise the benefit of having a gender-diverse team (Gurtler and Gurtler, 2019).

In relation to the second challenge, Georgeac and Rattan (2023) provided empirical evidence that fostering a sense of belonging is essential, particularly if an organization intends to avoid the potential negative consequences of a lack of commitment to diversity and inclusion. When team members experience a lack of a sense of belonging, they tend to display reduced levels of engagement, achievement, and subsequently performance (Cohen and Garcia, 2008).

Based on the challenges experienced by new ventures under study, we suggest that practising gender diversity management (DM) practices is paramount to overcoming some challenges. Kalev et al. (2006) identified three different practices of DM, including the need to establish a structure of responsibility, reduce bias through education and feedback, and prevent social isolation through networking and mentoring. Likewise, Turner and Merriman (2022) also emphasise the importance of management commitment to developing DM practices and policies to support diversity in the organization.

6. Conclusions

This study represents a pioneering effort in examining the process of new venture team development and its relationship with gender diversity. Looking at the influences on gender diversity and the subsequent mediating effect of it on innovation performance. The institutional context is negative towards it yet gender diversity is there and its growing due to the drive and determination of women to start up, build and develop new businesses and to contribute to innovation. Markets consist of men and women consumers so there is a clear need for a diverse team to be involved in developing products.

This paper unravels the fact that the ability of technology new venture teams to benefit from a gender-diverse team are contingent upon its capacity to identify and address the barriers and challenges that may arise from having such a team. Those that demonstrate an awareness of barriers and challenges are the ones that are potentially capable of formulating diversity management strategies that foster a supportive and inclusive environment, which is important to promoting innovation.

Drawing from how contextual and different innovation performance is, future studies should pay less attention on 'proving' the impact of having gender diversity on innovation performance and be more focused on what the firm does to benefit from gender diversity to promote innovation. Demonstrating best practices to the organisation is a crucial aspect to consider since having a gender-diverse team does not necessarily improve innovation performance. Therefore, future research needs to explore the provisioning conditions, both internal and external, to support a gender-diverse team to promote innovation.

Acknowledgement

We would like to express our sincere gratitude to Ministry of Religious Affairs and LPDP, who generously provides funding and facilitation for the completion of this study.

References

- Abels, G. 2012. Research by, for and about women: gendering science and research policy. *Gendering the European Union*. Springer, pp.187-207.
- Agussani, A. 2020. Are Women The Dominant Entrepreneurs In Indonesia? *The International Journal of Social Sciences and Humanities Invention*. **7**(5), pp.5935- 5947.
- Bear, J.B. and Woolley, A.W. 2011. The role of gender in team collaboration and performance. *Interdisciplinary science reviews*. **36**(2), pp.146-153.
- Biga-Diambeidou, M., Bruna, M.G., Dang, R. and Houanti, L.H. 2021. Does gender diversity among new venture team matter for R&D intensity in technology-based new ventures? Evidence from a field experiment. *Small Business Economics*. **56**(3), pp.1205-1220.
- Bornstein, G., Gneezy, U. and Nagel, R. 2002. The effect of intergroup competition on group coordination: An experimental study. *Games Economic Behavior*. **41**(1), pp.1-25.
- Braun, V. and Clarke, V. 2022. *Thematic analysis : a practical guide*. London: SAGE Publications Ltd.
- Chowdhury, S. 2005. Demographic diversity for building an effective entrepreneurial team: is it important? *Journal of Business Venturing*. **20**(6), pp.727-746.
- Cohen, G.L. and Garcia, J. 2008. Identity, Belonging, and Achievement: A Model, Interventions, Implications. *Current directions in psychological science : a journal of the American Psychological Society*. **17**(6), pp.365-369.
- Cropley, D. and Cropley, A. 2017. Innovation capacity, organisational culture and gender. *European Journal of Innovation Management*. **20**(3), pp.493-510.
- Dai, Y., Byun, G. and Ding, F. 2019. The Direct and Indirect Impact of Gender Diversity in New Venture Teams on Innovation Performance. *Entrepreneurship: Theory and Practice*. **43**(3), pp.505-528.
- Dai, Y., Byun, G., Ding, F.J.E.T. and Practice. 2019. The direct and indirect impact of gender diversity in new venture teams on innovation performance. **43**(3), pp.505-528.
- Der Foo, M., Wong, P.K. and Ong, A.J.J.o.B.V. 2005. Do others think you have a viable business idea? Team diversity and judges' evaluation of ideas in a business plan competition. **20**(3), pp.385-402.
- Eagly, A.H. and Karau, S.J. 2002. Role Congruity Theory of Prejudice Toward Female Leaders. *Psychological review*. **109**(3), pp.573-598.
- Eagly, A.H., Wood, W. and Diekmann, A.B. 2000. Social role theory of sex differences and similarities: A current appraisal. *The developmental social psychology of gender*. **12**, p174.
- Eisenhardt, K.M. 1989. Building theories from case study research. *Academy of management review*. **14**(4), pp.532-550.
- Ettlie, J.E., Groves, K.S., Vance, C.M. and Hess, G.L. 2014. Cognitive style and innovation in organizations. *European journal of innovation management*. **17**(3), pp.311-326.
- Georgeac, O.A.M. and Rattan, A. 2023. The business case for diversity backfires: Detrimental effects of organizations' instrumental diversity rhetoric for underrepresented group members' sense of belonging. *Journal of personality and social psychology*. **124**(1), pp.69-108.
- Groves, K., Vance, C. and Choi, D. 2011. Examining Entrepreneurial Cognition: An Occupational Analysis of Balanced Linear and Nonlinear Thinking and Entrepreneurship Success. *Journal of small business management*. **49**(3), pp.438-466.
- Gurtler, M. and Gurtler, O. 2019. Promotion signaling, discrimination, and positive discrimination policies. *The Rand journal of economics*. **50**(4), pp.1004-1027.
- 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.
- Kalev, A., Kelly, E. and Dobbin, F. 2006. Best Practices or Best Guesses? Assessing the Efficacy of Corporate Affirmative Action and Diversity Policies. *American sociological review*. **71**(4), pp.589-617.
- Marinova, J., Plantenga, J. and Remery, C. 2015. Gender diversity and firm performance: evidence from Dutch and Danish boardrooms. *International journal of human resource management*. **27**(15), pp.1777-1790.
- Nählinder, J., Tillmar, M. and Wigren, C. 2015. Towards a Gender-Aware understanding of innovation: A three-dimensional route. *International Journal of Gender and Entrepreneurship*. **7**(1), pp.66-86.
- Nielsen, M.W., Bloch, C.W. and Schiebinger, L. 2018. Making gender diversity work for scientific discovery and innovation. *Nature human behaviour*. **2**(10), pp.726-734.
- Okon Horodnyńska, E. and Zachorowska-Mazurkiewicz, A. 2015. Innovation, innovativeness and gender - approaching innovative gender. *Analele științifice ale Universității Al. I. Cuza din Iași. Secțiunea IIIc, Științe economice (1976)*. **62**(1), pp.1-22.
- Rice, L. and Barth, J.M. 2016. Hiring Decisions: The Effect of Evaluator Gender and Gender Stereotype Characteristics on the Evaluation of Job Applicants. *Gender issues*. **33**(1), pp.1-21.
- Ritter-Hayashi, D., Vermeulen, P. and Knoblen, J. 2019. Is this a man's world? The effect of gender diversity and gender equality on firm innovativeness. *PloS one*. **14**(9), pp.e0222443-e0222443.

- Roh, J. and Koo, J. 2019. The impacts of diversity on team innovation and the moderating effects of cooperative team culture. *International review of public administration*. **24**(4), pp.246-263.
- Ruiz-Jiménez, J.M., Fuentes-Fuentes, M.d.M. and Ruiz-Arroyo, M. 2014. Knowledge Combination Capability and Innovation: The Effects of Gender Diversity on Top Management Teams in Technology-Based Firms. *Journal of business ethics*. **135**(3), pp.503-515.
- Schneid, M., Isidor, R., Li, C. and Kabst, R. 2015. The influence of cultural context on the relationship between gender diversity and team performance: a meta-analysis. *International journal of human resource management*. **26**(6), pp.733-756.
- Siggelkow, N. 2007. Persuasion with case studies. *Academy of management journal*. **50**(1), pp.20-24.
- Steyn, R. and de Bruin, G. 2020. Gender differences in the relationship between innovation and its antecedents. *South African journal of business management*. **51**(1), pp.1-e12.
- Teruel, M. and Segarra, A. 2017. The link between gender diversity and innovation: What is the role of firm size?". *International Review of Entrepreneurship*. **15**(3), pp.319-340.
- Turner, L.A. and Merriman, K.K. 2022. Cultural intelligence and establishment of organisational diversity management practices: An upper echelons perspective. *Human resource management journal*. **32**(2), pp.321-340.
- Yang, Y., Tian, T.Y., Woodruff, T.K., Jones, B.F. and Uzzi, B. 2022. Gender-diverse teams produce more novel and higher-impact scientific ideas. *Proceedings of the National Academy of Sciences - PNAS*. **119**(36), pp.1-e2200841119.
- Yin, R.K. 2018. *Case study research and applications*. Sage.

Managing Uncertainties during the Development Process of Technological Innovation Projects: Lean Startup Contributions

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Abstract: During the development of technological innovation projects, the team has difficulty to identify and managing uncertainties, which represents a challenge to bring the technologies closer to the market. Although there are studies on the management of uncertainties in innovation projects in different contexts of organizations, no studies were found relating to the adoption of Lean Startup (LS) practices and the management of uncertainties during the development of technological project processes in academic environments. Thus, this research aims to identify the uncertainties that can be mitigated during the development of these technological projects using LS practices. A multiple case study was conducted within a Brazilian federal university to fill this gap, analyzing nine technological innovation projects. The research consisted of identifying the uncertainties experienced by the project innovation development team before and after the application of LS practices. In the end, the uncertainties were analyzed in the context of each technological project, considering the mitigation achieved after applying the LS practices, and comparing them with their initial state. As a result, it was observed that the initial uncertainty categories most experienced by the project teams were related to products and resources, especially those related to knowledge and team profile. When evaluating the uncertainties after applying the LS practices, it was possible to observe that the most mitigated uncertainties were related to resources followed by the business model, the latter being the third most experienced in the initial scenario of the project development process. On the other hand, the uncertainties related to products were the ones that presented the least mitigation. Regarding resource uncertainties, the LS practices contributed to the mitigation, specifically those related to process quality, obtaining resources and knowledge, and team profile. As for the uncertainties observed in the business model, better results were observed specifically in those focused on marketing strategy, pilot production, and definition of the revenue model. It is concluded that the LS practices made more significant contributions to the business-related uncertainties than to product-related ones since product-related uncertainties were the ones that obtained the lowest mitigation results.

Keywords: Lean Startup Practices. Uncertainty. Technological Innovation Projects. Projects.

1. Introduction

Risk and uncertainty are interrelated concepts with an inevitable interdependence. Risk is the effect that, when it occurs, has negative consequences (Sicotte and Bourgault, 2008). On the other hand, uncertainty is characterized by events that cannot be associated with the probabilities of their results (Gomes *et al.*, 2020). Uncertainties are often explained by two main causes: internal (related to the behavior of actors) and external (technological changes, market changes, for example) (Gomes *et al.*, 2020). Uncertainty management is an important factor in the formulation and implementation of nascent business strategies (Fernandes, Reis, Sérgio, 2017) and represents a major challenge for economies in constant innovation. In the academic environment, these unmanaged uncertainties can have a negative impact on the development process of technological innovation projects, which can lead to the failure of these innovations (Fernandes, Reis, Sérgio, 2017).

During the process of technological innovation, different types of uncertainties occur, such as technological and market uncertainties (Huang *et al.*, 2022; Sicotte and Bourgault, 2008). Uncertainties generate waste, such as waiting time, unnecessary circulation of documents (Araujo *et al.*, 2023), and the development of bad prototypes. The management of these uncertainties thus contributes to formulating and implementing technological business strategies (Fernandes, Reis, Sérgio, 2017), and also in preparing to reduce barriers to the adoption of new principles and technologies such as those related to Industry 4.0 (Cordeiro *et al.*, 2023a; Cordeiro *et al.*, 2023b; Carvalho de Sá *et al.*, 2022).

In this context, we discuss Lean Startup (LS) practices, which represent a set of tools to guide data collection and organization of information about products and markets, to mitigate different wastes (Ghezzi and Cavallo, 2020). These practices allow the improvement of the flow of information between those involved in the project (Reis *et al.*, 2022; Reis *et al.*, 2021; Reis, Fernandes, Armellini, 2021; Gomes *et al.*, 2020) and, consequently, promote the reduction of uncertainties inherent in the development process (Fernandes, Reis, Sérgio, 2017) since they can speed up the decision-making process (Zorzetti *et al.*, 2022; Ries, 2011).

In the researched literature, no studies were found to identify and evaluate in which situations LS practices

can contribute to the management and reduction of uncertainties during the development process of technological innovation projects. Thus, the objective of this investigation is to identify the uncertainties that can be mitigated during the development of these technological projects using LS practices. To do so, we consider five LS practices: i) Business Model Canvas; ii) Validation Board; iii) Minimum Viable Product ; iv) Empathy Map, and v) Value Proposition Canvas.

2. Theory Background

2.1 Innovations in the academic environment and LS practices

Technological innovation is related to significant improvements or new developments of products, services, or processes that are capable of generating additional value for the business or for customers (Reis *et al.*, 2022; Araújo, Reis, Morais, 2021; Reis *et al.*, 2018). This process of technological, both those conducted by large companies and those from the academic environment, are essential for the social and economic development of a country (Caviglioli *et al.*, 2023; Reis *et al.*, 2022).

Universities, as organizations capable of producing, disseminating, and applying knowledge, are considered essential to promote the process of technological innovation (Caviglioli *et al.*, 2023, Silva *et al.*, 2019) since they produce technologies that impact the generation of wealth and social development (Reis *et al.*, 2022; Boguszewicz-Kreft *et al.*, 2021).

Despite the importance of these technological innovations, development teams face several difficulties in making their projects develop and thrive, since, they are embedded in uncertain and volatile environments. These uncertainties lead teams to perform their activities using a trial-and-error approach, without the correct sequencing of activities necessary for project consolidation (Miller *et al.*, 2020).

These difficulties caused by volatility and uncertainty demonstrate the importance of developing methodologies and tools capable of managing such uncertainties and thus contributing to the process of formulating and implementing strategies technological business strategies that help operationalize the process of technological innovation (Jesemann *et al.*, 2021; Reis *et al.*, 2021; Fernandes, Reis, Sérgio, 2017). Within this context, LS brings a set of practices capable of assisting the process of implementing business technology strategies and, consequently, supporting the process of technological innovation (Fernandes, Reis, Sérgio, 2017).

LS is a methodology that aims to understand and assist the development of new innovative businesses immersed in a set of uncertainties and high-risk environments in a lean way (Reis *et al.*, 2023; Reis, Fernandes, Armellini, 2021; Veiga, 2015). It comprises a set of practices that seek to make the development process more dynamic, fast, and reliable, through continuous testing of product and business validation using an approach based on learning and information exchange (Jesemann *et al.*, 2021).

The LS practices explained in Figure 1 contribute to technology, product, and business development (De Faria, Santos, Zaidan, 2021; Ghezzi and Cavallo, 2020), as they enable the identification of customers and competitors and identify ways of relating to the market to generate value for the product or service and check market trends (Jesemann *et al.*, 2021; Dewobroto and Marie, 2020).

PRACTICE	CONCEPT	AUTHORS
Business Model Canvas (BMC)	It consists of a visual map of the company, divided into nine elements that help structure the business model, logically describing how the company intends to create, deliver and capture value.	Hidayat, Hendrix, Hidayat (2018); Pitayachaval, Chittrakool, Arjharn (2017) Osterwalder and Pigneur (2011)
Validation Board (VB)	It is a tool used to validate business-related problems, which helps teams to plan, execute and evaluate in a structured way the suitability of solutions for customers.	Peralta <i>et al.</i> (2020); Ardyanti <i>et al.</i> (2019); Veiga (2015)
Minimum Viable Product (MVP)	First prototype created with the lowest possible investment, capable of quickly demonstrating the value of the product to the customer and verifying whether the business is able (or not) to enter the market.	Jesemann <i>et al.</i> (2021); Maludin <i>et al.</i> (2021); Hokkanen, Kuusinen and Väänänen (2016)
Empathy Map (EM)	It is a tool used to capture customer information and needs in order to develop new solutions to old issues or rediscover old solutions to new issues.	Kahan <i>et al.</i> (2021); Staniec and Pilawa (2020); Osterwalder and Pigneur (2011)
Value Proposition Canvas (VPC)	It helps to better understand the customer and define a unique and attractive value proposition that is capable of promoting differentiation from competitors, in addition to structuring the way in which the product or service relates to customer needs.	Puurtinen and Pohjola (2021); Päivi and Helena (2020); Veiga (2015)

Figure 1: LS practices concepts

Source: The authors.

It can be observed that these practices focus on i) structuring the value proposition and customer segmentation (De Faria, Santos, Zaidan, 2021; Dewobroto and Marie, 2020), ii) encouraging interaction and information exchange among project members so that there is improvement in the organizational learning process (Reis, Fernandes, Armellini, 2021; Mansoori, Karlsson, Lundqvist, 2019) iii) so that the team can reduce resource utilization, minimize waste, and effectively address risks, uncertainties, and opportunities while generating value for the customer (Reis *et al.*, 2022).

2.2 Uncertainty and technological innovation

Technological projects inserted in the academic context are subject to internal and external actions that influence their performance and continuity (Miller *et al.*, 2020; Fernandes, Reis, Sério, 2017). During the process of technological innovation, there are uncertainties (Miller *et al.*, 2020) that must be managed to define operational actions, priorities, and objectives capable of delivering superior performance (Eker and Eker, 2019). Uncertainties related to the external environment, for example, make it difficult for companies to formulate and implement strategies, in addition to impacting decision-making (Reis *et al.*, 2022; Janka and Guenther, 2018).

Seminal studies address different categories of uncertainties, uncertainties related to the customer, technology, competition, and resources, among others (Jaworski and Kohli, 1993; Milliken, 1987; Jauch and Kraft, 1986). From the literature, seven categories of uncertainty were identified. Figure 2 presents these uncertainty categories.

Studies show how uncertainties can affect business activities, product, and service development project performance (Gomes *et al.*, 2020), both in the development process and in the project organization (Lee and Xu, 2019; Janka and Guenther, 2018). The literature shows that the need to manage uncertainty is more evident within new and small firms, as they tend to face greater business uncertainty than large firms (Elias *et al.*, 2022; Reis *et al.*, 2022), but despite this, they prefer to adopt improvisation in a short time rather than focusing on providing the necessary resources (Huang *et al.*, 2022).

Customer uncertainty and technology uncertainty are inherent to the process of technological innovation due to their environment and are addressed by Ye and Mai (2018) as uncertainties of the environment. Given this scenario, startups need to find ways to better deal with uncertainty to take advantage of market opportunities and capture new customers (Felin *et al.*, 2020; Foss, Klein, Bjørnskov, 2019), in addition to needing to be aware of the innovations that appear in the market (Ghezzi and Cavallo, 2020).

Categories	Description	Authors
Customer uncertainty (external environment uncertainty)	Uncertainty related to information coming from the market, including segment identification, changes in customer requirements, identification of distribution channels for products and services.	Huang <i>et al.</i> , 2022; Felin <i>et al.</i> , 2020; Foss, Klein, Bjørnskov, 2019; Ye and Mai, 2018
Technology uncertainty	Technological uncertainties talk about the main technological elements, the operation of technology, intellectual property, legalization, and registration of products.	Huang <i>et al.</i> , 2022; Ghezzi e Cavallo, 2020; Ye and Mai, 2018; Arteaga and Hyland, 2013
Competitive uncertainty (competitors)	Competitive uncertainty involves all changes in the competitive landscape, including competitors' actions and performance.	Jaworski and Kohli, 1993; Milliken, 1987; Jauch and Kraft, 1986
Resource uncertainty (internal uncertainty)	Related to the availability of and access to any additional specialized human or technical resources, goods or tools required for the process.	Xiong, Yang, Jia, 2019; Ye and Mai, 2018; Arteaga and Hyland, 2013; Vera and Crossan, 2005; Cunha, Cunha, Kamoche, 2003
Product uncertainty	Uncertainties related to product design and value proposition.	Felin <i>et al.</i> , 2020; Ghezzi e Cavallo, 2020; Mansoori, Karlsson, Lundqvist, 2019
Partnerships uncertainty (customer integration and financial partners)	It involves the entire relationship with partners in the co-innovation process, as well as partners in external funding sources, investors' risk perception, and purchase channels.	Arteaga and Hyland, 2013; Song, Ming, Xu, 2013; Enkel, Kausch, Gassman, 2005
Business model uncertainty	How to define trading strategies, a model for making a profit, and prices.	Felin <i>et al.</i> , 2020; Ghezzi e Cavallo, 2020; Mansoori, Karlsson, Lundqvist, 2019

Figure 2: Uncertainty Categories

Source: Based on literature review.

To respond to constant environmental changes, it is necessary to mitigate resource-related uncertainties by allocating existing resources optimally and effectively (Ye and Mai, 2018; Cunha, Cunha, Kamoche, 2003).

Xiong, Yang, and Jia (2019), highlight the need to seek new resources while making efficient use of available resources. Vera and Crossan (2005) emphasize not only the acquisition of new resources but also innovation.

Due to the volatility and speed of the market in which they are inserted, these startups have difficulties assembling a minimum viable product and validating their business model, where many times they are not tested against the market, generating an unwanted scenario of uncertainty (Felin *et al.*, 2020; Mansoori, Karlsson, Lundqvist, 2019). Other studies point out that these scenarios provide faster learning for the team, which contributes to uncertainty mitigation (Prashantham and Floyd, 2019; Xiong, Yang, Jia, 2019).

3. Methodology

The methodological approach used in this paper was a case study, for being a methodology that allows understanding the real world and acquiring knowledge to conclusions (Yin, 2008). As units of analysis, nine technological innovation projects were selected and developed within a Brazilian federal university. These projects (Figure 3) participated in the IIP program that aims to foster innovation in academics. They are selected by the university committee and by government institutions.

Projects	Knowledge	Application
Case 1	Pharmaceuticals	Male infertility in case of low count and / or motility of sperm.
Case 2	Mechanical and organic chemistry	Manufacture of organic electronic devices, conductive tracks, resistors, capacitors, and inductors plans, and then diodes, transistors and OLEDs.
Case 3	Mobile and cloud computing	Document management and cloud storage.
Case 4	Applied Mechanics	Detection of fractures in sleepers made of steel.
Case 5	Computer and Cytology	External quality monitoring for cytopathology of tipoll.
Case 6	Food and Chemical	Quality Monitoring and deterioration of real-time meat.
Case 7	Clean Energy	Economic and sustainable energy generation.
Case 8	Food and Chemical	Intelligent packaging with natural preservatives.
Case 9	Blockbuster Games - Technology and Innovation	Social inclusion of visually impaired people through assistive technology in the gaming market.

Figure 3: Characterization of the studied projects

Source: The authors.

The research consisted of identifying the uncertainties experienced by the project's innovation development team before and after applying the LS practices. During a period of 12 months, the five LS practices mentioned in the literature were applied simultaneously in the 9 cases (see Figure 1). For each practice, templates were created to guide its application. The practices were applied in parallel in such a way that the information collected in one was used in the application and the templates were always refined according to technological development. After this period, in which all practices had been applied to all cases, the final situation was analyzed. In the end, the uncertainties were analyzed in the context of each technological project, considering the mitigation achieved after applying the LS practices, and comparing them with their initial state.

For conducting data collection, several sources of evidence were involved in the case study (Yin, 2008), such as online meetings, semi-structured interviews, questionnaires, document consultation, and direct observation, which allowed follow the implementation of LS practices during a period of six months. Spreadsheets containing the standard theoretical framework of LS practices served as a template for the project teams during implementation. Two representatives from each project were interviewed, based on 11 questions and this data collection allowed for a strong connection with empirical reality, providing validation of the theory.

Through the analysis of the information collected by the different sources of evidence used, it was possible to triangulate the data (Yin, 2008). As a result, it was observed that the uncertainty categories most initially experienced by project teams were related to products and resources, especially those related to team knowledge and profile.

4. Data Presentation

The interviews with those involved in the projects were transcribed and coded about the problems faced by the teams during the technological innovation process, being related to a category and subcategory of uncertainty present in the literature. The relationships established allowed a more detailed assessment of the impact of adopting LS practices simultaneously on the types of uncertainties experienced. Each project had

internal standards that ended up being common to other projects, thus allowing the assessment of similarities and differences between the impacts of adopting combined LS practices to mitigate the uncertainties experienced. The segmentation into categories and subcategories, as well as the number of uncertainties initially experienced by the projects, are shown in Figure 4.

Uncertainty category	Uncertainty subcategories	C1	C2	C3	C4	C5	C6	C7	C8	C9	Total/Percent
Customer uncertainty	Market segment		1	1	1	1	1	1	1	1	8 13.56%
	Distribution channel									1	1 1.69%
Technology uncertainty	Technological protection	1	1	1				1	1		5 8.47%
Resource uncertainty	Process Quality	1							1		2 3.39%
	Knowledge and team profile		2	2	1		1	1		3	10 16.95%
	Resource obtainment				1	1			1		3 5.08%
Product uncertainty	Product Design. Product Value Attribute	1	1	1	1		1	2			7 11.86%
	Market application	1	1	1	1	1			1		7 11.86%
	Portfolio prioritization									1	1 1.69%
Partnerships uncertainty	Supplier	1									1 1.69%
	Relationship with the consumer		1								1 1.69%
Business model uncertainty	Revenue Template		1	1	1			1		1	5 8.47%
	Marketing strategy			1			1	1	1	3	7 11.86%
	Pilot production						1				1 1.69%
		5	8	8	6	3	5	8	5	11	59 100.00%

Figure 4: Frequency of uncertainties that are experienced by the different projects analyzed

Source: The authors.

Analyzing Figure 4, we have:

- Initially, a total of 59 uncertainties experienced by different projects were raised, and it is important to highlight that a project can experience more than one category of uncertainty.
- The categories "resource uncertainty" (25.42%), "product uncertainty" (25.42%), and "business model uncertainty" (22.03%) are the three categories that presented the highest frequency of occurrence among the projects.
- Analyzing the subcategory level, those with the highest frequency of occurrence are "knowledge and team profile" (16.95%) and "market segment" (13.56%), the first being linked to the category of "resource uncertainty" and the latter linked to the category of "customer uncertainty" category. Soon after, with 11.86%, the subcategories of "product design, product value attribute", "market application" and "market strategy" appear.

After analyzing the initial uncertainties, the five LS practices mentioned at the beginning of this paper were applied. At the end of the application, the development team identified and validated those that were possible to be worked through practices. Thus, to better understand the possible contributions of LS practices in mitigating uncertainties, a comparative table was prepared between initial uncertainties, resolved uncertainties, and unresolved uncertainties, applying the same categorization used during the initial survey, as shown in Figure 5. Furthermore, to enable a more assertive analysis of the contribution of LS practices to the mitigation of uncertainties, an indicator called mitigation level was created (for the categories and subcategories), which demonstrates the degree of resolution of uncertainties compared to initial uncertainties. This indicator is calculated by the existing ratio between the number of uncertainties experienced by the projects after the application of the practices by the number of initial uncertainties identified in the projects. The uncertainties mitigated over the course of technological development were the result of the combined use of practices. It should be noted that as the practices were applied simultaneously, it was not possible to identify individual contributions to the mitigation of waste.

Analyzing Figure 5, it is observed that:

- The "resource uncertainty" category was the one that presented the best results from the adoption of LS practices, with a 60% uncertainty mitigation level, indicating that projects were able to resolve 60% of the initial uncertainties experienced.
- The "partnerships uncertainty" category that had the lowest number of uncertainties initially, after adopting LS practices was the second with the highest mitigation level (50%), indicating that this level is not directly

related to the number of initial uncertainty experienced.

c) The "product uncertainty" category that appeared in the initial scenario as the first in several uncertainties along with the "resource uncertainty" category, after applying the practices, was the category that presented the lowest level of mitigation (20%), which corroborates the indication that a greater amount of initial uncertainties is not related to a higher level of mitigation.

To carry out the analysis of the results at the level of subcategories, those that presented uncertainties that appeared only once in one of the cases were excluded since this would only allow a dichotomous analysis between 0% and 100%. Thus, distribution channel, portfolio prioritization, supplier, relationship with the consumer, and pilot production were removed from our analysis, and subcategories represent only 1.69% of the initial uncertainties.

Uncertainty categories	Uncertainty subcategories	Initial Uncertainty		Resolved Uncertainty		Unresolved Uncertainty		Mitigation level (categories)	Mitigation level (subcategories)
Customer uncertainty	Market segment	8	13.56%	2	3.39%	6	10.17%	22.22%	25.00%
	Distribution channel	1	1.69%	0	0.00%	1	1.69%		0.00%
Technology uncertainty	Technological protection	5	8.47%	2	3.39%	3	5.08%	40.00%	40.00%
Resource uncertainty	Process Quality	2	3.39%	2	3.39%	0	0.00%	60.00%	100.00%
	Knowledge and team profile	10	16.95%	6	10.17%	4	6.78%		60.00%
	Resource obtainment	3	5.08%	1	1.69%	2	3.39%		33.33%
Product uncertainty	Product Design. Product Value Attribute	7	11.86%	1	1.69%	6	10.17%	20.00%	14.29%
	Market application	7	11.86%	2	3.39%	5	8.47%		28.57%
	Portfolio prioritization	1	1.69%	0	0.00%	1	1.69%		0.00%
Partnerships uncertainty	Supplier	1	1.69%	0	0.00%	1	1.69%	50.00%	0.00%
	Relationship with the consumer	1	1.69%	1	1.69%	0	0.00%		100.00%
Business model uncertainty	Revenue Template	5	8.47%	2	3.39%	3	5.08%	38.46%	40.00%
	Marketing strategy	7	11.86%	2	3.39%	5	8.47%		28.57%
	Pilot production	1	1.69%	1	1.69%	0	0.00%		100.00%
Total		59	100.00%	22	37.29%	37	62.71%		

Figure 5: Comparison between initial, resolved, and unresolved uncertainties

Source: The authors.

Thus, analyzing Figure 5 considering these exclusions, it can be seen that:

a) The subcategory, "process quality" was the one that presented the highest level of mitigation, with 100% of the uncertainties resolved. Soon after, "knowledge and team profile" appeared with 60%, both related to the resource uncertainty category. It can be inferred from the progress observed that the adoption of LS practices contributed to identifying points of improvement in the quality process, pointing out weaknesses and shortages of professionals, and providing improvements in the knowledge and team profile.

b) The subcategories "technology protection" (category of technology uncertainty) and "revenue template" (category of the business model uncertainty), both with 40%, appeared as the third ones that presented the highest level of mitigation. Regarding technology protection, we observed that the practices do not act directly on this uncertainty, but by stimulating those involved to think about the market and competitors, awakening them to the need for technology protection. Regarding the revenue template, the results indicate that the practices can contribute to the definition of the model since the characteristics of the technology, the product, and the market are analyzed to define it.

c) Comparing the number of unresolved uncertainties, the subcategories that had the most unresolved uncertainties were "product design, product value attribute" (product uncertainty category) and "market segment" (customer uncertainty category), both with 10.17%. It should be noted that these subcategories were the ones that presented the lowest level of mitigation (14.29% and 25% respectively), indicating that the adoption of LS practices did not present good results to mitigate these uncertainties.

5. Results and discussion

The most present uncertainties initially identified were related to resources and products, which is in line with the existing literature. Unlike established companies, startups initially do not focus on making the necessary resources available, and prefer to take advantage of improvisation in a short time (Huang *et al.*, 2022; Ye and Mai, 2018). The same happens about the product since startups do not test their business model and products before launching, unlike more mature companies (Ghezzi and Cavallo, 2020).

The main contribution of the research was to identify the uncertainties most worked on by the development teams of nine technological innovation projects, from the application of LS practices. It was observed that the LS practices contributed significantly to the reduction of uncertainties during the development of the projects, however, because they were applied simultaneously, it was not possible to identify their individual contributions. As demonstrated by the analyses, they contributed mainly to the mitigation of uncertainties in the resources category. Through the progress obtained about this category, specifically related to the subcategories of knowledge and team profile, process quality, and resources obtainment, it can be inferred that the practices contributed to identifying the weaknesses and shortage of professionals and were able to direct the search for knowledge and research information to improve the team's profile.

Reis *et al.* (2022) show that the use of LS practices leads the team to a positive increase in entrepreneurial skills, while Ladd and Kendall (2017) report an increase in the will and self-confidence of individuals exposed to LS to start new businesses. Other studies point out that due to the dynamic scenario in which they are inserted, there is faster learning by the team (Prashantham and Floyd, 2019; Xiong, Yang, Jia, 2019). LS practices have also shown great contributions to mitigate resource uncertainties since projects optimize and efficiently allocate resources to make quick decisions (Ye and Mai, 2018; Cunha, Cunha, Kamoche, 2003), and seek to acquire and innovate new resources to face environmental changes (Vera and Crossan, 2005).

6. Implications, limitations, and conclusions

Taking into account the need to structure the process of technological innovation and implement practices that help the team to overcome the barriers experienced in the development of products and companies, an intervention process was carried out in nine technological projects participating in the IPP at a Brazilian public university. As the projects aimed to transform their technologies into innovations, a set of LS practices was systematically applied by the project team, to help to mitigate uncertainties and, consequently, process waste. In addition, it was observed that the use of these practices allowed better management of the types of uncertainties experienced by the project teams, also contributing to the operationalization of the different phases of the project's process of technological innovation.

As a result, it was observed that the application of LS practices contributed mainly to reducing the uncertainties related to the subcategory "process quality" and "knowledge and team profile". Another finding is that most of the time when the issue of the team's profile is resolved, either by hiring people or forming and empowering people already in the team, these actions end up resolving the uncertainties arising from the lack of resources.

As an implication for the professionals involved in each project, it can be seen that the reduction of uncertainties during the development of technologies helped to identify gaps related to 1) skills needed to compose development teams; 2) necessary product and technology attributes to serve the target market; 3) planning marketing strategies for the desired market segment; and 4) knowledge of the business model adopted given the elaborated marketing strategies.

As a limitation of the investigation, 3 aspects can be highlighted: i) only nine cases were researched, ii) the study was carried out only in the Brazilian context; iii) the study focused on academic cases, which demonstrates the need for expansion and validation in the context of private initiative projects and startups; iv) the research did not seek to evaluate the contribution of each practice individually to mitigate uncertainties, and the mitigation of uncertainties was the result of the joint use of LS practices (Figure 1).

In future work, a longitudinal study is suggested that could provide more information about the contributions coming from the investigation, as it could evaluate the implementation of the defined strategies after the application of the methods. It is also suggested to evaluate the contribution of each lean practice individually. The results obtained can be analyzed based on projects and startups within the private sector, as well as on the reality of other countries. Other future works may investigate the relationship between the adoption of LS practices and Industry 4.0 principles, in an attempt to investigate the types of barriers associated with the

implementation of Industry 4.0 in the context of these business models.

Acknowledgement

The authors would like to thank the Federal University of Ouro Preto (UFOP/Brazil) (www.ufop.br), Foundation for Research Support of the State of Minas Gerais (FAPEMIG, Grant Number APQ-00951–22), Coordination for the Improvement of Higher Education Personnel (CAPES) and National Council for Scientific and Technological Development (CNPq), for their support and funding during the development of the research.

References

- Araújo, M., Reis, L., & Morais, I. (2021). Innovation Strategies for Adaptation of Organizations in a VUCA World. In *Proceedings of the 16th European Conference on Innovation and Entrepreneurship (ECIE)* (Vol. 2, pp. 1245-1253).
- Araujo, R., Fernandes, J.M., Reis, L.P. and Beaulieu, M. (2023), "Purchasing challenges in times of COVID-19: resilience practices to mitigate disruptions in the health-care supply chain", *Journal of Global Operations and Strategic Sourcing*, Vol. 16 No. 2, pp. 368-396. <https://doi.org/10.1108/JGOSS-04-2022-0026>
- Ardyanti, A.A.A.P., Wibawa, I.P.P.S. and Putra, I.G.J.E. (2019), "Evaluation and efficient measurement I-Canang digital startup in Bali with questionnaire user experience and lean startup machine validation board", *Journal of Physics: Conference Series*, Vol. 1402, 022070, doi: 10.1088/1742- 6596/1402/2/022070.
- Arteaga, R., & Hyland, J. (2013). *Pivot: How Top Entrepreneurs Adapt and Change Course to Find Ultimate Success*. Chichester: John Wiley & Sons.
- Boguszewicz-Kreft, M., Arvanitis, A., Karatzas, K., Antonelli, G. and Simonetti, B. (2021) "Technology Transfer Steps Towards the Commercialization of Research Results for Universities", *WSB Journal of Business and Finance*, Vol 55, No. 1, pp 26–39.
- Caviggioli, F., Colombelli, A., De Marco, A., Scellato, G., & Ughetto, E. (2023). The impact of university patenting on the technological specialization of European regions: a technology-level analysis. *Technological Forecasting and Social Change*, 188, 122216.
- Cordeiro, R.F., Reis, L.P. and Fernandes, J.M. (2023a), "A study on the barriers that impact the adoption of Industry 4.0 in the context of Brazilian companies", *The TQM Journal*, Vol. ahead-of-print No. ahead-of-print. <https://doi.org/10.1108/TQM-07-2022-0239>.
- Cordeiro, R. F., Reis, L. P., and Fernandes, J. M. (2023b). A hierarchical model for industry 4.0 concepts. *RAM. Revista de Administração Mackenzie*, 24, eRAMR230061. <https://doi.org/10.1590/1678-6971/eramr230061.en>.
- Cunha, M. P., Cunha, J. V., and Kamoche, K. (2003). Organizational improvisation: what, when, how, and why. *Int. J. Manag. Rev.* 1, 299–341. doi: 10.1111/1468-2370.00017.
- Carvalho de Sá, B., de Souza, E. H. D., Reis, L. P., & de Souza Dutra, M. D. (2022). Supply chain network design: a case study of the regional facilities analysis for a 3D printing company. *International Journal of Production Management and Engineering*, 10(2), 211-223. <https://doi.org/10.4995/ijpme.2022.17620>
- De Faria, V. F., Santos, V. P. and Zaidan, F. H. (2021) "The Business Model Innovation and Lean Startup Process Supporting Startup Sustainability", *Procedia Computer Science*, Vol 181, pp 93-101.
- Dewobroto, W. S., & Marie, I. A. (2020, April). Lean Startup Approach on Product Design and Manufacture Facility Planning in Uncertain Business Climate. In *IOP Conference Series: Materials Science and Engineering* (Vol. 847, No. 1, p. 012083). IOP Publishing.
- Eker, M. &. (2019). Exploring the relationships between environmental uncertainty, business strategy, and management control system on firm performance. *Business and Economics Research Journal*, 10(1), pp. 115-129.
- Elias, R., Reis, L., Delfino, T., & Fernandes, J. (2022). Entrepreneurial, Strategies Entrepreneurial Strategies for the Female Sector: Leveraging Instagram Sales During the Pandemic. In *European Conference on Innovation and Entrepreneurship* (Vol. 17, No. 1, pp. 692-700). <https://doi.org/10.34190/ecie.17.1.548>
- Enkel, E., Kausch, C., & Gassman, O. (2005). Managing the risk of customer integration. *European Management Journal*, 23(2), pp. 203–213.
- Felin, T., Gambardella, A., Stern, S., and Zenger, T. (2020). Lean startup and the business model: experimentation revisited. *Long Range Plann.* 53:101889. doi: 10.1016/j.lrp.2019.06.002
- Fernandes, J. M., Reis, L. P., & Serio, L. C. (2017). Planning technological businesses: a study of market positioning and the value chain. *RAM. Revista de Administração Mackenzie*, 18(3), pp. 70-116.
- Foss, N. J., Klein, P. G., & Bjørnskov, C. (2019). The context of entrepreneurial judgment: organizations, markets, and institutions. *Journal of Management Studies*, 56(6), 1197-1213.
- Ghezzi, A., & Cavallo, A. (2020). Agile business model innovation in digital entrepreneurship: Lean startup approaches. *Journal of business research*, 110, pp. 519-537. doi:<https://doi.org/10.1016/j.jbusres.2018.06.013>
- Gomes, L. A., Lopez-Vega, H., & Facin, A. L. (2020). Playing chess or playing poker? Assessment of uncertainty propagation in open innovation projects. *International Journal of Project Management*. doi:<https://doi.org/10.1016/j.ijproman.2020.07.002>
- Hidayat, A., Hendrix, T. and Hidayat, M. (2018) "Implementing Business Model Canvas for Cibinong Science and Technology Park", *Jurnal Bisnis dan Manajemen*, Vol 18, No. 1, pp. 47–58. doi: 10.24198/jbm.v19i1.159.

- Hokkanen, L., Kuusinen, K., & Väänänen, K. (2016). Minimum Viable User Experience: A Framework for Supporting Product Design in Startups'. In: Agile Processes, in Software Engineering, and Extreme Programming. *Agile Processes, in Software Engineering, and Extreme Programming: 17th International Conference Proceedings* (pp. 66-78). Edinburgh, UK: Springer International Publishing.
- Huang, B., Song, J., Jing, Y., Xie, Y., & Li, Y. (2022). How improvisation drives lean search: The moderating role of entrepreneurial team heterogeneity and environmental uncertainty. *Frontiers in Psychology*, 6111.
- Janka, M., & Guenther, T. W. (2018). Management Control of New Product Development and Perceived Environmental Uncertainty: Exploring Heterogeneity Using a Finite Mixture Approach. *Journal of Management Accounting Research*, 30(2).
- Jauch, L. R., & Kraft, K. L. (1986). Strategic Management of Uncertainty. *Academy of Management Review*, 11(4), pp. 777-790.
- Jaworski, B. J., and Kohli, A. K. (1993). Market orientation: antecedents and consequences. *J. Mark.* 57, 53–70. doi: 10.1177/002224299305700304
- Jesemann, I., Beichter, T., Constantinescu, C., Herburger, K., & Rüger, M. (2021). Investigation of the “lean startup” approach in large manufacturing companies towards customer driven product innovation in SMEs. *Procedia CIRP*, 99, 711-716.
- Kahan, E., Insfran, E., Genero, M., & Oliveros, A. (2022). Studying the influence of empathy maps on brainstorming for requirements elicitation: A quasi-experiment. In *Advances in Information Systems Development: Crossing Boundaries Between Development and Operations in Information Systems* (pp. 199-217). Cham: Springer International Publishing.
- Ladd, T. and Kendall, L. (2017), “Entrepreneurial cognition in the Lean Startup method”, *Academy of Management Proceedings*, Vol. 2017 No. 1, pp. 1-27, available at: <https://doi.org/10.5465/AMBPP.2017.10753abstract>
- Lee, J., & Xu, J. (2019). Tax uncertainty and business activity. *Journal of Economic Dynamics & Control*, 103, pp. 158–184.
- Maludin, S., Syarief, R., Rifin, A., & Rochman, N. T. (2021). Reassembling Technology Transfer in Indonesia. *International Journal of the Analytic Hierarchy Process*, 13(3).
- Mansoori, Y., Karlsson, T. and Lundqvist, M. (2019) “The influence of the lean startup methodology on entrepreneur-coach relationships in the context of a startup accelerator”, *Technovation*. Elsevier Ltd, Vol 84–85, pp. 37–47. doi: 10.1016/j.technovation.2019.03.001.
- Miller, C., Thomas, B. C., & Roeller, M. (2020). Innovation management processes and sustainable iterative circles: an applied integrative approach. *Journal of Work-Applied Management*.
- Milliken, F. J. (1987). Three types of perceived uncertainty about the environment: State, effect, and response uncertainty. *The Academy of Management Review*, 12(1), pp. 133-143.
- Osterwalder, A., & Pigneur, Y. (2011). *Business Model Generation*. Rio de Janeiro: Alta Book.
- Päivi, A., & Helena, A. (2020). Creating value propositions and service offering for the underground labs and their network: Part 2: Creation and reflection. *ePooki-Oulun ammattikorkeakoulun tutkimus-ja kehitystyön julkaisu*.
- Peralta, C. B. da L. et al. (2020) “A framework proposition to identify customer value through lean practices”, *Journal of Manufacturing Technology Management*, Vol 31, No. 4, pp. 725–747. doi: 10.1108/JMTM-06-2019-0209.
- Pitayachaval, P., Chittrakool, K., & Arjhan, W. (2017, April). Integration of Business Model Canvas (BMC) and Quality Function Deployment (QFD) to design product. In *2017 4th International Conference on Industrial Engineering and Applications (ICIEA)* (pp. 76-80). IEEE.
- Puurtinen, H. and Pohjola, P. (2021) “Multi-Stakeholder Service Model Creation to Improve the Efficiency of Research and Innovation Infrastructures”, pp. 61–71.
- Prashantham, S., and Floyd, S. W. (2019). Navigating liminality in new venture internationalization. *J. Bus. Ventur.* 34, 513–527. Doi:10.1016/j.jbusvent.2019.01.001
- Reis, L., Fernandes, J., Araújo, M., and Beaulieu, M. (2022, September). Lean Startup Practices: Operationalizing the Technological Business Planning Process in an Academic Environment. In *ECIE 2022 17th European Conference on Innovation and Entrepreneurship*. Academic Conferences and publishing limited. Doi:<https://doi.org/10.34190/ecie.17.1.544>
- Reis, L. P., Fernandes, J. M. and Armellini, F. (2021) “Leveraging a Process-Oriented Perspective on Frugal Innovation Through the Linkage of Lean Product Development (LPD) Practices and Waste”, *International Journal of Innovation and Technology Management*, Vol 18, No. 07, p 2130004. <https://doi.org/10.1142/S0219877021300044>
- Reis, L. P., Fernandes, J. M., Barreto, E. J., Lima, M. V. V. and Armellini, F. (2021) “Impact Assessment of Lean Product Development and Lean Startup Methodology on Information Technology Startups Performance”, *International Journal of Innovation and Technology Management (IJITM)*, Vol 18, No. 06, pp 1-24.
- Reis, L. P., Fernandes, J. M., Silva, S. E., & Andrade, H. A. D. (2018). 3Cs method for firms' make-or-buy decisions: application in a large metal mechanical company. *International Journal of Business Innovation and Research*, 17(4), 494-515. <https://doi.org/10.1504/IJBIR.2018.096370>
- Reis, L. P., Fernandes, J. M., Silva, S. E., & Andreosi, C. A. D. C. (2023). Managing inpatient bed setup: an action-research approach using lean technical practices and lean social practices. *Journal of Health Organization and Management*, 37(2), 213-235. <https://doi.org/10.1108/JHOM-09-2021-0365>
- Ries, E. (2011). *The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to create radically successful Businesses*. United States: Crown Business.
- Sicotte, H., & Bourgault, M. (2008). Dimensions of uncertainty and their moderating effect on new product development project performance. *R&D Management*, 38(5).

- Silva, S. E., Reis, L. P., Pereira, A. D. S., Fernandes, J. M. (2019). A knowledge taxonomy in the context of organizational routines: an study in a public university. *Informação & Sociedade*, 29(2). Doi:10.22478/ufpb.1809-4783.2019v29n2.28679.
- Song, W., Ming, X., & XU, Z. (2013). Risk evaluation of customer integration in new product development under uncertainty. *Computers & Industrial Engineering*, 65, pp. 402–412.
- Staniec, I. and Pilawa, J. (2020) “The use of design thinking in the creation of academic incubators”, *Journal of Economics and Management*, Vol 41, No. 3, pp. 105–127. doi: 10.22367/jem.2020.41.06.
- Veiga, F. D. (2015). Aplicação das metodologias Lean Startup a um negócio de inovação mobile. Dissertação de Mestrado. Lisboa: Instituto Superior de Economia e Gestão da Universidade de Lisboa.
- Vera, D., and Crossan, M. (2005). Improvisation and innovative performance in teams. *Organ. Sci.* 16, 203–224. doi: 10.1287/orsc.1050.0126
- Xiong, L., Yang, Y., and Jia, J. (2019). “Can do” or “want to do”: the impact of ambidextrous entrepreneurial improvisation on entrepreneurial performance based on internal driving. *Manage. World* 35, 137–151. doi: 10.19744/j.cnki.11-1235/f.2019.0168
- Ye, Z. X., and Mai, Y. Y. (2018). Explorative improvisation and exploitative improvisation: a study on entrepreneurial improvisation from the ambidexterity perspective. *Nankai Bus. Rev.* 21, 15-25.
- Yin, R. K. (2008) “Case Study Research-Design and Methods”, 4th edition, *Sage Pub.*, London, 240 pp.
- Zorzetti, M., Signoretti, I., Salerno, L., Marczak, S., & Bastos, R. (2022). Improving Agile Software Development using User-Centered Design and Lean Startup. *Information and Software Technology*, 141, 106718.

The Influence of Innovation on Competitive Advantage in the Management Consultancy Sector

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Abstract: Embracing the transformation and changes that innovation can bring is crucial for a business to maintain a sustainable competitive advantage in such a complex, volatile and competitive environment. Ignoring the transformative nature of the business environment and keeping operating with a business model that is outdated and does not move with time, can be extremely detrimental to a company and it may ultimately lead to the cannibalization of the business itself. The business consultancy sector in the UK saw a dramatic increase in the number of firms operating in the field. This brings the need for business consultancies to differentiate through innovation in their entrepreneurial proposition whether in a product or a service, in a new way of operating, in the resolution of an issue or in the implementation of systems, production or quality that will change the way in which a firm creates, delivers, and captures new value.

Keywords: Innovation, Entrepreneurship, Management Consultancies, Sustainable Advantage, Business Models.

1. Introduction

The saturation of the Business Consultancy sector brings the urgent need to innovate to sustain competitive advantage in the industry, not only aiming at survival but to create and capturing new value and pioneer the market. The case company object of examination for this paper is PTHR, which stands for People and Transformational HR, a micro consulting venture founded 9 years ago by Chief Energy Officer Perry Timms with the vision to foster better business for a better world (PTHR, 2022). Defined by their Stack model for their business, PTHR provides business consulting and advisory services to create solutions and capitalise on opportunities to unleash the potential of their clients. The author has decided to select this case company because PTHR is a very progressive business itself, thus, it seems interesting to evaluate what and how a business consultancy, already progressive and innovative in its nature, can develop as a new entrepreneurial proposition to further exploit market opportunities for value creation both for external stakeholders and for the organization itself whilst evaluating hindrances towards innovation in the management consulting industry.

1.1 Research Questions

- To what extent do innovation and entrepreneurship influence the development of sustainable competitive advantage for businesses?
- Are there hindrances preventing business consultancies from innovating and offering new value through entrepreneurial products or services?
- Will there be value generated for PTHR and its stakeholders by developing and launching a new entrepreneurial proposition: the HR Careers Accelerator? And, if so, what type of value will be generated for its stakeholders?

2. Literature Review

2.1 The nexus of entrepreneurship and innovation for Sustainable Competitive Advantage

Humankind has seen unprecedented increases in economic prosperity and living standards over the past century, but these developments have also been accompanied by a growing concern for a variety of externalities, including unequal wealth distribution, climate change, skills shortage, rising market competition, etc (Hart 1997; Zadek 2001). The scale of these concerns has driven a revaluation of the role of industries in the struggle for sustainable development, accounting for the role of innovation in this process. Innovation, just as it has been labelled the engine of growth at the societal level and a source of persistent competitive advantage at the business level, appears to offer the chance to appreciate how crucial it is for businesses to develop a competitive advantage in today's VUCA (Volatile, Uncertain, Complex and Ambiguous) business environment (Lovins et al. 1997; Senge and Carstedt 2001 cited in Wagner, 2017). Therefore, the link between entrepreneurship, innovation and SCA will be better exemplified in the next few paragraphs, and it shall give some highlights to complement the answer to RQ 1.

The term "sustained innovation" was coined by Christensen (1997) to characterise how most large firms direct their R&I efforts toward making small adjustments to current goods, services, or procedures to create a sustainable advantage over a sustained period. Literature pointed out that competitive advantage is what sets a successful entrepreneurial venture apart, in other words, gives a competitive edge. In fact, when a company has a competitive advantage, it might be because it has something other organisations do not; it might do something better or even do something they cannot do. Securing a competitive edge is regarded as the ingredient for long-term success, but is it easy to get? There are three most common views discussed in the literature on entrepreneurship and organisational success according to which competitive advantage can be achieved and kept. These include the industrial organisation approach (I/O), the resource-based view (RBW) and the guerrilla view.

In more detail, if looking at the I/O view, the focus of the analysis is external, meaning that getting and keeping a competitive advantage depends on the ability to see external trends and changes and interpret and act on them. Differently, the RBW has an internal focus and emphasizes exploiting organizational resources and capabilities and acquiring new and unique ones. Lastly, the main premise of the guerrilla view is that an organization's competitive advantage is temporary as the external environment is characterised by continual and radical changes because of market instability, technological disruptions etc. Thence, successful ventures must be adept at rapidly disrupting the current situation and surprising competitors to keep them off balance, in other words, acting like a guerrilla unit (Coulter, 2003). This brief digression into analysing the concept of competitive advantage and the three main ways in which it can be achieved and kept is relevant to RQ 1 and proves to be useful to appreciate what strategy the case company, PTHR, intends to adopt in building a SCA through the new entrepreneurial proposition that will be suggested later in this research paper. Consequently, literature on how to go about developing a new proposition is worth examining at this stage.

2.2 The growth pathway matrix

Research has stressed that a small, innovative business wishing to expand should create a completely new good or service that enables it to provide a benefit that the huge, established market leader has yet to provide. As the new proposition departs from the established business practices used by large organisations and seeks to provide a new value proposition, literature refers it to as a "disruptive innovation" (Chaston, 2010). Nevertheless, at the outset of any innovation process, it is advisable that the firm determines whether the product or internal processes are to be the focus of the entrepreneurial action at first. The growth alternatives indicated in the framework below can be looked at to help with this analysis to identify which strategy gives the highest possibility and potential for success to a specific business. Strategies can be about the development both of a new process and a new product, or one of the two as shown in the matrix below (Figure 1). When picking a growth pathway, small business entrepreneurs favour product innovation, according to research by Aris et al. (2000). In this respect, being PTHR a small consulting venture wanting to deliver new value different from what competitors are offering in the HR consultancy field whilst exploiting the future workplace trends as a source of opportunity, the disruptive innovation approach described above, will underpin the development of the new entrepreneurial proposition for the Company in the form of a new product and new process.

		Product	
		New	Same
Process	Same	Increased market penetration	Disruptive benefit innovation
	New	Disruptive process innovation	Disruptive diversification innovation

Figure 1: Growth pathway matrix (Chaston, 2010. p.127)

2.3 The Management Consultancy sector: outline of the industry in the UK

Despite being relatively new compared to other professions like law or accounting, consulting has been one of the knowledge industries' most successful sectors, with revenues rising by more than 10,000% in the last thirty years (O'Mahoney, 2010). The Management Consultants industry covers a range of consulting services including strategic planning, IT, marketing, human resources, and business process management (Olivieri, 2022). Plunging business confidence following the coronavirus pandemic reduced the demand for industry services in 2020-21 which rebounded in 2021-22 and is forecasted to slow in 2022-23. From a positive stance, industry revenue is forecasted to grow at a compound rate of 4.5% over the next five years driven by improved economic conditions and the strong demand to fill the skills gap in the market (ibid.). This leads to investigating how management consultancies can take the most out of the increasing demand for business consulting, which can represent a great market opportunity for growth. Nevertheless, as with any opportunity, if not promptly embraced, it can become a threat and outpaced by the growing competition in a sector in the growth stage of its life cycle (Olivieri, 2022) (Figure 2).



Figure 2: Management Consultants Industry Life Cycle (IBISWorld, 2022 p. 16)

According to the Institute of Consulting and the CMI (2011), there was a need and urgency for innovation in the consultancy industry in the UK already eleven years ago. Therefore, in this respect, it seems pertinent to highlight what business consultancies mean by innovation. The Institute of Consulting (ibid.) highlighted that when business consultancies are asked what innovation means for them and their operations, they mainly highlight four types of innovations: new solutions in terms of creating products and services new either to the market or itself; adapting solutions by modifying existing products, services and processes to entry new clients or markets; though leadership through papers and research that provides new insights and advice and creative problem solving with ad hoc solutions for clients. Considering the growing number of Business and HR consultancy firms in the UK, a need to increase the scope and maybe nature of their service portfolio to take advantage of the demand for new lines of consulting especially digital and progressive HR and OD solutions (Olivieri, 2022) could represent a prosperous market opportunity if timely exploited.

2.4 Investigating hindrances toward innovation

Misconceptions around innovation include thinking of innovation as mere inventiveness. However, by looking at the concept of innovation more holistically, it can be referred to as “something different that creates value” (Forbes, 2019). Research has highlighted that the most innovative organisations exhibit five key behaviours which include focusing on understanding customers' unstated needs and desires, cross-pollinating meaning collaboration across and beyond the organisation, recognising that success requires experimentation and failure at times, as well as empowering people to take considered risks, voice opinions and seek needed resources (Scott et al., 2019). The UK definition of innovation has its roots in the Organisation for Economic Co-operation and Development (OECD) definition, outlined in the Oslo Manual 2018, according to which if a company engages in any of the following activities is defined as ‘innovatively active’. These include: “the introduction of new or significantly improved goods, services or products; demonstrable engagement in innovation projects not yet complete, scaled back, or abandoned; the introduction of new and significantly improved forms of organisations' structures or practices, marketing concepts or strategies” (UK Innovation Survey Report, 2021. p.4).

Nevertheless, the UK Community Innovation Survey shows that even though there was an increase in the percentage of UK businesses' innovative activities from 36% in 2016-2018 to 45% in 2020, more than half of the existing businesses are not yet innovative active. Therefore, this leads to question if there are hindrances preventing businesses and, for the purposes of this paper, business consultancies, from innovating and offering new value through entrepreneurial products or services. This shall provide some insights into answering RQ2. In this regard, it shall be stressed that innovation activities are often associated with an uncertain amount of costs, uncertain return of invested money and risk for the company (Ceccagnoli, 2009). The most common categorization of innovation barriers used by many authors is based on Piatier's division of internal and external barriers (cited in Ceccagnoli, 2009). This defines internal barriers as those originating inside the company that an enterprise can influence and include issues relating to functional areas inside the company as financial resources, human resources, or corporate culture. On the other hand, there are barriers that are partially or completely beyond the influence of the enterprise as they arise in the external environment. In this respect, Duarte et al. (2017) define four main types of barriers to innovation: economic factors, knowledge factors, market factors and reasons to innovate, presenting market factors as external barriers (Figure 3).

Economic factors	Knowledge factors	Market factors	Reasons to innovate
• lack of funds within the enterprise or group • lack of finance of sources outside the enterprise • innovation costs too high	• lack of qualified personnel • lack of information on technology • lack of information on markets • difficulty in finding cooperation partners for innovation	• market dominated by established enterprises • uncertain demand for innovative goods or services	• no need due to prior innovations by the enterprise • no need because of no demand for innovation

Figure 3: Barriers to innovation (Duarte et al., 2017)

Since the case company selected for this paper is a small consulting venture consisting of 6 PTHR internal employees and 8 freelancers now, it seems essential to narrow this down and refer to any barriers that might hinder innovation activities in small and medium business consultancy enterprises. Madrid-Guijarro et al., (2009) determined specific barriers hindering innovation activities mostly in SMEs due to their specific characteristics such as "limitations regarding external clients, the existence of excessive control, lack of planning for changes demanded by the market and business environment, an inadequate education and lack of executives training" (Hussinger, 2010, p. 59). Therefore, according to the arguments proposed thus far, it is possible to infer that the size of the business as well as the limited availability of resources and capital can be two of the main aspects that decelerate the adoption of innovative approaches at different levels from strategic to operational.

Notwithstanding, from a critical perspective, it is worth asking whether a company to be able to integrate innovation at the core of its practices, does necessarily have to be a big-sized business with numerous resources and capital to invest. Deloitte and McKinsey (cited in Denning, 2020) suggest that less than 10% of big firms are making real progress in becoming more adaptive and agile. Truth is that when it comes to innovation, bigger companies might have to welcome disruptions and, if accounting for the fact that they might have spent many years developing a strong brand, the development of a new proposition might ultimately damage the brand itself if it does not prove to be successful or to bring value in the long-term and this might be too risky (Pazio, 2017). On top of this, most large firms are still organised as bureaucracies that are the antithesis of the agility required for bold innovation in any field (Denning, 2020). As a consequence, the myth around the size of a business is one hindrance towards innovation shall be critically evaluated and carefully scrutinized as it has been demonstrated above how both 'big' and 'small' sized companies can be reluctant or hindered to innovate regardless of the size of the enterprise itself.

2.5 The "solution shop" and the traditional business model (BM) of consulting

The extent of standardisation in offering consulting solutions determines how "conventional" business models (BM) used by consulting firms are classified (Grolik et al., 2003; Baaij, 2014). On the one hand, there are consulting firms that are accustomed to dealing with comparable issues and thus offer highly standardized solutions both in products and services. They use a kind of "re-use" BM, which is based on the reuse of already-existing consulting approaches and frameworks, with the goal of effectively solving recurring managerial issues, limiting the recurring investment of senior consultants and, being able to manage numerous projects at once.

Contrarily, companies with a “customized” strategy develop very distinctive and highly personalized solutions to unique clients' demands. In so doing, they offer guidance that is mostly targeted at high-level strategic problems by channelling individual expertise (Gressgard et al., 2014; Hansen et al., 1999).

The question about the appropriateness of management consultancies' BMs in the face of the drastic changes of the last decades has been posed by Christensen et al. (2013), who analysed the industry by looking for symptoms of a disruptive pattern. They discovered that the consulting business has remained resistant to disruption for so long due to opacity and agility, but they foresee an inevitable disruption for such incumbents (RQ 2). In more depth, a distinction between the “solution-shop” and the “traditional business model” (BM) of consulting has to be mentioned. In the so-called ‘solution-shop’, consultants work to diagnose and solve problems with an undefined scope and the value is delivered through their judgement rather than through standardised and repeatable processes. The logic of the solution business is very different from the logic of the product business; it calls for more collaborative management, more customer involvement in business planning, and recognition of the cross-functional character of the firm (Storbacka, 2011). Consequently, business consultancies wishing to deliver solutions effectively through this approach, need to integrate all their business functions, including product development, marketing, sales, and operations whilst ensuring an in-depth understanding of target clients' needs and identifying opportunities to create value (Ibid.). The creation of value must be understood through the eyes of the customers (Brady et al., 2005) and, in effectively doing so, the following model including capabilities and management practices is suggested highlighting how essential the interaction between stakeholders and the consultancy is when it comes to developing valuable solutions by combining customer insights and firm resources thus exploiting external opportunities and turning them into orders to secure customer value creation and firm value capture (Storbacka, 2011) (See Figure 4).

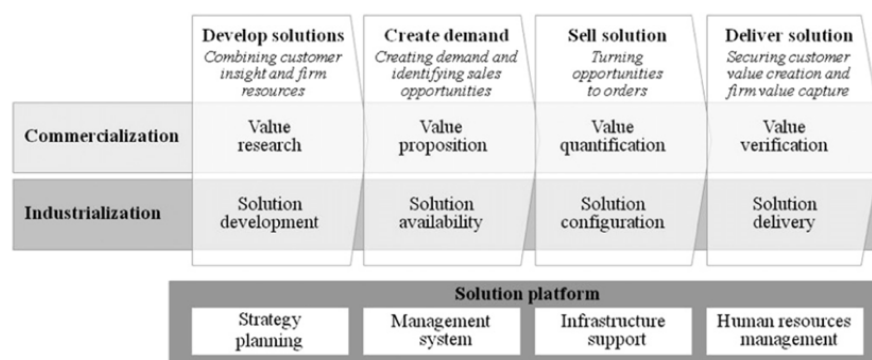


Figure 4: The solution business model framework (Storbacka, 2011. p.703)

3. Findings and Discussion

3.1 A new business-level strategy

It is stated that management consultancies sustain themselves through the generation, development, and dissemination of innovations for their stakeholders and clients (Clegg et al. 2004; Engwall and Kipping 2002 cited in O'Mahoney, 2011) using appropriate strategies. Business-level strategy determines a firm's strategic position to achieve a competitive advantage when competing in a single industry or product market (Hambrick, 1980). To achieve a competitive advantage over the competition, it is important that companies appreciate that competitive advantage can arise either from external change where the company's ability to respond to change and make it an opportunity will be essential or internally through innovation, and creative capabilities thus to create value for customers from novel products (Grant and Jordan, 2015). Indeed, innovation is not just about opportunity analysis and portfolio management but also about working with clients to generate and build new offerings and businesses.

The two main types of competitive advantage are cost advantage where the goal of the firm is to become the cost leader in its industry and differentiation advantage when the company can supply products that are differentiated in such a way that customer is willing to pay a price premium that exceeds the additional cost of differentiation leading to the so-called differentiation advantage (Grant and Jordan, 2015). In this respect, to identify the business-level strategy most suited to PTHR's new entrepreneurial product, Bowman's strategic clock is considered. It shows the range of options through which a business can position its products based on

price and perceived value leading to 8 strategic options categorized in four quadrants and demonstrated in a clock (Haselwanter et al., 2014).

Critically speaking, achieving competitive advantage through cost differentiation might not be suitable for PTHR because of the vision, mission and values the company holds which praises conscious business approaches for transformational work design, solutions and support with progressive HR, Organisational Development and Leadership through the creation of ad hoc seismic shifts in the culture, operating model, skills and behaviour for their clients. Therefore, if they suddenly were to provide standardized, basic products and services, this would go against their brand identity and purpose statement. Consequently, the strategy suggested to PTHR is to secure competitive advantage through differentiation by looking at its customers and their needs (the demand side), and creating new value with an innovative product that exceeds the costs of differentiation.

Being People and Transformational HR a specialised transformational business and HR consultancy, they could exploit the market opportunity highlighted throughout the paper by developing a new product, which can be named “The HR Careers Accelerator” (HRCA) aimed at giving people interested in advancing their career in HR the know-how to:

- (a) make choices to pursue one or more of these practice fields for their own career trajectory and
- (b) feel comfortable knowing how all the other elements of modern and progressive HR are without having done them all and most crucially
- (c) prepare them for advancement when automation removes administrative work from HR more widely

From the value proposition framework compiled below (Figure 5), it is worth highlighting that the gains of developing and launching the HRCA positively affect the broader community of practice, both PTHR itself and its main external stakeholders (clients). Therefore, it is possible to infer that the HRCA can bring value to its community of practice, both economically and socially. With regards to economic value, it is configured internally in the form of revenues to PTHR and externally if seen as a valuable investment from companies to empower their people to work better, more efficiently and productively. From a societal perspective, it will allow the People Profession to grow and change as the market changes rather than being cannibalized by it.

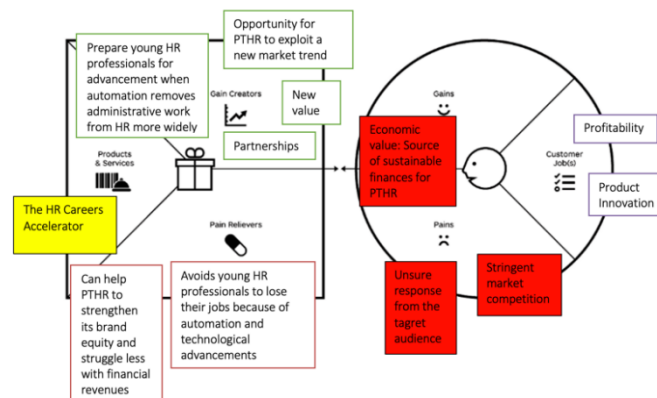


Figure 5: Value Proposition Canvas (Source compiled by the author)

4. Conclusion

The aim of this research action project was to understand and support entrepreneurial action in practice. The main objective was to evaluate the extent to which innovation and entrepreneurship influence the development of sustainable competitive advantage for businesses. The analysis was narrowed down to the consultancy sector in the UK. Given the saturation of the business consultancy sector in the UK, the need to innovate to sustain competitive advantage resulted in being paramount for business survival and value creation (RQ1; see para 2.2, 2.3). Thereafter, this research scrutinised hindrances preventing business consultancies from innovating concluding that the most common categorisation of innovation barriers includes internal barriers such as financial resources, human resources, or corporate culture and external barriers such as market factors. It was

concluded that it is more about the willingness companies have to welcome disruptions and their consequences rather than the financial resources themselves alone (RQ2).

This research background represented the rationale underpinning the suggested entrepreneurial proposition PTHR, an already transformative venture in nature, could launch in the form of an HR Careers Accelerator programme aiming at empowering HR professionals with skills required in the near future when automation will remove administrative work from HR more widely. Broadly, these research findings can affect both the way businesses act, managerial implications, and the way in which people think about the topic area, theoretical implications. In terms of managerial implications for businesses operating in the business consultancy field, this research stressed how crucial is to embed innovation in the corporate agenda and attempt to discard commonly shared presumptions on hindrances toward innovation in both big and small enterprises as innovation can take different facades and influence processes, products or both. An open managerial approach towards the new and the innovative with the potential disruptions these might bring can represent the turning point in securing a competitive advantage. From a theoretical perspective, this action research served to better appreciate how cutting-edge and always evolving the concepts of innovation and entrepreneurship are as demonstrated by the growing number of research in this topical area and underlined the crucial role business leader with an entrepreneurial mindset and entrepreneurship competencies have in driving a company's success. Interestingly enough, the application of theoretical frameworks such as the Business Model Canvas, the Value Proposition Canvas and the Product Canvas served to design a new entrepreneurial proposition for an actual company and, thanks to the aid of these tools and frameworks, the analysis can be replicated in other contexts.

Acknowledgements

I would like to deeply thank anybody (close or far) who, in whatever capacity and way, has been close to me, supported me, shared advice, good words or a smile. I also want to thank those who have been strict and objective at times and told me when I was making mistakes. This helped me to grow, massively. Sometimes, you understand only later why people who love you say or do certain things that might, at first, seem hostile. I am grateful for that too.

References

- Brady, T. Davies, A. and Gann, D.M., 2005. "Creating value by delivering integrated solutions." *International Journal of Project Management* 23.5 360-365.
- Ceccagnoli, M., 2009. Appropriability, preemption, and firm performance. *Strategic Management Journal*, 30(1), pp.81-98.
- Chaston, I., 2017. *Technological entrepreneurship: Technology-driven vs market-driven innovation*. Springer.
- Chaston, I. and Scott, G. J., 2012. Entrepreneurship and open innovation in an emerging economy. *Management Decision*.
- Chesbrough, H. and Rosenbloom, R.S., 2002. The role of the business model in capturing value from innovation: evidence from Xerox Corporation's technology spin-off companies. *Industrial & Corporate Change*, 11(3), 529-555
- Christensen, C.M., 1997. *The innovator's dilemma: when new technologies cause great firms to fail*. Harvard Business Press, Boston (paperback version 2000).
- Denning, S., 2020. Why Big Firms find it hard to innovate. *Forbes*. [online] Available at: < [Why Big Firms Find It Hard To Innovate \(forbes.com\)](https://www.forbes.com/sites/susan-denning/2020/07/20/why-big-firms-find-it-hard-to-innovate/) > [Accessed 15 July]
- Deloitte, 2022. Deloitte's Innovation Consultancy practice [online] Available at: < [Innovation | Deloitte | Strategy Consulting](https://www2.deloitte.com/uk/en/pages/innovation/articles/innovation-deloitte-strategy-consulting.html) > [Accessed 15 July]
- Duarte, F.A., Madeira, M.J., Moura, D.C., Carvalho, J. and Moreira, J.R.M., 2017. Barriers to innovation activities as determinants of ongoing activities or abandoned. *International Journal of Innovation Science*.
- Gressgard, L.J., Amundsen, O., Aasen, T.M. and Hansen, K., 2014. "Use of information and communication technology to support employee-driven innovation in organizations: a knowledge management perspective", *Journal of Knowledge Management*, Vol. 18 No. 4, pp. 633-650.
- Grant, R.M and Jordan, J.J., 2015. *Foundations of strategy*, 2nd Edition. Chichester: Wiley
- Grolik, S., Kalmring, D., Lehner, D. and Frigerio, C., 2003. "Analysis of interrelations between business models and knowledge management strategies in consulting firms", *ECIS 2003 Proceedings*, p. 71.
- Hambrick, D. C., 1980. Operationalizing the concept of business-level strategy in research. *Academy of management review*, 5(4), 567-575
- Hussinger, K., 2010. On the importance of technological relatedness: SMEs versus large acquisition targets. *Technovation*, 30(1), pp.57-64.
- Magretta, J., 2002. Why Business Models Matter. *Harvard Business Review*, 80(5), 86-92.
- Miller, D. and Friesen, P. H., 1982. Innovation in conservative and entrepreneurial firms: Two models of strategic momentum. *Strategic management journal*, 3(1), 1-25.

- O'Mahoney, J., 2011. Management Innovation in the UK consulting industry. Institute of Consulting [online] Available at: < https://www.bayes.city.ac.uk/_data/assets/pdf_file/0005/107159/InnovationinConsulting.pdf > [Accessed 20 June]
- Olivieri, B., 2022. Management Consultants in the UK. Business as usual: Growth is forecast to slow in 2022-23 following a strong rebound from the pandemic in 2021-22. IBISWorld. [online] Available at:< <https://my-ibisworld-com.proxy-lib.anglia.ac.uk/uk/en/industry/m70.229/aboutA> > [Accessed 10 July]
- Pazio, T., 2017. Why big companies struggle for innovation [online] Available at:< [Why big companies struggle with innovation | by Tomek Pazio | WAAT Ltd | Medium](#) > [Accessed 15 July]
- Piperopoulos, P.G., 2016. *Entrepreneurship, innovation and business clusters*. London: Routledge.
- PTHR, 2022. Better business for a Better World [website] Available at: <<https://www.pthr.co.uk> > [Accessed 10 June]
- Scott, G., & Chaston, I., 2013. Open innovation in an emerging economy. *Management Research Review*.
- Storbacka, K., 2011. A solution business model: Capabilities and management practices for integrated solutions. *Industrial Marketing Management* 40.5: 699-711.
- Swanson, E. B., 2022. Technology Entrepreneurship is More Than One Might Think. In *Academy of Management Proceedings* (Vol. 2022, No. 1, p. 11018). Briarcliff Manor, NY 10510: Academy of Management.
- Tavoletti, E., Kazemargi, N., Cerruti, C., Grieco, C. and Appolloni, A., 2021. Business model innovation and digital transformation in global management consulting firms. *European Journal of Innovation Management*.
- The Economist, 2022. The woolliest words in business [online] Available at:< [The woolliest words in business | The Economist](#) > [Accessed 12 July]
- UK Innovation Survey Report, 2021. UK Innovation Survey 2021: Report covering the survey period 2018 to 2020. Department for Business, Energy and Industrial Strategy [online] Available at: < https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1074069/UK_Innovation_Survey_2021_Report.pdf > [Accessed 14 July]
- Wagner, M. and Wagner, M., 2017. *Entrepreneurship, Innovation and Sustainability*. First edition. ed. London: Taylor and Francis

Innovation in Ophthalmology and Dentistry Services: Benefits and Challenges of using AI

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Abstract: The development of Artificial Intelligence (AI) is revolutionizing different organizational contexts, including health services. Among these services, ophthalmology and dentistry stand out for being areas with intense use of technological innovations, mainly for obtaining images. The use of AI promotes innovation in the provision of these services, helping the activities of professionals working in this area. However, the literature is still scarce on the perception of these professionals regarding the benefits and challenges arising from the use of these innovations. In this sense, the objective of this article is to evaluate the perception of ophthalmologists and dentists in the use of AI technological innovations in relation to the benefits for patient care, as well as the challenges for its implementation and adoption. This is a qualitative research that was developed from data collected, through a questionnaire, with 18 health professionals, 10 ophthalmologists, and 8 dentists. As a result, it was observed that the main benefits found with the use of AI-assisted innovations were diagnostic support, mainly in increasing assertiveness and reducing the time to detect diseases. In addition, these innovations provided an increase in the time of the doctor-patient relationship, reflecting greater satisfaction of the users of these health services. The challenge presented in the implementation of innovations in ophthalmology and dentistry was the lack of incentives from health plans in the application of AI. Without financial incentives, the costs of these innovations become a significant barrier to adoption. To overcome the barrier related to cost, some ophthalmologists acquired equipment in partnership with other health professionals, enabling the sharing and rationalization of costs related to the technological resource. Finally, in the perception of both professionals (ophthalmologists and dentists), AI promotes innovations in health services, complementing and not substituting the clinical diagnosis of a specialized professional.

Keywords: Artificial Intelligence; Ophthalmology; Dentistry; Decision-making process, Patient care.

1. Introduction

Technological innovations interfere in people's daily lives, facilitating existing processes or creating new problem-solving methods. In this sense, the use of Artificial Intelligence (AI) is revolutionizing different organizational contexts (Lobo, 2017), from manufacturing to the service sector, such as health (Dwivedi *et al.*, 2021; Alami *et al.*, 2020).

Among the areas of health, ophthalmology, and dentistry stand out because they are areas marked by the intense use of technology, mainly for obtaining images. In practice, access to technological innovations related to both AI and the Industry 4.0 context can contribute to the elimination of various types of waste and bottlenecks (Reis *et al.*, 2023; Reis *et al.*, 2022a) and quality improvement (Reis *et al.*, 2022b) both in key activities and in support activities such as purchasing (Araujo *et al.*, 2023), for example. In the case of ophthalmology, there are already several applications of tools related to innovation with the use of AI (Tan, Scheetz and He, 2019). Similarly, in dentistry, AI applications are rapidly evolving and their increasing application is due to the fact that it benefits dentists, improving the quality of patient care and simplifying protocols (Chen *et al.*, 2020).

However, according to Barros *et al.* (2020), publications on AI in healthcare are still limited. One of the major discussions is whether the machine will replace a human expert in the medical field and to what extent it will interfere with the decision-making process of the health professional (Alami *et al.*, 2020; Blease *et al.*, 2019). Innovations arising from the use of AI understand and stratify a large amount of data (Tan, Scheetz and He, 2019), but fail to understand what this represents for the patient. AI can contribute, for example, to the diagnosis, but it does not replace the professional's sensitivity in welcoming and psychologically supporting the patient (Mazzochi and Traiano, 2021; Cericato, Garbin and Fernandes, 2006).

In this sense, the objective of this research is to evaluate the perception of ophthalmologists and dentists in the use of AI technological innovations in relation to the benefits for patient care, as well as the challenges for

its implementation and adoption. With this, this work will seek to understand the effect of innovations in the decision-making process of professionals in these two areas of health, in addition to pointing out some perceptions about the impact on patient care. The study will allow health professionals and institutions to reflect on the implementation of AI tools from a practical point of view, obtaining information on several issues that involve this adoption.

2. Literature Review

Innovations in the health area resulting from the use of AI, especially those applied in ophthalmology and dentistry, provide professionals and patients with several benefits. However, professionals who are adept at using these AI technologies are also faced with challenges in adopting such innovations in their work routines. Thus, the theoretical framework will address the benefits and challenges of adopting AI in the two health areas mentioned.

2.1 Innovations in health services based on the use of AI

AI has revolutionized several industrial processes, including service delivery (Dodds *et al.*, 2022; Alami *et al.*, 2020). Among other areas of health, ophthalmology, and dentistry stand out for widely employing diagnostic imaging using AI (Kuiava *et al.*, 2021; Poomathi *et al.*, 2019).

AI innovations available in ophthalmology already aid in the diagnosis of Diabetic retinopathy, age-related macular degeneration, glaucoma, and retinopathy of prematurity (Tan, Scheetz and He, 2019). Fundus photography and Optical coherence tomography (OCT) are tools that have used deep learning to automate the screening and diagnosis of diseases and to increase the sensitivity of exams (Li *et al.*, 2021; Tan, Scheetz and He, 2019). Through OCT, it is possible to predict systemic cardiovascular risk factors, such as: age, sex, systemic blood pressure, and glycated hemoglobin (Ting, 2020).

Among the technologies used in dentistry, there is confocal laser endomicroscopy, which records subsurface microanatomical images for the analysis of cellular structure, which may be related to a new automatic approach for oral squamous cell carcinoma (Mazzochi and Traiano, 2021). In addition, computer-aided design and computer-aided manufacturing (CAD/CAM) technologies and the intraoral scanner can be mentioned (Moura and Pasini, 2020). The scanner, for example, makes optical impressions capable of collecting information about the shape and size of dental arches. It is used in different areas of dentistry such as: orthognathic surgery, endodontics, implantology, orthodontics and prosthesis (Moura and Pasini, 2020).

2.2 Benefits of using innovations in health services

The literature identifies the benefits of using innovation through the application of AI in healthcare. In ophthalmology, there has been an improvement in the accuracy and efficiency of diagnoses, an increase in patient safety, support for decision-making, a decrease in the incidence of errors, and an improvement in results with therapeutic decisions made for each patient (Kuiava, 2021; Ribeiro *et al.*, 2021, Korot *et al.*, 2020). The quality and excellence in medical care go beyond clinical care. In this context, AI seeks to ensure greater excellence in care by improving the patient's experience, and managing their expectations during their treatment (Barros *et al.*, 2020; Ting, 2020).

Another benefit of using innovations in ophthalmology is the possibility of telemedicine, which proves to be reliable in identifying diseases in their early stages in remote locations (Junior, 2019). Despite this contribution, scholars believe that the explanation of the diagnosis, the association with other diseases, and the decision regarding treatment are still up to the professional (Hazarika, 2020).

In dentistry, AI technologies, in addition to improving agility and effectiveness in diagnosis and clinical practice (Moraes, 2019), improve the reliability of diagnoses of complex oral diseases and have the potential to provide real-time information on suspicions (Mazzochi and Traiano, 2021).

To summarize the benefits of AI for the two health areas mentioned, Table 1 was structured.

Table 1: Benefits of AI in healthcare.

Field	Construct	Benefits	Authors
Ophthalmology	Aid in the diagnosis and treatment of diseases	It allows for faster and more accurate diagnoses, preventing the progression of changes in vision.	Kuiava <i>et al.</i> (2021)
		Allows to identify diseases in early stages in remote locations through telemedicine.	Junior (2019)
		It makes it easy to manage patient expectations during their treatment journey.	Ting (2020)
	Assistance in doctor x patient interaction	It makes it possible to improve medical care for patients.	Kuiava <i>et al.</i> (2021)
		It makes it possible to improve the quality of care with the patient, making it more humanized.	Ribeiro <i>et al.</i> (2021)
Dentistry	Aid in the diagnosis and treatment of diseases	Assists in diagnosis, planning, and dental treatment.	Moura and Pasini (2020)
		It makes the treatment more agile, effective, and comfortable for the professional and the patient.	Moraes (2019)
		Promote positive reflections among dentists and patients. Help explain the need for complex treatment alternatives.	Cericato, Garbin and Fernandes (2006)
	Assistance in doctor x patient interaction	It contributes to problem-solving and generates better working conditions for professionals. Contributes to high-quality patient care.	Mazzochi and Traiano (2020)

2.3 Innovation Challenges in Healthcare

Challenges are present in adopting recent research innovations. Among them, the changes in the routine of ophthalmological offices, and the difficulties of resistance and acceptance of the doctor and the patient to explore the potential of these innovations stand out (Li *et al.*, 2020; Tan, Scheetz and He, 2019). In addition, the high investment and the need for training necessary for this adoption stand out (Li *et al.*, 2020).

In dentistry, AI is still a challenge due to the lack of a database, lack of information, standardization of software, and professional experience to master these technologies (Mazzochi and Traiano, 2021). The challenge of using the intraoral scanner, for example, is also its high cost, which makes it a barrier to the wide use of professionals (Moura and Pasini, 2020). The numerous benefits of AI in dentistry were observed in the literature, however, its high cost, complexity, and system-specific training are emphasized (Cordeiro *et al.*, 2023a; Cordeiro *et al.*, 2023b; Moraes, 2019).

Finally, based on the literature, three main challenges can be highlighted: i) high acquisition cost, ii) lack of confidence in the diagnoses provided by the use of AI, and iii) difficulty in assigning responsibilities in the face of diagnostic and treatment failures. Regarding cost, it was observed that AI technologies are expensive, which makes their adoption difficult by professionals.

Table 2 presents the summary of AI challenges in the health area, presented by the studied authors.

Table 2: AI challenges in healthcare

Field	Construct	Challenges	Authors
Ophthalmology	Cost	High cost	Moura and Pasini (2020); Moraes (2019)
	Reliability	Challenges associated with implementing the technologies, include validation, patient acceptance, and end-user training. Patients' lack of confidence in the decision-making ability of the AI used.	Li <i>et al.</i> (2021) Groves and Kayyali (2013)
	Responsibility AI vs Professional	Difficulty assigning responsibilities in case of diagnostic errors.	Bonna and Sá (2021)
Dentistry	Cost	High cost	Moura and Pasini (2020); Moraes (2019)

	Reliability	Database limitation, lack of information and professional experience to master this technology. Patients' lack of confidence in the decision-making capacity of the AI used.	Mazzochi and Traiano (2021) Groves and Kayyali (2013)
	Responsibility AI vs Professional	Analysis of the dentist's performance, whether he acted with the necessary diligence or whether he acted with negligence, imprudence or clumsiness.	Bonna and Sá (2021)

3. Methods

This research is classified as descriptive, as it presents an exposition of the characteristics of certain populations or phenomena for the establishment of relationships between variables (Gil, 2002). In addition, it is characterized by the use of standardized techniques for data collection, such as the questionnaire. The research has a qualitative approach focusing on the opinions of ophthalmologists and dentists about the use of innovation, through the use of AI, in order to identify the benefits and challenges of adopting these innovations.

For data collection, a questionnaire containing 16 questions in Google Forms was used and the link was sent to the professionals. Responses were obtained from March 21 to April 22, 2022. A questionnaire with open and essay questions divided into four blocks was applied: i) characterization of the respondent, ii) innovative technologies used, iii) the benefits observed by adopting technologies, including an evaluation of the impact on the quality of care, the influence of the decision-making process and the level of confidence in innovations and, finally, iv) the challenges of using AI and the incentives given by the agreements.

The questionnaire was sent to an ophthalmology and dentistry professional, using Snowball sampling, which is a non-probabilistic sampling method in which new participants are recruited by other participants to compose the sample (Silva *et al.*, 2022). Snowball sampling can be useful for conducting research on people with specific characteristics that would otherwise be difficult to identify (Silva *et al.*, 2022).

The questionnaire was answered by 18 professionals, 10 ophthalmologists, and 8 dentists who work in the states of Minas Gerais and São Paulo (southeastern Brazil). These professionals serve both health plan networks and private individuals.

The data obtained with the application of the questionnaire were analyzed and elaborated, grouping the opinions of the participating professionals, and the result was converted into percentages.

4. Results

Of the 18 professionals interviewed, 90% of ophthalmology professionals and 60% of dentists use innovations that apply AI. Among the innovations explored in ophthalmology, "Optical coherence tomography (OCT)" and "fundus photography" were cited. In dentistry, it was the "intraoral scanner". Next, find the perception of health professionals regarding the benefits and challenges of adopting these technologies in their work contexts.

4.1 Perception of the benefits of using innovation in ophthalmology and dentistry services

Analyzing the collected data, those received benefits in terms of assistance in diagnosing and treating diseases, in the interaction between the professional (ophthalmologist and dental assistant) and the patient, and in the improvement of performance indicators for care.

In relation to the doctor's diagnosis, it is considered that one of the greatest benefits concerns the aid in the diagnosis, highlighting the increase in assertiveness, reliability of the diagnosis, and the reduction in the time of detection of the disease.

"[...] they reduce the time of detection of the disease because if they were done manually it would take longer, in the symptoms that are not detected in the routine exam, they help us to confirm a diagnostic suspicion, and also in the follow-up of the disease and follow-up of its treatment [...]". (Respondent 03).

Despite these benefits, professionals report that AI complements the diagnosis, but clinical examination is still very important. Thus, in their view, technology complements and does not replace human work. Even with AI helping in the diagnosis, most health professionals believe that the patient cannot define the diagnosis with AI alone.

"[...] The professional is always necessary to evaluate and close the diagnosis with all the complementary exams and clinical evaluations [...]" (Respondent 15).

Table 3 shows the agreement of professionals from the two areas analyzed regarding the benefits of AI.

Table 3: Benefits of applying AI in ophthalmology and dentistry

Field	Construct	Benefits
Ophthalmology	Aid in the diagnosis and treatment of diseases	100% of respondents believe that AI is complementary to the diagnosis made by the physician.
		70% reported having a high level of confidence in relation to the diagnosis made by the AI. 50% of these relate this level of confidence to the patient's health condition.
		80% say AI helps with a more accurate diagnosis.
	Assistance in doctor x patient interaction	80% do not believe that the patient can define his diagnosis only with the use of AI. Technology reduces diagnostic time, providing greater humanization of the doctor x patient relationship.
Dentistry	Aid in the diagnosis and treatment of diseases	100% of respondents agree with the need for coexistence between the use of AI and the clinical method.
		100% of respondents trust the diagnosis offered by AI. In this parameter, 50% believe that the patient's health does not interfere with the confidence level, and the other half think it is important to assess the patient's overall health status.
		87.5% say that the use of AI contributes to a more accurate and assertive diagnosis. 50% say it helps in planning and predicting treatment.
	Assistance in doctor x patient interaction	100% do not believe that the patient can define his diagnosis only as a result of the use of AI. AI allows the patient to have greater confidence in the relationship with the complicated dentist, which ends up improving the relationship between them.

4.2 Perception of the challenges faced by professionals in the implementation of innovations in health services

Regarding the challenges, challenges related to the high cost of acquisition, lack of confidence in the diagnoses provided by the use of AI, and the difficulty of assigning responsibilities in the face of diagnostic and treatment failures, in addition to the lack of incentives from health insurance were identified. Regarding cost, it was observed that AI technologies are expensive, which makes their adoption difficult by professionals.

The lack of accessibility for some is also related to the high cost of equipment.

"[...] In João Monlevade/Minas Gerais, it was necessary for us to join five ophthalmologists to become partners in the OCT equipment, in which each one has the right to use one day of the week [...]" (Respondent 02).

Considering that the diagnosis may contain failures, it is important to understand those responsible for them. Thus, in view of these failures in diagnosis or conduct, most respondents agree that the responsibility would lie entirely with the professional.

"[...]The responsibility is very great, the professional must first be able to interact with his patient, with time to extract all the necessary information from him, to order the complementary tests he deems necessary and to make the final decision [...]" (Respondent 07).

The data presented in Table 4 refer to the results of variations in the common responses of ophthalmologists and dentists on the challenges in relation to the AI technologies used in each specialty. In addition, the table provides for the existence of incentives provided by health insurance in relation to complementary exams that use AI.

Table 4: Challenges of AI application in ophthalmology and dentistry

Field	Construct	Challenges
Opht halm ology	Cost	50% due to high cost.
	Reliability	30% are no longer using it due to low reliability in using recent technologies.

Field	Construct	Challenges
		70% believe that there may be a discrepancy between the AI and the clinical diagnosis, as in some cases it is only possible to identify the disease through imaging tests with AI.
		In case of diagnostic errors, the responsibility lies only with the professional was affirmed by 60% of the interviewees. The other 40% argue that responsibility should be shared.
	Responsibility AI vs professional	100% agree that the interpretation and orientation of the correct treatment is the role of the health professional.
	Health insurance incentives	90% are not encouraged.
Dentistry	Cost	75% no longer use AI due to high cost.
	Reliability	12.5% for preferring a clinical examination.
		62.5% said there may be discrepancies between diagnoses.
	Responsibility AI vs professional	100% agree that the professional is fully responsible for the diagnosis, as the most appropriate diagnosis and treatment is legitimate.
		75% agree that the professional is responsible for the error. The other 25% say it could be shared with AI.
	Health insurance incentives	Although most professionals do not work through an insurance plan, 100% believe that there is no incentive from health insurance plans for the use of these technologies.
	Interaction with the patient	12.5% due to the difficulty of use in children.

Still, in Table 4, most professionals answered that health insurance does not encourage the use of complementary exams to help in decision-making, even professionals admitting that complementary exams are useful and essential.

5. Discussion

This discussion section was structured based on the pillars of the research: the technologies explored by the two areas of health, and the benefits and challenges experienced by professionals in relation to the implementation of technologies.

5.1 Existing Technologies

The literature shows that the existing technologies in ophthalmology are: fundus photography and Optical Coherence Tomography (OCT) (Li *et al.*, 2021; Tan, Scheetz and He; 2019). The survey results indicate that 90% of the ophthalmologists who participated in the survey use these technologies.

In the area of dentistry, the literature addresses technologies: confocal laser endomicroscopy (Mazzochi and Traiano, 2021) and CAD/CAM technology; Intraoral scanner (Moura and Pasini, 2020), but it was observed that only the intraoral scanner technology is used and by 60% of respondents. With this, we can say that the use of AI in dentistry is less explored.

The use of innovations with the application of AI technologies in these two health areas is very focused on aiding diagnosis and not on treatment, as demonstrated in the literature (Hazarika, 2020; Ting, 2020).

5.2 Benefits

Telemedicine, identified in the literature (Junior, 2019) was classified in this research from the perspective of quality of care. Respondents highlighted support for the diagnosis decision as the most commented. In this context, the increase in assertiveness, the reduction in the time of detection of the disease, and the follow-up of the disease stand out.

From the data collection, it was observed that most of the professionals who participated in the research consider that the use of AI complements the analyzes made by them, not replacing the human diagnosis, which corroborates the studies of Mazzochi and Traiano (2021). They also point out that only with the use of AI, the patient cannot define his diagnosis, emphasizing the importance of the physician's role in the process, as mentioned by Tan, Scheetz and He (2019). Most professionals consider a sovereign clinical analysis.

There are also cases in which the diagnosis made by clinical examination may seem normal, however, when performing tests such as OCT, it is possible to detect the initial stage of the retinal disease due to diabetes. Even in this case, the clinical examination is essential to analyze the patient's health history and complaints, in addition to requesting tests that help confirm the diagnosis.

As reported by a dental surgeon, through the intraoral scanner, it is possible to make the diagnosis more visible, showing whether any treatment is necessary and the options offered. This visibility increases the patient's safety and confidence in relation to the professional, corroborating the study presented by Kulkarni (2020).

5.3 Challenges

The literature presents the following challenges with the use of AI: i) Interaction with the patient (Groves and Kayyali, 2013); ii) Cost (Moura and Pasini, 2020; Moraes, 2019); iii) AI vs Professional Responsibility (Bonna, 2021); iv) Reliability (Li *et al.*, 2021; Mazzochi and Traiano, 2021). Note that the challenges cited in the literature were corroborated by the collected data. The cost of adopting these technologies was highlighted as a significant barrier (Cordeiro *et al.*, 2023a; Cordeiro *et al.*, 2023b). Some ophthalmologists responded that to manage the cost challenge, for example, it was necessary to work with resource sharing. In João Monlevade (Province of Minas Gerais, Brazil), five of them bought the equipment in partnership, which is available to each one once a week.

In dentistry, many professionals are not insured, impacting, even more, the cost challenge because, sometimes, the patient is not willing to pay for the private examination. Some respondents reported that AI technologies are not cost-effective. When it is necessary to perform a specific exam, which uses AI, the professionals refer the patient only to perform the exam with another professional who has it.

Thus, in addition to corroborating the literature, reality brought two contributions. In the analyzed context, the lack of incentives from health insurance represents an important challenge for the adoption of AI. Another contribution was the identification of the difficulty of applying technologies to pediatric patients in dentistry, reflecting the need to adapt existing technologies to generate comfort in their use by children.

In ophthalmology, many physicians are insured, but health insurance advises professionals to carry out diagnoses with a smaller number of exams, due to the cost. Therefore, convincing the use of AI for health insurance is an important point about the importance of AI technologies, as it will often influence their use by health professionals.

Thus, for there to be an effective adoption of AI by these professionals, on the one hand, it is necessary to convince them in relation to reliability, and the benefits of quality. On the other hand, on the part of health insurance, it is important to show the possible gains in terms of costs, with the reduction in the need to carry out different tests to obtain an accurate diagnosis. In this case, the use of AI can reduce the overall cost of diagnosis.

6. Conclusion

The research was realized to evaluate the perception of ophthalmology and dentistry professionals about the use of innovations arising from the application of AI, seeking to understand the benefits and challenges of its application in these areas of health.

Even though it is widespread in some areas of knowledge, research with the application of AI in the health area is still incipient. The study showed that an AI can perform a diagnosis in a short period compared to a professional in the area, but it is not possible to replace the professional. Although the research findings cannot be generalized, the opinion of the 18 participating professionals is that the use of AI helps to aid in the diagnosis, in addition to increasing the reliability of the analyzed data. They also reinforce that the professional's relationship with the patient, in the opinion of the interviewees, is fundamental for the translation of the diagnosis and for the conduction of the treatment actions.

One of the great challenges pointed out by the research in the adoption of AI is the lack of incentives from health insurance, in addition to the high cost of implementing AI for use in nurses, requiring the apportionment of the value by more professionals to enable the acquisition of new technologies that aid in the diagnosis.

Among the limitations of the work, there is the evaluation of a reduced number of professionals and the regionalization of the sample, evidenced in the performance of these professionals in only two Brazilian states.

As future work, it is suggested to analyze in greater depth the impact of IA on the dynamics of health work. For this, this work can be analyzed from the perspective of cognitive ergonomics to identify the extent to which AI is replacing or complementing human work. Analyzing from the patient's point of view, it is suggested that research be carried out with the objective of evaluating their perception in relation to the transformation of their experience, in the professional *versus* patient interaction. In addition, when analyzing the effect of AI technologies on the work process of health professionals, it is possible to identify possibilities for improving these technological solutions, stimulating new innovations.

Acknowledgement

The authors would like to thank the Federal University of Ouro Preto (UFOP/Brazil) (www.ufop.br), Foundation for Research Support of the State of Minas Gerais (FAPEMIG, Grant Number APQ-00951-22), Coordination for the Improvement of Higher Education Personnel (CAPES) and National Council for Scientific and Technological Development (CNPq), for their support and funding during the development of the research.

References

- Alami, H., Lehoux, P., Denis J.L., Motulsky, A., Petitgand, C., Savoldelli, M., Rouquet, R., Gagnon M.P., Roy, D. and Fortin J.P. (2020). "Organizational readiness for artificial intelligence in health care: insights for decision-making and practice". *Journal of Health Organization and Management*.
- Araujo, R., Fernandes, J.M., Reis, L.P. and Beaulieu, M. (2023), "Purchasing challenges in times of COVID-19: resilience practices to mitigate disruptions in the health-care supply chain", *Journal of Global Operations and Strategic Sourcing*, Vol. 16 No. 2, pp. 368-396. <https://doi.org/10.1108/JGOSS-04-2022-0026>
- Barros, J.C., Roriz, T.B.A., Gonçalves, R.M., Silva, D.E.G. and Andrade, D.D.B.C. (2020). "A inteligência artificial a caminho da visão da experiência do paciente". *Brazilian Journal of Development*, v. 6, n. 4.
- Blease, C., Kaptchuk, T.J., Bernstein, M.H., Mandl, K.D., Halamka, J.D. and Desroches, C.M. (2019). "Artificial Intelligence and the Future of Primary Care: Exploratory Qualitative Study of UK General Practitioners' Views". *Journal of Medical Internet Research*. Vol. 21. n. 3.
- Bonna, A.P. and Sá, V.V. (2021). Responsabilidade civil do médico por erros ocasionados no uso da inteligência artificial. *Revista Brasileira de Direito Civil em Perspectiva*, v. 7, n. 1, p. 45-66.
- Cericato, G., Garbin, D. and Fernandes, A. (2006). "Uso dos sistemas especialistas em odontologia". Departamento de Estomatologia–Universidade Federal de Santa Catarina. Florianópolis-SC, 2006.
- Chen, Y.W., Stanley, K. and Att, W. (2020). "Artificial intelligence in dentistry: current applications and future perspectives". *Quintessence International*. p. 248-257.
- Cordeiro, R.F., Reis, L.P. and Fernandes, J.M. (2023a), "A study on the barriers that impact the adoption of Industry 4.0 in the context of Brazilian companies", *The TQM Journal*, Vol. ahead-of-print No. ahead-of-print. <https://doi.org/10.1108/TQM-07-2022-0239>.
- Cordeiro, R. F., Reis, L. P., and Fernandes, J. M. (2023b). A hierarchical model for industry 4.0 concepts. *Revista de Administração Mackenzie*, 24(2), 1–41. <https://doi.org/10.1590/1678-6971/eRAMR230061.en>.
- Dodds, S., Russell-Bennett, R., Chen, T., Oertzen, A.S., Salvador-Carulla, L. and Hung, Y.C. (2022), "Blended human-technology service realities in healthcare", *Journal of Service Theory and Practice*, Vol. 32 No. 1, pp. 75-99.
- Dwivedi, Y.K., Hughes, L. Ismagilova, E., Aarts, G., Coombs, C., Crick, T., Duan, Y., Dwivedi, R., Edwards, J., Eirug, A., Galanos, V., Ilavanasan, P.V., Janssen, M., Jones, P., Kar, A.K., Kizgin, H., Kronemann, B., Lal, B., Lucini, B., Madaglia, R. And Williams, M.D. (2021). "Artificial Intelligence (AI): Multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research, practice and policy". *International Journal of Information Management*, v. 57.
- Gil, A.C. (2002). Como classificar as pesquisas. Como elaborar projetos de pesquisa, v. 4, p. 44-45, 2002.
- Groves, P.; Kayyali, B. (2013) "The Big Data Revolution in Healthcare: Accelerating value and innovation". McKinsey & Company.
- Hazarika I. (2020). "Artificial intelligence: opportunities and implications for the health workforce". *International Health*. Vol. 12, n 4. P. 241-245.
- Junior, N.K.J. (2019). "Oftalmologia 4.0". *Revista Brasileira de Oftalmologia*, v. 78, n. 3, p. 157-8.
- Kuiava, V.A., Kuiava, E.L., Chielle, E.O. and Syllos, R. (2021). "Desenvolvimento de sistema estruturado com inteligência artificial para apoio no diagnóstico de patologias oftalmológicas mais relevantes". *Clinical and Biomedical Research*, v. 41, n. 1.
- Korot, E., Wagner, S.K., Faes, L., Liu, X., Huemer, J., Ferraz, D., Keane, P.A. and Balaskas, K. (2020). "Will AI replace ophthalmologists?". *Translational vision science & technology*, v. 9, n. 2, p. 2-2.
- Li, J.P.O., Liu, H., Ting, D.S.J., Jeon, S., Chan, R.V.P., Kim, J.E., Sim, A., Thomas, P.B.M., Lin, H., Chen, Y., Sakamoto, T., Loewenstein, A., Lam, D.S.C., Pasquale, L.R., Wong, T.Y., Lam, L.A and Ting, D.S.W. (2021). "Digital technology, telemedicine and artificial intelligence in ophthalmology: A global perspective". *Progress in Retinal and Eye Research*, v. 82.
- Lobo, L.C. (2017). "Inteligência artificial e medicina". *Revista Brasileira de Educação Médica*, v. 41, p. 185-193, 2017.

- Mazzochi, A.C.D. and Traiano, A.P.P.V. (2020). "Artificial intelligence: a futuristic concept in dental diagnosis". *Revista Voos Polidisciplinar*. Vol. 10, n 3. p. 155-179.
- Moraes, M.V.O., Filho, E.S.T., Baía, D.M. and Vasconcelos, R.A. (2019). "Desenvolvimento de um aplicativo como ferramenta auxiliar de diagnóstico endodôntico". *Anais SEMPESq*, n. 7.
- Moura, I.G., Pasini, M. (2020). "The use of intraoral scanner dentistry: literatura review". 2020.
- Poomathi, N., Singh, S., Prakash, C., Patil, R.V., Perumal, P.T., Barathi, V.A., Balasubramanian, K.K., Ramakrishna, S. and Maheshwari, N.U. (2019), "Bioprinting in ophthalmology: current advances and future pathways", *Rapid Prototyping Journal*, Vol. 25 No. 3, pp. 496-514.
- Reis, L., Fernandes, J., Araújo, M., and Beaulieu, M. (2022a). Lean Startup Practices: Operationalizing the Technological Business Planning Process in an Academic Environment. In ECIE 2022 17th European Conference on Innovation and Entrepreneurship. Academic Conferences and publishing limited. Doi:<https://doi.org/10.34190/ecie.17.1.544>.
- Reis, L.P., Fernandes, J.M., Silva, S.E. and Andreosi, C.A.d.C. (2023), "Managing inpatient bed setup: an action-research approach using lean technical practices and lean social practices", *Journal of Health Organization and Management*, Vol. 37 No. 2, pp. 213-235. <https://doi.org/10.1108/JHOM-09-2021-0365>.
- Reis, L. P., Fernandes, J. M., Silva, S. E., and Pereira, A. D. S. (2022b). Application of Quality Function Deployment as an Integrative Method to Knowledge Management Implementation. *Journal of Information & Knowledge Management*, 21(02), 2250022.
- Ribeiro, J.F., Chaves, N.S.G., Lopes, D.C. and Macedo, G.E. (2021). "Reestruturação das profissões da saúde e perspectivas para o futuro na era da Inteligência Artificial". *Comunicação em Ciências da Saúde*, v. 32, n. 03.
- Silva, I.M., Nogueira, T.Q.S., Couto, D.N., Lima, P.C.T.M., Bonfim, N.S.C., Sousa, I.G.V., Telles, A.C.T., Hecht, F., Alkmim, N.R., Penna, G.C., Ferraz, C., Tomimori, E. And Ramos, H.E. (2022). "Feasibility of a snowball sampling survey to study active surveillance for thyroid microcarcinoma treatment among endocrinologists and surgeons of Brazil". *Brazilian Journal of Otorhinolaryngology*, vol. 88, pp. 163-169.
- Tan, Z., Scheetz, J. and He, M. (2019). "Artificial intelligence in ophthalmology: accuracy, challenges, and clinical application". *The Asia-Pacific Journal of Ophthalmology*, v. 8, n. 3, p. 197-199.
- Ting, D.S.W. (2020). "Artificial intelligence, the internet of things, and virtual clinics: ophthalmology at the digital translation forefront". *The Lancet Digital Health*, v. 2.

Analysing Waste in The Development Process of Technological Innovation Projects in a Brazilian Public University

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Abstract: Technological innovation assumes a strategic role in organisational competitiveness. In this sense, it is perceived that universities represent a point of reference for the development of technological projects. The academic innovations arising from these projects are the result of three processes: product development process, business process and technology transfer. During the development of these projects, the team of researchers-entrepreneurs experiences different types of waste. This waste can be studied from the Lean Production Development (LPD) perspective. The LPD constitutes a set of practices capable of mitigating the waste that affects the new product development process (NPD). Aiming to address the scarcity of studies that address incident waste in the NPD of academic projects, this research aims to identify the frequency with which researcher-entrepreneurs experience each category and subcategory of waste during the development of the three processes (technology planning process - TPP; ii) technology transfer planning process - TTPP, and business planning process - BPP), from the perspective of the LPD. These three processes were subdivided into phases: i) initial, ii) intermediate and iii) final. Based on a quali-quantitative approach and using the methodological strategy of multiple case studies, this research analysed the context of nine technological innovation projects developed in a Brazilian federal university. Data were collected using a questionnaire prepared on a Likert scale. Eleven categories and 47 subcategories of waste were analysed in these projects. As a result, it was observed that during NPD, the waste category "waiting" was the most experienced in the different stages of the development of technological innovation, especially the subcategory "unavailability of resources". Regarding business development and technology transfer processes, the "waiting" category was also the most experienced, except in the initial phase when the "defects" category was more significant. However, analysing the 11 categories of waste, it was observed that the category "defect", especially the subcategory "information with insufficient quality" was the most experienced in the phases of technological innovation. From the identification of the different categories and subcategories of waste experienced in the context of technological innovation projects, it is clear that this research provides important elements to help identify LPD practices capable of mitigating the waste experienced during the NPD process in the academic environment.

Keywords: Technological Innovation; Waste; Lean Product Development; Academic Environment; New Product Development.

1. Introduction

Technological innovations in the academic environment involve different viable configurations of business models that allow technologies and products developed in universities to reach the market, through technology transfer to established companies and startups (Menezes *et al.*, 2023; Reis *et al.*, 2022; Elias *et al.*, 2022; Silva *et al.*, 2019; Fernandes, Reis, Serio, 2017). These innovations are the result of integration between technology/product development processes, technology transfer and business development (Reis *et al.*, 2022). These processes seek to promote better collaboration between technologies, products, processes, businesses and the market (Reis *et al.*, 2022; Fernandes, Reis, Serio, 2017).

Studies have shown that during the development of these innovations, different types of waste affect the operationalisation of these three processes (technology/product development, technology transfer and business development) (Reis *et al.*, 2022; Reis *et al.*, 2021). To mitigate this waste, Lean Product Development (LPD) and Lean Startup (LS) practices emerge (Reis *et al.*, 2022; Reis, Fernandes, Armellini, 2021; Reis *et al.*, 2021). However, it is important to note that during New Product Development (NPD), the focus of LPD practices is not on the physical or manufacturing processes, but on improving the information being processed (Cordeiro *et al.*, 2023a; Cordeiro *et al.*, 2023b; Carvalho de Sá *et al.*, 2022; Reis *et al.*, 2021; Dal Forno *et al.*, 2016).

The intensity with which entrepreneur-researchers experience different types of waste during the NPD was not observed in the researched literature. So, aiming to overcome the lack of studies that address the waste incident in the process of developing technological innovations, this research aims to identify the frequency with which the development teams of these innovations experience each category/subcategory of waste during the

development of the three processes cited, from the perspective of the LDP. It should be noted that these three processes were subdivided into phases: i) initial, ii) intermediate and iii) final.

Considering its contribution to related literature, the research identifies that the incidence of waste in the development of business originates from the wastes experienced during technology development. It was recognised that waste identification could lead to the creation of a prescriptive model of the main practices, for example, one that is related to LPD, which can contribute towards making the process of management of technological innovation, in an academic environment, leaner and free of losses, thus favoring the operationalisation of the development of technology and business through LPD practices (Reis *et al.*, 2023; Reis *et al.*, 2022; Fernandes, Reis, Serio, 2017).

2. Literature review

2.1 Technological Innovation in the academic context

The growing engagement of universities in promoting technological innovation has fostered new developments and technology transfers from the academic environment to the market (Angrisani, Cannavacciuolo, Rippa, 2023). Studies show that industry development strongly depends on scientific research, technological innovation projects developed at universities, research institutes, science and technology, as well as companies with R&D capabilities. (Li, Zhou, Tian, 2023).

To promote technological innovation in the academic environment, there are two mechanisms: technology transfer to startups (Gómez-Baquero, 2023; Papaderos, Bücken, 2023; Reis *et al.*, 2022; Fernandes, Reis, Sério, 2017) or for companies established in the market (Siegel *et al.*, 2023).

With a focus on the generation of startups, it is advised that these TTOs together with academic incubators develop policies more focused on providing people with the resources, connections and knowledge they need to create new startups (Gómez-Baquero, 2023). Success in generating startups from universities, the so-called academic spinoffs, depends not only on factors at the micro level, but also factors at the meso and macro levels, such as relationships with parent organisations and regional contexts (Hossinger, Chen, Werner, 2020). Thus, the startup generation is the result of a set of stages, of a technological innovation process that comprises the integration of technologies, products, processes, business and market. (Hossinger, Chen, Werner, 2020; Ndonzuau, Pirnay, Surlémont, 2002).

According to Reis *et al.* (2022), these stages comprise three processes: i) technology planning process (TPP); ii) technology transfer planning process (TTPP), and iii) business planning process (BPP). The technology and product development process (Cooper, 2008) aims to help incorporate technology into a product and bring it closer to the market. The technology transfer process comprises the phases that begin with the development of the technology until its transfer to the market (Boguszewicz-Kreft *et al.*, 2021; Siegel *et al.*, 2004) and the business development process (Majdouline, El Baz e Jebli, 2022), which “corresponds to the phases of business development, which occur in parallel with technology and product development” (Reis *et al.*, 2022).

The integration of the three processes is possible based on three distinct phases. i) World of technology (initial): the researcher seeks to identify theoretical problems with practical applicability in the academic environment; ii) World of transition from technology to product and business (intermediate): the three processes become distinct, and the first approximations with the market begin; iii) Business world (final): represents the insertion of the business in the market through a commercial product (Reis *et al.*, 2022).

To support the operationalisation of these processes, there are several management practices such as those based on lean thinking, representing a way of specifying a value and minimising the efforts applied (Klein *et al.*, 2023; Reis, Fernandes, Armellini, 2021; Reis *et al.*, 2021). In this context, the principles of lean thinking applied to NPD can be operationalised by LPD practices. The use of LPD practices allows the processes of technology and product development, technology transfer and business development to be leaner, reduce waste (by identifying and mitigating impacts) and favor the elimination of elements that do not add value to products, business and technology transfer, in the process of generating technological business (Fernandes, Reis, Serio, 2017).

2.2 Classification of Waste from the Perspective of Lean Product Development

Lean Product Development (LPD) is the application of lean principles to product development, with the aim of developing new or improved products that are successful in the marketplace (de Toledo et al., 2023; Belvedere et al., 2019). By focusing on the product development process, LPD increases efficiency and reduces waste in the design of new products, identifying waste that increases costs without adding value to the product (Araujo et al. 2023; Reis et al., 2021).

Ohno (1988) identified the seven types of waste in Lean Manufacturing which include overproduction, waiting, necessary dependency, transport, overprocessing, defect and inventory. These wastes are applicable to LPD, but were reinterpreted by Bauch (2004), which added three more wastes (reinvention, lack of discipline, and restrictions on information technology resources) to achieve greater consistency and inclusiveness. This research was based on the study by Bauch (2004) as a framework for development. In it, a breakdown of categories and subcategories of losses and an emphasis on the cause-and-effect relationship inherent to each waste was identified. Thus, table 1 presents the categorisation of LPD waste.

Table 1: Categorisation of Lean Product Development Waste

Category	Subcategory	Authors
Waiting	1) People waiting for answers, approvals of test results, decisions, signatures; 2) Information waiting for people; 3) People waiting for available capacity of man or machine	1) Bauch (2004); 2) Bauch (2004); McManus (2005); 3) Bauch (2004)
Transport	1) Excessive information movement; 2) Handoffs - one of the causes of property change which is related to the waste of lack of communication of information; 3) Task Swapping; 4) Ineffective Communication	1) Bauch (2004); 2) Bauch (2004); Kato (2005); Oehmen and Rebentisch (2010); 3) Bauch (2004); 4) Bauch (2004)
Unnecessary movement	1) Lack of direct access; 2) Search for Information; 3) Remote Locations	1) Millard (2001); Bauch (2004); McManus (2005); 2) Bauch (2004); 3) Slack (1998); Bauch
Excessive processing	1) Unnecessary processes and characteristics; 2) Unnecessary precision and detail - "Excessive engineering" where too much detail is specified or exceeds required specifications; 3) Excessive transactions; 4) Inadequate use of skills; 5) Inappropriate use of tools and methods; 6) Excessive Approval	1) Bauch (2004); 2) Bauch (2004); Oehmen and Rebentisch (2010); 3) Bauch (2004); 4) Bauch (2004); 5) Bauch (2004); 6) Millard (2001); Bauch (2004); McManus (2005)
Inventory	1) Excessive data storage - considers the collection, processing, and storage of data that the process participants consider important, whether these are usable or not; 2) Queues in the critical path; 3) Unnecessary testing of equipment and prototypes	1) Bauch (2004); McManus (2005); 2) Bauch (2004); 3) Bauch (2004)
Overproduction (Non-Synchronized Processes)	1) Low timing with respect to content; 2) Low synchronization with respect to time and capacity; 3) Excessive dissemination of information - information is sent to all without the knowledge of what each one really need of ; 4) Redundant Tasks - "perform duplicate work", which may be a consequence of unclear division of labor, and poor communication and misconduct	1) Bauch (2004); 2) Bauch (2004) 3) Millard (2001); Bauch (2004); McManus (2005); 4) Bauch (2004); Oehmen and Rebentisch (2010)
Defects	1) Information deficiency with quality - "lack of quality information" 2) Erroneous information and data - "wrong data, information and reports"; 3) Anxious thinking; 4) Testing the specifications in whose content there are failures; 5) Failed tests and verifications	1) Millard (2001); Bauch (2004); 2) Bauch (2004); McManus (2005); 3) Ward (2000); 4) Ward (2000); 5) Millard (2001); Bauch (2004)
Reinvention	1) Poor reuse of projects; 2) Creativity not used; 3) Knowledge discarded; 4) Useless information; 5) Poor reuse of knowledge	1) Bauch (2004); 2) Liker (2004); 3) Ward (2000); 4) Ward (2000); 5) Bauch (2004)
Lack of discipline	1) Poorly developed objectives; 2) Badly defined roles, responsibilities and rights; 3) Rules not clear; 4) Low discipline regarding compliance with schedules; 5) Insufficient willingness to cooperate; 6) Incompetence/ poor training	1) Bauch (2004); 2) Bauch (2004); 3) Bauch (2004); 4) Bauch (2004); 5) Bauch (2004); 6) Bauch (2004)
IT resource limitation	1) Poor Compatibility; 2) Poor ability; 3) Low Capacity	1) Bauch (2004); 2) Bauch (2004); 3) Bauch (2004)
Correction of Information	1) Repair and Reformulation / Rework; 2) Scrap; 3) External Inspection of Information	1) Oehmen and Rebentisch (2010); 2) Oehmen and Rebentisch (2010); 3) Oehmen and Rebentisch (2010)

Source: The authors.

The studies mentioned above helped to structure a table with 11 categories and 47 subcategories of waste that served as a reference for the construction of a questionnaire, in order to identify the frequency with which researchers experience each category/subcategory of waste from the perspective of the LDP.

3. Methodology

This research is classified as quali-quantitative and the methodological strategy adopted was the case study, in the context of a Brazilian federal university. A case study is a research strategy that involves an in-depth and detailed investigation of one or more cases, with the aim of understanding the phenomena in question (Yin, 2009).

In this context, nine technological projects included in an innovation incentive program were studied. For the collection of project data, interviews were conducted with members of the innovation development teams, in order to build a close connection with the empirical reality, providing the development of a relevant, testable and valid theory (Eisenhardt, 1989).

In order to identify the frequency with which the members of the nine project teams experienced each category and/or subcategory of waste from the perspective of the LPD in the different stages of development of the technological innovation process, (technology and product development processes, transfer of technology and business development and with the integration of these processes from three distinct phases: initial, intermediate and final), a questionnaire was applied containing self-explanatory questions related to each of the categories and subcategories of waste. For each question, respondents indicated the degree of experience of waste in each phase of technological innovation, assigning scores from 1 to 5 (being F1-did not experience it, F2-experienced it rarely, F3-experienced it occasionally, F4-experienced it frequently and F5- experienced very often). The interviews were conducted online, lasting approximately 150 minutes each. The scores were converted into frequencies of occurrence to then perform multivariate analyses.

The analysis of the results was consolidated through Principal Component Analysis (PCA). PCA is a technique that makes it possible to reduce the number of variables, forming new variables that are linear combinations of the original variables (Hair et al., 2014). From these linear combinations, scores are calculated that, when sorted, identify the waste most experienced by members of the innovation development team. To run the PCA, the statistical software Minitab version 16 was used.

An analysis focused on the technology and product development process was carried out, and another on the technology transfer process and business development (analysed concomitantly by the similarity of the context of the processes). For each of the two processes, an analysis was carried out comparing the categories and then the subcategories of the waste considering: i) general analysis of categories and subcategories, regardless of phases (considering the three phases: initial, intermediate, and final); 2) analysis of categories and subcategories for the initial phase; 3) analysis of categories and subcategories for the intermediate phase; and 4) analysis of categories and subcategories for the final phase. With the ACP, it was possible to classify the most experienced categories and subcategories of waste based on the experience of team members.

4. Analysis and Discussion of Results

This section presents a summary of the nine researched technological projects and analyses the results regarding the degree of experience of the categories and subcategories of waste for the three evaluated processes: technology and product development process, technology transfer process and business development process in its initial, intermediate and final phases.

4.1 Project Presentation

Table 2 was constructed to detail the technological projects studied, and contains a brief description of them and their market profile. Cases 1 and 5 are focused on the pharmaceutical area, with the first focusing on the development of a drug that seeks to increase the number and quality of male reproductive cells, and the second is responsible for the development of software that increases the quality of cytological analyses. Case 3 is focused on mobile and cloud computing. Cases 2, 4, 7, and 9 focus on the mechanical areas, on the development of machines capable of optimising processes, generating energy, and monitoring possible non-compliance. Finally, cases 6 and 8 are aimed at the food industry, in order to contribute to the quality and monitoring of food.

By the end of this research, most projects were still focused on technology and product development, with no conviction about the decision to transfer to an established company or a new company. Other projects, for

example, which had the intention of transferring technology to technology-based companies, were still in the initial and intermediate stages of business development, with significant immaturity, which challenged the understanding of the frequency with which researchers- entrepreneurs experienced different types of waste.

Therefore, the researchers answered questionnaires considering their individual experience in technological projects and accounted for the uncertainties experienced in ongoing projects, in order to make predictions and design the path to be followed, based on the technology transfer and development phases of the business.

Table 2: Description of Analysed Projects

Projects	Knowledge area	Description
Case 1	Pharmaceuticals	Medication based on a species of plant that changes male behavior and induces an increase in the number of spermatozoa produced by it, in addition to an improvement in semen quality.
Case 2	Mechanics and organic chemistry	Polymer printing machine that allows you to mold objects from polymers (plastic). This equipment aims for the production of a detailed object with volume and depth, obtained by overlapping several layers of polymers, layer by layer, giving the final shape.
Case 3	Mobile and cloud computing	The technology developed was born from a concept called "information management in the agent life cycle" (IMALC), which consists of a new paradigm of information and document management.
Case 4	Applied mechanics	The purpose of the technology is to detect deterioration of the geometry of the rails and the appearance of its fractures. The process for obtaining the data is done by producing a stimulus on one end of the sleepers with a hammer or similar tool.
Case 5	Computation and cytology	Analysis of cervical cell samples by imaging treatment. It is intended to create a high-performance semiautomatic computational tool capable of identifying and quantifying cellular components.
Case 6	Food and chemistry	Sensor of the chemical type the verification of the pH alteration of foods. It undergoes a change of color (light pink to violet) when in the presence of compounds released from the metabolism of decaying bacteria. The technology contributes to reducing the excess of meat waste in Brazil caused by bad conditions.
Case 7	Electrical	Generation of electrical energy by means of the waterfall of the residential or building reservoir. It works in a similar way to a hydroelectric plant.
Case 8	Food and chemistry	The research studies a way to incorporate the extract (Brazilian fruit isolates) of antimicrobial action in cellulosic film, in which the extract would be released from the same on the packaged food product. In addition to economic benefits, it can reduce losses and reduce intoxications and other problems related to food consumption.
Case 9	Blockbuster Games	Simple and innovative equipment, which integrates two technologies that already exist in the market, and enables the creation of games with sounds, through a virtual 3D environment, making its use viable for the visually impaired.

Source: The authors

4.2 Analysis and discussion of the results within the scope of the technology/product development process

To analyse the waste in the technological planning process, comparative analyses were carried out between the categories and subcategories of waste in each of the three phases (initial, intermediate and final) and, then, those with the highest level of experience were identified for the nine analysed cases. Interpreting the Minitab software output for waste categories regardless of phase, the first principal component Y1, for example, showed a variance of 0.020836, explaining 64.5% of the total variability of the original variables. In this way, the principal component can be described according to expression 1:

$$Y_1 = -0.693 (F1) - 0.325 (F2) + 0.451 (F3) + 0.124 (F4) + 0.443 (F5) \quad (1)$$

Table 3: Ranking of waste experienced during the technological planning process

Categories of Waste	F1	F2	F3	F4	F5	Score	Ranking
Wait	0,2222	0,0494	0,2346	0,2469	0,2469	0,0757	1
Inventory	0,222	0,370	0,204	0,204	0,000	-0,157	2
Unnecessary movement	0,324	0,259	0,093	0,222	0,102	-0,194	3
Transport	0,333	0,296	0,126	0,156	0,089	-0,212	4
IT resources Limitation	0,389	0,315	0,093	0,176	0,028	-0,296	5
Excessive Processing	0,402	0,365	0,079	0,111	0,042	-0,329	6
Defects	0,407	0,348	0,081	0,163	0,000	-0,338	7
Reinvention	0,469	0,272	0,025	0,235	0,000	-0,373	9
Lack of discipline	0,494	0,241	0,037	0,210	0,019	-0,369	8
Overproduction	0,519	0,267	0,059	0,133	0,022	-0,393	10
Correction of information	0,543	0,235	0,012	0,210	0,000	-0,421	11

Source: Drawn from Minitab 16 output.

The coefficients of the equation indicate the relative weight of each variable in the component. A higher absolute value of the coefficient means the importance of the corresponding variable in the construction of the component. As the variables F1 and F2 have negative factors (represent the frequency of projects that had no or little waste), the categories of waste with low Y1 have a greater proportion of these scores, and are considered categories of waste little experienced, and may not even experience waste. Thus, the interviewees' scores for component 1 helped to create a ranking of the relevance of waste experienced during the technology/product development process (Table 3). The resulting Table 3 indicates that the higher the value of the principal component, the stronger the experience of waste.

Conducting an evaluation of the technological planning process, it was concluded that the most common subcategories (Table 4) were "type of waiting C" and "type of movement C", both with a score of 0.172. The "waiting" category was the most frequent due to the unavailability of resources, being classified as the most experienced waste, with a score of 0.076. The incidence of "type of wait B" was also observed, with a score of 0.134, representing the wait for information, results, signatures, and decisions.

Table 4: Ranking of waste experienced during the technological planning process

Subcategories of Waste	Score	Ranking	Subcategories of Waste	Score	Ranking	Subcategories of Waste	Score	Ranking
Type of Wait C	0,172	1	Type of Process E	-0,260	15	Type of Process F	-0,350	30
Type of movement C	0,172	1	Type of Defect A	-0,265	16	Type of Reinvention A	-0,355	31
Type of Wait B	0,134	2	Type of Inventory A	-0,266	17	Type of Limitation B	-0,361	32
Type of Limitation D	0,030	3	Type of Process G	-0,268	18	Type of Overproduction A	-0,364	33
Type of transport C	-0,012	4	Type of Defect E	-0,270	19	Type of movement A	-0,380	34
Type of Overproduction C	-0,014	5	Type of transport E	-0,280	20	Type of Defect D	-0,397	35
Type of Wait A	-0,015	6	Type of Fault F	-0,283	21	Type of Correction C	-0,416	36
Type of Inventory B	-0,027	7	Type of Fault B	-0,289	22	Type of Fault C	-0,419	37
Type of Fault D	-0,040	8	Type of Limitation A	-0,299	23	Type of Overproduction B	-0,426	38
Type of Correction A	-0,112	9	Type of Process D	-0,303	24	Type of Overproduction E	-0,434	39
Type of movement B	-0,188	10	Type of Defect C	-0,309	25	Type of Limitation C	-0,442	40
Type of transport D	-0,206	11	Type of transport A	-0,318	26	Type of Fault E	-0,490	41
Type of transport B	-0,208	12	Type of Process C	-0,318	26	Type of Correction B	-0,524	42
Type of Reinvention B	-0,221	13	Type of Defect B	-0,321	27	Type of Process B	-0,533	43
Type of movement D	-0,238	14	Type of Fault A	-0,329	28	Type of Overproduction D	-0,573	44
Type of Process A	-0,260	15	Type of Reinvention C	-0,335	29			

Source: Minitab 16 Score Analysis. The categorisation of waste types was based on the information available in table 1.

The "inventory" category ranked second (score -0.157), standing out in the technological and product planning phase due to the occurrence of situations in which queues are caused by bottlenecks or critical paths, such as case 7, which caused delays in the product development stage.

The "unnecessary movement" category was the third most frequent (-0.194), and "type C" was classified as the most experienced waste subcategory, with emphasis on case 9, which had many displacements in the validation of its steps. Waste of "transport" (Score -0.212) ranked fourth, evidenced in complex projects, as in case 5. The category "limitations of IT resources" ranked fifth, with "type of limitation D" evidenced in cases 2 and 4. "Excessive processing" was classified in sixth place (Score -0.329) and addressed the excess of work throughout the technology transfer process, to achieve the results. The "defect" category ranked seventh, which is one of the major causes of rework in new projects.

In eighth place is the waste generated by the "lack of discipline" category (Score -0.369), evidenced in the "type D" subcategory, characterised by the lack of meeting deadlines during technological and product planning, demotivating team members and leading to the abandonment of the project, as an example of case 9. The ninth position is occupied by "reinvention" (Score -0.373), characterised by the non-use of knowledge acquired in previous projects, which could contribute to several stages of development, experienced in case two. The "overproduction" category occupied the penultimate position (Score -0.393), due to an excessive disclosure of information and redundancy of tasks, mainly in the subcategory "type of overproduction D". Finally, "information correction" was in the tenth position of waste (Score -0.421), in which the need for rework is seen as inherent to the technological planning process.

A comprehensive waste assessment was carried out in the context of the nine projects, where the experience of waste was evaluated in a broad context throughout the technological planning process. Waste categories and subcategories were classified, considering simultaneously the initial, intermediate and final phases of the technological business planning process of all technological projects. The adoption of this procedure helped us to understand waste and its ramifications and allowed us to identify the most frequent wastes in the development of technologies and products.

Analysing the collected data, the "waiting" category was the most frequent, due to the delay caused by the lack of resources and qualified personnel. In the initial phase, the most experienced subcategory was the excessive search for information. It is observed that the subcategory "type of overproduction D" was less experienced in the intermediate and final phases. The subcategory "type of correction C" originated from the category "correction of information" and was less frequent, which contributed to identifying that, in the initial phases of project development, information was significantly scrapped in the initial phases due to the high degree of uncertainty involved in the development of the project.

4.3 Analysis and discussion of results within the scope of the technology transfer process and business development process

Similar to the method developed in section 4.2, wastes were jointly analysed for the technology transfer planning process and the business planning process. This analysis applied the answers to the questionnaires used in the nine technological projects.

In order to create rankings for the frequency with which a given waste was experienced during the technology transfer planning process and business planning process, through the PCA, the scores of the first component were calculated based on the responses of the researcher-entrepreneurs of the nine projects. The results show that when the score value is higher (score), more waste was experienced (Table 5).

Table 5: Ranking dos desperdícios vivenciados durante processo de transferência da tecnologia e processo de desenvolvimento do negócio

Categories of Waste	F1	F2	F3	F4	F5	Score	Ranking
Wait	0,6670	0,0740	0,0250	0,1230	0,1110	-0,0790	1
Inventory	0,689	0,096	0,015	0,111	0,089	-0,115	4
Unnecessary movement	0,630	0,093	0,065	0,130	0,083	-0,088	3
Transport	0,688	0,143	0,037	0,116	0,016	-0,167	7
IT resources Limitation	0,648	0,148	0,037	0,167	0,000	-0,141	6
Excessive Processing	0,711	0,133	0,044	0,022	0,089	-0,193	8
Defects	0,607	0,119	0,030	0,178	0,067	-0,085	2
Reinvention	0,728	0,198	0,000	0,074	0,000	-0,247	10
Lack of discipline	0,716	0,099	0,006	0,130	0,049	-0,124	5
Overproduction	0,657	0,324	0,019	0,000	0,000	-0,367	11
Correction of information	0,753	0,160	0,012	0,037	0,037	-0,232	9

Source: Analysis of Minitab 16 scores.

By analysing the frequency tables and processing the data, a small reduction in waste was observed during the technology transfer planning and business planning process, compared to the technology planning process. Most waste came from the literature on technology and product development. However, waste typologies were common in business development processes, emphasising the need for evaluation in this area of study. Detailed results of the waste subcategories can be found in Table 6. Among the categories of waste, "waiting" took first place (-0.079), justified by the lack of technical resources and people capable of providing the necessary market guidance. In second place, the category "defect" (-0.085) stood out, in which the "types of defect B" (-0.710) and "type of defect E" (-0.741) were the most common, indicating an execution of work with insufficient quality of information. The category "necessary movement" (-0.088) evidenced the loss of time and resources with the necessary displacements of people to access information that could be transmitted through more efficient electronic communication.

"Transport" (-0.115) gained prominence due to excessive movement of information, and "lack of discipline" (-0.124) was characterised by poor management of goals, objectives and responsibilities, which generate lack of motivation in teams and non-compliance with scheduled activities.

The "inventory" category (-0.141) generated delays in the business development stages mainly caused by slowness in the decision-making process and waiting for information. "Excessive processing" (-0.167) was experienced by the use of advanced tools and methods and by excessive approvals for executed processes, overloading the team. The "overproduction" category (-0.193) was characterised by the lack of experience of those involved and the excessive generation of inaccurate information. "Information correction" has also been experienced, due to failures of external organs. For example, the lack of monitoring and verification procedures by the bodies, considering the way in which the projects were being carried out, exposed a certain amateurism in supporting technological projects. The "reinvention" category had little experience across multiple projects, receiving a score of -0.247. The "Limited IT Resources" category came in last, with a score of -0.367, demonstrating that it was not a significant barrier in the business planning process.

Table 6: Result after general analysis of the waste subcategories in the context of the technology transfer planning process and business planning process

Subcategories of Waste	Score	Ranking	Subcategories of Waste	Score	Ranking	Subcategories of Waste	Score	Ranking
Type of Defect B	-0,710	1	Type of Overproduction C	-1,536	13	Type of Wait A	-1,859	24
Type of Defect E	-0,741	2	Type of Defect C	-1,536	13	Type of transport A	-1,859	24
Type of movement c	-0,836	3	Type of Fault A	-1,536	13	Type of transport E	-1,867	25
Type of Process A	-0,877	4	Type of Reinvention B	-1,557	14	Type of Limitation B	-1,880	26
Type of Wait C	-1,155	5	Type of Process D	-1,562	15	Type of Process E	-1,899	27
Type of movement D	-1,266	6	Type of Inventory A	-1,576	16	Type of Reinvention A	-1,899	27
Type of Fault B	-1,291	7	Type of Fault E	-1,576	16	Type of Reinvention C	-1,899	27
Type of Inventory B	-1,352	8	Type of Overproduction D	-1,584	17	Type of Fault C	-1,899	27
Type of transport C	-1,395	9	Type of Fault D	-1,584	17	Type of Correction A	-1,899	27
Type of Limitation A	-1,436	10	Type of Overproduction E	-1,624	18	Type of Overproduction A	-1,947	28
Type of Limitation D	-1,436	10	Type of movement A	-1,684	19	Type of Overproduction B	-1,948	29
Type of transport B	-1,447	11	Type of Correction B	-1,759	20	Type of Correction C	-1,948	29
Type of transport D	-1,447	11	Type of Limitation C	-1,773	21	Type of Process B	-1,988	30
Type of Process G	-1,447	11	Type of Defect D	-1,778	22	Type of Process C	-1,988	30
Type of Process F	-1,535	12	Type of movement B	-1,811	23	Type of Fault F	-2,223	31
Type of Wait B	-1,536	13	Type of Defect A	-1,811	23			

Source: Minitab 16 Score Analysis.

The evaluation process considered each phase of the technology transfer process and business development process, with the "waiting" category being the most experienced in the protected and final phase. In the preserved phase, the lack of knowledge in management led the researchers to seek external help, increasing the waste of "waiting". In the final phase, the market feedback time contributed to the high degree of "waiting" waste. In the initial phase, the "defect" waste was the most experienced. The least experienced category of waste was "limitation of IT resources". The most experienced subcategory was "type B defect", while the least experienced subcategory was "type F fault". The subcategories "types of processes B and C" were the least experienced in the intermediate and final phases, related to waste from "excessive processing" that does not add value to business development.

5. Conclusion

Technological planning faces losses and waste, just like in other organisations. In this context, this study highlights the importance of assessing the frequency of waste occurring during technology, product and business development. From the data analysis it is possible to infer that the adoption of lean product development tools throughout the process can contribute to reducing waste. Comparing LPD practices with the contributions arising from the waste analysis can improve processes and rationalise the use of resources in technological projects and startup companies. Table 7 summarises the plus (+) and minus (-) waste categories experienced at different stages of the process.

It is observed that the "waiting" category is the most experienced in all three phases of the technology and product development process (TPP), as well as in the intermediate and final phases of the technology transfer planning process (TTPP) and business planning process (BPP). Regarding the waste subcategories, at least three positions are occupied by some type of waste related to waiting in the technology and product development process, while all four positions are occupied by "type B defect" in the transfer planning process of technology and business planning process.

Table 7: Summary of categories and subcategories of waste experienced throughout the development of technological innovations

	General		Initial		Intermediate		Final	
	Category	Subcategory	Category	Subcategory	Category	Subcategory	Category	Subcategory
TPP	1		2		3		4	
	(+) Waiting (-) Correction of information	(+) Type of wait C (-) Type of overproduction D	(+) Waiting (-) Reinvention	(+) Type of movement C (-) Type of correction C	(+) Waiting (-) Correction of information	(+) Type of wait B (-) Type of overproduction D	(+) Waiting (-) Correction of information	(+) Type of wait C (-) Type of overproduction D
TTPP/BPP	5		6		7		8	
	(+) Waiting (-) IT resource limitation	(+) Type of defect B (-) Type of fault F	(+) Defeitos (-) IT resource limitation	(+) Type of defect B (-) Type of fault F	(+) Waiting (-) IT resource limitation	(+) Type of defect B (-) Type of limitation B and C, type of process B and C, transport E	(+) Waiting (-) IT resource limitation	(+) Type of defect B (-) Type of process B and C

Source: The authors

This research's theoretical contribution focused on identifying the main wastes experienced in the three processes (TPP, TTPP, and BPP). In relation to the theory, it was possible to expand the scope of the table presented on wastes (Table 1). In parallel, new findings were added. Initially, the framework proposed by Bauch (2004) had 10 categories and 37 subcategories of waste. This research enriches the literature with another structure containing 11 categories and 47 subcategories of waste. From the analysis of this new table of residues, it is possible to understand the ways in which a type of residue can be identified in the PDP. In this way, it is possible to analyse each subcategory of waste and understand the extent to which the different wastes impact the PDP.

The empirical contribution will be centered on the identification of a practice or a set of practices capable of assisting researchers-entrepreneurs in each phase (initial/intermediate/final) to mitigate the waste experienced by those involved during the development of technologies, products, and business.

A limitation is the lack of evaluation to confirm the direct influence of this waste on the development and success of technological projects. Future developments of this research may include the creation of a prescriptive model that integrates LPD with wasteful practices and LPD practices with the different phases of the three processes.

Acknowledgement

The authors would like to thank the Federal University of Ouro Preto (UFOP/Brazil) (www.ufop.br), Foundation for Research Support of the State of Minas Gerais (FAPEMIG, Grant Number APQ-00951-22), Coordination for the Improvement of Higher Education Personnel (CAPES) and National Council for Scientific and Technological Development (CNPq), for their support and funding during the development of the research.

References

- Angrisani, M., Cannavacciuolo, L., & Rippa, P. (2023). Framing the main patterns of an academic innovation ecosystem. Evidence from a knowledge-intensive case study. *International Journal of Entrepreneurial Behavior & Research*, 29(11), 109-131.
- Araujo, R., Fernandes, J. M., Reis, L. P., & Beaulieu, M. (2023). Purchasing challenges in times of COVID-19: resilience practices to mitigate disruptions in the health-care supply chain. *Journal of Global Operations and Strategic Sourcing*, 16(2), 368-396. <https://doi.org/10.1108/JGOSS-04-2022-0026>.
- Bauch, C. (2004). Lean product development: making waste transparent (Doctoral dissertation)..
- Belvedere, V., Cuttaia, F., Rossi, M., & Stringhetti, L. (2019). Mapping wastes in complex projects for Lean Product Development. *International Journal of Project Management*, 37(3), 410-424.
- Boguszewicz-Kreft, M., Arvanitis, A., Karatzas, K., Antonelli, G. and Simonetti, B. (2021) "Technology Transfer Steps Towards the Commercialization of Research Results for Universities", *WSB Journal of Business and Finance*, Vol 55, No. 1, pp 26–39.
- Carvalho de Sá, B., Dutra de Souza, E. H. ., Reis, L. P., & de Souza Dutra, M. D. (2022). Supply chain network design: a case study of the regional facilities analysis for a 3D printing company. *International Journal of Production Management and Engineering*, 10(2), 211–223. <https://doi.org/10.4995/ijpme.2022.17620>.
- Cordeiro, R. F., Reis, L. P., & Fernandes, J. M. (2023a). A hierarchical model for industry 4.0 concepts. *Revista de Administração Mackenzie (RAM)*, 24, eRAMR230061. <https://doi.org/10.1590/1678-6971/eRAMR230061.en>.
- Cordeiro, R. F., Reis, L. P., & Fernandes, J. M. (2023b). A study on the barriers that impact the adoption of Industry 4.0 in the context of Brazilian companies. *The TQM Journal*. <https://doi.org/10.1108/TQM-07-2022-0239>.

- Dal Forno, A. J., Forcellini, F. A., Kipper, L. M., & Pereira, F. A. (2016). Method for evaluation via benchmarking of the lean product development process: Multiple case studies at Brazilian companies. *Benchmarking: An International Journal*.
- De Toledo, J. C., Pinheiro, L. M. P., Poltronieri, C. F., Barbalho, S., & González, M. O. A. (2023). Lean development and its impacts on the performance of new product processes: an analysis of innovative Brazilian companies. *Research in Engineering Design*, 1-16.
- Eisenhardt, K. M. (1989). Building theories from case study research. *Academy of management review*, 14(4), 532-550.
- Elias, R., Reis, L., Delfino, T., & Fernandes, J. (2022). Entrepreneurial, Strategies Entrepreneurial Strategies for the Female Sector: Leveraging Instagram Sales During the Pandemic. In *European Conference on Innovation and Entrepreneurship*, Vol. 17, No. 1, pp. 692-700. <https://doi.org/10.34190/ecie.17.1.548>
- Fernandes, J., Reis, L. P., & Serio, L. C. D. (2017). Planning technological businesses: a study of market positioning and the value chain. *RAM. Revista de Administração Mackenzie*, 18, 70-116.
- Gómez-Baquero, F. (2023). Experimentation in academic technology commercialization. In *Intellectual Property Management for Start-ups: Enhancing Value and Leveraging the Potential* (pp. 263-279). Cham: Springer International Publishing.
- Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. (2014). *Pearson new international edition. Multivariate data analysis, Seventh Edition*. Pearson Education Limited Harlow, Essex.
- Hossinger, S. M., Chen, X., & Werner, A. (2020). Drivers, barriers and success factors of academic spin-offs: a systematic literature review. *Management Review Quarterly*, 70(1), 97-134.
- Kato, J. (2005). Development of a process for continuous creation of lean value in product development organizations (Doctoral dissertation, Massachusetts Institute of Technology).
- Klein, L. L., Vieira, K. M., Alves, A. C., & Pissutti, M. (2023). Demystifying the eighth lean waste: a knowledge waste scale. *International Journal of Quality & Reliability Management*.
- Li, Y., Zhou, L., & Tian, H. (2023). The symbiosis evolution mechanism and simulation research of developed science-based innovation ecosystem. *International Journal of Entrepreneurship and Innovation Management*, 27(1-2), 77-97.
- Liker, J. K. (2004). *The Toyota Way: 14 management principles from the world's greatest manufacturer*, McGraw-Hill.
- Majdouline, I., El Baz, J. e Jebli, F. (2022) "Revisiting technological entrepreneurship research: An update bibliometric analysis of the state of art", *Technological Forecasting and Social Change*, pp 121589.
- McManus, H. L. (2005). *Product Development Value Stream Mapping (PDVSM) Manual Release 1.0*.
- Menezes, R. P., Fernandes, J. M., Silva, A. L., & Reis, L. P. (2023, May). Digital transformation: a study of the actions taken by museums during the pandemic. In *International Conference on Tourism Research* (Vol. 6, No. 1, pp. 203-211). <https://doi.org/10.34190/ictr.6.1.1312>
- Ndonzuau, F. N., Pirnay, F., & Surlmont, B. (2002). A stage model of academic spin-off creation. *Technovation*, 22(5), 281-289.
- Millard, R. L. (2001). *Value Stream Analysis and Mapping for Product Development*, Master Thesis, LAI and Massachusetts Institute of Technology.
- Oehmen, J., & Rebentisch, E. (2010). *Waste in lean product development*. Lean Advancement Initiative.
- Ohno, T. (1988). *Toyota production system: beyond large-scale production*. CRC Press.
- Papaderos, A. E., & Bücken, O. (2023). The technology transfer office as facilitator between researchers and investors: A German perspective. In *Intellectual Property Management for Start-ups: Enhancing Value and Leveraging the Potential* (pp. 303-319). Cham: Springer International Publishing.
- Reis, L. P., Fernandes, J. M., & Armellini, F. (2021). Leveraging a process-oriented perspective on frugal innovation through the linkage of lean product development (LPD) practices and waste. *International Journal of Innovation and Technology Management*, 18(07), 2130004. <https://doi.org/10.1142/S0219877021300044>
- Reis, L. P., Fernandes, J. M., Silva, S. E., & Andreosi, C. A. D. C. (2023). Managing inpatient bed setup: an action-research approach using lean technical practices and lean social practices. *Journal of Health Organization and Management*, 37(2), 213-235. Doi: <https://doi.org/10.1108/JHOM-09-2021-0365>.
- Reis, L., Fernandes, J., Araújo, M., and Beaulieu, M. (2022). Lean Startup Practices: Operationalizing the Technological Business Planning Process in an Academic Environment. In *ECIE 2022 17th European Conference on Innovation and Entrepreneurship*. Doi: <https://doi.org/10.34190/ecie.17.1.544>
- Slack, R. A. (1998). *The Application of Lean Principles to the Military Aerospace Product Development*, Master Thesis, LAI and Massachusetts Institute of Technology.
- Siegel, D. S., Waldman, D. A., Atwater, L. E., & Link, A. N. (2004). Toward a model of the effective transfer of scientific knowledge from academicians to practitioners: qualitative evidence from the commercialization of university technologies. *Journal of engineering and technology management*, 21(1-2), 115-142.
- Siegel, D., Bogers, M. L., Jennings, P. D., & Xue, L. (2023). Technology transfer from national/federal labs and public research institutes: Managerial and policy implications. *Research Policy*, 52(1), 104646.
- Silva, S. E., Reis, L. P., Pereira, A. D. S., & Fernandes, J. M. (2019). A knowledge taxonomy in the context of organizational routines: an study in a public university. *Informação & Sociedade*, 29(2). <https://doi.org/10.22478/ufpb.1809-4783.2019v29n2.28679>
- Ward, A. (2007). *Lean Product and Process Development*. 1. Ed. Cambridge: The Lean Enterprise Institute.
- Yin, R. K. (2009). *Case study research: Design and methods* (Vol. 5). Sage.

Build-Measure-Learn in Education: Lessons Learned from the Iterative Development of a digital Project-based, International Entrepreneurship Format

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Abstract: How can we best possibly design an international and multidisciplinary entrepreneurship learning experience which combines elements of on- and offline learning? This paper will outline the iterative design development of such a project-based, international, and cross-functional entrepreneurship course on Greentech, Agriculture, and Food in a flipped classroom format.

Keywords: Entrepreneurship Education, Digital Education, Project-based Education, International Collaboration, COIL Collaborative Online International Learning

1. Introduction

Today, one of the most important priorities in teaching-learning is to encourage entrepreneurship among students in universities (Bergman et al., 2018; Ratten and Usmanij, 2021; Rauch and Hulsnik, 2015). Such activities that strengthen students' entrepreneurial mindsets can contribute to the local economy, opening new businesses and income without harming the environment (Severo et al., 2019). Students show a high demand for entrepreneurship courses. Grimm and Bock (2022) pointed to examples of good practices from Germany and the United States, where public, political, and social entrepreneurship have been integrated into curricula. As Olokundun et al. (2018) suggest, entrepreneurship teaching in higher education institutions, which includes practical activities and active student participation, can stimulate the development of students' entrepreneurial interests, and support their potential to start a business.

The COVID-19 pandemic was a huge challenge for education (Daniel, 2020). One of the most significant changes was the way in which classes were conducted, but on the other hand, it made it possible for students from other universities to take part in classes remotely. The major impacts of the COVID-19 pandemic are still affecting all social dimensions. Its specific impact on education is extensive and quite evident in the adaptation from face-to-face teaching to online methodologies throughout the first wave of the pandemic and the strict rules on lockdown (Baltà-Salvador et al., 2021). As lesson formats changed radically, the relevance of evaluating student online learning processes in university degrees throughout this period became clear (Revilla-Cuesta et al., 2021). What is more, students are continuously seeking specialised skills and seeking employment after graduation, so applied entrepreneurial activity is increasingly popular (Oliver & Oliver, 2022). Furthermore, innovation is one of the competencies needed in a workplace (Usher et al., 2021). This study aims to show a case of an international and multidisciplinary entrepreneurship learning experience that combines elements of on- and offline learning.

2. Methodological Approach: Case Study Research

The authors used the “research onion” by Saunders et al. (2023) to define the methodology for this research (Fig.1). Coming from a Critical realism philosophy and an abductive approach to theory development, the authors chose a mixed method research which includes qualitative as well as quantitative procedures. In order to figure out what is the best way to teach and combine on- and offline learning in an international and multidisciplinary setting to achieve the best learning experience for students, a case study approach was chosen. A case study is an in-depth inquiry into a topic of phenomenon within its real-life setting (Yin 2018). The entrepreneurship course which started in the winter term 2020 served as this real-life setting. As the data was collected from five differently executed online entrepreneurship courses between winter term 2020 and winter

term 2022, a longitudinal study was used. The five iterations of the course were all on the topic of Green Tech, Agriculture, and Food for students of their respective faculties (see Fig. 4). A sixth face-to-face course is planned for summer 2023 in Munich, Germany.

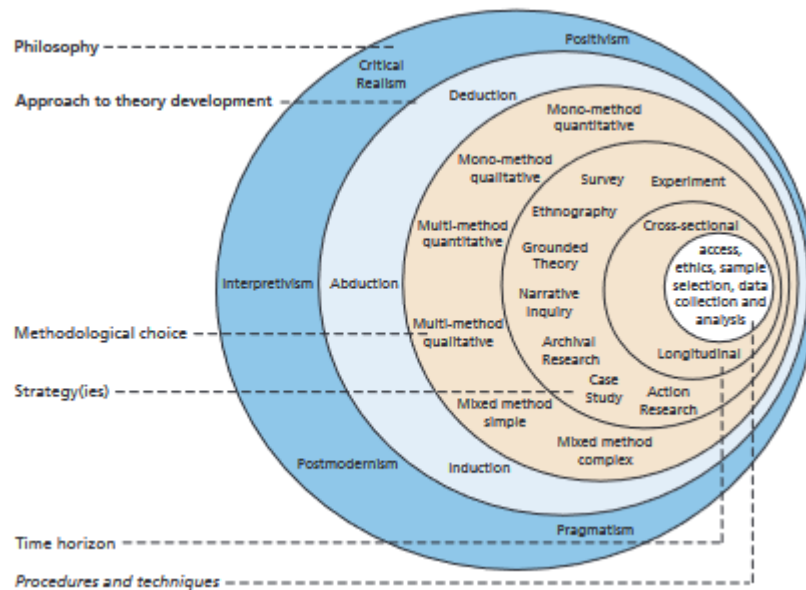


Figure 1: The research onion (Saunders et al., 2023, p. 131).

The scope of the case study is in total 6 courses with a total of 257 students (167 from Germany, 44 from Nepal, 24 from Poland, and 22 from South Africa).

The authors applied a Lean Startup (Ries, 2020) approach to continuously improve their course. The Lean Startup approach allows innovators (including innovative educators) to rapidly identify and refine promising ideas into models that work (Cook et al., 2022). It follows the logic to build something, measure its success, learn from the feedback, and integrate necessary changes into the design. In short, this is called a build-measure-learn methodology.

3. Results and Discussion

3.1 Initial setup

The course which is the basis of this case study started in the winter term of 2020 at Hochschule Munich University of Applied Sciences, when Verena Kaiser and Bettina Maisch held a joint online entrepreneurship course on the topic of Green Tech, Agriculture, and Nutrition for students of their respective faculties of business administration and mechatronics. The course went well given the fact that Vaiciukynaite et al. (2023) highlighted that COVID-19 infused challenges to entrepreneurial education that are more significant than in other business domains because entrepreneurial education is based on experiential education.

Therefore, the authors asked themselves: how might we enrich the learning experience of the next cohort of students in this online setting? Should we aim for not only a multidisciplinary course with students of Mechatronics and Business Administration, but also open the course for international students from other universities (apart from the incoming Erasmus students)? They wanted to turn the disadvantages of a digital-only course into an advantage by creating a richer student experience by adding a more international, as well as a broader functional experience. Therefore, they reached out to their network of international partner universities to find peer facilitators for their journey from a COL format (Collaborative Online Learning) to a COIL format (Collaborative Online International Learning).

3.2 Becoming international

Lecturers from Durban Technical University (South Africa) and King's College in Kathmandu (Nepal) joined the team and brought in 10 students each for the class. This required a few changes to the course design. On the

organisational side, a switch from a weekly format to a one-week block due to different semester structures at the different universities, as well as additional communication tools apart from the Moodle online learning platform, which was only accessible with all functionalities for students from Munich. Time difference was not an issue, as South Africa is only one hour different from Munich, and Nepal is 3 hours 45 minutes ahead, however all facilitators and students were aware (and used to) the necessity of starting the day later in the morning and continuing to late evenings when working in international projects. Regarding coaching, warm-up exercises every morning and after lunch break facilitated by the lecturers were added, to freshen up participants during those long days. To sum up, including international students and lecturers as well as changing the format from weekly to block course were the main iterations in this semester.

3.3 Subject-matter expertise

The next iteration in the winter term 21/22 brought some significant changes. Małgorzata Krzywonos, a subject-matter expert in Food Technology joined the lecturer team and brought with her students' valuable knowledge for the course topic. Furthermore, the time of learning (when do students study/learn and when do they apply the learning) switched from in-classroom to a flipped classroom format. In a flipped classroom concept, the delivery of the learning content is flipped from input in the classroom and studying at home to studying the content at home, coming prepared to class and using the course time for exercises, discussion and application of the content. For the case study course, the authors recorded the theoretical content in small video bits which were provided to the students upfront. So, the content delivery and studying took place outside course hours. Students came prepared for the online sessions and the whole lecture time was used for coaching the team, i.e. applying the lessons learned from the theoretical input sessions on the real project challenges the students worked on. Course assessment was in addition to facilitator brainwriting also captured via a student feedback grid (Fig. 2).

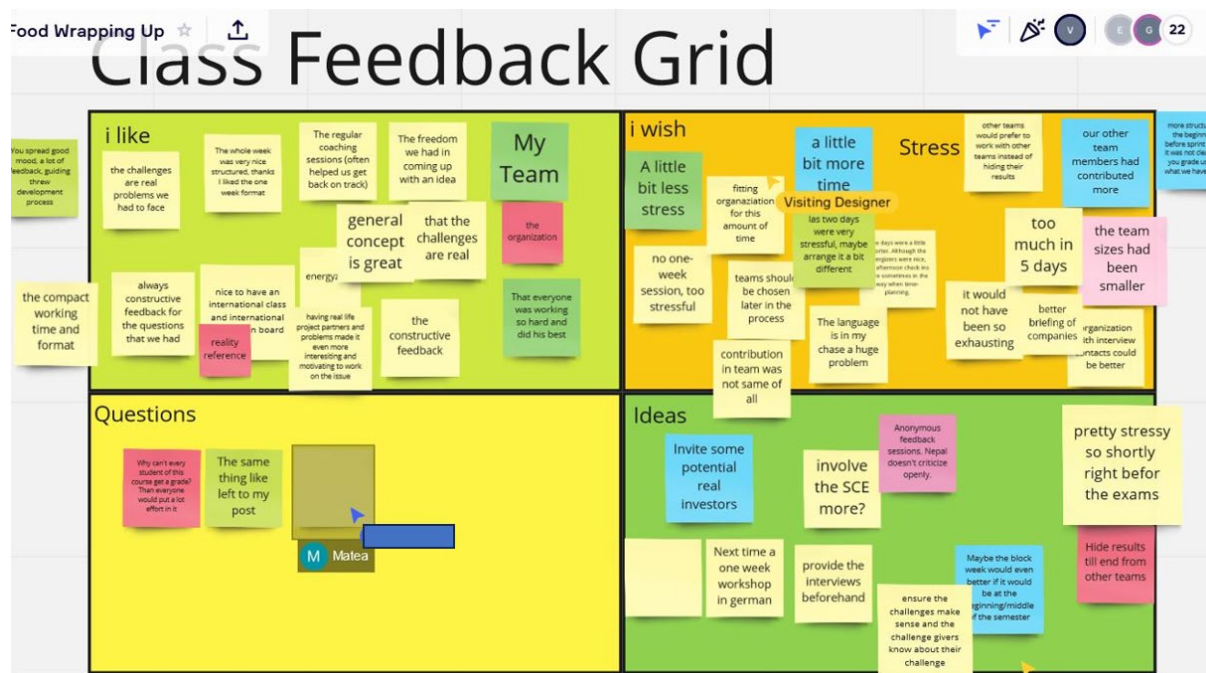


Figure 2: Class Feedback Grid on www.mural.com, winter term 21/22

Content-wise, presentations on intercultural teamwork were added, as well as student exercises like “introduce your favourite song in your local language to everyone” to enhance cross-cultural understanding and collaboration. We used problem-based learning approach (Kek and Huijser, 2015), in which a ‘real-life’ industry could be brought in, which helped to forge long-term, collaborative partnerships to facilitate learners’ acquisition of more meaningful knowledge and opportunities (Oliver & Oliver, 2022). The challenges were not created by the students themselves, but brought in by the lecturers and their network. It felt very valuable to have real and relevant problems by existing companies or individuals at hand, and the problem definition phase was easier for the students. To give one example, a team worked on the question of how to make the best use of apple pomace as a by-product in juice production, provided by a farmer in Poland (Fig. 3).

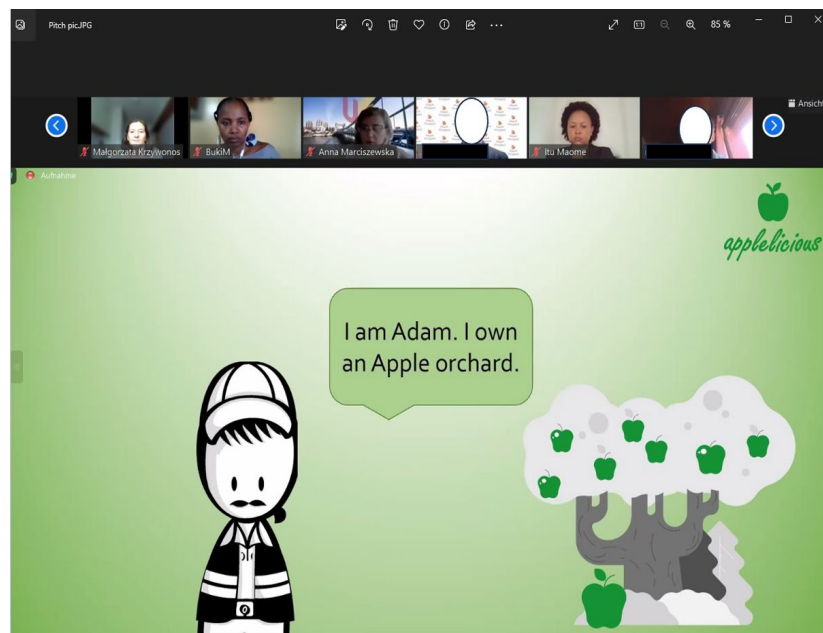


Figure 3: Pitch presentation team applelicious, winter term 21/22

To summarise, bringing in subject-matter expertise as well as introducing the flipped-classroom approach were the main changes during this semester, clearly enhancing the learning experience for students as they felt more comfortable with subject-matter experts in each team plus there was more coaching time available during course hours as the theoretical input was delivered outside course hours.

3.4 More coaching sessions

The South African students could no longer participate in the course due to lacking lecturer availability, and to enable student teams to participate in the START FOR FUTURE community (<https://startforfuture.eu>), the course was held in a weekly format again in the summer term of 2022. START FOR FUTURE is a community platform where teams interested in founding their startup can take part in various programs, present and find offers for collaboration, and exchange with like-minded innovators. It was mandatory for student teams to participate in the start of future programs. To foster the motivation for founding even more, startup founders in the space of Greentech, Agriculture, and Nutrition were invited for short presentations of their startups followed by Q&As. The flipped classroom content, which was until that time provided in a cloud working environment, moved to the MOOC (massive open online course) platform of Strasczeg Center for Entrepreneurship (<https://www.sce.academy>). On the coaching side, it became mandatory for students to book coaching slots with lecturer tandems of their choice. So far, coaching was voluntary, and the lecturer teams realised that certain teams never booked coaching slots. Those were the teams that eventually did not fully meet expectations, so coaching was made a mandatory item of the course. In a nutshell, the summer term 2022 was adjusted in a way that even more coaching was given - through mandatory coaching sessions and via the START FOR FUTURE community. Both changes to the course design were based on lecturer feedback.

3.5 Enhanced team dynamics through consistent grading

In the following iteration of the course in the winter term 22/23, several more changes were introduced based on student and lecturer feedback. As the lecturers had got the feeling from previous classes that students did not always come prepared to class, meaning they had not watched the flipped classroom videos upfront, self-assessment quizzes after the three milestones were introduced. The aim was to give students a way to control their progress themselves, and the lecturers a way to identify which of the videos needed additional advertising or finetuning. As per another desire by the lecturers, the startup talks delivered by young founders were opened to the public and communicated via social media channels of the universities and lecturers.

To communicate among lecturers and students on one channel only, Slack was introduced (<https://slack.com>). This was based on the student feedback that too many different communication channels were at times confusing. On the coaching side, participation in the START FOR FUTURE program was made voluntary for teams

for two reasons which students responded back to the lecturer team: on the one hand, not all teams had the desire to find their own companies and therefore did not seek additional networks and peers. On the other hand, meeting times of the START FOR FUTURE program did not align with students' curricula sometimes, which generated additional pressure on the teams. Finally, and certainly the most important iteration of the case study course, the class was made part of the regular curriculum in all participating countries. Therefore, all participants received grades and could use the earned credits for their degrees, which was a hygiene effect for team dynamics. Until that time, there had been constant friction within teams where some team members felt others were not equally contributing to the team success, especially when there were only certificates of participation issued and no grades for the final degrees given.

Figure 4 shows an overview of all changes over time.

	Winter 20/21	Summer 21	Winter 21/22	Summer 22	Winter 22/23	Outlook: Summer 23
Organization						
Format	COL Collaborative Online Learning	COIL Collaborative Online International Learning	COIL Collaborative Online International Learning	COIL Collaborative Online International Learning	COIL Collaborative Online International Learning	COIL Collaborative Online and Offline International Learning
Setting	Weekly	Block course	Block course	Weekly	Weekly	Block course
Faculties involved	Mechatronics, Business Administration, Design	Mechatronics, Business Administration, Design	Mechatronics, Business Administration, Design, Engineering in Food Technology	Mechatronics, Business Administration, Design, Engineering in Food Technology	Mechatronics, Business Administration, Engineering in Food Technology, Print Technology	Mechatronics, Business Administration, Engineering in Food Technology, Print Technology
Countries involved	Germany	Germany, Nepal, South Africa	Germany, Nepal, South Africa, Poland	Germany, Nepal, Poland	Germany, Nepal, Poland	Germany, Nepal, Poland
Time of learning	In class	In class	Flipped classroom, videos provided on Google drive	Flipped classroom, videos provided via SCE Academy MOOC https://www.sce.academy/start	Flipped classroom, videos provided via SCE Academy MOOC https://www.sce.academy/start	Flipped classroom and Onsite in Munich
Assessment of learning	via heinnovate	via heinnovate	n/a	n/a	Self-assessment quizzes after milestones	Self-assessment quizzes after milestones
Course assessment	Reflection by facilitators via brainwriting	Reflection by facilitators via brainwriting	Reflection by facilitators via brainwriting, student feedback grid	Reflection by facilitators via brainwriting, student feedback grid	Reflection by facilitators via brainwriting, student feedback grid	Reflection by facilitators via brainwriting, student feedback grid
Grading	For all participants	For German students, certificate of completion for others	For all participants	For all participants	For all participants	For all participants
Faculty organization	Part of regular curriculum (elective)	Part of regular curriculum (elective) in Germany, voluntary course in Nepal and South Africa	Part of regular curriculum (elective) in Germany, voluntary course in Nepal, South Africa, and Poland	Part of regular curriculum (elective) in Germany, voluntary course in Nepal and Poland	Part of regular curriculum in all countries via Erasmus+ program	Part of regular curriculum in all countries via Erasmus+ program
Communication tools	Moodle	Google Drive, Moodle, Email	Google Drive, Moodle, Email	Google Drive, Moodle, Email	Slack	Slack
Content						
Addressing intercultural and team issues upfront	n/a	n/a	Presentations on intercultural management, country introductions (our favorite song) per team	Live by coaches at the start and throughout the course	Live by coaches at the start and throughout the course	Presentations on intercultural management online before course start, country introductions (our favorite song) per team live
Challenges	Designed by students	Designed by students	Brought in by coaches and their networks	Brought in by coaches and their networks	Brought in by coaches and their networks	Brought in by coaches and their networks
Foster motivation for founding	n/a	n/a	n/a	Selected founders of food startups invited for inspirational talks	Startup series with founders communicated via university channels and social media, open for everyone (not only participants)	1/2 day "Startup day" with inspirational pitches by founders in the food area
Coaching						
Management of coaching	Voluntary coaching slots	Voluntary coaching slots	Voluntary coaching slots	Mandatory coaching for all teams	Mandatory coaching for all teams	Mandatory coaching for all teams
Subject-matter expertise	Basic, one coach used to be a chef	Basic, one coach used to be a chef	Biotechnology & Food Engineer from Poland joined lecturer team	Biotechnology & Food Engineer from Poland	Biotechnology & Food Engineer from Poland	Biotechnology & Food Engineer from Poland
Warm-up sessions	n/a	By coaches	By teams	n/a due to weekly format	n/a due to weekly format	By teams
Additional coaching via International Programs	eBridge Alliance	n/a due to block week format	n/a due to block week format	Mandatory participation in Start for Future program https://startforfuture.eu	Voluntary participation in Start for Future program https://startforfuture.eu	n/a due to block week format

Figure 4: Iterative changes to the entrepreneurship course from winter 20/21 to summer 23

All the changes described above were rather incremental, small improvements that were introduced based on student and lecturer feedback and helped to improve the class in terms of a build-measure-learn Lean Startup procedure. One major topic however has been present in all iterations so far. After several semesters of online teaching, it is time to move the class to a hybrid format. Team interaction across continents remained a challenge given the fact that the students never saw each other face-to-face. This observation is in line with Usher et al. (2021) who pointed out that students in class and online reported similar levels of innovative behavioural tendencies. However, the face-to-face team students gained higher mean scores on innovation than the online team projects. Therefore, the biggest change lies ahead: bringing lecturers and students together in Munich, Germany in the summer term 23 for a first onsite block week. The plan is to invite have students from all four partner universities/countries participate. This onsite week will be enriched with two preparatory online meetings plus sessions on intercultural management upfront, as well as the flipped classroom elements. Vaiciukynaite et al. (2023) found that digital interaction and collaboration among participants and facilitators on various platforms promoted the development of an entrepreneurial mindset, therefore some online elements will be kept. Startup founders will be invited on each lecture day for short presentations of their companies and challenges. Summing up, the author team is looking forward to this new design of the course, to the new lessons learned, and to reporting back to the conference community on what is to improve next. This will be done during the mini track on Entrepreneurship Education and Learning, and will hopefully include lively discussions and feedback.

Acknowledgments

The authors would like to thank the other lecturers, in particular Udgun Khadka, Swechhya Rajbhandary, Prof. Anna Marciszewska, Prof. Dr. Martin Mayer, as well as the students in the courses who actively helped to further iterate and refine the course.

References

- Baltà-Salvador, R., Olmedo-Torre, N., Peña, M. *et al.* (2021) Academic and emotional effects of online learning during the COVID-19 pandemic on engineering students. *Education and Information Technologies*, 26, 7407–7434 <https://doi.org/10.1007/s10639-021-10593-1>
- Bergmann, H., Geissler, M., Hundt, C., & Grave, B. (2018). The climate for entrepreneurship at higher education institutions. *Research Policy*, 47(4), 700–716 <https://doi.org/10.1016/j.respol.2018.01.018>
- Cook, D. A., Bikkani, A., & Poterucha Carter, M. J. (2022). Evaluating education innovations rapidly with build-measure-learn: Applying lean startup to health professions education. *Medical Teacher*. <https://doi.org/10.1080/0142159X.2022.2118038>
- Daniel, S.J. Education and the COVID-19 pandemic. *Prospects* 49, 91–96 (2020). <https://doi.org/10.1007/s11125-020-09464-3>
- Grimm, H. M., & Bock, C. L. (2022). Entrepreneurship in public administration and public policy programs in Germany and the United States. *Teaching Public Administration*, 40(3), 322–353. <https://doi.org/10.1177/01447394211021636>
- Kek, M. Y., & Huijser, H. (2015). 21st Century skills: Problem based learning and the university of the future. In *Third 21st century academic forum conference: Facilitating, fostering, and harnessing innovation to meet key challenges of the 21st century* (Vol. 6, No. 1, pp. 406–416)
- Oliver, P. G., & Oliver, S. (2022). Innovative online learning in entrepreneurship education: The impact of embedding real-life industry practice in the virtual learning environment. *Industry and Higher Education*, 36(6), 756–767. <https://doi.org/10.1177/09504222221121283>
- Olokundun, M., Moses, C. L., Iyiola, O., Ibidunni, S., Ogbari, M., Peter, F., & Borishade, T. (2018). The effect of non traditional teaching methods in entrepreneurship education on students entrepreneurial interest and business startups: A data article. *Data in Brief*, 19, 16–20. <https://doi.org/10.1016/j.dib.2018.04.142>
- Ratten, V., & Usmanij, P. (2021). Entrepreneurship education: Time for a change in research direction?. *The International Journal of Management Education*, 19(1), 100367. <https://doi.org/10.1016/j.ijme.2020.100367>
- Rauch A. Hulsink, W. (2015) Putting Entrepreneurship Education Where the Intention to Act Lies: An Investigation Into the Impact of Entrepreneurship Education on Entrepreneurial Behavior. *Academy of Management Learning & Education*, 14, 187–204, <https://doi.org/10.5465/amle.2012.0293>
- Reis, D. A. D., Fleury, A. L., Bento, T., Fabbri, K., Ortega, L. M., & Bagnato, V. (2019). Application of new agile approaches at University of São Paulo innovation agency's entrepreneurship and innovation course. *Gestão & Produção*, 26(4). <https://doi.org/10.1590/0104-530X4122-19>
- Revilla-Cuesta, V., Skaf, M., Varona, J. M., & Ortega-López, V. (2021). The outbreak of the covid-19 pandemic and its social impact on education: Were engineering teachers ready to teach online? *International Journal of Environmental Research and Public Health*, 18(4), 1–24. <https://doi.org/10.3390/ijerph18042127>
- Ries, E. (2020). *Lean Startup. Schnell, risikolos und erfolgreich Unternehmen gründen*. 7th edition. Redline, Munich.
- Saunders, E., Lewis, P., Thornhill, A. (2023). *Research methods for business students*. 9th edition. Pearson, Harlow.

- Severo, E. A., Becker, A., Rotta, C., & de Guimarães, J. C. F. (2019). The teaching of innovation and environmental sustainability and its relationship with entrepreneurship in Southern Brazil. *International Journal of Innovation and Learning*, 25(1), 78–105. <https://doi.org/10.1504/IJIL.2019.096553>
- Usher, M., Barak, M., & Haick, H. (2021). Online vs. on-campus higher education: Exploring innovation in students' self-reports and students' learning products. *Thinking Skills and Creativity*, 42. <https://doi.org/10.1016/j.tsc.2021.100965>
- Vaiciukynaite, E., Ihasz, O., Portyanko, S., & Vyakarnam, S. (2023). Transforming a Highly Tactile Entrepreneurship Course "Ideas to Innovation" to an Entirely Online Delivery Model: Lessons for Theory and Practice. In *FGF Studies in Small Business and Entrepreneurship*. https://doi.org/10.1007/978-3-031-11371-0_7
- Yin, R.K. (2018). *Case Study Research and Applications: Design and Methods*. 6th edition. Sage, London.

Enterprise and Entrepreneurship Education: Exploring a new Dynamic Model to Integrate Sustainability Within Curricula

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Abstract: This paper recognises sustainability's role as a core competence of all entrepreneurs and reviews and discusses the drivers for and challenges of integrating 'Education for Sustainable Development' (ESD) within entrepreneurship curricula. The authors have contributed to this literature and have discussed at length the development of the field from both academic and practitioner perspectives. The paper includes reference to policy initiatives promoting the integration of ESD within Higher Education, and the competencies that all graduates are expected to achieve, and discusses the challenges faced by HE providers and Enterprise Educators in particular. Building on the contributions of Moon (2022) and Moon et al. (2022) the authors posit that a new dynamic model based on Passion for the subject, Pride in the university, Personal contribution, and Performance impact, is a novel approach for recognising some of the challenges faced but also the cross-cutting and transdisciplinary benefits of a renewed focus on Impact – using the UN Sustainable Development Goals as a framework – and building on *identity* as a foundation.

Keywords: Enterprise and Entrepreneurship Education, Sustainability, ESD, EntreComp, GreenComp, Identity.

1. Introduction

EntreComp (2016) cites ethics and sustainability as core competences of all entrepreneurs, and more recently GreenComp (2022) cites the green skills needed to develop economies across the world. Thus, integrating ethics and sustainability within curricula is essential for enterprise and entrepreneurship education (Moon et al. 2022). AdvanceHE and QAA (2021), two leading professional bodies for Higher Education in the UK, published *Education for Sustainable Development Guidance* as a landmark report seeking to influence educators to incorporate ESD within their curricula. Similarly, 313 Higher Education providers have signed up to the *SDG Accord* (2023) committing them to achieving the United Nations Sustainable Development Goals (SDGs) and this includes integrating sustainability into the curriculum. The latest report on progress, *SDG Accord Report* (2022), cites 227 HE signatories and numerous institutional benefits of SDG integration. However, challenges highlighted included: staff capacity, budget constraints, and an absence of training. Thus, there appears to be a gap between policy and practice, between what is desired and what is being achieved. The purpose of this paper is to narrow that gap by providing a new model based on Passion, Pride, Personal Contribution and Performance Impact that is both theoretically robust but also practically implementable. Two hypotheses are thus posed: Ho1. Institutional challenges to integrating ESD into the curriculum can be overcome by placing an emphasis on impact. Ho2. Personal challenges to integrating ESD into the curriculum can be overcome by placing an emphasis on identity.

2. Drivers and challenges

The Advance/HE (Ibid) guidance provides sustainability competences that all graduates should achieve. Howarth et al. (2019) were among the first authors to comment on progress with integrating ESD into the curriculum. Nottingham Trent University (NTU) is cited as a beacon of best practice after being accredited by the National Union of Students 'Responsible Futures' accreditation audit indicating the university's commitment to sustainability within the formal curriculum. Key drivers at NTU are in Figure 1.

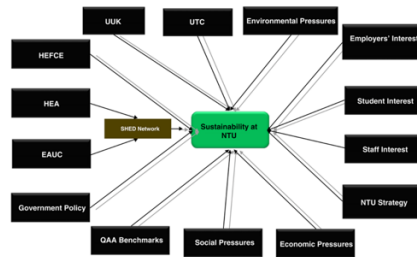


Figure 1: An overall summary of sustainability drivers at NTU in 2009, Howarth et al. (2019).

Guiry et al. (2022) report on integrating ESD into the curriculum based on experiences at HEIs in Ireland. The main challenges highlighted include: ‘Many staff currently lack the skills and knowledge necessary to integrate sustainability into the curriculum; lack of free time available to staff and students to engage with sustainability, both academically and through extracurricular activities; insufficient resources, including funding and training for ESD; the absence of dedicated ESD Officers was highlighted as a major deficiency; inadequate support and commitment of higher management to ESD and sustainability goals as strategic priorities; engaging with students and staff who are not interested in sustainability is a persistent obstacle to successfully integrating ESD across all disciplines’. These were subsumed by Guiry et al. into four key themes (Figure 2).



Figure 2: Challenges facing ESD, Guiry et al. (Ibid).

Guiry et al (Ibid) conclude that time, resources, and funding need to be allocated to overcome some of these challenges. They also recommend that ESD is developed in collaborative partnerships including the student voice, and the need for a national ESD standard.

3. Discussion

This paper recognises the above drivers and challenges and presents a new model based on four pillars: Passion for your subject, Pride in the university, Personal contribution, and Performance Impact. Based on a paper by Moon (2022) which develops a model based on ‘Identity’, we hold that the next step in integrating ESD into the curriculum is to be more holistic and more person centred. This approach recognises that HEIs need to balance commercial and educational imperatives and in so doing fundamental tensions can result in a ‘loss of identity’ for both the university as a whole and for individual staff. Rebuilding this sense of identity is crucial to integrating ESD within curricula.

Moon (2022:2) states: “...educators, even if they are mapped onto different teaching, research or practice pathways, still need to demonstrate the impact of their work. This has led to lecturers integrating an emphasis on employability skills, researchers conducting more applied research, and practitioners being used to inspire students based on their experience.” These trends are evident in all HE providers. However, the question of lecturer identity and how it has changed or is changing or will change is under researched.

Is a focus on identity important? Suarez and McGrath (2022), in a working paper for the OECD, cites empirical research which relates the professional identity of teachers to considerable influence on students’ performance

and attitudes, and to the way educational policies are interpreted and implemented. These findings largely relate to the school context. However, Boyd and Harris (2010) found that former teachers that became academics faced tensions about the value of abstract knowledge compared to work-based practice, and about what a lecturer in teacher education should be, and this encouraged them to hold on to their existing identities as schoolteachers rather than as academics.

More recently, Harness and Boyd (2021:1) posit that academics ‘develop multiple identities ...and these have a strong influence on practice...’ and describe some academics as having to negotiate different identities. These authors point out that there is a tension within higher education caused by the ‘primacy of research.’ These tensions between the potentially different identities or multiple identities of lecturers associated with teaching, research and practice pathways in HE is an important focus of this paper.

4. New dynamic model based on Identity.

Moon (2022) recognises that many universities have signed up to either the United Nations Higher Education Sustainability Initiative (HESI, 2012) or the SDG Accord (2018), committing to progress towards achieving the SDGs including integrating ESD within the curriculum. This commitment, therefore, heralds real change in ethos and practices i.e., ‘identity’. There are implications here for the changing identity of the Higher Education provider but also for individual lecturers. Moon (Ibid:4) presented a new dynamic model of lecturer identity based on two concentric circles (Figure 3).

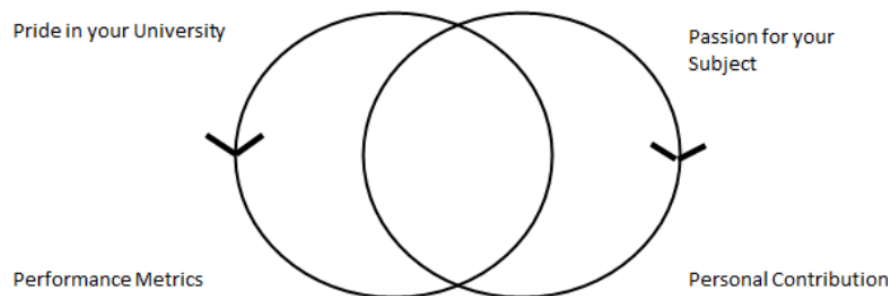


Figure 3: Dynamic model of lecturer identity, author image.

If the concentric circles are moving in the same direction, then they can be mutually reinforcing leading to higher motivation and performance impact. If the circles are moving in opposite directions, then the result could be tension and frustration and lower performance impact. The model is yet to be tested and it is possible that positive impact could result from ‘disruptive’ tensions and challenges. However, the model is designed to provide a basis for discussion and review.

There is some support for such a model in the literature if one considers the positive affect of being passionate about one’s subject discipline and teaching (e.g., Robson 2020 regards lecturer passion as a pre-requisite for inspirational teaching) and being proud of one’s organisation can have a positive influence on lecturer performance (Nadatien et al, 2019). Similarly, if one’s personal contribution is recognised by students, staffs, and leaders, then this is also likely to be motivating (c.f. Salbiyah, 2019). However, if performance metrics mitigate against such personal recognition, then the result could be staffs feeling frustrated or disenfranchised (c.f. Otache, 2022).

Further, placing emphasis on the long-term needs of students can have positive benefits (c.f. Mesny et al, 2021). And whilst Kioupi and Voulvoulis (2019) guard against overly prescriptive focuses on the SDGs, they do relate Education for Sustainability and Sustainability Competencies within a normative framework (see Figure 4.) that provides a basis for monitoring and evaluation.

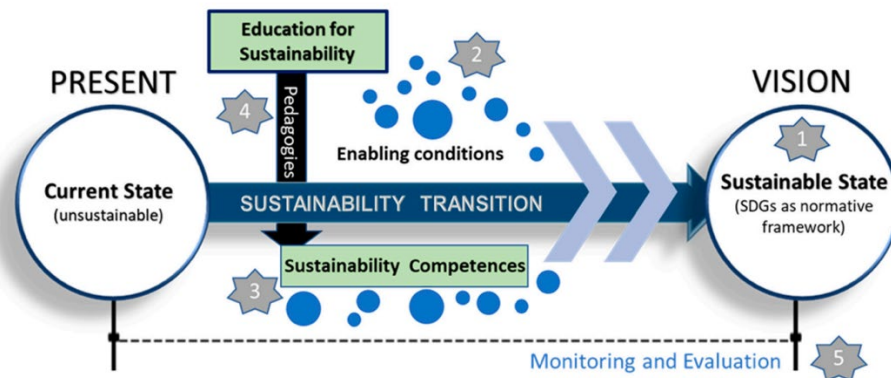


Figure 4: Educational framework for sustainability transformation (Kioupi and Voulvoulis, 2019:6).

5. Conclusions

The purpose of this paper was to narrow the gap between policy and practice in HE considering the need to integrate ESD into the curriculum. Two hypotheses were presented: Ho1. Recognised institutional challenges to integrating ESD into the curriculum can be overcome by placing an emphasis on impact. This paper provides some support for the focus on impact i.e., in relation to the SDGs. However, the integration of the ESD into the curriculum needs to be within a normative framework allowing for monitoring and evaluation.

Ho2. Recognised personal challenges to integrating ESD into the curriculum can be overcome by placing an emphasis on identity. This paper provides some support for the focus on identity as there are numerous tensions in academia that lecturers must deal with. The focus on identity can provide some succour to lecturers faced with multiple and conflicting pressures on their time such as the need to balance teaching with research and practice.

There are strategic and operational implications for Higher Education seeking to integrate ESD within curricula. In terms of strategy, it is important that if any HE provider makes a commitment to a policy initiative such as the HESI or the SDG Accord then follow up action is the result. Such actions need to be mutually agreed, reviewed, and evaluated in such a way that these lead to positive change for all stakeholders.

In terms of operations, it is important to check that existing processes do not mitigate against such positive change. Typically, senior leadership in higher education signs up to the policy and staffs endorse the strategy. However, middle management can be stuck with entrenched ways of working and be ineffective at positive implementation. With identity as a focus, then both the HE provider and individual lecturers can take a more positive and holistic approach to development based on impact.

Acknowledgements

This working paper is based on a keynote address delivered by Dr CJ Moon at the International Conference on Lecturer Identity at the University of Pecs, Hungary, and follow up paper published below (Moon, 2022).

References

- AdvanceHE/QAA. 2021. Education for Sustainable Development Guidance.
- Apostolopoulos, N., Moon, C. J. and Walmsley, A., 2018. The entrepreneurial university as an engine for sustainable development, *International Journal of Innovation and Regional Development*, 2018 Vol.8 No.4, pp.358 - 372.
- Boyd, P., and Harris, K., 2010. Becoming a university lecturer in teacher education: expert schoolteachers reconstructing their pedagogy and identity. *Professional Development in Education*, 36 (1-2). pp. 9-24. Available from: <http://insight.cumbria.ac.uk/id/eprint/359/>
- EntreComp. 2016. In: Bacigalupo, M., Kampylis, P., Punie, Y. and Van den Brande, G., 2016. *EntreComp: The entrepreneurship competence framework*. Luxembourg: Publication Office of the European Union, 10, p.593884.
- GreenComp. 2022. In: Bianchi, G., Pisiotis, U. and Cabrera Giraldez, M., 2022. *GreenComp The European sustainability competence framework* (No. JRC128040). Joint Research Centre (Seville site).
- Guiry, Niamh & Barimo, John & Byrne, Edmond & O'Mahony, Catherine & Reidy, Darren & Dever, Dara & Mullally, Gerard & Kirrane, Maria & O'Mahony, Michael. 2022. *Education for Sustainable Development: Co-Creating Common Areas of Need and Concern*. 10.13140/RG.2.2.12453.58080.

- Harness, S., and Boyd, P., 2021. Academic identities and their deployment within tutorials, *International Journal of Educational Research*, Volume 108, 2021, 101777, ISSN 0883-0355, <https://doi.org/10.1016/j.ijer.2021.101777>.
- HESI. 2012, 2023. Available at: <https://sdgs.un.org/HESI>
- Howarth R, Ndlovu T, Ndlovu S et al. Integrating education for sustainable development into a higher education institution: beginning the journey. *Emerald Open Res* 2019, 1:9 (<https://doi.org/10.12688/emeraldopenres.13011.1>)
- Jones, P., Apostolopoulos, N., Kakouris, A., Moon, C.J., Ratten, V., Walmsley, A., 2021. Universities and Entrepreneurship. Meeting the Educational and Social Challenges, *Contemporary Issues in Entrepreneurship Research*, Emerald Publishing, ISBN: 978-1-83982-075-5.
- Kioupis, V. and Voulvoulis, N., 2019. Education for sustainable development: A systemic framework for connecting the SDGs to educational outcomes. *Sustainability*, 11(21), p.6104.
- Mesny, A., Pastoriza Rivas, D. and Poisson-de Haro, S., 2021. Business school professors' teaching approaches and how they change. *Academy of Management Learning & Education*, 20(1), pp.50-72.
- Moon, C. J. 2018. Contributions to the SDGs through Social and Eco entrepreneurship: new mindsets for sustainable solutions. In: *Entrepreneurship and the Sustainable Development Goals*. Apostolopoulos, Nikolaos and Al-Dajani, Haya and Holt, Diane and Jones, Paul and Newbery, Robert, eds. *Contemporary Issues in Entrepreneurship Research*, 8. Emerald, pp. 47-68. ISBN 9781787563766.
- Moon, C. J. Walmsley, A., Apostolopoulos, N., 2018. Governance implications of the UN Higher Education Sustainability Initiative. *Corporate Governance: The International Journal of Business in Society*, 18 (4). pp. 624-634. ISSN 1472-0701.
- Moon, C.J., 2019. Ethics, Sustainability and 95 Theses for the Reform of Higher Education, in Remenyi, D et al (Eds.) *The University of the Future*, Academic Book Publishers Ltd. UK.
- Moon, C. J. 2019. 'Rio+25', the global compact in Brazil and opportunities presented by the UN Sustainable Development Goals. In: *Corporate Social Responsibility in Brazil: The Future is Now*. Stehr, Christopher and Dziatko, Nina and Struve, Franziska, eds. *CSR, Sustainability, Ethics & Governance*. Springer, pp. 3-27. ISBN 9783319906041.
- Moon, C.J., and Bace, E., 2020. Green Finance for Entrepreneurs: Current Perspectives and Conceptual Model, *International Innovation and Entrepreneurship Conference 2020*.
- Moon, C.J., Middlesex University Towards 2031 Strategy. A Case history of excellence in transformative leadership, in Remenyi, D., (Ed.) 2021. *Excellence in University Leadership and Management. Case Histories. Vol.1*. Academic Book Publishers Ltd. UK.
- Moon, C.J., *Entrepreneurship and Sustainability: Plugging the Green Skills Gap with Empathy, Compassion and Connectedness to Nature*, in Apostolopoulos, N., Chalvatzis, K., Liargovas. P. (Eds.) 2021. *Entrepreneurship, Institutional Framework and Support Mechanisms in the EU*, Emerald Publishing Limited. ISBN: 9781839099830.
- Moon, C. J. 2022. The university of the future and lecturer identity. *Social Review*, 15(1), 1–7. <https://doi.org/10.15170/SocRev.2022.15.01.01>
- Moon, C., Walmsley, A. and Apostolopoulos, N., 2022, September. EntreComp and GreenComp for Entrepreneurship. What is the 'Real' Relationship?. In *European Conference on Innovation and Entrepreneurship (Vol. 17, No. 1, pp. 726-732)*.
- Nadatien, I., Handoyo, S., Pudjirahardjo, W.J. and Rahayu, Y.P., 2019. The influence of organizational pride on the performance of lecturers in health at the Nahdlatul Ulama university in Surabaya. *Indian Journal of Public Health Research & Development*, 10(1), pp.538-542.
- Otache, I. and Inekwe, E.O.I., 2022. The relationship between job satisfaction, turnover intentions and performance of Nigerian polytechnic lecturers with doctorate degrees. *Journal of Applied Research in Higher Education*, 14(2), pp.762-783.
- Robson, R., 2020. Lecturer passion: a pre-requisite for inspirational teaching. *Compass: Journal of Learning and Teaching*, 13(1). Available from: <https://journals.gre.ac.uk/index.php/compass/article/view/1062>
- Salbiyah, S., Kes, M., Fitri Nuraini, S.E., Ak, M. and Asyidatur Rosmaniar, S.E., 2019. Motivation And Its Effect On Women's Lecturer Performance In University of Muhammadiyah Surabaya. *SSRG International Journal of Economics and Management Studies (IJEMS)*, 6(09), pp.48-55.
- SDG Accord. 2018. Available at: <https://www.sdgaccord.org/>
- SDG Accord Report. 2022. Available at: https://www.sustainabilityexchange.ac.uk/files/2022_sdg_accord_report_.pdf
- Suarez, V. and J. McGrath (2022), "Teacher professional identity: How to develop and support it in times of change", *OECD Education Working Papers*, No. 267, OECD Publishing, Paris, <https://doi.org/10.1787/b19f5af7-en>.
- Walmsley, A., Moon, C., Apostolopoulos, N. and Jones, P. 2019. Towards Responsible Entrepreneurship Education, 42nd Institute for Small Business and Entrepreneurship conference, Crowne Plaza Hotel, Newcastle, UK, 14-15th November. ISBN: 978-1-900862-32-5.

Entrepreneurship Education: Methods and Tools to Increase Successful Academic Venture Creation

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Abstract: Higher Education Institutions (HEIs) face a high degree of complexity when designing entrepreneurial education programmes at the level of University Business Incubators (UBIs) and beyond. Our paper addresses these concerns by answering the question: "What are the entrepreneurial and pedagogical methods, templates and tools that a new academic venture needs to be exposed to in order to not only raise awareness but also increase the level of successful start-up creation?". To this end, we seek to build a framework that delineates different entrepreneurial education (EE) approaches along the lifecycle of new venture creation at universities. Moreover, we reflect our theory-based framework with a case study of different EE education provided to different target groups (students, academic venture teams) at a German university, i.e. the Ruhr-Universität Bochum and its excellence start-up centre "Worldfactory". This study will provide new insights into EE and higher education, and the dynamics of new ventures and their entrepreneurs in the awareness EE stage.

Keywords: Entrepreneurship Education, Academic New Ventures, Life Cycle, Incubator

1. Introduction

Universities, entrepreneurship education (EE) and their university business incubators (UBIs) have gained importance since the 1990s, when the link between UBIs and the entrepreneurial ecosystem was recognised as an important element for economic growth (Plaschka and Welsch, 1990). In order to promote economic growth, many EE programmes have been developed and it has been recognised that programme designers should provide training that corresponds to the different stages of the business life cycle of a new venture. The training needs of an entrepreneur starting a new venture are different from those of a mature entrepreneur seeking funding for product development. In addition, different career stages, regional or cultural requirements need to be taken into account (Maresch et al. 2016). Higher education institutions (HEIs) face a high degree of complexity in designing EE programmes at the UBI level and beyond. Starting with the question of how to integrate EE programmes into curricula (Plaschka and Welsch, 1990) or how entrepreneurial education should ideally evolve along the maturity of an academic venture. Our paper will address these concerns by answering the question: "What are the entrepreneurial and pedagogical methods and tools that different members of the university need to be exposed to in order to not only raise awareness, but also to increase the level of successful start-up formation?". This paper will review the Fisher et al. (2013) conceptual framework of new venture legitimacy acquisition over time, the European Entrepreneurship Competence Framework (EntreComp) (Bacigalupo et al. 2016) and the recommended entrepreneurial and pedagogical methods, templates and tools used by new venture coaches and courses. This review will highlight the weaknesses and strengths of the framework.

2. Theoretical Framework

Prior literature suggests that a new venture is unlikely to attract resources if it is perceived as illegitimate (Zimmerman and Zeitz 2002). The acquisition of legitimacy by a new venture may also be non-linear, as for a new venture to be perceived as legitimate, its identity must be aligned with the norms, values, beliefs and definitions of the social ecosystem in which it is embedded. Change may occur over time as the new venture gains autonomy and must meet the expectations of changing audiences (Fisher et al. 2013). In their conceptual framework, Fisher et al. (2013) suggest that the achievement of legitimacy is in line with norms, values, beliefs and definitions and occurs throughout the lifecycle of a technology venture from conception through to commercialisation and the growth phase. EntreComp is the European reference framework developed by the Joint Research Centre and the European Commission's Directorate-General for Employment, Social Affairs and Inclusion to support the promotion of entrepreneurial competences in Europe (Bacigalupo et al. 2016). The framework identifies three areas of competences (Into Action, Resources, Ideas and Opportunities). These competences are all interrelated; there is no particular order or level of importance. Depending on the context, one area of competence may be more important than others. The EntreComp progression model has been designed on the basis that The development of entrepreneurial learning leads to increased autonomy and

responsibility in transforming opportunities to create value for others. The model does not predict a linear sequence of steps for an individual to develop his or her entrepreneurial competencies, but rather a progression of skills through external support to transformative value creation. It consists of four stages of maturity: Foundation, Intermediate, Advanced and Expert (Bacigalupo et al. 2016). EE was one of the first fields to introduce the use of design thinking, defined as 'the combination of tools, processes and mindsets that designers use to solve problems', which was seen as a productive approach for learners to experience the entrepreneurial journey (Sarooghi et al. 2019). The Lean Startup (Ries, 2009) contextualised the principles of design thinking in EE. The first set of tools (customer development, agile engineering and minimum viable product (MVP)) were created to find a problem-solution fit, focusing on the smallest solution that provides maximum value to customer problems. The business model canvas and value proposition canvas (Osterwalder et al. 2015) are conceptual tools that describe the value a firm provides to one or more customer segments and the architecture of the firm and its network of partners to create, market and deliver that value and relationship capital to generate profitable and sustainable revenue streams. With the rise of established entrepreneurship programmes, 'business plan competitions' are typically offered. (Laud, Betts and Basu, 2015). Business plans are seen as experiential learning, and it is agreed that entrepreneurial learning needs to provide experiential components. In Figure 1, we propose that the teaching of EE should be progressive, using the first three levels of competence found in the EntreComp progression model: basic, intermediate and advanced. Taking into account the evolution of competences along the stages: relying on the support of others, building independence and taking responsibility, we propose, based on the progressive competence of the audience, "what to teach" at each of the stages. The set of tools to be used at each stage of the entrepreneurial education progression can be divided into: tools to be used at the individual level and at the level of the venture idea. The importance of the multidimensional aspects of new venture creation should not overlook the individual expertise as a key element for new venture creation, as well as the organisational entity that develops the idea and evolves over time within its context, resources and competencies in the market (Gartner, 1985). What tools should be used to build competences at both levels?

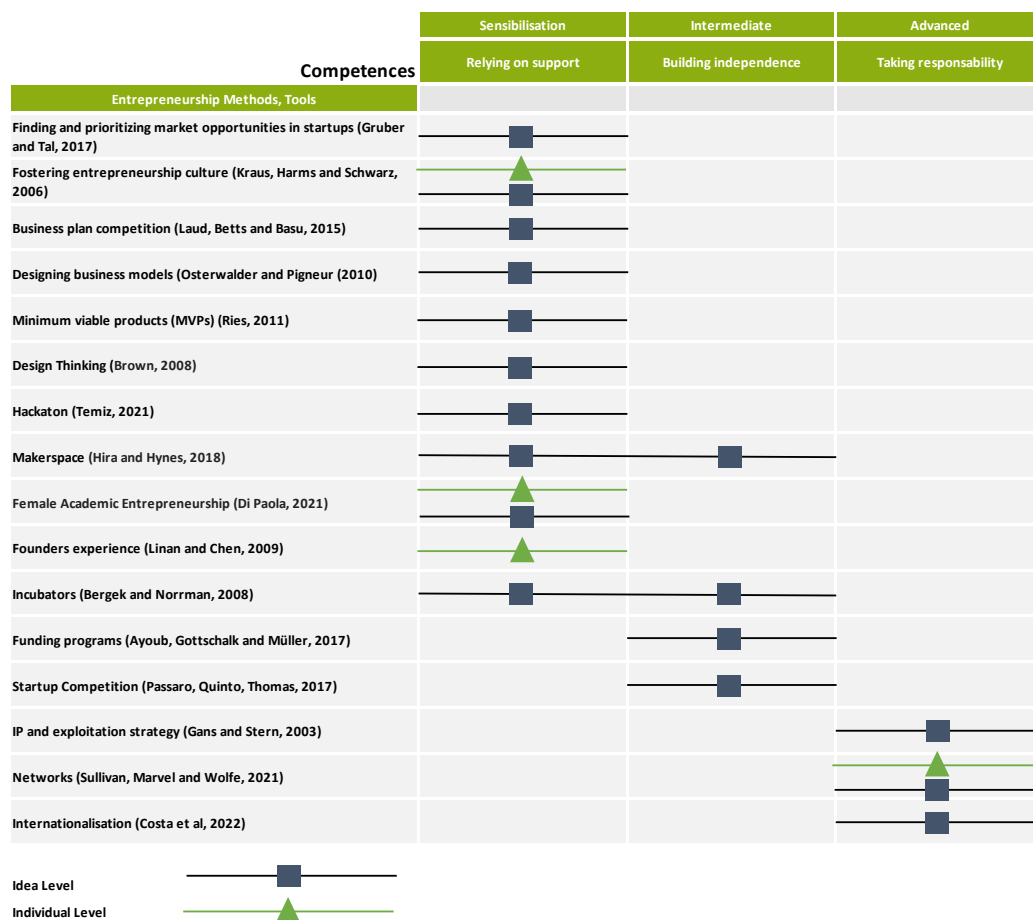


Figure 1: Entrepreneurship education tools along skill levels at individual and venture idea level

Source: own illustration

3. Method

The research is exploratory in nature, as there are no firm ideas about the exact behaviour and causal relationships of the concepts in practice. Case study research, which involves the examination of a contemporary phenomenon in its real-life context, is the recommended design for exploring a complex and under-explored area (Eisenhardt, 1989). Multiple cases allow a phenomenon to be observed in multiple settings. Multiple case studies also allow for replication logic as each case is treated as an independent experiment. (Eisenhardt, 1989). This research uses a multiple case study design, following a theoretical replication, to explore key socio-cultural factors and provide new theoretical insights. The theoretical framework is applied to a multiple case study, specifically cases selected from the Worldfactory Excellence Start-Up Center (WSC) at the Ruhr-University Bochum (Germany). One of the authors is currently employed as a research assistant at this university, which was important in gaining access to documents and sharing experiences with other academics at the institution, as well as gaining access to interviews with new venture founders. The selection process began with an analysis of the different start-ups that existed there. Informal contact was made with the central coordination team. In the second stage, 17 start-ups were selected from all the sustainable development goals. The selection was based on obtaining a diversity of cases and maturity levels of the start-ups. This selection process resulted in a list of 17 selected start-ups. The data were collected through semi-structured interviews over a period of 6 months, complemented by secondary sources consisting of five internal documents describing the structures and implementation of the EE strategies set by the university management per faculty and their implementation at the individual level as well as at the idea level. For the interviews, personal contacts were made and the interviews were recorded. The field notes included observations. We also interviewed experts in the field (researchers, project coordinators and incubator mentors). An inductive approach was used for coding. An inventory of open codes was created based on the themes that emerged from the interviews. To organise the codes, we created second-order themes based on the theoretical framework presented earlier.

4. Contribution

Our paper will contribute to the current understanding in the EE community by explaining the link and impact that EE has on EI in the specific context of an incubator. The WSC case studies will help by (a) understanding how best to organise (iteratively optimise) the different tools in EE, (b) understanding how the proposed reorganisation (assumed in advance) affects the level of success. The literature has identified the following criteria for the success of new venture creation: resource-based capability, competitive strategy, product characteristics, market characteristics and financial criteria (Kakati, 2003). In the WSCs process, the success criterion for incubated start-ups is the establishment as a German GmbH. In addition, this study will contribute to a better understanding of how design EE activities should be integrated into university curricula, helping not only academics but also entrepreneurs and practitioners with a more comprehensive contextual analysis of this growing topic.

References

- Bacigalupo, M., Kampylis, P., Punie, Y., and Van den Brande, G. (2016) "EntreComp: The entrepreneurship competence framework", *Luxembourg: Publication Office of the European Union*, Vol. 10, pp 593884.
- Eisenhardt, K. M. (1989) "Building theories from case study research", *Academy of management review*, Vol.14, No.4, pp 532-550.
- Fisher, G., Kotha, S., and Lahiri, A. (2016) "Changing with the times: An integrated view of identity, legitimacy, and new venture life cycles", *Academy of Management Review*, Vol. 41, No.3, pp 383-409.
- Gartner, W. B. (1985) "A conceptual framework for describing the phenomenon of new venture creation", *Academy of management review*, Vol.10, No.4, pp 696-706.
- Kakati, M. (2003) "Success criteria in high-tech new ventures. *Technovation*", Vol. 23, No 5, pp. 447-457.
- Laud, R., Betts, S. and Basu, S. (2015) "The 'Business Concept' Competition as a 'Business Plan' Alternative for New and Growing Entrepreneurship Programs: What's the Big Idea?" *Journal of Entrepreneurship Education*, Vol. 18, No.2, pp 53.
- Maresch, D., Harms, R., Kailer, N. and Wimmer-Wurm, B. (2016) "The impact of entrepreneurship education on the entrepreneurial intention of students in science and engineering versus business studies university programs", *Technological forecasting and social change*, Vol. 104, pp 172-179.
- Nicholls-Nixon, C. L., Valliere, D., Gedeon, S. A. and Wise, S. (2021) "Entrepreneurial ecosystems and the lifecycle of university business incubators: An integrative case study". *International entrepreneurship and management journal*, Vol.17, pp 809-837.
- Osterwalder, A., Pigneur, Y., Bernarda, G. and Smith, A. (2015) "Value proposition design: How to create products and services customers want", John Wiley & Sons.

- Plaschka, G. R. and Welsch, H. P. (1990) "Emerging structures in entrepreneurship education: Curricular designs and strategies", *Entrepreneurship theory and Practice*, Vol.14, No.3, pp 55-71.
- Ries, E. (2009) "Minimum viable product: a guide", *Startup lessons learned*, Vol.3, No.1.
- Sarooghi, H., Sunny, S., Hornsby, J. and Fernhaber, S. (2019) "Design thinking and entrepreneurship education: Where are we, and what are the possibilities?", *Journal of Small Business Management*, Vol.57, pp 78-93.
- Zimmerman, M. A. and Zeitz, G. J. (2002) "Beyond survival: Achieving new venture growth by building legitimacy", *Academy of management review*, Vol. 27, No.3, pp 414-431.
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Unprecedented Living Lab Approach: Technological Innovations for Paediatric Cancer Support System

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Abstract: The paediatric oncology field still faces significant challenges, despite the substantial progress in childhood cancer diagnosis and treatment. Not only in terms of incidence and mortality rate reduction but also in terms of patients, their support system (e.g. family, school staff) and the cancer survivors' well-being. The use of innovation has provided new forms to support the paediatric oncology community. As these solutions continue to emerge it is necessary to test and validate them based on the end-users' specific needs. In this context, this article shares the ongoing work in the development of an unprecedented and unique Living Lab project. In this ecosystem, a paediatric oncology patients' physiological monitoring device, an app that combines technology and science with culture and arts to create mental health promotion solutions device, a virtual reality solution to help paediatric oncology patients manage pain via gamified environments and a methodology to diagnose difficulties in problem-solving that arise among parents and caregivers of children with cancer survivors, breakthroughs technologies where supported and leveraged during their participation in this Living Lab program. Considering the symbiotic interdependence between end-users empowered by Living Labs and the Living Labs' success dependency on the end-users involvement and motivation, an original methodology for entrepreneurship fostering and innovation support based on end-user participants' high involvement was proposed and evaluated. This methodology was based on interlinked and tailored sessions which were characteristically re-designed based on the stage of development of the proposed innovation, the technical support required and the end-users' needs and engagement level as well as the feedback obtained from previous activities. As a result of the complexity of the context in which the solutions are implemented and the changing openness and engagement of the end-users, the activities and sessions were constantly being created and customized. Although this is a work-in-progress, the tailored engagement program developed already allowed the value creation for all the participants and an efficient evaluation and validation of new end-user-centred solutions which will harness progress through their path to the market.

Keywords: Living Lab; Paediatric; Oncology patients; Childhood cancer; Caregivers

1. Introduction

Globally, childhood cancer is a significant, but comparatively neglected, cause of morbidity and mortality (Johnston et al. 2021) and which concern should also be extended to the network of intervenients whose needs should not be neglected. Patients' caregivers (parents and the family) which provide the children's primary source of physical and psychosocial support have to cope with psychological stress and fear (Suzuki and Kato 2003, Carrion-Plaza et al. 2020) while additionally being associated with an increased mortality rate and health issues as a result of caring for their loved ones (Morrison et al. 2016).

The Living Labs (LLs) have been applied around the globe, to generate impactful solutions (technologies and/or services) within and suited to real-life problems and contexts (Bronson et al. 2021). These ecosystems provide the conditions for innovations co-designing, evaluation, validation, testing, prototyping and commercial strategy development in cooperation with and adapted to the end-users' needs. So, the LL tool is expected to foster the societal impact of the breakthroughs by enhancing their robustness, inclusiveness and delivered value (Niitamo et al. 2006, Nakagawa et al. 2021).

As solutions for paediatric oncological patients and their caregivers continue to increase and progress, the question, of whether the innovations are designed based on and to fit the patient's specific needs, arises. There is also a concern if innovations for paediatric oncology survivors and their families and caregivers are being suitably developed. In this context, this article shares the ongoing work in the development of a LL which was tailored to support innovations centred on the well-being of paediatric cancer patients and their support system. This LL initiative was developed by the RESOLVE-Health 2.0 program, based at the Institute of Health Innovation and Research (i3s in Portuguese Instituto de Investigação e Inovação em Saúde). This action had the collaboration of the Associação Acreditar in Porto, an organization that assists families of children with cancer.

There is reduced literature describing and discussing LLs for cancer-based solutions (Hague University of Applied Sciences (THUAS) 2013, Institut National du Cancer 2023) and to the authors' best knowledge, this is the first LL dedicated to supporting innovations with an oncological pediatric focus.

2. Methods

This study was developed in collaboration with the Associação Acreditar ('ACREDITAR Associação de Pais e Amigos de Crianças com Cancro') which provides support for the development of the LLs in terms of physical space, technical support material (e.g. projectors, tables and chairs, coffee machine for coffee breaks etc.) and access to their internal personnel.

The end-users considered were oncological children's parents and personnel from the Associação Acreditar. The activities were tailored and designed based on an action research methodology. This research approach aims at both taking action and creating knowledge or theory about that action as it unfolds (Coghlan 2023).

3. Results and discussion

An international open call for solutions to improve the health and quality of life of paediatric oncology patients and their families during patients' journeys was made. The program was not extended to large players and SMEs as innovative solution providers as is often suggested in the literature (Niitamo et al. 2006). The breakthrough technologies that participated in this LL are presented in Figure 1.

Acronym	Description	TRL
IMAGI	Virtual reality solution to help paediatric oncology patients to manage pain via gamified environments	2
NeuroCog	A methodology to diagnose difficulties in problem-solving that arise among parents and caregivers of children with cancer survivors and how it affects their personal, social and professional lives	2
Flanair	An app that combines technology and science with culture and arts to create mental health promotion solutions	2
LuckieTech	Paediatric oncology patients' physiological monitoring device that provides immediate and continuous information for parents and clinicians	4

Figure 1: Information regarding the participant innovations' acronym, short description and technology readiness levels (TRL)

As it is possible to verify in Figure 1, different solutions to improve the health and quality of life of paediatric cancer patients, the survivors and their network support system, participated in this LL. The actions developed in this LL were organized into three categories, conceptualization, concretion and specialization, as presented in Figure 2.

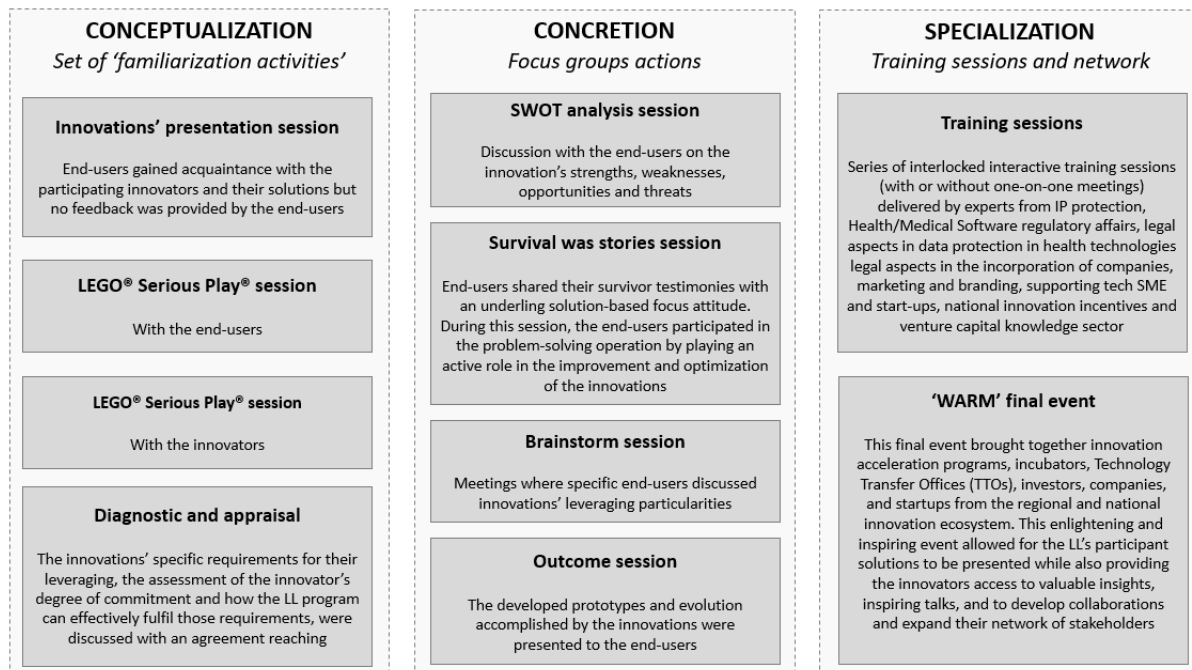


Figure 2: Schematic representation of the actions developed in the LL according to a three-stage framework process constituted by the conceptualization, concretion and specialization stages.

The activities and sessions were designed based on the stage of development of the participant innovations, the technical support required and the end-users needs and engagement level. Due to the complexity of the context in which the innovation will be implemented and the changing openness and engagement of the end-users, the activities and sessions are constantly being created and customized based on the action research method. As it is possible to verify in Figure 2 this created an ecosystem which was able to integrate different stakeholders for the user-driven validation and leveraging of the solutions that aim to improve the health and quality of life of paediatric cancer patients, the survivors and their network support system. This LL also created a comfortable and 'safe space' for caregivers to disclose their concerns and unmet needs so synergetic collaboration could be developed for both the improvement of the participating solutions and the end-users value creation. The activities allow the creation of value for all the LL participants in the form of knowledge acquisition, empowerment, interpersonal bonding, mindset change, and education.

It is important however to highlight that, although the LL achieved excellent engagement from end-users, some of them decided not to share their views. Despite finding the activities involved, they preferred to listen to others and be in the community. This illustrates that despite the desire and effort to involve end-users, their engagement in some cases can remain limited. The outcomes so far obtained from the innovators' participation in this LL program are presented in Figure 3.

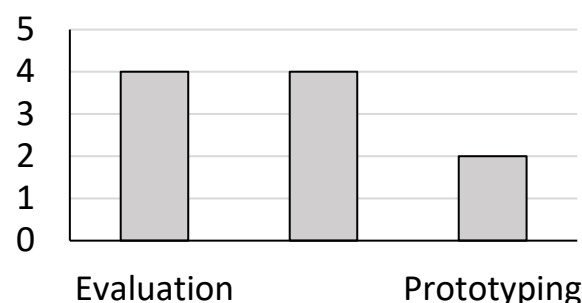


Figure 3: Number of evaluations, validations and prototypes obtained from the innovations participation in the LL

From Figure 3 it is possible to verify that prototypes were developed and solutions were evaluated and validated by the end-users which will increase their acceptance, adoption and deliver value to the market. These outcomes

resulted from the significant engagement registered which was associated with the development of tailored sessions based on active research methodology but also due to end-user empowerment and emphasis given to their opinions and needs. We do believe that an additional upgrade in these innovations improvement and optimization level could in the future be obtained if a wider network of end-user intervenient, namely oncological patients themselves or cancer survivors and other caregivers (e.g. teachers, schoolmates, and peers who provide significant areas for the promotion of patient's psychosocial adjustment intervention (Suzuki and Kato 2003)), could be included in the LL sessions.

4. In conclusion

This LL was able to create value for all the participants through the development of a tailored program to enhance their engagement and guarantee an efficient evaluation and validation of new end-user-centred solutions. Hence through this unique innovation system, disruptive solutions in the field of paediatric oncology evolved in their path to reach the market while also guaranteeing increased acceptability and effectiveness of these technologies to the end-users' needs. In the long term, we would like this study to encourage a more general adoption of LLs for end-user-based paediatric cancer innovations.

Acknowledgements

RESOLVE 2.0 (Respostas Específicas para Superar Obstáculos que Limitam a Valorização Eficaz) is funded by FEDER – Programa Operacional Competitividade e Internacionalização, in the setting of Contrato de Concessão, under the reference POCI-01-0246-FEDER-181287. We thank the support from Associação Acreditar as well as the participation and contribution of the “Barnabés”, caregivers, volunteers and other stakeholders to this Living Lab.

References

- 'ACREDITAR Associação de Pais e Amigos de Crianças com Cancro', [online], available: <https://www.acreditar.org.pt/en/> [Accessed 17th March 2023].
- Bronson, K., Devkota, R. and Nguyen, V. (2021) 'Moving toward generalizability? A scoping review on measuring the impact of living labs', *Sustainability*, 13(2), 502.
- Carrion-Plaza, A., Jaen, J. and Montoya-Castilla, I. (2020) 'HabitApp: New play Technologies in Pediatric Cancer to improve the psychosocial state of patients and caregivers', *Frontiers in psychology*, 11, 157.
- Coghlan, D. (2023) 'Action research' in *The Palgrave Encyclopedia of the Possible*, Springer, 9-16.
- Hague University of Applied Sciences (THUAS) (2013) 'A healthy lifestyle for cancer patients (Medical Delta Living Lab Better In Better Out)', [online], available: <https://www.thuas.com/research/centre-expertise/healthy-lifestyle-cancer-patients-medical-delta-living-lab-better-better> [Accessed July 12th 2023].
- Institut National du Cancer (2023) 'The Living Lab of the Institut National du Cancer', [online], available: <https://living-lab.e-cancer.fr/> [Accessed July 12th 2023].
- Johnston, W., Erdmann, F., Newton, R., Steliarova-Foucher, E., Schüz, J. and Roman, E. (2021) 'Childhood cancer: Estimating regional and global incidence', *Cancer epidemiology*, 71, 101662.
- Morrison, C. F., Szulczewski, L., Strahlendorf, L. F., Lane, J. B., Mullins, L. L. and Pai, A. L. (2016) 'Designing technology to address parent uncertainty in childhood cancer', *Advances in Nursing Science*, 39(1), 15-25.
- Nakagawa, A., Freeman, S., Koopmans, A., Ross, C. and McAloney, R. (2021) 'Best Practices for Living Labs When Studying Older Adults Living in Rural Communities', *Innovation in Aging*, 5(Supplement_1), 1026-1026.
- Niitamo, V.-P., Kulkki, S., Eriksson, M. and Hribernik, K. A. (2006) State-of-the-art and good practice in the field of living labs, translated by IEEE, 1-8.
- Suzuki, L. K. and Kato, P. M. (2003) 'Psychosocial support for patients in pediatric oncology: the influences of parents, schools, peers, and technology', *Journal of Pediatric Oncology Nursing*, 20(4), 159-174.

Virtual 3D Entrepreneurship: An Exploration of Entrepreneurship Activities in Immersive Settings

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Abstract: This article aims to present the potential of virtual 3D and virtual reality for entrepreneurship activities such as the creative process and idea generation in the context of digital entrepreneurship education. It describes the set-up of a virtual 3D platform as part of the international project AGORA to explore how immersive technologies can support online creativity sessions. Following a Design Science Research methodology, the project team has dealt with the relevance of the topic, scholarly literature, and an iterative process for the development of the 3D platform. The paper discusses this process and motivates educators and practitioners to further explore and apply immersive technologies as an innovative tool for raising interaction and creativity in online sessions on innovation management and entrepreneurship education.

Keywords: Virtual 3D, Creativity, Entrepreneurship, Virtual Reality, Design Science Research

1. Introduction

Given the importance that visual perception has in how humans understand the world, virtual 3D technologies and virtual reality (VR) seem to be the future of the internet. Not surprisingly, investments in these markets are on the rise: by 2030, products and services based on virtual and augmented reality could contribute US\$1.5 trillion to the global economy (PricewaterhouseCoopers 2019). A three-dimensional internet will impact virtually every sphere of human interaction and it raises questions about how processes in all fields of knowledge will evolve. Creativity and idea generation will not be an exception. But how can entrepreneurship educators and higher education institutions in general address this challenge in an iterative and cost-efficient manner?

Following the cycles of Design Science Research proposed by Hevner (2007), this article introduces the development of a virtual 3D platform (AGORA 3D) for digital entrepreneurship education with an emphasis on creativity. All activities described here are work-in-progress within the framework of the project AGORA, an international initiative led by the Strasczeg Center for Entrepreneurship (SCE) at the Munich University of Applied Sciences (HM) and funded by the German Academic Exchange Service (DAAD). The research activities of the SCE and the HM in the project AGORA aim at supporting international entrepreneurship collaboration by setting up innovative digital tools that allow interaction between entrepreneurship stakeholders (students, start-up, established companies, investors, civil society, public sector, etc.) in new synchronous and asynchronous manners.

2. Methodology

This case study presents the design and set-up of the platform AGORA 3D. Data has been collected between May 2021 and March 2023 in the form of surveys, interviews, and observations made by the project team. Theoretical inputs from Design Science Research (DSC) have contributed to project implementation and will therefore be addressed throughout the article. Thanks to its pragmatic nature, DSR highlights the application of artifacts, i.e. novel solutions, to solve a real-world problem or address an opportunity in a given environment (Hevner 2007) providing a suitable framework for the implementation of the artifact at hand, i.e. the AGORA 3D.

The first section deals with the context that led to the exploration of VR in entrepreneurship education, corresponding to the Relevance Cycle of DSR proposed by Hevner (2007), in which the focus lies not only on the design of artifacts but also on their application and their connection to the contextual environment of the problem and the definition of the requirements. The second section addresses the Rigor Cycle (Hevner 2007), i.e. the existing knowledge about creativity in VR stemming from science, practical experience, and expertise. Finally, section three addresses the Design Cycle (Hevner 2007) and covers the set-up of AGORA 3D, the artifact resulting from iterations, feedback, and evaluation conducted by the project team.

3. Results

3.1 Relevance Cycle - Context of Entrepreneurship Education within and post-Pandemic

As a result of a growing international network and Covid-19-related constraints, HM and SCE have expanded their digital entrepreneurship education offerings. Amid the pandemic, project-based entrepreneurship classes at both institutions incorporated asynchronous formats through massive open online courses (MOOC), as well as synchronous formats via online conferencing platforms like ZOOM or MS Teams. In addition, digital collaboration tools such as cloud drives like Sync & Share, digital whiteboards like Miro, and virtual project management solutions like Trello were used for teamwork. Students in online classes had the opportunity for coaching, reflection, and live question-and-answer sessions. However, it was common for instructors to encounter a relatively anonymous audience, with many students opting to keep their cameras and audio off.

The communication on these current digital collaboration platforms is limited to two-dimensional audio and partial video, which makes it difficult to have three-dimensional encounters and interactions. Also, important factors that contribute to creativity, such as the individual's physical space, are not considered in digital 2D formats. The SCE and HM are researching how to improve this situation by experimenting with VR and virtual 3D technology in entrepreneurship education. The primary focus at the time of writing is on how these innovations can support creativity and idea generation in online lessons.

3.2 Rigor Cycle - Literature Review

Since the project started, research and regular exchange with different target groups of AGORA 3D, such as instructors, students, and industry partners, has been a core activity to ensure innovation and avoid the implementation of existing, well-known processes (Hevner 2007). Furthermore, this has allowed for testing and iterations of AGORA 3D from an early stage, taking into consideration feedback and wishes from potential users in order to improve creativity sessions on the platform.

Creativity depends on a variety of factors, such as personality, talent, and motivation (Taplick, 2021), and lays the ground for idea generation for innovative solutions. The individual physical space constitutes an important factor influencing creativity, because it has an impact on other factors such as interpersonal interaction, sharing of information, autonomy, and a sense of control, all of which contribute to the creative process (Vithayathawornwong et al. 2003).

Further, being able to look around the physical environment is associated with a higher number of creative ideas. In video conferencing, this number decreases significantly, as participants tend to fix their visual focus on conversation partner(s) – that is to say, on the screen. In their study of the effects of video conferencing on collaborative idea generation, Brucks and Levav (2022) point out that video conferencing hinders idea generation because the virtual space shared by participants is limited to the screen of the device being used. When virtual communicators restrict their visual domain to the shared environment of a screen, their cognitive focus is also narrowed. This narrowed focus restricts the associative process responsible for idea generation (Brucks and Levav 2022).

3.3 Design Cycle - Development of AGORA 3D

As Hevner (2007) posits, the Design Cycle takes input from the other two cycles for the construction, testing, and evaluation of artifacts and processes. In this project, the first step was the definition of the requirements for the software to set up AGORA 3D, based on inputs from the Relevance Cycle and ongoing research activities conducted in the Rigor Cycle. Using a four-factor scale (25, 50, 75, and 100), the project team in collaboration with two professors and three students assessed four software suppliers: Anata (www.anataworld.com), ENGAGE (www.engagevr.io), Mozilla Hubs (www.hubs.mozilla.com), and Spatial (www.spatial.io).

The criteria for the assessment included quality of visuals, usability, access to the platform (e.g. download of software and required sign-up information), country of origin (relevant for European data protection policies), price, supported devices, and satisfaction with the customer support of the software provider. Based on the results an initial AGORA 3D was created on Mozilla Hubs, an open-source platform for which no licenses are necessary, and therefore it is a suitable backup for the financial sustainability of activities after the project end. But at the end, the project had to switch to the platform Spatial, because of its rapid development, intuitive character for hosts as well as users, and compatibility with different devices.



Figure 1: SCE 3D - Immersive representation of the Strascheg Center for Entrepreneurship on the SCE/HM AGORA 3D

4. Discussion

Research and experience in creativity and digital entrepreneurship education laid the ground for the design and iterations of AGORA 3D. The platform currently offers a space for Meet&Match, it displays information about project partners (ten international universities) as well as posters of start-up teams; further, it has portals that allow users to teleport to other virtual 3D spaces. On AGORA 3D, every user generates an avatar and accesses the space through their computer, mobile device, or VR headset. The project team has observed that for most participants, creating an avatar is a new activity that triggers their creativity and team spirit, as they have the possibility of selecting skin color, hair, clothes, body shape, etc.; it also serves as a warm-up and a team-building activity.

The emphasis on a dynamic and fun experience is paramount in the creative process. Users always have an experience – whether good, bad, or indifferent – whose quality makes them feel more or less committed to the creative activity. Ideally, it drives them to continue and keeps them motivated to perform at their best (Kohler et al. 2019). Thus, an enjoyable and engaging experience is extremely valuable because it brings participants into the flow, a state of mind that people try to maintain and seek to repeat.

AGORA 3D allows for visualization and interaction with digital information in various forms, such as uploading presentations, videos, pictures, 3D models, and sticky notes for feedback. These collaboration mechanisms and tools help teams identify potential errors, adjustments, and improvements at an early stage, leading to increased efficiency and efficacy and saving time and money in the innovation process.

Testing of AGORA 3D occurs mostly during project-based innovation seminars, where students are asked to familiarize themselves with the platform and the toolkit containing sticky notes, import of digital and 3D content,

teleport possibilities, and avatars' reactions. Observations made by the project team indicate that for most participants, the novelty of being in VR for the first time has a positive impact on their motivation and willingness to check out the virtual 3D spaces. When asked to give feedback on one of the rooms, for instance, a participant wrote on his sticky note "I want to stay in this place forever." Such enthusiastic reactions tend to be the rule when participants experience VR for the first time.

As mentioned above, video conferencing reduces idea generation due to the visual focus of users on the screen. Idea generation in a virtual 3D/VR environment can help overcome this problem because the user's eyes gaze around the virtual space while wearing a VR headset. Consequently, in principle, the visual-cognitive link that contributes to idea generation is present. Moreover, virtual 3D/VR allows users not only to set up creative spaces that resemble their physical spaces but also to create spaces that look completely different and are even imaginary or inaccessible in the physical world. Users can teleport to another planet for a creative and inspiring brainstorming session or immerse themselves in places relevant to their target audience to better understand its daily context, problems, and needs.

Furthermore, since creativity in groups relies on team members' communication and ability to access, visualize, and display content, technologies that expand visual representations are beneficial. Ewenstein and Whyte (2011) draw attention to the communicative dimensions of visual representations as artifacts to interact with and point out that they play a central role in knowledge work. Also, research on the use of virtual worlds in industry underlines that visualization provides opportunities to communicate differently in a remote work context and helps create greater awareness and understanding of different insights, ideas, and cultures (Bosch-Sijtsema & Sivunen 2013).

5. Conclusion

Given the rising importance of digital education and international collaboration, through the project AGORA, the SCE and HM are looking into innovative tools, like the AGORA 3D platform, to support entrepreneurship activities in digital sessions. Immersion has positioned itself as one very likely future of the internet and, as such, it will impact human communication and interaction in unknown ways. Indeed, 3D and VR allow for new ways of bringing people together to meet, exchange and ideate overcoming some of the limitations of 2D formats, such as a restricted visual field and low interaction levels.

Because of the novelty of the topic, the project team has followed a DSR approach during the conception and implementation phases of the 3D platform. This has enabled the team to understand the context, existing challenges, academic literature, and perform iterative adaptations whenever required. Throughout the entire process, students have been involved as they are the main target group and users of the platform.

Although student participation has been high (more than 700 visits to the 3D rooms between in 2022/2023) and reactions as well as feedback are very positive, the actual use of 3D and VR by students is still very low. Despite having the opportunity to rent the available VR equipment, like headsets and 3D cameras, users remain rather cautious. When asked in a survey about the reasons, students stated that they would appreciate more time for instructors to show them how to use the equipment, because they felt there were too many technical barriers. Also, motion sickness and lack of intuitive usage have prevented students from using the equipment more often. Nonetheless, it is worth noting that most of the participants in seminars and workshops have expressed that they would find it a good idea to complement online lessons with activities in VR.

Creativity and idea generation in online sessions can benefit from the introduction of new digital tools, such as 3D and VR; furthermore, research shows that other relevant areas in entrepreneurship education, including team building, generating empathy, prototyping, marketing, and public speaking can also be improved through these technologies. For the second half of the project (2023-2024), the AGORA team will further explore and test further applications of 3D and VR in the realm of entrepreneurship education and the development of new business models.

References

- Bosch-Sijtsema, P. M., & Sivunen, A. (2013) "Professional virtual worlds support computer-mediated communication, collaboration, and learning in geographically distributed contexts", *IEEE Transactions on Professional Communication*, 56(2), 160-175.
- Brucks, M. S., & Levav, J. (2022) "Virtual communication curbs creative idea generation", *Nature*, 605(7908), 108–112.

- Ewenstein, B., & Whyte, J. K. (2007) "Visual representations as 'artefacts of knowing'", *Building Research & Information*, 35(1), 81-8
- Hevner, A. R. (2007) "A three cycle view of design science research", *Scandinavian journal of information systems*, 19(2), 4.
- Kohler, T., Fueller, J., Stieger, D., & Matzler, K. (2011) "Avatar-based innovation: Consequences of the virtual co-creation experience", *Computers in human behavior*, 27(1), 160–168.
- Pricewaterhouse Coopers (2019) "2030 werden in Deutschland 400.000 Menschen mit AR/VR arbeiten". Retrieved on March 15, 2023 from <https://www.pwc.de/de/pressemitteilungen/2019/2030-werden-in-deutschland-400000-menschen-mit-ar-vr-arbeiten.html>
- Taplick, P. (2021) *Kollaborative, virtuelle Kreativumgebungen – Unterstützung der Ideengenerierung durch Virtual Reality* (Unpublished doctoral dissertation), Paderborn University.
- Vithayathawornwong, S., Danko, S. and Tolbert, P. (2003) "The Role of the Physical Environment in Supporting Organizational Creativity", *Journal of Interior Design*, 29: 1-16. <https://doi.org/10.1111/j.1939-1668.2003.tb00381.x>

Legitimizing the Entrepreneurship Educator

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Abstract: The entrepreneurship educator plays a key role in entrepreneurship education (EE) with the responsibility to plan and execute its delivery. Though scarce, research on the topic underlines how educators evolve and interact in an environment full of other actors (Folliard, Le Pontois, Fayolle, & Diermann, 2019) and deliver teaching entrepreneurship from a dialogical based ecosystem (Birgitte Wraae & Walmsley, 2020). One of these many interactions is with the educational institution, whose role it is to brand themselves externally to potential stakeholders and students (Jones & Matlay, 2011). This preliminary study uses as its theoretical foundation Legitimacy Theory, specifically Suchman's (1995) constructs of 'pragmatic', 'moral' and 'cognitive' legitimacy. Our aim is to understand how the institutional environment legitimises the entrepreneurship educator and by implication what this means for EE more generally. The study will thereby provide insights into what role the educator plays and the mechanisms by which legitimacy is granted. Data were collected in 2022 on all undergraduate enterprise or entrepreneurship programmes (all programmes with either enterprise or entrepreneurship in their title) at undergraduate level in the UK. Access to programme information was provided via the central government-supported body UCAS. In total 73 programmes were identified and scrutinised for how the entrepreneurship educator was legitimised conforming to a form of discourse analysis. More specifically, following Suchman (1995) our search was focused on any mention of the teaching staff and whether that mention contained a pragmatic, moral or cognitive legitimising element. The preliminary results are startling in the sense that only rarely is the entrepreneurship educator directly legitimised. With this, we mean the role they play in the delivery of EE is neither argued on the grounds of their prowess (pragmatic legitimacy), their benefits to wider society (social legitimacy) or even just by explaining what makes them distinct as educators (cognitive legitimacy). Rather than focussing on the educator directly, programme specifications indirectly provide some insights into what they expect from the educator, or what is valued in EE. These early results raise a number of important questions as to how the entrepreneurship educator is perceived, legitimised and possibly even taken for granted. Recommendations for future research and practice are offered.

1. Introduction

Ongoing expansion of entrepreneurship education (EE) has led to ongoing need for entrepreneurship educators. And yet, to date, focus on the educator has been very limited (Birgitte Wraae, Brush, & Nikou, 2020; Birgitte Wraae & Walmsley, 2020), with a focus on the legitimacy of the educator almost non-existent.

Entrepreneurship education, and those who teach entrepreneurship do not operate in a vacuum but are embedded within an institutional environment (North, 1990; Scott, 2001) that includes perceptions of what is, and what is not legitimate. Thus, what expectations are with regard to who the educator is and what s/he does is in large part couched within a framework of what is regarded as legitimate.

On this basis, this study seeks via access to university documents to understand how entrepreneurship is legitimised within university strategies and how this is then reflected in the legitimisation of the entrepreneurship educator as evidenced in programme specifications and job descriptions.

2. Literature Review

Legitimacy has been variously defined, but is often, within the context of entrepreneurship focussed on the legitimacy of new ventures newness (Bruton, Ahlstrom, & Obloj, 2008; Stinchcombe, 1965; Yousafzai, Saeed, & Muffatto, 2015). Here Suchman (1995) distinguishes between institutional- and strategic legitimacy. The former is the environment surrounding the organisation that proposed what is legitimate. The latter, strategic legitimacy, is how the organisation responds to institutional legitimacy, i.e. it is the organisation's attempt to legitimise itself.

For the educator to be legitimate, entrepreneurship as a field of study and instruction must be legitimate. Thus, we argue, the starting point for legitimising the educator is establishing the legitimacy of entrepreneurship. Despite the expansion of EE, there remain questioning voices (Cooper, Bottomley, & Gordon, 2004; Gibb, 2011); the issue of the legitimacy of EE is not definitely settled. Thus, the legitimacy of the educator must start at a macro (societal) level with an appreciation of the legitimacy of entrepreneurship. This should be addressed in

university strategies in the sense that the use of enterprise and entrepreneurship should serve to legitimise the university's strategy and contribution to its goals.

Based on how universities employ entrepreneurship in their strategies, which reflects societal legitimacy of entrepreneurship (institutional legitimacy), this should provide some indication of how they then legitimise the entrepreneurship educator (strategic legitimacy).

3. Methodology

Data for the study were sourced via programme specifications, university strategy documents and job advertisements. In total 73 programme specifications were obtained via the UCAS website in the UK that lists all undergraduate courses. All undergraduate courses (excluding top-up degrees) with either enterprise or entrepreneurship in their title were identified in June 2022. University strategies were then sourced from all universities that provided UG entrepreneurship education (n=61). Finally, job descriptions were identified at four time points between 19th June 2022 and 23rd March 2023 with enterprise or entrepreneurship in their title from the academic employment portal: www.jobs.ac.uk. Only jobs were included that had a teaching element. 35 unique job descriptions were sourced.

The software Nvivo was used to assist in the analysis, a) to help code the text with themes, and b) also to undertake a form of content analysis via word counts. Initially authors reviewed all strategy documents to gain a 'flavour' of the emphasis on entrepreneurship before writing a brief summary. The same was done with the programme specifications. These summaries were, along with the actual documents, uploaded to Nvivo for analysis. Job descriptions were not summarised as these were in the majority of cases brief documents.

4. Preliminary Findings

The use of enterprise/entrepreneurship varied considerably in the university strategies. Many strategies did not, or hardly mentioned either term. Where the terms were mentioned, they were done so within the context of driving change, supporting knowledge exchange, contributing to graduate entrepreneurship, contributing to intrapreneurship and entrepreneurial ecosystems (the latter two featured only minimally).

With regard to the programme specifications, firstly it is important to note that the educator was not mentioned frequently, and often when mentioned it was difficult to determine how the legitimisation would be any different to any other type of educator. In other words, there was limited emphasis on the 'entrepreneurialness' of the entrepreneurship educator. Keyways the educators were legitimised comprised: general support and guidance, tailored academic support, their academic credentials, and their specific approach to teaching. Although these items were mentioned in some programme specifications, overall, there was a limited effort to legitimise the educator.

Turning to the job descriptions, we expected to see some clear expression of how the educator would add value (thereby legitimising their role as entrepreneurship educators). One of the key things that stood out here was how little reference there was to their teaching. By this we mean, of course, the educator was required to teach but typically there was no emphasis placed on any specific pedagogical approach or the importance of teaching method. The teaching was taken for granted. What did feature more strongly was the educator's research prowess, and to a lesser degree their engagement with industry and income generation.

5. Discussion and Conclusion

As we continue to engage with the data, we hope to be able to provide a stronger picture of how the institutional environment legitimises entrepreneurship and how this is then reflected in universities' attempts to legitimise the entrepreneurship educator (strategic legitimacy). What we can say is that universities that do include a focus on enterprise/entrepreneurship in their strategies do so largely on pragmatic grounds, i.e. they seek to justify their role to society (Suchman, 1995). Entrepreneurship is seen as a means for universities to achieve their desired ends which should be of value to society. In programme specifications there is limited recourse to this value-adding function of universities, including with regard to the role of the educator. The programme specifications draw more on cognitive legitimacy (Suchman, 1995). This means, they try to explain the nature of the programme to those unfamiliar with higher education (prospective students and their guardians), but the educator is not placed in a central role in helping the student achieve their desired outcome – perhaps their role is taken for granted? The job descriptions were more forthcoming in terms of describing how the educator would add value (be legitimised), and yet here the focus was not really on their teaching prowess (again, this seems to

have been taken for granted), but on whether they are in a position to undertake research, as well as how they might generate income and liaise with industry.

Overall, legitimization of the educator was limited and did not focus strongly on education. This leads to questions surrounding what the nature and purpose of the educator are? There was some connection between societal contribution in university strategies and educators' ability, via links with industry, to prepare graduates for the world of work. Innovative approaches to teaching were seldom mentioned, and it does not, in contrast to what Foliard et al. (2019) propose, appear that the primary function of the educator is to deliver teaching that has been proven in its effectiveness.

The study therefore opens up a number of avenues for further research that try to make sense of what is expected of entrepreneurship educators and how (and for what) they are valued by higher education institutions. The study also offers a first insight into how universities attempt to legitimise the entrepreneurship educator based on Suchman's (1995) classification. Further studies could focus not only on the educator but in building on and extending our work, also target entrepreneurship education (some interesting insights have begun to emerge in our study, for example about the lack of emphasis on entrepreneurship, in many of the programme specifications). Far from entrepreneurship education being a 'done deal', there is still much scope to understand how it is viewed in society, and ultimately, to what extent it is fulfilling societal expectations, without which its legitimacy would be undermined.

References:

- Bruton, G., Ahlstrom, D., & Obloj, K. (2008). Entrepreneurship in Emerging Economies: Where Are We Today and Where Should the Research Go in the Future. *Entrepreneurship Theory and Practice*, 32(1), 1-14.
- Cooper, S., Bottomley, C., & Gordon, J. (2004). Stepping out of the classroom and up the ladder of learning. An experiential learning approach to entrepreneurship education. *Industry and Higher Education*, 18(1), 11-22.
- Foliard, S., Le Pontois, S., Fayolle, A., & Diermann, I. (2019). The Legitimacy of Teachers in Entrepreneurship Education: What we Can Learn From a Literature Review. In D. Higgins, P. Jones, & P. McGowan (Eds.), *Creating Entrepreneurial Space. Talking through Multi-Voices, Reflections on Emerging Debates* (Vol. 9A, pp. 7-24). Bingley, UK: Emerald.
- Gibb, A. (2011). Concepts into practice: meeting the challenge of development of entrepreneurship educators around an innovative paradigm: The case of the International Entrepreneurship Educators' Programme (IEEP). *International Journal of Entrepreneurial Behavior & Research*, 17(2), 146-165.
- Jones, C., & Matlay, H. (2011). Understanding the heterogeneity of entrepreneurship education: Going beyond Gartner. *Education & Training*, 53(8-9), 692-703.
- North, D. (1990). *Institutions, Institutional Change and Economic Performance*. Cambridge: Cambridge University Press.
- Scott, R. W. (2001). *Institutions and Organizations*. Thousand Oaks, CA: Sage.
- Stinchcombe, A. L. (1965). Social structure and organizations. . In J. G. March (Ed.), *Handbook of organizations* (pp. 142-193). Chicago, IL: Rand McNally.
- Suchman, M. C. (1995). Managing Legitimacy: Strategic and Institutional Approaches. *Academy of Management Journal*, 20(3), 571-610.
- Wraae, B., Brush, C., & Nikou, S. (2020). The Entrepreneurship Educator: Understanding Role Identity. *Entrepreneurship Education and Pedagogy*, 5(1), 3-35. doi:10.1177/2515127420979662
- Wraae, B., & Walmsley, A. (2020). Behind the scenes: spotlight on the entrepreneurship educator. *Education & Training*, 62(3), 255-270. doi:10.1108/ET-01-2019-0009
- Yousafzai, S. Y., Saeed, S., & Muffatto, M. (2015). Institutional Theory and Contextual Embeddedness of Women's Entrepreneurial Leadership: Evidence from 92 Countries. *Journal of Small Business Management*, 53(3), 587-604. doi:10.1111/jsbm.12179

Late Submissions

Enhancing the Entrepreneurial Capabilities of Female Immigrant Entrepreneurs Through Entrepreneurship Education and Training (EET): The Irish Context

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Abstract: Under-represented groups, such as female immigrant entrepreneurs, experience entrepreneurship differently to the mainstream population. In view of this, it is necessary that entrepreneurship policies and supports are tailored, in order to effectively address their unique and specific needs, thereby becoming more inclusive. This would guarantee some degree of level playing field in entrepreneurship. Thus, if female immigrant entrepreneurs are to successfully maximise the opportunities within their host nations and manage the challenges they potentially face, especially as it relates to entrepreneurship, it is imperative that they receive the kind of support, which recognises and considers their uniqueness and entrepreneurial potentials in its design, development and delivery, and which increases the likelihood of their entrepreneurial success. Essentially, Entrepreneurship education and training (EET) has value in creating opportunities for their socioeconomic inclusion and for fostering and facilitating entrepreneurial capability development. This empirical study presents findings on the extent to which the current provision of entrepreneurship education and training in Ireland meets the entrepreneurial capability needs of female immigrant entrepreneurs. Study 1 is a systematic analysis of documentation on the current provision of EET in Ireland from 2011 – 2021, while Study 2 is based on findings from semi-structured interviews with 21 female immigrant entrepreneurs resident in Ireland. The research questions were centred on their experience of entrepreneurship in Ireland, what entrepreneurial capabilities they require to start and grow their businesses, as well as their perception of the extent to which the current EET provision meets their need.

Keywords: Inclusive Entrepreneurship; Ireland; Entrepreneurship Education & Training; Female Immigrant Entrepreneurs; Immigrant Entrepreneurship; adult learning

1. Introduction

In view of the interest in and the growing importance of entrepreneurship (Cooney, 2012; Nakara, Messeghem, and Ramarosan, 2021), entrepreneurship education and training is steadily gaining momentum and priority (Galvão et al, 2020), having value for creating a pipeline of skilled entrepreneurs through the development of the entrepreneurial skills and competencies requisite for encouraging and promoting innovation, economic growth, the creation of new business ventures, and a positive influence on the individual's career development (Galvão, Marques and Ferreira, 2020; Galvao, Souza, and da Silva, 2019; Warhuus et al, 2017).

Furthermore, Sullivan and Meek (2012) argue that the value of entrepreneurship is also in the opportunity it provides for women to overcome (societal/traditional) barriers to professional/career advancement. This is also true for immigrant women, who face various obstacles and challenges, some of which are linked not just to their gender, but also to their status (as immigrants), country of origin, and skin colour/race. Some authors have referred to this as the double (and triple) disadvantage notion (Azmat, 2014; Njaramba, Chigeza and Whitehouse, 2018; De Luca and Ambrosini, 2019; Stapleton, Polakowski, and Quinn, 2022). Thus, entrepreneurship creates opportunities to access the labour market through employment or business ownership (Sullivan and Meek, 2012).

Also, the opportunities that entrepreneurship presents are of even greater significance in the face of increased global migration, which is creating a pool of potential entrepreneurs, who can contribute to the economic growth and development of their adopted countries (Njaramba, Chigeza and Whitehouse, 2018; Brieger and Gielnik, 2020). Research also indicates that at least half of the world's migrant population and the majority of Europe's migrant population are women (Bloch, Kumarappan and McKay, 2014; Njaramba, Chigeza and Whitehouse, 2018). It therefore makes economic and moral sense to support immigrant females to develop the entrepreneurial capabilities to facilitate their socio-economic independence and inclusion, as well as assure a higher likelihood of better business performance and entrepreneurial success. Furthermore, Sarfaraz, Rahman, and Qureshi (2014) allude to a link between the economic development of nations, and the active participation of women in all facets of society, including entrepreneurship. Thus, the growing research interest in the concept

of female immigrant entrepreneurship, after years of neglect and seeming “gender-blindness” (De Luca and Ambrosini, 2019, p. 201) is a welcome development.

The role and importance of Entrepreneurship Education and Training (EET) in advancing and enhancing the development of these entrepreneurial capabilities cannot be overstated (Galvão, Marques and Ferreira, 2020; Bullough et al., 2015). In view of this, it can be argued that If immigrant communities in general and female immigrant entrepreneurs, in particular, are to maximise their potentials and to become significant contributors to the growth and development of their new/adopted countries, it is critical that they access entrepreneurship education and training opportunities (and other necessary supports), which are tailored and targeted to meeting their unique needs.

This paper presents preliminary findings on the extent to which the current provision of entrepreneurship education and training in Ireland meets the entrepreneurial capability needs of female immigrant entrepreneurs. Specific to Ireland, some researchers have focused on the concept of ethnic entrepreneurship (for example, Hession, Van der Meer, and Jones, 2015, Birdthistle, 2019) and on immigrant entrepreneurship (for example, see Murphy et al. 2020). However, the gender dimension presents an opportunity for significant research interest due to the growing number of female migrants in the Irish nation. As of 2019, an estimated 310, 800 migrant women had taken residence in Ireland.

2. Female immigrant entrepreneurship in Ireland

Female immigrant entrepreneurship is a relatively new phenomenon in Ireland due to her very recent migration history. In 2020 there were almost 89,000 non-EU women and girls living in Ireland, representing 3.5% of the resident female population. An increase in the number of migrants without a corresponding rise in the number of jobs presents an opportunity for entrepreneurship and self-employment to circumvent this issue. Also, some may want to replicate their businesses from their homeland, explore new ideas, or simply want to be their own boss. Whatever the reason might be, a continued increase in entrepreneurial activities in Ireland is expected. It is therefore important that those vested with the responsibilities of working with entrepreneurs, devise strategies and tools to meet the unique challenges of this demography.

Thus, with studies indicating a proclivity for entrepreneurship among immigrants (Brieger and Gielnik, 2020; Nazareno, Zhou and You, 2018; Lofstrom, 2017), and indications that female immigrants are also strong players in the entrepreneurship landscape globally (De Luca and Ambrosini, 2019; Njaramba, Chigeza and Whitehouse, 2018). However, in addition to the potential “triple disadvantage” faced by female immigrant entrepreneurs (Azmat 2014, p. 201), other challenges exist, which include lack of access to start-up capital, language barriers, discrimination and racism, lack of appropriate business and social networks, childcare issues, gender-based/domestic violence, and unfavourable country-of-origin patriarchal culture and practices (Stapleton, Polakowski, and Quinn, 2022, Azmat, 2014).

The challenge of a patriarchal system is underscored by De Luca and Ambrosini (2019, p. 202), drawing on other works), who note the existence of beliefs and practices within some ethnic groups, of entrepreneurship being a male domain, with females obligated/expected to support businesses on familial grounds, as part of “family strategies”, and without wages. This common feature of a patriarchal structural system and gender inequality, underpin the way some communities live and interact. The International Finance Corporation (IFC) argue that female entrepreneurship can provide a solution to the issue of gender inequalities within these ethnic enclaves.

Despite these challenges, there are opportunities to be harnessed from female immigrant entrepreneurship, including the wealth of cultural, social and economic value through their ties to their countries of origin, while fostering transnational trade relationships (Njaramba, Chigeza and Whitehouse 2018). Thus, EET for women immigrants should focus on equipping and enabling them to circumvent some of the afore-mentioned barriers/challenges and to develop new capabilities and competencies, which are critical to managing an enterprise successfully, while creating products or services, which add economic value and leads to self-employment (Resende et al, 2020).

Ireland has made significant investments in EET, in order to meet individual, institutional and societal goals and purposes. Thus, a mapping of the range and suite of EET programmes/courses was imperative, in order to determine the breadth and depth of current provision and the extent to which this meets the needs of female immigrant entrepreneurs. ‘Breadth’ in this study refers to the range/volume of EET programmes/courses available across the country at both the pre-growth and growth stages, and ‘Depth’ refers to the diversity and specific focus of programmes using metrics such as the diversity of industry (range of industry-specific programmes/courses) and the specialised education and training provided within each Industry.

The aim of this study, therefore, was to determine the extent to which the current provision advances/enhances the entrepreneurial capabilities of female immigrant entrepreneurs, by assessing the current provision of EET training in Ireland in terms of the breadth and depth of provision at the pre-growth and growth stages of business and matching the findings against what female immigrant entrepreneurs say they need. Pre-growth businesses are in early-stage entrepreneurship and are measured by the Total Early-Stage Entrepreneurs Activity (TEA) index (Fitzsimons and O’Gorman, 2022). These early-stage entrepreneurs are classified in two groups - nascent entrepreneurs and new business owners. Nascent entrepreneurs are those in the very early stage of business, while new business owner are people who have started a new business within the previous three years and have paid salaries for at least three months.

3. Methodology

This qualitative study took a dual method approach. Study 1 was a systematic review and analysis of existing EET programmes. This “methodical, comprehensive, transparent and replicable” method (Siddaway, Wood, and Hedges, 2019, p.751) involved the identification, selection, critical appraisal and analysis of all available related and relevant documentation based on pre-determined criteria and objectives. Study 2 employed semi-structured interviews to investigate the entrepreneurial capabilities required among female immigrant entrepreneurs.

3.1 Study 1 - Identification and selection of EET programmes for systematic review

The search, selection and inclusion of programmes was undertaken using a systematic approach, where Inclusion and exclusion criteria were applied to ensure that only programmes reflecting the notion of the phenomenon would be included in the review, in order to build a comprehensive database of EET programmes. Thus, only programmes that were training-centred were included – programmes/courses that focused on skills acquisition, capability-building and the application of existing or acquired knowledge to entrepreneurial ideas. Excluded from the selection were entrepreneurship education programmes/courses within the university/higher education setting.

The author conducted an online search for documentation on EET programmes, setting the search parameters as programmes/courses between Year 2011 and Year 2021, in order to determine which programmes were provided, for whom they were provided (which groups of entrepreneurs) and for which phase of the entrepreneurship journey/which specific entrepreneurial needs – Pre-growth or growth. The time frame of 2011 to 2021 was selected because it gave the researcher the opportunity to review the range of programmes offered within a 10-year period, in order to understand the breadth and depth of offerings/provision as well as the evolution over this period.

To identify these programmes, a Boolean search using Google and Bing search functions was conducted. After the removal of duplicates, the search resulted in a database of 162 EET programmes/courses - 106 programmes at the pre-growth stage and 56 programmes designed for businesses at the growth stage. The researcher is aware that there may be a small number of EET programmes held within the 10 year period under review, which may have been missed during the search.

3.2 Analysis of Study 1 data

The data was analysed using two approaches – Descriptive and Thematic analyses. The descriptive classification of the programmes was useful to identify the trends at the pre-growth and the growth stages and included the name of the programme, year of (programme) delivery, providers, target participants, location of delivery, cost, and whether the programme was industry-specific, immigrant-specific and/or gender-specific.

The thematic analysis of the suites of programmes was based on the Andragogy-in-Practice (AIP) Model. The AIP Model is based on the underlying assumption of andragogy as proposed by Knowles (1980). It is a programme design planning model for designing, implementing and evaluating programmes, courses and learning activities for adult learning (Knowles et al, 2005). Its purpose is to ensure that effective learning processes are provided for adult learners, and it is centred on the notion that the support, design and implementation of curricula should be tailored to the specific needs of the adult learner.

The principles of andragogy espouse an adult learning process involving identifying what skills, knowledge and competency (encapsulated here as capabilities) gaps need to be addressed, determining what the desired learning outcomes should be and what resources are available to achieve those desired outcomes, as well as determining how the programme will be implemented and then evaluated. Thus, the AIP framework and corresponding principles apply in all adult learning situations.

The seven (7) augmented adult learning principles of the AIP model (Neck and Corbett, 2018) were thematically applied through a deductive approach, to analyse the research findings. Therefore, the study focused on **(1) Learner's need to know; (2) Learner self-concept; (3) Prior learner experience; (4) Readiness to learn (5) Orientation to learning (6) Motivation; and (7) The role of the educator.** Coding captured related patterns (Braun and Clarke, 2006), and the themes were framed as core themes, first-order themes and second-order themes. The process of generating and organising themes was influenced by the work of Jones, Coviello and Tang (2011).

3.3 Study 2 - Data Collection

Data collected was through face-to-face semi-structured interviews conducted with 21 immigrant women entrepreneurs from different countries, including Brazil, South Africa, Nigeria, Cameroon, Poland, Hungary, Eswatini, Botswana, Czech, The Philippines, Bulgaria, South Africa, and Bulgaria. These entrepreneurs were selected using purposive sampling. Purposive sampling is ideal where the researcher includes participants, who fit into the specific selection criteria and therefore, could cover the full range of perspectives required to give good insight into the questions to be asked during data collection (Campbell et al, 2020; Saunders and Townsend, 2018).

Thus, participants for this study comprised of female immigrant entrepreneurs based in Ireland, and the selection criteria for the respondents were as follows:

- First generation immigrant, resident in Ireland (not born in the Republic/North of Ireland).
- Not originally from the UK, Norway, Sweden, France, Germany, Italy, etc or from any of the countries identified as Western Europe.
- Originally from countries classified as either under-developed or developing.
- Owner of a valid business, trading, with the business registered or in the process of registration.
- The business should be at either the nascent/start-up/pre-growth or growth stages according to the entrepreneurship index of the Global Entrepreneurship Monitor (GEM) (Fitzsimons and O'Gorman 2022).

Through the interview, the respondents shared their lived experience of entrepreneurship and what their entrepreneurial capabilities needs were.

After the initial selection of participants – five female entrepreneurs, snowballing sampling technique was used to invite other respondents fitting the criteria (Parker, Scott and Geddes, 2019). Questions asked were derived from a review of literature, which was useful for establishing themes and areas to be explored. The data was coded and analysed using Nvivo.

4. Findings

4.1 Lack of inclusive EET information/support/provision.

Findings indicated that the needs of female immigrant entrepreneurs for **quality and easily accessible (Inclusive)** EET provision (information/supports/learning activities) were not being met through the current EET provision. While the analysis of EET provision pointed to a significant breadth and some depth in EET provision, about 97% of interviewees expressed the lack of quality (**delineated in this study as focused, specific, relevant, targeted, adequate, and current**) EET provision, as well as difficulty in accessing this provision. The provision of quality and easily accessible (inclusive) EET provision signified for many of them the first leg of gaining the entrepreneurial capabilities they require in order to succeed as entrepreneurs in Ireland. O'Brien, Cooney and Blenker (2019, p.386)'s standpoint affirms this finding where they stated: "Inclusive entrepreneurship policies suggest that developing entrepreneurial potential within under-represented groups requires specific targeted initiatives that are transparent, inclusive and sensitive to their needs".

Furthermore, the mapping of the current provision showed that within the 10-year period under review, only 3 programmes were run specifically for immigrants – in 2018, one programme was run for female immigrants by the Migrants Right Council of Ireland (MRCI) in partnership with DCU Ryan Academy, and in 2021, the Enter2Transform programme for Refugees (EU funded) as well as SPARK (migrants' edition) were run by Social Entrepreneurs Ireland (SEI). The paucity of these kind of programmes for female immigrants (entrepreneurs) in the face of a growing migrant population indicates that inclusion is yet to be prioritised by EET policy makers or practitioners. As earlier stated, the researcher is aware that in the 26 counties in the Irish Republic and the 31 Local Enterprise Offices, there may have been some specific related programmes that were run in some counties but not made available across the country, and that were not captured in this search.

Again, the mapping of the provision did not reveal any dedicated service to support (female) immigrant entrepreneurship in Ireland, nor were there indications of needs assessments carried out to better understand the learning needs/capability gaps of the demography under review prior to programme/course/learning activity design. Learning needs assessments are pivotal to (the design of) effective training and learning, fundamental to the success of any training programme, and necessary for good programme planning (Grant, 2002; Brown 2002). “Often, organisations will develop and implement training without first conducting a needs analysis. These organisations run the risk of overdoing training, doing too little training, or missing the point completely” (Brown, 2002, p.569).

4.2 Shortage of opportunities to upskill to meet Irish regulatory standards.

Some of the interviewees shared that since their vocational/trades qualifications from their home countries were not recognised in Ireland, they were keen to upskill to meet the Irish regulatory standards in certain industries. However, cost and availability were challenges to overcome to access industry-specific training. The mapping of programmes/courses indeed indicated that the depth of EET provision specifically at the pre-startup/startup stage was inadequate for the industry-specific skills development of female immigrant entrepreneurs.

Currently, there are only two sectors providing industry-specific upskilling/reskilling training programmes for entrepreneurs at this stage – The Food, and the Craft and Design sectors. Outside of these, all other programmes are generic, ‘one-size-fits all’ EET programmes, covering a wide range/breadth of programmes/courses/learning activities specifically curated for start-up/early-stage entrepreneurs, including idea generation and development, marketing, sales and branding, costing and pricing, social media and digital marketing, taxation, bookkeeping and accounts for the small business, HR, costing and pricing, etc. Thus, current provision lacks depth at the start-up/pre-growth stage, not offering sufficient opportunities to upskill to meet the regulatory requirement of the wide range of sectors in which female immigrant entrepreneurs could potentially start their businesses.

4.3 The impact of the role of the educator on learners’ experience, and Peer-to-Peer learning

Biney (2015, p.33) recommended that educators should serve as “facilitators, encouragers, helpers, assisters, colleagues and friends of adult learners to motivate them to learn”, which suggests that the multi-faceted role of an educator is influential and may have direct consequence on learners’ motivation to learn and on whether they continue a learning programme or not. The findings of this study correspond with Biney’s position, where respondents recognised the multiplicity of the role of educators but found more value in the coaching and mentor-guide role of educators. Furthermore, findings indicated that female immigrant entrepreneurs attribute some of their learning success and consequently their business success to the mentoring, facilitating, coaching and guiding role played by an EET educator.

Also, respondents indicated a preference for educators from experienced entrepreneurs and EET educators from immigrant communities/background as mentor-guides and coaches. One of the women interviewed, like some others, indicated a preference for someone of the same migrant background as mentor:

*“...Because it's different if like, it's different coming from somebody who knows what it's like, you know...
Yes, yes, exactly. Whereas, you know, I don't think like an Irish person, or somebody born and raised here
would kind of understand where we're coming from”- Nc-Phik*

Further to this, respondents indicated that they would find value in connecting with their business peers for learning and sharing sessions, in addition to mentorship, coaching and guidance from educators. Therefore, it can be deduced that peer-to-peer networking and learning is a means by which female immigrant entrepreneur may enhance their entrepreneurial capabilities.

5. Recommendations

5.1 Provide more depth to EET programmes through strategic partnerships.

Of the 106 programmes identified at the start-up/pre-growth level, only 10 programmes/courses provided industry-specific training in the Food sector and the Craft and Design sector. In view of this, it is recommended that EET in Ireland be amplified to incorporate and focus on more industry-specific training, and to also cater to the specific needs of (female) immigrant entrepreneurs, who want to upskill to meet Irish (regulatory) standards and customer expectations. This can be accomplished through strategic partnerships with industry/trades organisations in fields such as plumbing, hairdressing, health and wellbeing, beauty, ICT, etc, to provide fully/partly funded training programmes for female immigrant entrepreneurs. In addition to compliance with

regulatory standards, there is also the opportunity to broaden the sectors in which female immigrants could potentially start businesses, thus increasing entrepreneurship opportunities.

5.2 Provision of inclusive EET activities based on robust need assessments.

As afore-stated, Inclusive EET in this study refers to the quality of EET activities (**focused, specific, relevant, targeted, adequate, and current**) and the ease of accessibility. The provision of **quality and easily accessible (inclusive)** is critical to promoting and supporting the entrepreneurial capability requirements. With the currently growing population of immigrant women in Ireland (exacerbated by the war in Syria and Ukraine and the continued political instability and deplorable living standards in most African countries) and the proclivity of immigrants for entrepreneurship, it makes economic sense to adopt more inclusive policies and practices, preceded by need assessments and analyses.

5.3 The need for more people from the immigrant community as EET educators/mentors.

With female immigrant entrepreneurs indicating that they would like to experience mentorship, support and guidance from educators, who are themselves immigrants, as they believed this would be valuable for their entrepreneurial journey, it is recommended that mainstream EET educators and agencies recruit more people from the immigrant communities into EET educator, mentorship, guidance and coaching roles. Attachment theory suggests that Adults learn from those who are like them and are influenced by those with whom they share a bond (Fleming, 2008).

6. Conclusion

The objective of this study was to determine the extent to which the current provision of entrepreneurship education and training (EET) in Ireland meets the entrepreneurial capabilities required by female immigrant entrepreneurs. This was achieved by evaluating the current provision against the entrepreneurial capability needs expressed by female immigrant entrepreneurs. This is based on the viewpoint that Ireland, as a country of entrepreneurs and with a culture of entrepreneurship has made extensive investments in entrepreneurship education and training, providing a range of programmes, courses, learning activities and support to help entrepreneurs from business startup to maturity.

The study was underpinned by Knowles' Andragogy-in-Practice (AIP) theoretical framework, a versatile, flexible and adaptable transactional model based on Knowles' (1980) andragogical principles of adult learning, which facilitates the application of andragogy "more systematically across multiple domains", across different purposes and goals, and "arenas of application" (Holton, Swanson and Naquin, 2001, pp. 126, 129). Although the theoretical, especially pedagogical foundation of entrepreneurship education is beginning to receive more attention, this is still an area where theory lags practice (Kakouris, Morselli, and Pathway. 2023; Neck and Corbett, 2018). This study sought to address this gap, hence the adoption of Knowles' AIP framework.

7. Implications

7.1 Implications for policy -

This study serves as a call for a review of current EET policy in Ireland as it relates to the inclusion of groups, such as female immigrant entrepreneurs, who are underrepresented in entrepreneurship and potentially socio-economically disadvantaged. Therefore, an evaluation of the current provision in Ireland based on specific inclusion-based criteria is highly recommended. These criteria include specificity, relevance, targeting/focus accessibility/proximity and sensitivity to the (needs of) target group. It also includes stakeholder consultation (co-diagnosis of issues and co-production of solutions), which are criteria shared by O'Brien, Cooney and Blenker. (2019) and Barkhuizen and Bennett (2014). Facilitating and enhancing stakeholder engagement and consultation will provide an opportunity for female immigrant entrepreneurs to become key players in policy development, as it relates to entrepreneurship, entrepreneurship education and business development in Ireland.

7.2 Implications for practice

As already discussed, EET in Ireland is lacking in inclusivity, thus, the need for more inclusive practices to meet the needs of female immigrant entrepreneurs. The findings highlighted the need for the completion of a needs assessment of female immigrant entrepreneurs to kickstart this process of achieving inclusivity in EET, as espoused by Brown (2002). With findings indicating that information pathway, from the perspective of female immigrant entrepreneurs, was inadequate and not easily accessible. The implications of this for EET educators and support agencies is a re-evaluation of information pathways, provision and dissemination, and possibly a more innovative way of engaging with this underrepresented group.

8. Limitations of the study -

As with every study, there are some limitation worth highlighting. Although the diversity of participants was in some respects a strength of the study, it also presented as a potential drawback, in that the study did not focus on any specific ethnic group. Being able to theorise on the broader 'female immigrant' category is useful, but the study recognised that as an analytical category, its constituents are likely to present unique features (i.e., there will be some heterogeneity within the category).

Another potential limitation of this study is that it utilised an approach in its exploration of the experiences of female immigrant entrepreneurs. In view of this, the respondents could only provide information, perspectives and opinions from previous experiences and knowledge. A longitudinal approach would be useful for capturing a panoramic view of the experiences of the respondents as they engage in their businesses from the pre-startup phase to the growth stage, giving better insight into the impact of EET for the development of entrepreneurial capabilities over a period.

9. Recommendations for future research.

9.1 The empirical data /information deficiency on (female) immigrant entrepreneurship in Ireland.

Currently, there is no up-to-date information or data in Ireland regarding the entrepreneurial activities of female immigrant entrepreneurs or immigrant groups in Ireland. This empirical data deficiency is not surprising due to Ireland's relatively recent history of migration, particularly of those outside the EU now resident in Ireland. Since the early 2000s, Ireland's new immigrant communities have continued to grow steadily and significantly.

Currently, it is estimated that 10% of businesses in Ireland is of immigrant origin (Gazeta, 2022) but the exact figure or extent of their contribution has been difficult to estimate. However, there are indications that the value of immigrant entrepreneurship is growing, with anecdotal evidence that restaurants, services, and retailing are the principal business sectors of immigrant entrepreneurship (Gazeta, 2022). With the influx of migrants into Ireland in the last two decades from various parts of the world, Syria, Eastern Europe, Africa, and South America. The paucity/lack of information and data on female immigrant entrepreneurs in Ireland presents a future research opportunity.

9.2 A further exploration of the study to include interviews with EET educators and other stakeholders.

In Study 2 of this study, interviews were conducted with 21 female immigrant entrepreneurs, in order to understand their background, *lived experiences* within the Irish entrepreneurship landscape, and their individual perspectives regarding how their entrepreneurial capabilities could be enhanced through EET. Thus, this study was focused on what is currently available in EET and what female entrepreneurs identified as their needs. Future research could also incorporate interviews with policy makers, educators and other relevant organisations, to generate a triangulation of opinions. Given that the focus was on the lived experience of female immigrant entrepreneurs for this study, these perspectives of these other groups can be captured in future studies.

Acknowledgement

I am deeply indebted to the Holy Spirit for His guidance and support all through this journey. I am also very grateful for the guidance and support of my supervisors - Dr Andreas Walmsley and Prof. Sukanlaya Sawang, as well as the incredible support and encouragement received from my family and friends. My sincere thanks to my mentors, Evans Adetokunbo Emmanuel, Wale Soyingbe and Prof Thomas Cooney.

A new season has begun!

References

- Azmat, Fara (2014) "Migrant women entrepreneurs: exploring the barriers". Deakin University. Chapter. <https://hdl.handle.net/10536/DRO/DU:30069645>
- Barkhuizen, N., and Bennett, M. (2014) "Training Adult Entrepreneurs in an Emerging Economy: The Case of Namibia". Mediterranean Journal of Social Sciences, Vol. 5, No, 3, pp. 298.
- Biney, I.K. (2015) "Exploring self-concept among adult learners: The case of students pursuing adult education and human resource studies at SCDE", University of Ghana. International Journal of Educational Policy Research and Review Vol.2 No.3, pp. 32-40 Available online at <http://www.journalissues.org/IJEPRR/> <http://dx.doi.org/10.15739/IJEPRR.009>
- Birdthistle, N. (2019), "Under the microscope – an examination of the supports for ethnic entrepreneurs in Ireland", Education & Training, Vol. 61, No. 6, pp. 666-683.
- Bloch, A., Kumarappan, L. and McKay, S. (2014) "Women migrants today: New directions, no papers, old barriers", Working U S A, Vol 17, No. 3, pp. 339-355.

- Braun, V., and Clarke, V. (2006) "Using thematic analysis in psychology". *Qualitative research in psychology*, Vol. 3, No. 2, pp. 77-101.
- Brieger, S.A., and Gielnik, M.M. (2020) "Understanding the gender gap in immigrant entrepreneurship: a multi-country study of immigrants' embeddedness in economic, social, and institutional contexts", *Small Bus Econ.* Vol 56, pp. 1007–1031 <https://link.springer.com/article/10.1007/s11187-019-00314-x>
- Brown, J. S. (2002) "Growing up digital: How the web changes work, education, and the ways people learn", *Change: The Magazine of Higher Learning*, Vol. 34, No. 2, pp. 11-20.
- Bullough, A., De Luque, M. S., Abdelzaher, D., and Heim, W. (2015) "Developing women leaders through entrepreneurship education and training", *Academy of Management Perspectives*, Vol. 29, No.2, pp. 250-270.
- Campbell, S., Greenwood, M., Prior, S., Shearer, T., Walkem, K., Young, S., Bywaters, D. and Walker, K. (2020). "Purposive sampling: complex or simple? Research case examples". *Journal of research in Nursing*, Vol. 25, No. 8, pp.652-661.
- Cooney, T. M. (2012, November) "Entrepreneurship skills for growth-orientated businesses". In Report for the Workshop on 'Skills Development for SMEs and Entrepreneurship' Vol. 28, pp. 1-24
- De Luca, D. and Ambrosini, M. (2019) "Female Immigrant Entrepreneurs: More Than a Family Strategy". *Int Migr*, Vol. 57 pp. 201-215.
- Fitzsimons, P. and C. O'Gorman (2022) "Entrepreneurship in Ireland 2021". *Global Entrepreneurship Monitor (GEM)*, Dublin.
- Fleming, T. (2008) *A Secure Base for Adult Learning: Attachment Theory and Adult Education*. *The Adult Learner*, 35. pp. 33-53. ISSN 978-0-906826-27-0
- Galvão, A. C., Souza, J. P. D., and da Silva, W. L. (2019) "Entrepreneurial intention among Brazilian students: A study based on Ajzen's theory of planned behaviour". *Journal of Entrepreneurship Education*, Vol.22, No. 2, pp. 1-11.
- Galvão, A., Marques, C., and Ferreira, J. J. (2020) 'The role of entrepreneurship education and training programmes in advancing entrepreneurial skills and new ventures', *European Journal of Training & Development*, Vol. 44 No. 6/7, pp. 595–614.
- Gazeta N. (2022) *Why More Immigrant Entrepreneurs Are Needed in Ireland*, Published on 2nd February 2022 <https://www.russianireland.com/en/pochemu-irlandii-nuzhno-bolshe-immigrantov-predprinimatelej/>
- Grant, J. (2002) "Learning needs assessment: assessing the need". *British Medical Journal*, Vol. 324, No, 7330), pp.156-159.
- Hession, P., Van der Meer, R., and Jones, T. (2015) "Ethnic entrepreneurship and home-based businesses: Exploring the determinants of success. *Journal of Ethnic and Migration Studies*", Vol. 41 No. 3, pp.339-356.
- Holton, E. F., Swanson, R. A., and Naquin, S. S. (2001) "Andragogy in practice: Clarifying the andragogical model of adult learning". *Performance improvement quarterly*, Vol. 14, No. 1, pp.118-143.
- Jones, M. V., Coviello, N., and Tang, Y. K. (2011) "International entrepreneurship research (1989–2009): a domain ontology and thematic analysis", *Journal of business venturing*, Vol. 26, No. 6, pp.632-659.
- Kakouris, A., Morselli, D., and Pittaway, L. (2023) "Editorial: Educational theory driven teaching in entrepreneurship" *The International Journal of Management Education*, Vol. 21, No. 2.
- Knowles, M. S. (1980) *The modern practice of adult education: From pedagogy to andragogy*. Englewood Cliffs, NJ: Cambridge Adult Education.
- Knowles, M. S., Holton III, E. F., and Swanson, R. A. (2005) *The adult learner: The definitive classic in adult education and human resource development*. Routledge.
- Lofstrom, M. (2017) "Immigrant Entrepreneurship: Trends and Contributions", *Cato Journal*. Vol. 37, No 3 pp. 503-522.
- Murphy, A., Bogue, J. and O'Flaherty, B. (2020) "Exploration of the role of immigrant entrepreneurs in regional entrepreneurial food ecosystems", *European Conference on Innovation and Entrepreneurship*, Rome, Italy, 17-18 September, pp. 817-823.
- Nakara, W.A., Messegghem, K. and Ramarosan, A. (2021) "Innovation and entrepreneurship in a context of poverty: a multilevel approach". *Small Bus Econ* Vol. 56, pp. 1601–1617.
- Nazareno, J., Zhou, M. and You, T. (2019) "Global dynamics of immigrant entrepreneurship", *International Journal of Entrepreneurial Behaviour & Research*, Vol. 25, No. 5, pp. 780-800.
- Neck, H., and Corbett, A. (2018) "The Scholarship of Teaching and Learning Entrepreneurship", *Entrepreneurship Education and Pedagogy*, Vol 1, No. 1 pp.8-41.
- Njaramba, J., Chigeza, P., and Whitehouse, H. (2018) "Barriers and challenges experienced by migrant African women entrepreneurs in North Queensland, Australia", *Entrepreneurship and Sustainability Issues*, Entrepreneurship and Sustainability Centre, Vol. 5 No 4, pp.1054 – 1068
- O'Brien, E., M. Cooney, T. and Blenker, P. (2019), "Expanding university entrepreneurial ecosystems to under-represented communities", *Journal of Entrepreneurship and Public Policy*, Vol. 8 No. 3, pp. 384-407. <https://doi.org/10.1108/JEPP-03-2019-0025>
- Parker, C., Scott, S. and Geddes, A. (2019) *Snowball sampling*. SAGE research methods foundations.
- Resende, N. C., Coelho, A. L., Lima, E. D., Barreto, M. R., and Rios, J. A. (2020) "Entrepreneurial Education: Source of Social Transformation". In Mosquera, S., & Jardim da Palma, P. (Ed.), *Multidisciplinary Approach to Entrepreneurship Education for Migrants* pp. 192-210. IGI Global. <http://doi:10.4018/978-1-7998-2925-6.ch011>
- Saunders, M. N., and Townsend, K. (2018) *Choosing participants*. *The Sage handbook of qualitative business and management research methods*, pp. 480-494.
- Sarfraz, L., Rahman, Z., and Qureshi, J. A. (2014) "Gender, social support and entrepreneurship", *Journal of Entrepreneurship in Emerging Economies*, Vol. 6, No 1, pp.7-27.

- Siddaway, A. P., Wood, A. M., and Hedges, L. V. (2019) "How to do a systematic review: A best practice guide for conducting and reporting narrative reviews, meta-analyses, and meta-syntheses", *Annual Review of Psychology*, Vol. 70, pp. 747-770
- Stapleton, A., Polakowski, M., and Quinn, E. (2022) "The Integration of Non-EU Migrant Women in Ireland", *ESRI Research Series* Vol. 148, September 2022, pp.1-79
- Sullivan, D., and Meek, W. R. (2012) "Gender and entrepreneurship: Advancing debate and challenging myths; exploring the mystery of the under-performing female entrepreneur", *International Journal of Gender and Entrepreneurship*, Vol. 4 No.3, pp. 236-256.
- Warhuus, J.P., Tanggaard, L., Robinson, S. and Ernø, S.M. (2017), "From I to We: collaboration in entrepreneurship education and learning?", *Education þ Training*, Vol. 59 No. 3, pp. 234-249.

How a Small-town Enterprise Delivers “Worldwide” Services: A Case from the Music Production Industry

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Abstract: In Rena, a small town (approx. 2,500 inhabitants) in a small municipality (approx. 5,000 inhabitants), there is a rather small enterprise that has not only had a national impact, but also attracts international attention. The company has specialized in music production and developing singer/songwriters and are running a substantial number of “music camps” that are sessions lasting either a weekend or a week with different themes. With increasingly better equipment accessible to “everyone” and digital platforms with short access to the public, the competition regarding being spotted on the different music apps is high and increasing rapidly. In our paper, we have investigated how this company has made a living out of facilitating for the development of music. We have used qualitative methods, and primarily focussed on in-depth interviews with the employees and participants, as well as observations during sessions. Our results show that not only their business model, but also the structure and facilitation, is vital for developing products that may be published. The structure and facilitation have been developed over some time. During this time, the founder and colleagues have shown exceptional learning abilities, and not only developed as music producers, but also as facilitators. We have found some explanations for this success, not only from theory on innovation and entrepreneurship, but also in theory on Positive Deviance, which we will present in the paper. The combination of these directions has provided a richer understanding of how this small-town company has a worldwide customer database. The innovation capacity of the company has supported the development of the organization as they have been able to utilize their dynamic skills, hired staff with complimentary skills and through a leadership and management style managed to engage the staff by involving and including them in the strategic development of the organization and what they offer their customers. Their ability to attract and develop competency and their professionalism have contributed towards turning potential disadvantages to a part of what they offer the customers as a support and positive means to finish or enhance their products.

Keywords: innovation, entrepreneurial behaviour, music production camps

1. Introduction

Establishing a company generally requires a good idea and a lot of guts. Establishing it at a place where it is not necessarily “natural” to place a company and may even be a daunting task. One would assume that a larger city, or even the capital of Norway, would be a more natural place to set up a company that will be dealing with established artists, as well as “up and coming” stars. Yet, two hours north of the capital, in a tiny town called Rena, which has approximately 2,500 inhabitants, The Woods is thriving and steadily growing.

The company offers music production services, and over the years has specialized on offering so-called “music camps”. These are singer-songwriter seminars ranging from a few days up to a week. Most of the camps are held at their offices/studios at Rena.

What would make both famous and less famous people from Norway, the USA, Belgium, France, UK, etc. come to this remote place to work with the people working at The Woods? And, what made them think at all that they would attract these people to a place so far away from anything remotely actionlike? As there are no bars, only a few restaurants, one hotel, and a couple of food shops and very little else at this place, why would both celebrities and coming stars want to travel to this place to be creative and write, record and produce potential hits?

These are among the questions we had, and that we seek to answer. For this paper, we have focussed on:

How do they view their own success?

How this is perceived by experienced participants?

How does this align with the theory on innovation and entrepreneurship?

And lastly: How does this also fit with the theory on Positive Deviance?

In the following, we will present the theory that has enlightened our study, and our methodological choices, before we present our results. Lastly, we will conclude, and suggest how to study this further.

1.1 Case: The Woods

The Woods is a music production company based in Rena, Norway, a two-hour drive north of Oslo, the capital of Norway. The company employs no less than 11 music producers who are not only capable music producers, but who also play instruments, are able text writers, melody writers, and can sing. They are based on the 2nd floor of an industry building, and specialize in planning, organizing, and conducting “songwriting camps”. In short, these are seminars where established artists (singers, singer-songwriters, etc.), and artists *in spe* from Norway and the rest of the world, participate in making music. They apply for taking part in the seminars, and must fill out an extensive form describing themselves, their skills and what they may contribute with. When being considered for an offer of participation, they are interviewed by representatives from The Woods. In this interview, they not only look for the skills and talents they have described in the form, but also investigate their personalities. Are they shy and withdrawn, or are they forward and «pushy»?

From the time they are invited to these seminars, they have observed, reflected, discussed and refined the way they organize the teams. Another thing they have learned “the hard way” is about establishing and presenting the rules of dialogue within the groups as an introduction to the seminars.

The employees have meetings every day of the seminars, where they discuss and reflect upon what has taken place during the day. In addition, they update each other on their plans for the upcoming day. For the employees who have been there from the beginning, facilitating seminars has become a part of their tacit knowledge, and a lot of what happens regarding facilitating, feedback, development, handling, producing, etc., which is something that they “just do”, and that they have “learned by experience”. They sometimes work in different projects, with one of these projects being to develop potential contributions to the national competition that will end up with a winner who will take part in the Eurovision Song Contest. These camps are called “MGP camp’s”, in which the acronym MGP is “Melodi Grand Prix” – the name of the Norwegian song contest.

The experiences they gain from all of these music camps are valuable knowledge, in addition to be a part of the knowledge base within their organization. Another asset is their ability to doubly and triply learn from their experiences, share tacit and explicit knowledge, as well as their professionalism; hence several of the artists keep returning to these camps.

Distribution of the products (the songs/melodies/videos) have also become easier with the digitalization and enhanced internet connections in basically the whole world. Markets that previously were less accessible have become highly accessible, and the cooperation and collaboration across borders enabled by the digital technology have been truly beneficial for the type of products, distribution and service provision The Woods are working within.

In the following, we will present the theory that has enlightened our study and the methodology used for the data collection, followed by the results and discussion. Lastly, we will present the conclusion and our future research.

2. Theoretical foundation

We have chosen innovation and entrepreneurship as the company has found a niche, and through hard work, market communication and opportunities from having a university close by and managed to develop a business that in a short time has put a significant stamp on the Norwegian music business. As they have managed to do this in an area remote from the “big cities” where you would expect them to be, and that they have made a business out of their passion and hobbies in a very competitive business area, resembles how it is possible to define Positive Deviance; being able to develop something that has become an international business in a place far from where one would expect “the action” to be.

2.1 Innovation and entrepreneurship

Innovation is strongly connected to growth (Bessant & Tidd, 2015, p. 5) and about “identifying or creating opportunities, new ways of serving existing markets, growing new markets, rethinking services, meeting social needs and improving operations (doing what we do but better)” (Bessant & Tidd, 2015, pp. 7-9).

Schumpeter claimed that entrepreneurship drives economic development, and that entrepreneurs thus utilize ideas and technical inventions, sees funding opportunities, and turn ideas into technological, commercial and

organizational innovations (Schumpeter, 1934, 2021), even if there are debates on whether business opportunities are unveiled or created, if they take to existing solutions or invent something new (Malerba & McKelvey, 2020).

According to Schumpeter (1934, 2021), entrepreneurs are risk takers, and may develop new ways of combining new and/or existing businesses. Entrepreneurs not only take risks but are able to organize capital for the development of innovations. According to Kurz (2012), any new combinations are: “the systematic production of new, economically useful knowledge out of existing knowledge” (Kurz, 2012, p. 883). Malerba and McKelvey (2020) claim that an entrepreneur takes risks, develops new combinations and secure resources in order to convert ideas into innovations. Also, the entrepreneur may introduce new products, processes, technology and constellations of the organization. It may also be on the use of technology, as this has enabled a worldwide distribution of digital material, which allows new markets to be reached from anywhere by exploiting technological solutions (Heggernes, 2020).

According to Malerba and McKelvey (2020), entrepreneurs are: “involved with others in the diffusion, use and creation of knowledge, engage in learning and problem-solving activities, use knowledge in new combinations for innovation” and “are affected by education, knowledge and experiences in their innovative activities” (Malerba & McKelvey, 2020, p. 506). Similarly, entrepreneurship is: “a process with emergent properties which involves actors searching for opportunities and generating new knowledge, is affected by the learning, technological and knowledge context” and “involves the co-evolution of knowledge, firms, industrial structure and institutions” (Malerba & McKelvey, 2020, p. 506).

They even present a theoretical definition of a knowledge-intensive entrepreneurship: “Knowledge-intensive innovative entrepreneurial firms are new learning organizations that use and transform existing knowledge, and generate new knowledge in order to innovate within innovation systems” (Malerba & McKelvey, 2020, p. 508).

Ridley (2020) claim that innovation is a *process* and one of the most important sources for growth. It is about finding new useful ways of reorganizing. Many innovations fail to be used due to costs, being too advanced or that they are unfinished at the point of release.

2.2 Innovation capacity

Developing innovation capacity is about training the ability to innovate (Meyer *et al.*, 2022). Succeeding over and over again require skills regarding developing this innovation capacity. It will also draw on theory on dynamic skills. It is important that the co-workers have or gain the right competencies and that there is support regarding the development of innovations. Enthusiastic co-workers that persevere and don't give up is equally important.

The three components that make up innovation capacity are:

- Dynamic skills
- Complementary skills
- Engagement

The dynamic skills consists of identifying (technological) possibilities, needs of the customers and to recognize strategic challenges (Meyer *et al.*, 2022). This thus needs to seize the opportunities that lie in the identified possibilities and needs, and to transform the organization in order to utilize them. For this, complementary skills are needed, such as the ability and capability of producing, supporting customers, or other skills necessary to support and develop the production or the services. It is thus not just about inventing and having new ideas to services and products, but also about being able to act on them and having support and skills in the organization to be able to work systematically to provide the services or products to the public. The co-workers' engagement also represent an important factor and should be a result of leadership and be incorporated in the culture of the organization (Meyer *et al.*, 2022).

There are nine organizational elements identified as important for the innovation capacity: organizational structure, competence, work processes, incentives, culture, technological platforms, external relations, leadership and management, and ownership.

Regarding organization, it is about having a structure that allow people from different parts in the organization to work towards a common goal. Regarding competence, the most important skill is about learning to learn (Toner, 2011; World Economic Forum, 2020; Meyer *et al.*, 2022). Also, it is about developing the existing competence. The culture is also important as it expresses common values, norms and mental models. Innovative business culture may also be paradoxical; for example: to err is accepted, but incompetence is not, psychological safety is important, but honesty is highly valued, autonomy is supported but with a strong leadership.

Technological development and choice of technological platforms also play an important role regarding innovative capacity. Development of a national and an international technological infrastructure supporting exchange of for example knowledge, services and products will allow for example different ways of distributing services and/or products and open up for other markets.

2.2.1 Adult learning

As learning is important for both entrepreneurial behaviours, being innovative and for innovative capacity, it is necessary to include adult learning theories.

In adult learning Malcolm Knowles has presented his six key principles on andragogy: self-direction, learning through experiences and with a basis in prior experience, readiness to learning, problem-centred (more than subject-centred), internal motivation (rather than external), and they need to understand why they need to know what they are learning (Knowles, 1978; Roe, 2023).

Reflection is also very important for learning (Raelin, 2002; Del Carlo, Hinkhouse and Isbell, 2010; Moon, 2013; Knowles, Holton III and Swanson, 2015). Reflection can be undertaken both prior to, during and after a learning experience (Schön, 1987). As innovations and the work on innovating may be a learning experience and thus require reflections in order to evaluate the innovations (Meyer *et al.*, 2022).

2.3 Positive Deviance

Positive Deviance (hereafter called PD) has generally been used to find the positive exceptions when all parameters predict a negative outcome. One definition is about it being a “practical strategy to identify and promote exceptionally high performance in a problem domain of interest” (Herington and van de Fliert, 2018, p. 664). It has been a theoretical concept as well as a practical strategy. Regarding the theoretical viewpoint, it is about understanding how and why the positive deviance arises. Regarding a practical approach, the understanding may contribute to attend to social problems. An example that is much used, regarding teenage pregnancy, in which some girls did not get pregnant, despite all parameters, suggested they should. The difference (positive deviance) was due to the parents’ plea for them to wait with getting pregnant until finishing school, while the other parents lectured their daughters about contraception options.

Pascale (2010) present the basic premises: “(1) solutions to seemingly intractable problems already exist, (2) they have been discovered by members of the community itself, and (3) these innovators (individual positive deviants) have succeeded even though they share the same constraints and barriers as others” (Pascale, 2010, p. 3,4). It is therefore about finding the reasons to “why things work” when it *normally* should not. It may also be about detecting issues that should be visible but appears invisible in plain sight. It is often referred to a story of a smuggler that is repeatedly stopped with his donkeys carrying bags of straw. They never find anything and have to let him pass. Upon later encounter with the chief of customs he reveals that what he has been smuggling are the donkeys (Pascale, 2010).

Ochieng (2007) offers the following definition of PD: “intentional behaviour that significantly departs from the norms of a referent group (in honourable ways) to create social, technical, institutional, organizational, and policy innovations, whether embraced and amplified by the referent group or not” (Ochieng, 2007, pp. 456–457). Also, Slettli and Singhal (2016) claim that PD may aid the amplification of tacit knowledge. In their study, they claim that the positive deviants are aiding in the communication of change, and that it is important to facilitate for arenas for people-driven changes.

Herington and Van de Fliert (2018) claim that PD tends to “be applied as a tool or framework in practice” (p. 676). When a PD is unveiled it is possible to utilize the results for social change. It is suggested to encourage to describe a situation or episode where a situation was resolved well but where the circumstances were not optimal and it is claimed that it is important to define the intention, how the solutions departs from any norms and the actions are “of an Honorable Nature” (Spreitzer and Sonenshein, 2004, p. 842). An example of this is displayed by Vold and Kiørnig (2015) where they have interviewed two municipalities to investigate PD during a crisis situation and detected how situations were resolved, how it differed from normal practice and that the action was executed out of the respect and dedication of a profession. One of the cases were from the 1995 flood where there were clients of the health care sector that their nurses were unable to reach due to the flood. This was solved by the nurses that lived more accessible to the one in need of care, but that originally were occupied with other tasks, chose to take over the jobs for the nurses that were unable to attend to their clients. This was, however, due to local knowledge and a sense of duty to the community members (Vold and Kiørnig, 2015).

3. Method of inquiry

In this case study (Dubois & Gadde, 2002, 2014; Yin, 2014; Saunders, Lewis, & Thornhill, 2016), we have chosen a qualitative approach, where we have conducted an in-depth interview with two informants using a semi-structured interview guide (Creswell, 2007; Dalen, 2011; Jacobsen, 2015; Saunders, Lewis, & Thornhill, 2016). We have chosen to do a case study, as this is a unique study (Remenyi, 2012). The data are particularly important when doing case studies (Remenyi, 2012). In this study, we have had a “gatekeeper” (Remenyi, 2012, p. 87), who had provided us access to the organization, and which is the main informant (informant 1). One of the informants is the founder, managing director and music producer. The other informant (informant 2) is one of the participants of one of the MGP camps. The latter, with more than 40 years of experiences from a long international career working with international stars and organizing singer-songwriter retreats. Hence, the informants are carefully chosen with the purpose of providing feedback both from a managerial point of view and a customer point of view.

To secure the data, we have used checkback as described in Guba and Lincoln (1989) where the informants are shown the text with the possibility of commenting and correcting any statements. The interviews were recorded and transcribed, in addition to the interviewers notes from the meetings.

4. Results and discussion

Regarding being an entrepreneurial organization, the main informant claims, “I followed my passion and started out with my mates to do what we liked to do: make music. However, we did have to make some money, and inspired by conventions we went to in Europe, we started offering singer-songwriting camps. We already had access to the technological tools, and we could reach our markets online” (informant 1). This concurs with Schumpeter’s claim about entrepreneurship driving economic development, and the utilization of technology, seeing financial opportunities, and that they were able to turn their ideas into commercial and organizational innovations (Schumpeter, 1934, 2021).

They were also willing to take the risks of failing when they started their singer-songwriting camps, but as Kurz (2012) explains about combining: They were able to utilize their own competencies as singer-songwriters and producers to develop “new economically useful knowledge out of existing knowledge” (Kurz, 2012, p. 883).

Informant 1 further claim: “We have developed from two, sometimes three to 11 employees, and we aim to utilize the individuals’ personal knowledge and skills in order to maximize the outcome for our clients. Also, we are very careful to reflect after each camp in order to learn from each other and from our experiences.” (informant 1). This resembles how Malerba and McKelvey (2020) describe entrepreneurs, namely regarding being: “involved with others in the diffusion, use and creation of knowledge, engage in learning and problem-solving activities, use knowledge into new combinations for innovation” (Malerba and McKelvey, 2020, p. 506).

This is confirmed by informant 2, claiming that: “The guys at The Woods know what they are doing. They are highly qualified music producers, and they run decent camps. I have taken part in a few, and I am impressed about how they develop between each time I am here. I am “old” in the game, as I have worked in the business for about 40 years and have been at many camps. I have even organized a few myself, and I still learn from them about organizing camps, and about how to organize the work in the groups. I have actually asked them to come to San Francisco to co-operate on a retreat/singer-songwriting camp” (informant 2). Here, the respondent is not only referring to their professionalism, but also to their ability to develop from their learning, and about expanding their business (Malerba and McKelvey, 2020).

What the informants present, also bear witness to innovation capacity. It has started with a passion and the company has expanded, attracting relevant competencies and been able to sustain an engagement of the employees. The company has the ability of working together, drawing upon each other’s experiences. What theory on innovation capacity is not focussing on but which The Woods is great at is to *reflect* and thereby supporting the development of *reflective practitioners* (Schön, 1987). The reflection processes are integrated in the way they work and is found to be a strong support for their development process. The reflections are organized in a way that also support inclusion and involvement of the co-workers and thus support engagement amongst the members of the organization. And *engagement* is one of the pivotal elements of the innovation capacity.

As they are able to *sense* the different trends in the music business due to their close connections to the business and are able to understand and recognize their customers needs as well as being able to solve the strategic challenges. Informant 2’s statement above, also confirms this. In addition, informant 1 explain that we always reflect after each and every music camp, in order to learn from their experiences and improve. One example has

been extremely important and is about being clear about rules for communication. The Woods have been agile regarding recruiting needed competences based on a recognized gap regarding lack of competencies and resources in general due to expanding their business.

The leadership style is very inclusive and the manager (informant 1) claim that it is extremely important that the employees are heard in the meetings. Their opinions are valued and form the base of any decisions made for the company and for the way they conduct their business.

Regarding Positive Deviance, informant 1 is clear about the intentionality of keeping it in a remote place: "We want the participants to focus on the music, collaboration and development, rather than being distracted by fancy shops, restaurants and pub-life. They pay good money to develop songs, and then they should be able to focus on this. Besides, the scenery here is wonderful and may even inspire to creativity" (informant 1). This fits with Ochieng's definition of PD, in which he claims that this is: "intentional behaviour that significantly departs from the norms of a referent group (in honourable ways) to create social, technical, institutional, organizational, and policy innovations, whether embraced and amplified by the referent group or not" (Ochieng, 2007, pp. 456–457).

Informant 2 confirms this when he reports: "I was surprised the first time I came here, as it was such a small place. I am used to a bit busier environment. But I understand their philosophy and their business intentions – we do focus more on the music when there is nothing else to do" (informant 2).

The remoteness may also support their opportunities of reflecting after each camp and share any learning, something which also may enable the discovery of any tacit knowledge. Respondent 1 claims that: "There are things that we have discovered little by little, as we have summed up after the camps. Things we took a bit for granted, and did not pay too much attention to, have become important features and a part of why we are successful and why our clients return to us. For example, the rules we have developed are a result of our reflections, and they have proven to be crucial regarding how clients work together in order to establish a positive and thriving environment in the groups" (informant 1). This example can be tied to Slettlil and Singhal's (2016) claim that PD may aid in the amplification of tacit knowledge. Also, The Woods and how they are able to grow and get national and international attention contribute to theory on PD by the fact that Norway is country with approximately 5,5 million inhabitants, mostly with a standard of living that is above the examples that generally are presented in the PD literature. Hence, theory on PD can be used to understand positive exceptions also in a high cost country, within an established business market, and to recognize how perceived disadvantages (small place, far from any major city), can be turned to an advantage when presented as one (far from "noise" and "disturbances", "areas for reflections"). It also shows how thorough business skills and knowledge, ability to be professional, and inhabiting innovation capacity, facilitates for success, even if it the business/organization to outsiders may have some clear disadvantages, such as perceived poor location, for example.

The technology has, however, been an enabler of reaching different markets and supported continued work between the participants at the camps. As informant 1 claim: "Sometimes we are not finished with the production when the camp is over. But this is not a problem as we only send the digital files to the artists when they are done. Also, we sometimes distribute them on the agreed platforms to the public." This show that the technology enables the innovation capacity (Meyer *et al.*, 2022). Informant 1 continues: "We are even able to distribute the products to markets in different parts of the world. We are for instance, serving the Asian market with a lot of songs and melodies developed for this market. This is distributed online via secure channels." The technology thus allows for reaching markets previously less accessible from countries outside Asia. Hence, the digitalization of the music business facilitates for remote working as the product transfer is no longer an obstacle for working away from any density of similar businesses.

5. Conclusion

We can conclude that The Woods fits within the definitions of entrepreneurial organization. The organization has utilized technology, not only in their work to support the production of music, but also to be able to distribute to different markets. Also, they are learning from their experiences in order to improve and expand both in markets and in services. They take risks by venturing into new markets and new customer groups.

They have also been agile regarding exploiting their innovation capacity as they have been able to utilize their dynamic skills, hired complimentary skills and through the leadership and management style enabled involvement and thus engagement in the organization.

The Woods have been able to establish a company in growth in a remote part of Norway, although the business is within a business area mostly identified with having a network close by, such as in the larger cities. They have

utilized the remoteness to their advantage and communicated to the market about the enabling of focus and efficiency due to the remoteness of the location. The remoteness has also allowed the organization to evaluate and turn their tacit knowledge into explicit knowledge about how to run efficient and productive singer-songwriting camps, without the disturbance normally taking place in a busier place.

The digitalization and development of the technological platforms have supported a connectedness that has enabled working remotely as one is no longer dependent on physical delivery of the products.

5.1 Further research

The Woods are continuously developing their products, exploiting and exploring new customer markets. Their latest venue is about organizing singer-songwriting camps for children/youths from 9–13 years old. To investigate this, we will need the consent from the parents, but it will be interesting to see how this age group perceives these camps. Also, we are planning on doing research on camps they call “Bad Manors”, which takes place in the autumn outside London, UK. Here, the aim is to further investigate the international market and how they perceive the camps, and how any learning from this is taken back into the “ordinary” singer-songwriting camps.

References

- Bessant, J. R. and Tidd, Joe (2015) ‘Innovation and entrepreneurship’. Edited by Joseph Tidd. Chichester, West Sussex, England: Wiley (New York Academy of Sciences Ser).
- Del Carlo, D., Hinkhouse, H. and Isbell, L. (2010) ‘Developing a Reflective Practitioner through the Connection between Educational Research and Reflective Practices’, *Journal of science education and technology*, 19(1), pp. 58–68. doi: 10.1007/s10956-009-9178-y.
- Creswell, J. W. (2007) *Qualitative inquiry & research design : choosing among five approaches*. 2nd ed. Thousand Oaks, Calif: Sage.
- Dalen, M. (2011) ‘Intervju som forskningsmetode [Interview as a research method]’, *Oslo: Universitetsforlaget*.
- Dubois, A. and Gadde, L.-E. (2002) ‘Systematic combining: an abductive approach to case research’, *Journal of business research*, 55(7), pp. 553–560.
- Dubois, A. and Gadde, L.-E. (2014) ‘“Systematic combining” —A decade later’, *Journal of Business Research*, 67(6), pp. 1277–1284.
- Forum, W. E. (2020) ‘The Future of Jobs Report 2020’, in. World Economic Forum, Geneva, Switzerland.
- Guba, E. G. and Lincoln, Y. S. (1989) *Fourth generation evaluation*. Sage.
- Heggernes, T. A. (2020) *Digital Business Understanding: from Big Data to Small Bits (translated from Norwegian: Digital forretningsforståelse: fra store data til små biter*. 2nd edn. Bergen: Fagbokforlaget.
- Herington, M. J. and van de Fliert, E. (2018) ‘Positive deviance in theory and practice: A conceptual review’, *Deviant Behavior*, 39(5), pp. 664–678.
- Jacobsen, D. I. (2015) *How to conduct research: introduction to social science research methods (Translated from Norwegian: Hvordan gjennomføre undersøkelser? : innføring i samfunnsvitenskapelig metode*. 3. utg. Oslo: Cappelen Damm akademisk.
- Knowles, M. S. (1978) ‘Andragogy: Adult learning theory in perspective’, *Community College Review*, 5(3), pp. 9–20.
- Knowles, M. S., Holton III, E. F. and Swanson, R. A. (2015) *The Adult Learner: The definitive classic in adult education and human resource development*. London: London: Routledge. doi: 10.4324/9781315816951.
- Kurz, H. D. (2012) ‘Schumpeter’s new combinations: revisiting his Theorie der wirtschaftlichen Entwicklung on the occasion of its centenary’, *Journal of evolutionary economics*, 22, pp. 871–899.
- Malerba, F. and McKelvey, M. (2020) ‘Knowledge-intensive innovative entrepreneurship integrating Schumpeter, evolutionary economics, and innovation systems’, *Small business economics*, 54(2), pp. 503–522. doi: 10.1007/s11187-018-0060-2.
- Meyer, C. et al. (2022) ‘Innovation Capacity (from Norwegian: Innovasjonskapasitet)’, *Bergen: Fagbokforlaget*.
- Moon, J. A. (2013) ‘Reflection in learning and professional development: Theory and practice’.
- Ochieng, C. M. O. (2007) ‘Development through Positive Deviance and its Implications for Economic Policy Making and Public Administration in Africa: The Case of Kenyan Agricultural Development, 1930–2005’, *World development*, 35(3), pp. 454–479. doi: 10.1016/j.worlddev.2006.04.003.
- Pascale, R. T. (2010) *The power of positive deviance : how unlikely innovators solve the world’s toughest problems*. Edited by J. Sternin and M. Sternin. Boston, Mass: Harvard Business Press (Leadership for the common good).
- Raelin, J. A. (2002) ‘I Don’t Have Time to Think!’ (vs. The Art of Reflective Practice)’, *Reflections*, 4(1), pp. 66–79.
- Remenyi, D. (2012) ‘Case study research: The quick guide series’, in. Academic Conferences Limited.
- Ridley, M. (2020) *How innovation works: And why it flourishes in freedom*. Harper New York.
- Roe, L. (2023) ‘Applying andragogy to service-learning in graduate education: An interpretive phenomenological analysis’, *Journal of adult and continuing education*, 29(1), pp. 147–169. doi: 10.1177/14779714221079368.
- Saunders, M., Lewis, P. and Thornhill, A. (2016) *Research methods for business students: 7. ed*. Harlow u.a: Harlow u.a: Pearson.

- Schön, D. A. (1987) *Educating the reflective practitioner: Toward a new design for teaching and learning in the professions*. Jossey-Bass.
- Schumpeter, J. A. (1934) *The theory of economic development : an inquiry into profits, capital, credit, interest, and the business cycle, Theorie der wirtschaftlichen Entwicklung*. Cambridge, Mass: Harvard University Press (Harvard economic studies).
- Schumpeter, J. A. (2021) *The Theory of Economic Development*. Milton: Milton: Taylor and Francis (Routledge Classics). doi: 10.4324/9781003146766.
- Slettli, V. K. and Singhal, A. (2016) 'Amplification of tacit knowledge through the positive deviance approach'.
- Spreitzer, G. M. and Sonenshein, S. (2004) 'Toward the construct definition of positive deviance', *American behavioral scientist*, 47(6), pp. 828–847.
- Toner, P. (2011) 'Workforce skills and innovation: An overview of major themes in the literature'.
- Vold, T. and Kiønig, L. (2015) 'Exploring the possibilities of using "positive deviance" for enhancing crisis training in municipalities'.
- Yin, R. K. (2014) *Case study research: design and methods*. 5. edition. Los Angeles: Los Angeles: SAGE.

Developing Green Entrepreneurship Skills in Indonesia: A Community Perspective

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Abstract: Amid the ascension of climate change and global warming as pervasive issues of worldwide relevance, the urgency for environmental entrepreneurship and sustainable development has been notably emphasized. This focus becomes critical within rapidly maturing economies such as Indonesia, where the potential to significantly influence climate neutrality and business competitiveness is immense, contingent upon the effective cultivation of green entrepreneurial ethos. However, the integration rate of eco-friendly business tenets remains discouragingly static, largely due to acute insufficiencies in consciousness-raising, pedagogical resources, and sector-specific proficiency. The present paper embarks on a critical scrutiny of environmental business opportunities within the Indonesian milieu. A comprehensive discrepancy analysis pertaining to the development of green entrepreneurship proficiencies is detailed, predominantly from a community vantage point. This inquiry constitutes a part of the European-endorsed initiative, the ASEAN Network for Green Entrepreneurship and Leadership (ANGEL), purposed to fortify entrepreneurial competence and sustainable perspective among diverse community stakeholders. Through a methodologically structured survey, engagement with academia, requisite support for communal development, and perceived hindrances to nurturing green entrepreneurship are explored. The findings highlight a substantial interest to the promotion of green entrepreneurship within the community, with resource scarcity emerging as a formidable challenge. Moreover, our discrepancy analysis underscores a pressing need for escalated cooperation among key participants, including local enterprises, governmental agencies, and residential communities, to enable the efficacious actualization of green entrepreneurial ventures. The paper extends its probe to capture the community's perspective on green entrepreneurship, considering the viewpoints of women, minority groups, and financially marginalized segments within urban and rural contexts. Despite a robust commitment towards green entrepreneurship detected in the survey responses, the manifestation of sustainability-centred initiatives remains sparse. The paper concludes by delineating the impediments encountered in the proliferation of green entrepreneurship, underlining the vital need for sustained efforts to overcome these barriers and further propel Indonesia's journey towards sustainability. The research delineated in this paper represents a significant leap towards comprehending and fostering green entrepreneurship in Indonesia, providing crucial insights to stakeholders aiming to act as catalysts for future progression in this domain.

Keywords: Green Entrepreneurship, Green Business, Sustainability, Entrepreneurial Skills, Community, Sustainable Development

1. Introduction

Global warming and climate change associated with industrial human activity led to socio-environmental destruction, that requires an immediate and comprehensive response. A promising economic solution gaining momentum in this critical context is green entrepreneurship. This innovative business approach brings together profitability with sustainability and is particularly crucial in emerging economies like Indonesia. It presents a potential pathway to simultaneously significantly contribute to climate neutrality and business competitiveness. Despite its potential, the development of green entrepreneurship is fraught with significant challenges, including insufficient environmental awareness, lack of necessary educational resources, and industry-specific expertise. The present study aims to conduct an in-depth investigation of these barriers and opportunities for green entrepreneurship within Indonesia's rapidly evolving economy. For this purpose, we present a detailed gap analysis focused on the development of green entrepreneurial skills within the community, a key stakeholder in shaping and delivering sustainability efforts. Our research study is part of the ASEAN Network for Green Entrepreneurship and Leadership (ANGEL) initiative, a project funded by the European Union, aiming to enhance the understanding and adoption of green entrepreneurship in the region.

In collaboration with Universitas Gadjah Mada (UGM), we conducted a gap analysis through a community survey and a focus group discussion (FGD), involving a representative sample of community participants. This mixed-method approach offered a holistic perspective on the community's experiences and expectations, thereby helping us to identify gaps and potential areas of improvement in fostering green entrepreneurship. This paper offers insights into the community's perception and practice of green entrepreneurship, highlighting the strong

commitment to and various challenges faced in pursuing environmentally-friendly business initiatives. It further delves into the current state of support, expectations, and challenges towards green entrepreneurship and leadership, as perceived by the community. The present study underscores the importance of overcoming barriers to green entrepreneurship in an inclusive manner, thereby paving the way for Indonesia's transition towards a sustainable economy.

2. Literature Review

The domain of green entrepreneurship, emerging as a powerful catalyst for sustainable economic development, has piqued the interest of scholars globally. By intertwining financial aspirations with environmental goals, green entrepreneurship unlocks avenues in eco-centric markets (Xiaoyi et al., 2023; Gupta & Dharwal, 2022; Schaper, 2016). Its inception owes to several catalysts. Chiefly, it addresses the intricate weave of economic and environmental dilemmas that societies grapple with, forging a blueprint for economic endeavors aligned with eco-conscious principles. This not only counters prevalent challenges but also holds the promise of a sustainable tomorrow (Mukherjee, Onel, & Nuñez, 2016; Barton, 2010).

Significantly, green entrepreneurship is more than just an economic model; it is a transformative movement heralding a transition to sustainable economies. Such economies, by incubating innovation, have the potential to revitalize job markets, benefiting both urban and rural demographics and, in turn, rejuvenating national economies (Chandel, 2022; Halder, 2019). As Papageorgiou et al. (2021a) contend, traditional tools used in entrepreneurial endeavors often portray a static perspective on business conditions. They advocate for dynamic approaches that consider both present and future interrelationships among pivotal business entities. The emphasis on systems theory and dynamic modeling, as noted in their research, provides valuable insights into the holistic environment in which green entrepreneurship operates.

Yet, the path to widespread green entrepreneurship is strewn with hurdles, especially in emerging economies like Indonesia. Limitations range from limited environmental cognizance and capital constraints to the dearth of requisite training infrastructures (Muo & Azeez, 2019). Papageorgiou et al. (2021b) further supplement this by highlighting the value of systemic configurations in supporting entrepreneurial ventures. The incorporation of system thinking and dynamics tools, especially in sectors like the creative arts, can effectively elevate the chances for survival and prosperity of entrepreneurial endeavors by spotting opportunities and enhancing creativity. Given this context, Indonesia's green entrepreneurship arena, despite its pivotal role in global environmental conservation and competitive business, is glaringly under-researched. This research vacuum, juxtaposed with Indonesia's rapid economic ascent, accentuates the significance of scholarly investigations in this realm. Indonesia's role in the ASEAN ensemble, coupled with its endorsement of endeavors like the ASEAN Network for Green Entrepreneurship and Leadership (ANGEL) initiative, underscores the urgency of such an exploration.

Connecting the dots between social entrepreneurship and green entrepreneurship, especially in Asia's dynamic backdrop, is vital. Green entrepreneurship can be seen as a subset of the broader social entrepreneurship movement, with its emphasis on solving societal challenges through business acumen (Hockerts, 2015, 2017). Our inquiry, anchored in Schumpeter's (1942) elucidations on innovative entrepreneurs' economic role and fortified by Hockerts' perspectives, seeks to delve into the multifaceted realm of green entrepreneurship. This encompasses societal, economic, and environmental facets, dissecting their potential to fuel sustainable growth in Indonesian communities. In echoing the broader objectives of the ANGEL initiative, we aspire to deepen the comprehension of green entrepreneurship within Indonesian societies and bridge the gap between the domains of social and green entrepreneurship.

3. Methodology

Utilizing a mixed-methods approach, as advocated by Creswell and Clark (2017) and Molina-Azorin (2012), our research aimed to unpack the intricacies of green entrepreneurship within the Indonesian community. This approach was chosen for its capability to harness both quantitative and qualitative data, thereby ensuring a comprehensive understanding of the topic. The initial phase involved a survey informed by the theories of Cohen and Winn (2007). The survey consisted of several segments. The Demographics segment was designed to gather fundamental data on the participants, facilitating a nuanced demographic-based analysis. The Engagement segment focused on evaluating the nature and depth of interactions between the community and the university, drawing inspiration from York and Venkataraman's (2010) model. The Needs/Support segment aimed to identify specific needs for community development and their preferred sources of support. In the Expectations segment, the survey gauged the satisfaction levels of the participants concerning the role of universities and their aspirations for future engagement. Lastly, the Challenges segment consisted of an open-ended question to

identify specific barriers that the community faces in promoting green entrepreneurship. Subsequent to the survey, a Focus Group Discussion (FGD) was organized, following the guidelines presented by Krueger and Casey (2014). This discussion was primarily driven by the insights gained from the survey. It was also informed by Schaltegger's (2002) work on ecopreneurship and Gibbs' (2009) model for sustainability entrepreneurship. The FGD provided a platform for participants to delve deeper into issues surrounding green entrepreneurship, offering qualitative insights that complemented the survey findings.

Finally, ethical considerations played a pivotal role throughout our research process. Maintaining the highest ethical standards was of utmost importance. All participants were thoroughly informed about the study's objectives, methodologies, potential outcomes, and implications. Ensuring the confidentiality of the participants was a primary concern; thus, all collected data was anonymized and stored securely. Furthermore, focus group discussions were conducted with utmost respect to participant comfort, and every participant was given the freedom to withdraw from the study at any point. Our adherence to these stringent ethical practices was reviewed and approved by a relevant ethics committee, further solidifying the study's credibility and our unwavering commitment to ensuring the well-being of all participants.

4. Results

Within the conducted survey, a representative group of eleven entrepreneur-respondents were analyzed to uncover insights into green entrepreneurship within the local Indonesian community. Both men and women participated in the survey with their age distribution spanning from 27 to 66 years, with a median of 46 and an average of 43 years. With regard to their interaction with Green Entrepreneurship, the range fluctuates between 1 to 28 years, showcasing a varied interaction spectrum. The findings reveal a substantial interest to green entrepreneurship and leadership. However, it is evident that dedicated study programs emphasizing sustainability are limited. Some of the pressing challenges participants indicated include the difficulty in educating communities on sustainable habits, ensuring continuous organizational growth, balancing business funds, synchronizing the green conceptual framework with market demand, and managing production waste efficiently. A recurring theme was the necessity for intensified mentoring, swift access to supporting institutions, and the ability to manage the diverse backgrounds of members within the community.

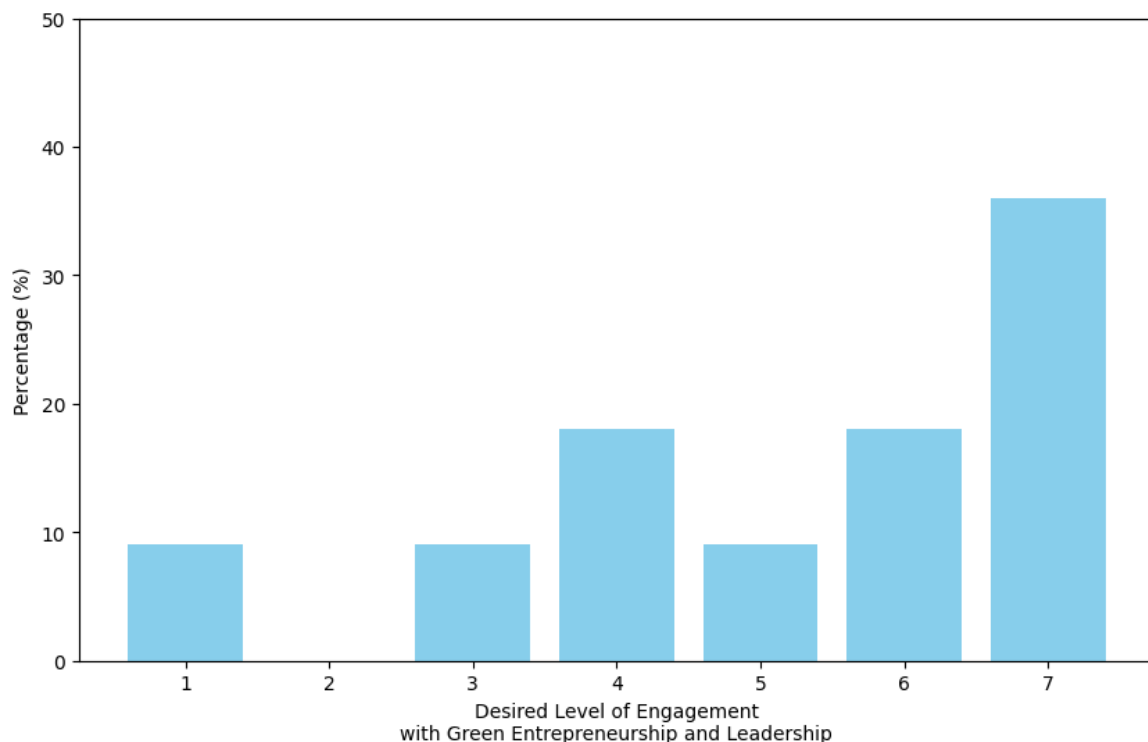


Figure 1: Community's Desired Level of Engagement with Green Entrepreneurship and Leadership

In one particular question in the survey, participants evaluated the extent to which they believe university/educational institutions should be involved with their community regarding green entrepreneurship and leadership. As illustrated in the bar chart of Figure 1, participants displayed diverse opinions on the desired level of involvement. Specifically, 9% feel should maintain its current engagement, represented by "1" on the

scale, where "1" denotes the least engagement and "7" signals the maximum. Further, 9% chose level "3," 18% identified with level "4," levels "5" and "6" were selected by 9% and 18% respectively. Notably, a significant 36% expressed a strong wish for engagement with Green Entrepreneurship and Leadership, highlighted by level "7." The collective insights from Figure 1 underscore the community's strong preference for Green Entrepreneurship. This finding provides an opportunity to governmental and educational institutions to support the community and play a more proactive role in advancing green entrepreneurship and leadership initiatives.

In the Focus Group Discussion (FGD), we delved deeper with four selected participants, all of whom have affiliations as entrepreneurs dedicated to green initiatives and are alumni of university MBA programs. These participants bring a wealth of insights from the entrepreneurial landscape, shedding light on the practical challenges of integrating green initiatives into traditional business models. They highlighted the impediments in securing environmentally-friendly supplies, pointing out the practical drawbacks of biodegradable packaging and consumer preferences that often tilt towards non-sustainable options for reasons such as hygiene. An evident gap emerged during discussions: the pace at which green business practices evolve in the market far outstrips the rate at which academic institutions integrate such practices into their curriculum. While there is a budding emphasis on sustainability in academic discourse, the practical business solutions and a full-fledged commitment to a green community seem lagging.

A notable expectation from these academic institutions is the urgent need for them to accelerate knowledge creation around sustainability. Participants expressed a desire for increased research, tangible studies, and shared practical experiences in this domain. Furthermore, there was a palpable demand for academic institutions to establish dedicated centres fostering green communities. These centres are visualized as hubs of interaction among scholars, entrepreneurs, government officials, and the broader community, fostering discussions and knowledge sharing on sustainability. Drawing on these insights, it becomes clear that the pathway to a greener business future is not without its set of challenges. The commitment of businesses to adopt more sustainable practices is driven not just by entrepreneurial vision but also by the evolving demands of consumers and the environment. Businesses, therefore, are poised at a crucial juncture where they must adapt to this emerging trend. Yet, to do so effectively, they require the cohesive support of academic institutions, government policies, and community initiatives.

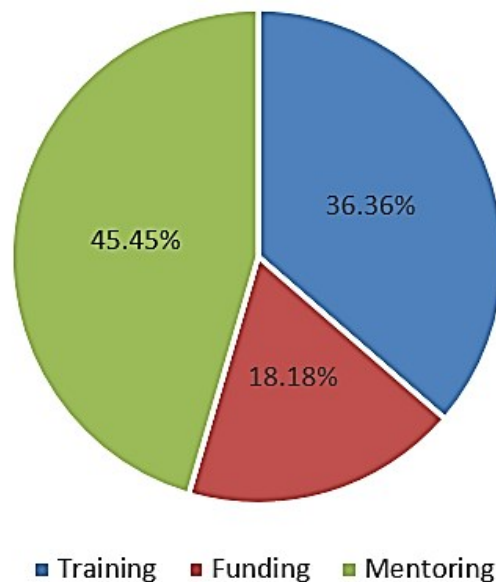


Figure 2: Desire Support on Green Entrepreneurship and Leadership by the Community

To understand the kind of assistance participants need in promoting green entrepreneurship and leadership within their communities, we presented them with several options. The pie chart in Figure 2 captures these preferences. A compelling 46% of the respondents recognized "Mentoring" as the paramount form of support, underscoring the critical role of experienced guidance in this journey. Following this, 36% of respondents emphasized the significance of "Training," indicating the importance of honing skills and knowledge in this realm. Additionally, "Funding" was highlighted by 18% of respondents, spotlighting the role of financial backing for sustainable ventures. The varied responses in Figure 2 provide a comprehensive view of the main needs of communities for support when embarking on green entrepreneurial paths and hint at the potential roles of

educational institutions to cater to these needs. It is quite remarkable that entrepreneurs of local Indonesian communities choose to be educated on green entrepreneurship (82%) compared to be financially supported (18%).

5. Discussion

The Indonesian community's evident enthusiasm towards green entrepreneurship showcased through our survey and FGD results, is indeed promising. However, this enthusiasm, while strong, faces various challenges that hamper the full realization of tangible green enterprises. These challenges, notably in educating communities, balancing business funds, managing waste, and bridging the gap between sustainability concepts and market demands, corroborate global sentiments faced by green entrepreneurs. This community's unique challenges align with Hockerts's (2015, 2017) study on social entrepreneurial intentions, reinforcing the importance of an individual's attitude combined with perceived behavioural control in shaping entrepreneurial ambitions. Our study underscores the pressing need for institutions to be more proactive, not only in integrating sustainability into their curriculum but also in fostering dedicated hubs that promote and nurture green communities. Such sentiments have been echoed by scholars like Gibbs (2009) and Schaltegger (2002) who advocate that 'ecopreneurs' hold the key to a sustainable economy, but their potential can be unleashed only through well-planned interventions.

6. Conclusion

Green entrepreneurship in Indonesia presents a complex landscape. While there's clear excitement for sustainable practices, evident challenges remain that threaten to impede progress. The commitment of the community is unwavering, but the path to manifesting this vision is marred by obstacles, from funding shortfalls to knowledge disparities, and the ever-present market dynamics. Our study, however, signals potential pathways to navigate these challenges. Recommendations span policy adjustments, infusing sustainability into academic teachings, and a fortified community engagement model. In broader strokes, our research findings underscore the intricacies of championing green entrepreneurship in emerging economies like Indonesia. The way forward demands a cohesive effort from all societal segments, including government, academia, business sectors, and the broader community. It is through this collaborative push that we can overcome existing barriers, paving the way for a sustainable business landscape and ensuring a greener tomorrow for Indonesia and other analogous economies.

Acknowledgements

This work was supported by the Erasmus + Programme of the European Union: Project ANGEL - ASEAN Network for Green Entrepreneurship and Leadership (ANGEL, 619421-EPP-1-2020-1-MY-EPPKA2-CBHE-JP).

References

- Barton, D. (2010) "Green growth in Asia: An opportunity for business", *Global Asia*, 4(4), 32-34.
- Chandel, T. A. (2022) "Green Entrepreneurship and Sustainable Development", In *International Perspectives on Value Creation and Sustainability Through Social Entrepreneurship* (pp. 173-208). IGI Global.
- Cohen, B., & Winn, M. I. (2007) "Market imperfections, opportunity and sustainable entrepreneurship", *Journal of Business Venturing*, 22(1), 29-49.
- Creswell, J. W., & Clark, V. L. P. (2017) "Designing and conducting mixed methods research", Sage Publications.
- Denscombe, M. (2017) "The good research guide: For small-scale social research projects", McGraw-Hill Education (UK).
- Gibbs, D. (2009) "Sustainability entrepreneurs, ecopreneurs and the development of a sustainable economy", *Greener Management International*, 55, 63-78.
- Gupta, M., & Dharwal, M. (2022) "Green entrepreneurship and sustainable development: A conceptual framework", *Materials Today: Proceedings*, 49, 3603-3606.
- Haldar, S. (2019) "Green entrepreneurship in theory and practice: insights from India", *International Journal of Green Economics*, 13(2), 99-119.
- Hockerts, K. (2015) "Determinants of social entrepreneurial intentions", *Entrepreneurship Theory and Practice*, 41(1), 105-130.
- Hockerts, K. (2017) "Determinants of Social Entrepreneurial Intentions", *Entrepreneurship Theory and Practice*, 41(1), 105-130.
- Krueger, R. A., & Casey, M. A. (2014) "Focus groups: A practical guide for applied research", Sage Publications.
- Molina-Azorin, J. F. (2012). *Mixed methods research in strategic management: Impact and applications*, *Organizational Research Methods*, 15(1), 33-56.
- Mukherjee, A., Onel, N., & Nuñez, R. (2016) "Business strategies for environmental sustainability", In *An Integrated Approach to Environmental Management* (pp. 195-230).
- Muo, I., & Azeez, A. A. (2019) "Green entrepreneurship: Literature review and agenda for future research", *International Journal of Entrepreneurial Knowledge*, 7(2).

- Papageorgiou, G., Yiannaki, S. M., & Varnava-Marouchou, D. (2021a) "A Critical Evaluation of Contemporary Tools on Developing Innovative Thinking Competencies for Entrepreneurship", In European Conference on Innovation and Entrepreneurship, pp 701-R24, Academic Conferences International Limited.
- Papageorgiou, G., Yiannaki, S. M., Varnava-Marouchou, D., Anastasiades, T., Hadjipapa-Gee, S., & Englezou, D. (2021b) "A System Dynamics Approach to Entrepreneurship Applied to the Case of the Creative Arts Industry", In European Conference on Innovation and Entrepreneurship (pp. 707-R24). Academic Conferences International Limited.
- Schaltegger, S. (2002) "A Framework for Ecopreneurship: Leading Bioneers and Environmental Managers to Ecopreneurship", *Greener Management International*, 38, 45-58.
- Schaper, M. (2016) "Understanding the green entrepreneur", In *Making ecopreneurs* (pp. 7-20). Routledge.
- Schumpeter, J. A. (1942) "Capitalism, socialism, and democracy", Harper & Brothers.
- Xiaoyi, Z., Yang, H., Kumar, N., Bhutto, M. H., Kun, W., & Hu, T. (2023) "Assessing Chinese Textile and Apparel Industry Business Sustainability: The Role of Organization Green Culture, Green Dynamic Capabilities, and Green Innovation in Relation to Environmental Orientation and Business Sustainability", *Sustainability*, 15(11), 8588.
- York, J. G., & Venkataraman, S. (2010) "The entrepreneur-environment nexus: Uncertainty, innovation, and allocation", *Journal of Business Venturing*, 25(5), 449-463.