

Capabilities for Knowledge Management in Virtual Collaboration: A Systematic Review

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Abstract: Virtual collaboration has become an integrated part of knowledge-intensive work, especially after the pandemic. Researchers claim that working partly in the physical workplace and partly working virtually will persist in the future among knowledge workers. As knowledge sharing is a challenge when working across distances, it highlights the need for knowledge-intensive organizations to develop capabilities for knowledge management (KM). Capabilities will be investigated as organizational factors that create, extend, or modify behavior, aiming for effective KM across distances. This systematic literature review explores how knowledge creation, retention, and transfer are managed in virtual collaboration and the required capabilities for this process. Based on 33 articles, the study found that organizational structures facilitating frequent interactions and transactive memory, supported by technology, enable capabilities for KM. Hence, retention and transfer of tacit knowledge are challenged and might be a hindering factor.

Keywords: Virtual collaboration, Knowledge management, Capabilities, Knowledge-intensive work, Knowledge-intensive organization

1. Introduction

Virtual collaboration has increased, particularly after COVID-19, when knowledge workers were forced to collaborate virtually (Miles et al. 2021). Researchers claim that working partly virtual and partly from the physical office is the "new normal" (Kattenbach, Kump & Moskaliuk 2021; Holdt Christensen 2022), especially among knowledge workers (Wang et al. 2020; Hamouche 2021). An ongoing discussion about KM enablers focuses on the KM processes, e.g., Sahibzada et al. (2022), however, the study does not focus on the context of virtual collaboration in hybrid work or virtual teams when working across time, space, and culture. Hence, research demonstrates challenges with knowledge-sharing, spontaneous interaction, and coordination when working from geographical distances (Waizenegger et al. 2020; Kirchner, Ipsen & Andersen 2022). Typically, knowledge work is characterized by being intellectual work with autonomy, requiring extensive communication and coordination (Alvesson 2004:21). Therefore, challenges with KM, e.g., knowledge-sharing, are critical for knowledge workers, as the success of virtual collaboration is highly dependent on effective knowledge processes (Townsend et al., 1998). An increased level of virtual collaboration among knowledge workers, but challenges with knowledge management (KM) demonstrates a discrepancy in ambitions, assuming to impact future knowledge work unless needed capabilities are developed (Mattarelli et al. 2017). In this study, capabilities refer to organizational factors that create, extend, or modify behavior aiming for effective KM across distances (see 2. Background). Although working across time, space, and culture (Fisher & Fisher 2001) increases complexity, demanding employees to attend the physical workplace is not ideal due to the current state of the labor market and employee preferences (Smite et al. 2023).

Examining the literature, this study aims to explore KM when collaborating virtually in knowledge-intensive organizations, answering the question: *Which capabilities are required to support KM in virtual collaboration?*

2. Background

The increased use of virtual collaboration has entailed different work structures, e.g., telecommuting, remote work, or hybrid work (Dimartino & Wirth 1990; Holdt Christensen 2022). Referring to virtual collaboration in this study includes working partly or fully remote from central offices with the possibility of communicating through technology. Virtual collaboration demands KM processes to overcome distances and persist despite different contexts. In knowledge-intensive organizations, knowledge is a key resource (Jemielniak 2012), and the effectiveness of KM is essential for the organization's survival. Examples of knowledge-intensive organizations are human-resource departments. Organizations focusing on the embrained skills of individual members and the cognitive and conceptual skills of employees will not be objective in this study, e.g., software developers (Blackler 1995).

When experiences are transformed into knowledge, the organizational context affects this process (Argote, Denomme & Fuchs 2012). As research ascertains challenges with knowledge sharing when collaborating virtually (van der Meulen et al. 2019; Kirchner et al. 2022), this support that when the organizational context is divided across time, space, and culture, it impacts the KM process. Argote et al. (2003) describe KM as a process consisting of the following KM outcomes: Knowledge creation, knowledge retention, and knowledge transfer. *Knowledge creation* is the subprocess of creating new knowledge. *Retention* is storing and embedding knowledge, persisting over time. *Knowledge transfer* is when knowledge is disseminated, and experiences from a team or organization affect another team or organization (Argote et al. 2003; Argote 2013) However, the outcomes of these processes are interconnected, meaning that retention makes transfer possible, but transfer can establish possibilities for new knowledge creation (Argote et al. 2003). Responding to these processes, research calls for more research about the development of capabilities and how new organizational forms affect this process (Argote 2011).

Capabilities can be defined as "(...) *the capacity of an organization to purposefully create, extend, or modify its resource base*" (Helfat et al. 2007). Resource base refers to tangible, intangible, and human resources (Helfat & Peteraf 2009), which in this review will be resources for KM, enhanced through, e.g., routines. Taking a behavioral approach, capabilities are apparent through routines, processes, decision-making, etc. (Helfat & Peteraf 2009). In this study, analyzing capabilities related to KM will be defined as organizational factors that create, extend, or modify behavior, e.g., routines and processes aiming for effective KM (creation, retention, and transfer) across distances. The capabilities embeddedness is reflected in "*the extent to which a capability is contextually entrenched within the structural, social, and cultural aspects of the firm*" (Grewal & Slotegraaf, 2007, p. 454). Having multiple contexts through virtual collaboration requires these capabilities to persist between contexts.

3. Methodology

This systematic review explores KM in virtual collaboration and the required capabilities for this process, reflected in enabling and hindering organizational factors. Inspired by a framework, the investigation of KM will focus on the process of knowledge creation, retention, and transfer (Argote et al. 2003).

The search was conducted using two databases: Scopus and Web of Science. Based on the research question, the following keywords were used with boolean logic principles and synonyms. The search was performed through Title, Abstract, and Keywords. Only articles and reviews in English were included.

Table 1: Search

Working virtually	Collaboration	Capabilities	Learning and knowledge	Knowledge workers and knowledge-intensive organizations
"working from home" "online work*" virtual* "disper* team*" "hybrid office*" "hybrid work*" telework* "working from anywhere*" remote* (distribut* NEAR/2 team*) (distribut* NEAR/2 organi*ation*)	collaborat* cooperat* Team* coordinati* "work together*" "online collaborat*"	capabili* capacit* ability* "knowledge enabler*"	learn* knowledge*	knowledge* W/3 work* human resource management* "HRM" int*-organi*ational* int* organi*ational* employe* ("Knowledge intensive compan**") ("Knowledge-intensive compan**") ("Knowledge intensive firm**") ("Knowledge-intensive firm**") ("Knowledge intensive organi*ation**") ("Knowledge-intensive organi*ation**")

The inclusion and exclusion process was based on criteria developed according to the research question and appearing in Table 2. Individual capabilities were excluded since the focus is on team and organizational levels. Studies about teaching students have been excluded, as the focus is on organizations with employees. Healthcare and software contexts have been excluded due to the differences and variances in work practices in knowledge-intensive work (see 1.1).

Table 2: Inclusion and Exclusion Criteria

Inclusion criteria	<ul style="list-style-type: none"> Contribute to answering the research question. Intra-or inter-organizational collaboration Network and social network Only journal papers (review or article)
Exclusion criteria	<ul style="list-style-type: none"> The context of students and healthcare Software developers, software teams, software companies Individual capabilities and individual learning Algorithms and collaboration networks Machine learning and modeling.

The flowchart (figure 1) demonstrates the screening. Totally, 338 hits were identified, and after the screening, 33 articles were included in the study.

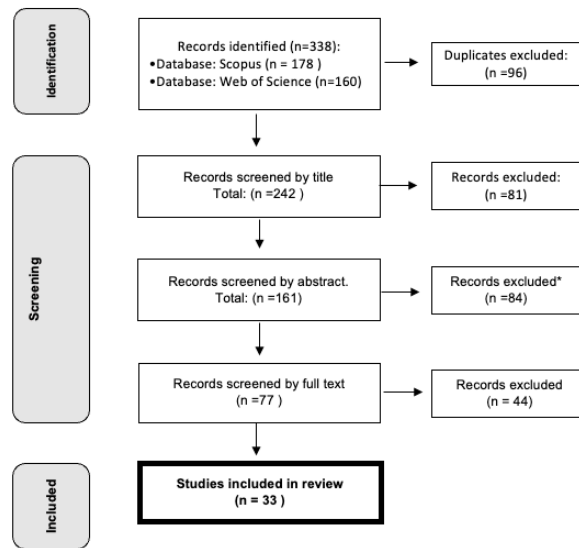


Figure 1: Flowchart

Included articles were systemized through four processes (Figure 2). (1) Sections that involved KM in the included articles were coded with themes. (2) the codes were structured into the KM process: knowledge creation, retention, and transfer. (3) Codes were clustered into themes that emerged from codes. (4) These themes are subheadings in the synthesis, appearing in results (4).

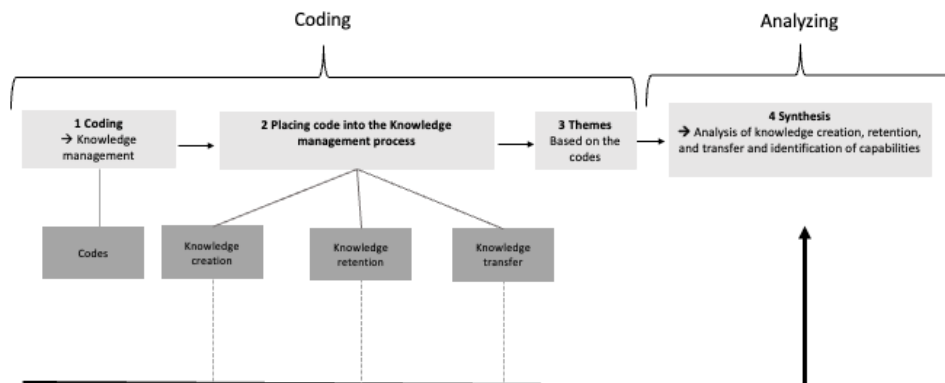


Figure 2: Coding

4. Results

Referring to the codes, table 3 illustrates an overview of the emerging themes connected to the KM process.

Table 3: Themes

	Themes
Knowledge creation	Structure Technology Interaction
Knowledge retention	Shared understanding Transactive memory Technology
Knowledge transfer	Structure Internal and external factors Explicit knowledge

4.1 Knowledge Creation

This section explores how knowledge creation has been managed and identifies needed knowledge when collaborating virtually.

Structure

Studies report how structural changes have been made to enable KM, e.g., implementing a new organizational structure to improve collaboration during the pandemic (Chakrabarti & Mukherjee 2022) or knowledge-sharing platforms to ensure knowledge exchange (Abualqumboz 2022). Regarding intra-organizational structure, research proposes alignment of policies and practices (Harvey, Novicevic & Garrison 2004; Bosch-Sijtsema et al. 2011). Bookhamer and Zhang (2016) argue that IT capabilities must be incorporated strategically to secure KM across distances. Hence, structure and facilitation of virtual collaboration through digital platforms (thinkLets) might be a way to enhance knowledge sharing (Horwitz & Santillan 2012). These studies demonstrate that structures must be established to enable knowledge creation, which needs to be reflected in the organizational structure, policies, and practices.

Technology

As a part of facilitating structure when collaborating virtually, technological tools must be available. Bosch-Sijtsema et al. (2011) found that a lack of communication tools challenged information sharing. However, it is important to consider the technology design (Akoumianakis 2009) and facilitation of knowledge-sharing activities through collaboration tools (Horwitz & Santillan 2012). Hence, employees need knowledge and experience with technological tools to use them (Thomas & Bostrom 2010), highlighting the need for different skills and realigning employees' skills (MacDuffie 2007; Pass & Ridgway 2022), e.g., technical skills (MacDuffie 2007; Pass & Ridgway 2022). Based on these studies, technology tools and realignment of skills are important in enabling knowledge creation when working virtually.

Interaction and communication

Creating knowledge and shared experiences through heterogeneous backgrounds (Qureshi et al. 2018) depends on how organizations find new ways of communication and organizational abilities (Rezazadeh & Molaei 2018), as traditional social mechanisms do not facilitate communication (Demirel 2020), resulting in communication being challenged (Zeuge et al. 2023). Exemplifying this, joint online breaks during the pandemic were found to be important, strengthening information sharing or creation of informal exchange activities (Zeuge et al. 2023). Arguing that spontaneous communication does not happen naturally when working virtually, it must be concerted action (MacDuffie 2007). Researchers claim that communicating virtually might decrease information sharing (Demirel 2020) and employees' ability to engage in issues (Knoll, Feldt & Zacher 2022). However, leaders also play an important role in minimizing distance through technology and encouraging information flow (Contreras, Baykal & Abid 2020). The frequency of social virtual interactions effectively increases knowledge sharing (Qureshi et al. 2018), which is supported by Gratton & Erickson (2007), proposing that structures and routines of interaction are supported through a "gift" culture enabling collaborative behavior where interaction is seen as a valuable gift.

4.1.1 Capabilities for knowledge creation

Overall, these studies propose managing knowledge creation through (1) generating structures in the organization that facilitate collaboration and are supported by policies and strategies, (2) Supporting structures through technological tools and realigning employees' skills. (3) Interaction, facilitated through joint action and frequent social virtual interaction. Enhancing capabilities for knowledge creation is, therefore, dependent on structures and technology facilitating interaction. However, these studies do not elaborate on how experiences are generated in practices and how experiences are applied in the interaction between employees, which is also a part of knowledge creation.

4.2 Knowledge Retention

This section focuses on both explicit and tacit retention of knowledge. Explicit knowledge can transmit through language, and tacit knowledge is often context-specific and unconscious know-how (POLANYI 1962; Nonaka & Takeuchi 1995).

Shared understanding

Multiple locations in virtual collaboration might affect unwritten norms and assumptions that guide behavior, as some knowledge is stored in the physical context (Assudani 2009). Researchers propose that mobility negatively impacts shared codes, values, common, and collective knowledge (Griffith, Sawyer & Neale 2003; Ali-Hassan, Nevo & Nevo 2010). A study about situated knowledge, which is "*knowledge embedded in the work practices of a particular organizational site*" (Sole & Edmondson 2002:20), found that remotely situated knowledge was harder to recognize than locally situated knowledge, both because norms of participation are different, and the physical context is different. Similarly, Demirel (2020) argues that virtual communication struggles with delivering social and contextual information about tasks. MacDuffie (2007) highlights that shared understanding is especially important in distributed work with interdependent tasks, requiring both receiving consistent knowledge, and organizational members having a common language, common ground, and shared reference frame when facing problems. Often, shared understanding can be challenged in distributed work (Al-Habaibeh et al. 2021), and there might also be a less shared understanding of tasks (Griffith, Sawyer & Neale 2003; Gifford 2022). More studies propose temporary stay in another location, either to get insight into other locations' situated knowledge in dispersed teams (Sole & Edmondson 2002) or as a way to transfer norms and practices (Choudhury 2020)(see 4.3). Similarly, Kauppila et al. (2012) propose that physical meetings are necessary to acquire a shared understanding, enabling the internalization of knowledge. These studies highlight how contextual knowledge and shared understandings are important but challenging to retain when working virtually.

Transactive memory

Transactive memory is a shared system for organizing, storing, and retrieving knowledge (Griffith et al. 2003), which is important for knowledge retention when working across distances (Sole & Edmondson 2002). However, more studies point out that the development of transactive memory can be challenged (Griffith et al. 2003; MacDuffie 2007; Assudani 2009). Griffith et al. (2003) propose that high levels of virtuality have a negative impact on the development of transactive memory. Similarly, Macduffie (2007) argues that familiarity from frequent interactions makes it easier for colocated employees to develop transactive memory than virtual teams. Nevertheless, familiarity between organizational members (Assudani 2009) or a high level of communication and interaction (Al-Habaibeh et al. 2021) can increase the development of transactive memory. An example of a low transactive memory was found in cases where work processes were not stored or shared, which resulted in double work (Bosch-Sijtsema et al. 2011; Zeuge et al. 2023). However, Griffith et al. (2003) propose that the level of transactive memory is connected to the level of technological and organizational systems that support transactive memory development, e.g., an intranet portal (Kauppila 2012). Furthermore, Jackowska & Lauring (2021) found that physical distance and lack of information about organizational colleagues contributed to a negative perception of employees' location and knowledge utilization (Jackowska & Lauring 2021). These studies demonstrate that transactive memory is important but might be challenged when collaborating virtually, highlighting a need for frequent interactions and technology.

Technology

Internet or intranet is an important communication technology in the retention process, creating the possibility for teams to archive information, e.g., monitoring processes of projects (Demirel 2020). However, the use of technology will be affected by the group's social adaption of technology into working styles and routines (Demirel 2020). Corso et al. (2009) found that the use of the intranet has changed from being a top-down channel to a place where employees can find the needed information to learn and interact with others, which is in line with the demands for technology in the retention of knowledge. When collective knowledge is formed in virtual teams, it is more assessable (Griffith et al. 2003). Using technology to communicate and developing norms for knowledge retention through communication channels will develop the possibility of transferring knowledge (Al-Habaibeh et al. 2021).

4.2.1 Capabilities for knowledge retention

Overall, the studies demonstrate the retention process of tacit and explicit knowledge when collaborating virtually. An efficient retention process in virtual collaboration involves (1) Shared understandings and contextually anchored tacit knowledge, which is challenged and, therefore, requires temporary stays in the physical location. (2) An efficient transactive memory enabled by frequent interactions, technology, and familiarity with organizational members. (3) Technology that supports transactive memory and communication. Thus, studies highlight the importance of developing tacit and explicit knowledge retention capabilities but

acknowledge challenges with retaining tacit knowledge when collaborating across distances. Propositions of physical relocation to enable shared understandings might be costly for organizations in the future, and therefore retention of tacit knowledge might be a hindering factor when enhancing the capabilities of knowledge management.

4.3 Knowledge Transfer

Transferring knowledge can be between different organizations (inter-organizational) and within the same organization (intra-organizational). The following studies demonstrate examples of both processes.

Structure

Structural changes within an organization might be needed to enable knowledge transfer when working across distances. A proposition of intra-organizational knowledge transfer is moving employees from the place of knowledge creation to where knowledge needs to be transferred (Choudhury 2020). Moving employees physically would also allow tacit knowledge transfer (Choudhury 2020). Another study demonstrated establishment of virtual teams with expert knowledge – "knowledge activists" facilitating internal knowledge transfer and knowledge sharing in the organization (Kauppila 2012), or "knowledge pools" organized around skills (Baker et al. 1997). Haas (2006) investigated knowledge transfer by employing locals and cosmopolitans (employees with knowledge from different countries) (Haas 2006), assuming that cosmopolitans contributed with technical knowledge and locals contributed with national knowledge (Haas 2006). These findings demonstrate examples of structures increasing capabilities for intra-organizational knowledge transfer.

Internal and external factors

Internal factors can impact the level of knowledge transfer, e.g., when knowledge that is visible and shared, is used and acquired by others (Kauppila 2012), which is considered a motivational factor for knowledge transfer. Similarly, the level of absorptive capacity, defined as the organizational and internal capacity of employees to recognize new knowledge and integrate it, was increased by the level of communication (Rehman, Khawaja & Ali 2019). However, a high level of workload decreased knowledge transfer (Bosch-Sijtsema et al. 2011).

Transferring knowledge inter-organizational can be established through networks (Sabah & Cook-Craig 2010; Caldas & Cândido 2013). Hence, there is a risk that the motivation for sharing and transferring inter-organizational knowledge is limited due to incentives. A study found that an inter-organizational network did not transfer and share information with other participants because they were holding proprietary information and seeking individual benefits rather than collective advantage (Caldas & Cândido 2013). This shows that external and internal factors impact knowledge transfer.

Explicit knowledge transfer

More researchers underline that knowledge transferred through technology is more likely to be explicit, as the transfer of tacit knowledge is challenging (Griffith et al. 2003; Kauppila 2012; Al-Habaibeh et al. 2021). Virtual teams will therefore try to transform implicit knowledge into explicit knowledge (Griffith et al. 2003), but deep tacit knowledge will be hard to transfer (Kauppila 2012). However, according to Demirel (2020), knowledge transfer in virtual teams highly depends on common values, shared understandings, and trust, where the efficiency of knowledge sharing is affected by tacit factors, e.g., organizational trust (Cheng et al. 2022). This is supported further by Al-Habaibeh et al. (2021), arguing that a high level of common ground will make it easier to transfer knowledge and lead to learning. In accordance with the retention of tacit knowledge, these findings indicate that virtual knowledge transfer is more likely to be explicit knowledge, and implicit knowledge must be translated into explicit forms (Griffith et al. 2003; Kauppila 2012; Al-Habaibeh et al. 2021). As implicit knowledge does not have an inherent structure, makes it impossible to write down, requiring multiple interactions, which technology must provide (Baker et al. 1997) However, deep tacit knowledge might still be impossible to transfer into a usable explicit form (Kauppila 2012). These studies propose that enabling structure and considering internal and external factors might increase knowledge transfer in explicit form, but deep tacit knowledge might still be challenged, and therefore be considered as a hindering factor.

4.3.1 Capabilities for knowledge transfer

Overall these studies demonstrate how to manage the knowledge transfer process in virtual collaboration through (1) Establishing structures that facilitate inter-organizational knowledge transfer, e.g., through virtual teams with the purpose of internal transfer of knowledge, (2) Managing internal and external factors which can increase or decrease motivation and time for knowledge transfer (3) Virtual transfer of knowledge will be

explicit, but enabled through tacit factors. Similarly, as challenges with retention of tacit knowledge, these studies highlight challenges with transferring deep tacit knowledge, even though this is considered as an enabling factor for knowledge transfer. Enhancing capabilities for knowledge transfer through these factors might enable explicit knowledge transfer and implicit knowledge that can be translated into explicit form. Hence, transferring deep tacit knowledge is still challenged, assumed to be a hindrance that starts with the retention of tacit knowledge.

5. Discussion and Conclusion

The purpose of this study was to investigate KM when collaborating virtually in knowledge-intensive organizations, exploring the required capabilities for KM. Based on a systematic review of 33 articles, we investigated the enabling and hindering organizational factors in the processes of knowledge creation, retention, and transfer, forming the capabilities for KM.

The findings demonstrate that *knowledge creation* is facilitated through structures that enable interaction and collaboration through technology (e.g. Chakrabarti & Mukherjee 2022). *Retention* of explicit knowledge is established through transactive memory, enabled by interactions, and supported by technology (e.g. Al-Habaibeh et al. 2021). *Retention* of tacit knowledge is challenged, suggesting temporary employee stays (e.g. Sole & Edmondson 2002). Similarly to knowledge creation, intra-organizational knowledge transfer is generated through organizational structures (Kauppila 2012). Hence, transferring intra and inter-organizational knowledge can be affected by internal and external factors, determinizing motivation (e.g. Caldas & Cândido 2013). Transferring knowledge virtually might be explicit (Griffith et al. 2003), as it is challenging to transfer deep tacit knowledge (Kauppila 2012) even though tacit knowledge enables knowledge transfer (Demirel 2020; Al-Habaibeh et al. 2021).

Based on the findings, capabilities for KM in virtual collaboration are enhanced through organizational structures reflecting the needs of virtual KM, frequent interactions, and technology that supports routines for communication and the creation of transactive memory. As organizational structure appears as a central capability, this finding supports that the organizational context affects the KM process (Argote et al. 2012). However, an unsolved challenge and major hindrance is the retention of tacit knowledge and transfer of tacit knowledge without relocating employees. However, tacit factors enable the retention and transfer of knowledge (Demirel 2020), making this a crucial hindrance that might affect the KM process significantly and hinder the enabling factors. This highlights the importance of future research investigating the retention and transfer of tacit knowledge when collaborating virtually. Similarly, this challenge emphasizes research to shed light on hybrid work – working partly at the office and partly virtual, where partly collocation is an integrated part of the work structure. Therefore, a limitation of this study is limited hits concerning virtual collaboration through hybrid work. Another limitation is the fast-developing technological tools, which makes some of the included articles outdated in relation to technological abilities.

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