Strengthening digital innovation processes by effectively structuring the management of knowledge for organizations in the B2B information technology sector

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Award date:
2021

Department of Industrial Engineering and Innovation Sciences

Master Thesis

Strengthening digital innovation processes by effectively structuring the management of knowledge for organizations in the B2B information technology sector.

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MSc Innovation Management
Student ID: 0885082
Publishing date: 18-08-2021

In partial fulfillment of the requirements for the degree of:
Master of Science in Innovation Management

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Series: Master Thesis Innovation Management

Keywords: Organizational knowledge management, Digital innovation processes, Environmental technology scanning, Design science research, Business-to-business IT sector

Management Summary

Background

Knowledge is a key enabler for continuous organizational innovation and thus a source of competitive advantage. Therefore, organizations benefit from well-structured knowledge management practices.

In the knowledge-intensive business-to-business IT sector specifically, it is challenging for organizations to document the knowledge of their employees due to the high prevalence of tacit knowledge. This type of knowledge is more difficult to quantify than explicit knowledge.

B2B IT organizations create value for their clients by engaging in digital innovation processes, which means carrying out new combinations of digital and physical components based on digital tools and technologies. In the current organizational management literature, several sources consider the knowledge management practices in the IT sector in general. However, there is a gap in the literature concerning the role of knowledge management for digital innovation processes specifically.

The purpose of this thesis is to fill this theoretical gap by conducting design science research to come to implementable strategies concerning how to structure knowledge management effectively to strengthen the digital innovation processes of B2B IT organizations.

Problem statement

As a case study, this research is conducted in the context of Company A, an all-round B2B IT solution provider. Division A is one of the newest additions to Company A's services, providing an environment where existing and new clients are involved in design-thinking to experiment with new technologies. As one of the largest Dutch B2B IT organizations, Company A is a suitable company to assist in the creation of boundary objects that would support KM in the digital innovation processes of this class of organizations in general.

After exploratory meetings, the problem statement was formulated as follows:

Division A currently has an ineffective process of generating, sharing and integrating knowledge. This results in unstructured decision-making about which projects to work on, a lack of structure for how these projects can best be handled and general difficulties in extracting value from the knowledge of Company A's employees. Consequently, Division A's digital innovation processes do not always progress towards reaching their main goals.

See Figure 1 for the cause-effect diagram of Division A.

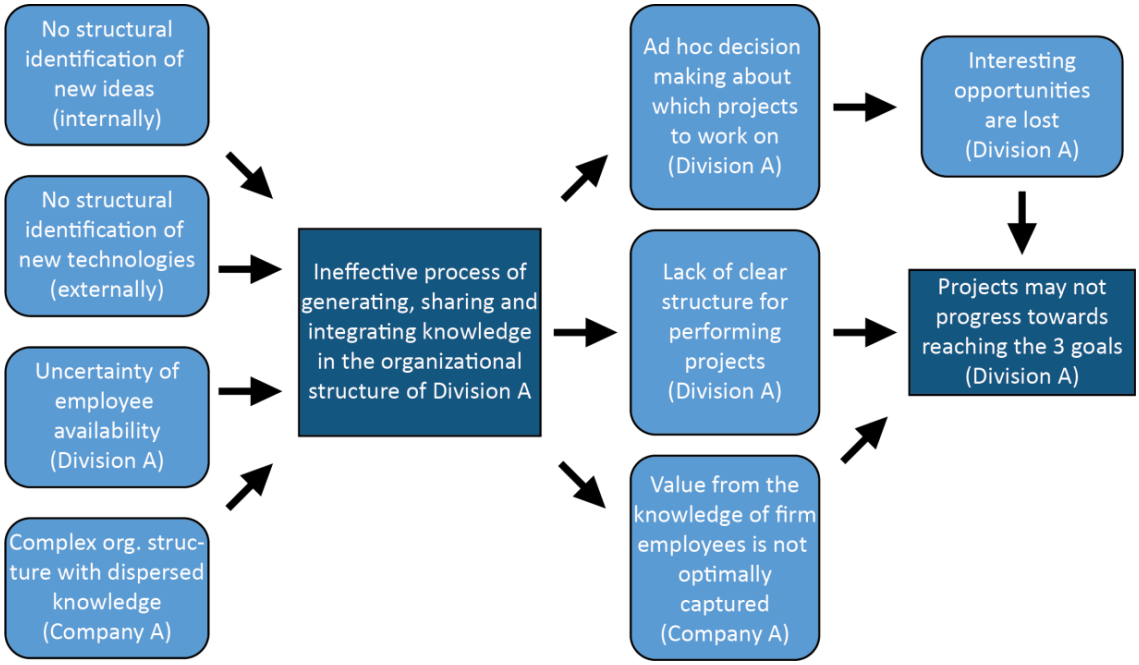

Figure 1: Cause-effect diagram of Division A

Research Question

Based on the research context, the following research question was formulated:

'How can the management of knowledge be structured effectively to strengthen the digital innovation processes of organizations in the B2B IT sector?'

This research question was divided into four sub-questions. The first sub-question was answered by conducting a theoretical analysis, whereas the second and third sub-questions were answered by conducting an empirical analysis at Division A.

The final sub-question was answered by combining the theoretical and empirical results into implementable strategies following a design science methodology.

Methodology

This thesis follows the design science methodology and combines its two strategies: theory-driven design science and practice-driven design science. The mission of design science is to develop general knowledge to support the design of solutions to field problems. This approach suits the purpose of providing a method to bridge the gap between theory and practice in the given problem context.

The theoretical analysis was carried out by employing a systematic literature review built around the constructs of *knowledge management* and *digital innovation processes*. Based on the final set of articles, five theoretical themes were identified: *1) organizational knowledge management, 2) environmental technology scanning, 3) knowledge creation, 4) knowledge sharing,* and *5) knowledge acquisition.* Outcome-based analyses were performed on these theoretical themes to provide an overview of the current literature, leading to design guidelines.

The empirical analysis was carried out by conducting semi-structured interviews with all sorts of employees across the organization. Based on these interviews, five empirical themes were

identified: *1) the goals of Division A, 2) the need for dedicated employees, 3) effective knowledge sharing in the current setup, 4) a lack of centralized vision of trends and technology,* and *5) the challenges concerning external reach and monetization*. Whereas some themes were brought up more frequently than others, these five themes were most prevalent in the interviews. Based on these themes, more design guidelines were presented.

Designs

After defining the design directions and design requirements based on the theoretical and empirical results, three concept designs are proposed by the author.

The first design pertains to the implementation of a **knowledge repository** to provide an overview of past and current projects to stimulate knowledge sharing.

The second design is a framework for **centralized portfolio management** in which internal and external knowledge is combined during periodic portfolio deliberation sessions to develop an organization-wide vision on trends and technologies.

The third design revolves around **assigning communication roles** to specific employees to get a more complete and actionable knowledge base in the center of a specific division.

After a thorough evaluation of the three design concepts, the selected artefact is the framework for portfolio management due to its adherence to the design requirements and relevance for Division A in terms of potential impact. See Figure 2 for the final version of this artefact.

Discussions and Conclusion

The research question was answered by synthesizing the theoretical and empirical analyses into an artefact that serves as a boundary object that could help B2B IT organizations to strengthen their digital innovation processes by effectively structuring their KM processes. This is also the main theoretical contribution of this thesis, which fills the theoretical gap that was identified in the form of an implementable strategy to improve digital innovation processes.

The centralized portfolio management framework resulting from this research contains theoretical value by being based on several theoretical concepts. The framework ties into several articles about knowledge mapping and the ability to make well-informed decisions when the knowledge gaps are evident (Calabrese & Orlando, 2006; Millar, Lockett & Mahon, 2016), formal environmental technology scanning (Borges & Janissek-Muniz, 2018) devising a learning-oriented decision-making process (Barabba, 2018) and configuring internal and external networks (Lopez & Estevez, 2013).

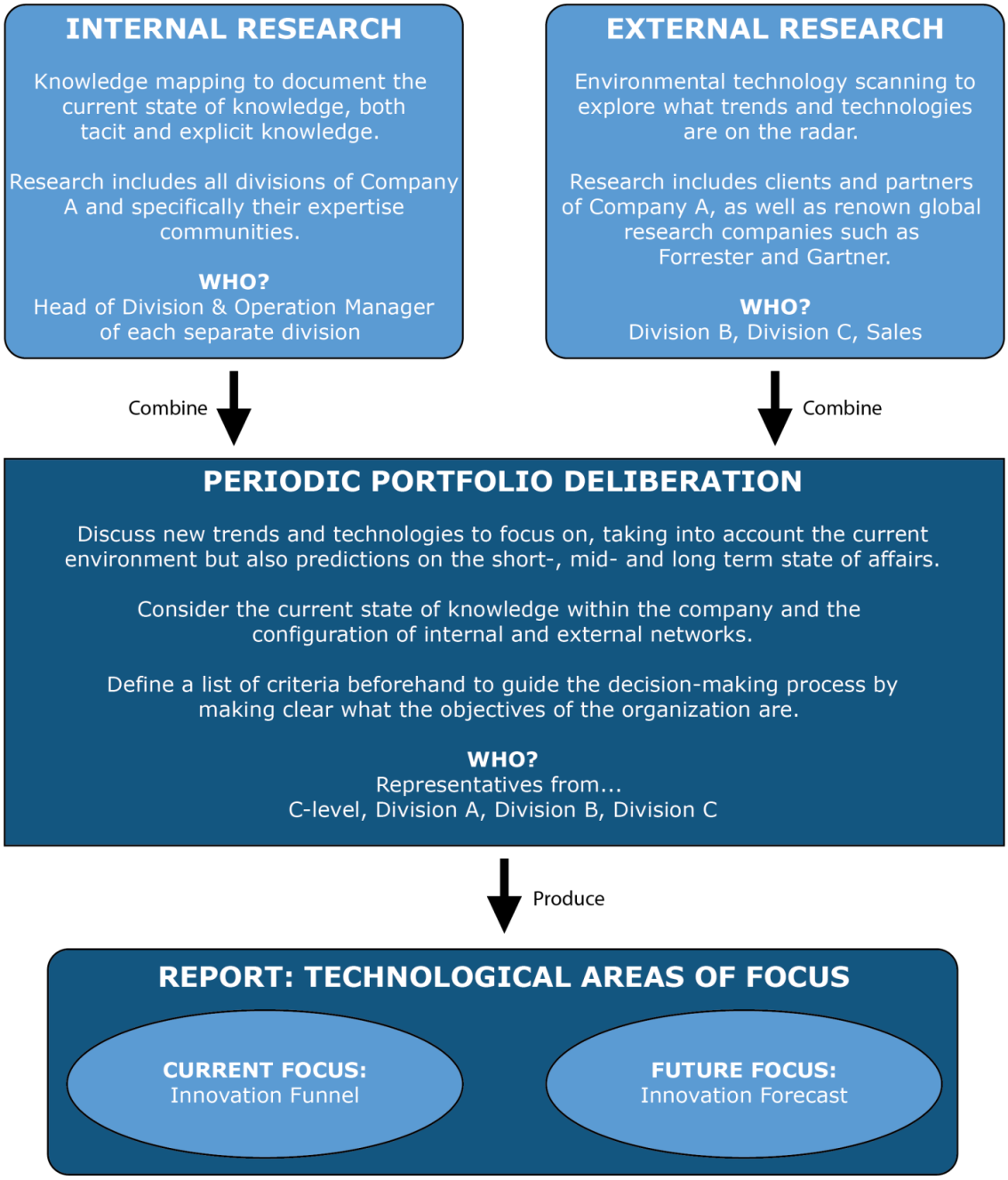

Figure 2: Centralized Portfolio Management Framework

The resulting artefact is an addition to the organizational science in the form of a boundary object that allows practitioners to implement the best practices of knowledge management literature without having to perform a literature analysis. The final artefact can be implemented by B2B IT organizations that aim to structure their knowledge management processes more effectively, and is adaptable to the needs and constraints of whoever wishes to use it. From a managerial perspective, the three design concepts can be generalized to pertain to the digital innovation processes for other B2B IT organizations than Company A exclusively.

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1. Introduction

Knowledge plays a central role in today's organizations, serving as one of the most important enablers of continuous innovation and thus a source of competitive advantage (Nonaka, Yoyama & Konno, 2000). Ensuring an effective environment for sharing, creating and acquiring knowledge through knowledge management (KM) helps an organization's employees to work efficiently and productively.

In the current business-to-business (B2B) information technology (IT) landscape, the complexity of delivered products and services increases at a fast pace due to technological advancements and therefore, effective knowledge management (KM) is essential. KM in the IT sector is challenging, however, since it mainly revolves around tacit knowledge and not explicit knowledge (Chandani & Neeraja, 2007). Tacit knowledge is relatively difficult to quantify or document, and therefore practitioners need KM strategies to bring structure to their digital innovation processes.

Most research in the IT sector focuses on specific parts of specific KM practices such as only the acquisition (for example Li et al., 2009; Gupta & Govindarajan, 2000) or creation (for example Smith, 2016.; Song, Yoon & Uhm, 2012) of knowledge. For digital innovation processes specifically, there is a gap in the literature concerning implementable strategies that adhere to the best practices of KM. Thus, the author argues that the role of KM for these processes is underrepresented in the literature, and presents a gap to be filled.

A design science approach is used in this research to apply theoretical insights to the practical circumstances of a Dutch IT solution provider. As a result, this research presents design solutions that serve as boundary objects to facilitate the mediation of science and practice (Tanskanen et al., 2017). Based on organizational literature, these boundary objects could help B2B IT organizations to strengthen their digital innovation processes by effectively structuring their KM processes.

As a case study, this research is conducted in the context of Company A, an all-round B2B IT solution provider. Division A is one of the newest additions to Company A's services, providing an environment where existing and new clients are involved in design-thinking to experiment with new technologies. This research specifically focuses on the digital innovation processes of Division A, aiming to evaluate and improve upon the current organizational structure by following a design science approach. As one of the largest Dutch B2B IT organizations, Company A is a suitable company to assist in the creation of boundary objects that would support KM in the digital innovation processes of this class of organizations in general.

This thesis first introduces the research context by elaborating on the business context and theoretical background. Additionally, the main research question and several sub-questions are formulated to solidify the aim of the research. The following section introduces the methodology which was followed while conducting this research, outlining the design science methodology and its strategies, as well

as stating the measures that were taken to ensure the reliability and validity of the research. Next, the results section elaborates on the results of the theoretical and empirical analyses, yielding design guidelines. Consequently, design directions and requirements are formed to guide the process of making three concept designs, one of which is chosen to become the final design after an evaluation. The final section provides answers to the research questions and discusses the theoretical and managerial implications of this research. In the end, the limitations of this research and suggestions for further research are elaborated on.

2. Research Context

In this chapter, the business context and theoretical background are first elaborated upon before the research questions are introduced.

2.1 Business Context

The world is considered to have entered a new historical period called the *Information Age;* a period in which the rise of information technology (IT) transforms the world's economies, societies and cultures (Castells, 1996). The introduction of technologies like computers and the internet has fundamentally shifted the way products and services are perceived and is often referred to as digitalization (Negroponte et al., 1995).

According to Gartner, digitalization is defined as "the use of digital technologies to change a business model and provide new revenue and value-producing opportunities; it is the process of moving to a digital business" (Gartner, n.d.). This definition coins digitalization as a way to exploit new opportunities and create more value as a consequence by utilizing IT. The transformational power of digitalization can best be understood by examining several ways in which digital innovations have shaped the way organizations conduct business (Milani, 2019), as portrayed in Table 2.1.

Table 2.1: Impact of digitalization on traditional business models (Milani, 2019, adapted)

#	Impact of digitalization
1	Digital technologies have enabled separating data from the physical objects. Music, books, magazines, money and many other products that were recognized in their physical form, have now become digital. (p.14)
2	Data is cheaply stored, sent, accessed and shared so that it can be available at all the places it is needed. The cost of sharing data is virtually zero. (p.14)
3	Digitalization has also allowed work to be detached from a specific physical space. By means of a wireless connection, laptops, notepads, and mobile apps, the customer has access to all data and functions from any location. (p.15)
4	Digitalization allows for the collection of real-time data that can be used by organizations to analyze, predict, plan, and adapt to the changing needs and context in which they operate. (p.15)

5	Digitalization disrupted the trade-off between reach and richness. Formerly, reaching a large audience often meant a decrease in the quality or richness of the contents and vice versa. With today's possibilities of online channels, this trade-off is put out of play. (p.16)

Digitalization has major implications for how companies conduct business. '*Every company is now a software company*' is a common paradigm that accurately describes the current state of the world. The paradigm gained traction in the early 2000s and is becoming increasingly relevant as the century develops. Microsoft's CEO Satya Nadella often shares this view, emphasizing that "computing is a core part of every industry" and therefore there will not be a tech industry in the future but rather a widespread embeddedness of IT in all other industries (Microsoft News, 2018; Holmes, 2019).

In other words, this paradigm emphasizes the importance of dealing with digitalization. Hence the emergence of scientific literature concerning *digital innovation,* which is referred to as "the creation of (and consequent change in) market offerings, business processes, or models that result from the use of digital technology" (Nambisan et al., 2017, p. 224). According to this definition, digital innovation includes a wide range of outcomes such as products, platforms and services, that do not necessarily have to be digital themselves. Instead, the emphasis lies on the use of digital technologies and digitized processes to arrive at these outcomes.

Dealing with digital innovation is especially challenging for companies that are not IT-centered at the core. Increasingly often, these companies are forced to either incorporate IT knowledge in order to keep up with the market, or turn to external knowledge in the form of partnerships or insourcing, both of which are forms of *digital innovation management* (Henfridsson et al., 2014). Digital innovation management refers to "the practices, processes, and principles that underlie the effective orchestration of digital innovation" (Nambisan et al., 2017, p. 224).

Many IT firms are specialized in providing services and solutions to support companies from other sectors in their digitalization efforts. In order to do so, it is vital for IT firms to create a suitable infrastructure to be able to provide these services, thereby strengthening their own digital innovation processes. Specifically, IT firms must create an environment where knowledge is generated, shared and integrated effectively (Nonaka & Toyama, 2003) and IT firms must keep up with new technologies in order to stay relevant and improve their value offerings (Van Wyk, 1997).

2.1.1. Business context: Division A

The research is conducted at Company A; one of the largest all-round IT service and solution providers in the Netherlands. They have over 25,000 professionals worldwide, collaborating to provide B2B services. Employees either are seconded

to clients for specific periods or work on projects (e.g. apps) from within Company A to enhance aspects like their clients' business growth, agility and flexibility.

Employees that are temporarily not involved in a secondment or project are encouraged to work on exciting ideas using new technologies. Some of these ideas turn out to be valuable projects for Company A's clients, whereas others provide educational benefits for the employees and offer them an opportunity to experiment. In an effort to centralize and improve these efforts, Division A was introduced in April 2020, providing a physical location to come together and practice the design thinking mindset. It is still in its start-up phase. All initial information in this research about Division A was derived from exploratory meetings with the manager of Division A.

According to her, the goals of Division A are threefold: 1) serving as an environment that allows employees to bond and work on exciting topics; 2) improving the innovative capabilities of employees in a practical setting, and 3) presenting valuable outcomes to clients leading to further acquisition and profits. The formation of Division A is not the first project of its sort: in 2016, Company A launched a comparable digital start-up to create more space for innovation and experimentation.

Although it served the same goals, the start-up was discontinued and replaced by Division A for several reasons. First, it became detached from Company A in terms of culture in the sense that the employees did not feel like they were part of Company A anymore. This caused a divide which translated into a disruption of shared goals. Secondly, as the start-up operated apart from its parent company, it did not have access to the expertise, communities and internal quality-assuring measures of Company A. As a consequence, it was a large challenge for them to provide good solutions for their clients. Finally, the start-up's efforts did not improve Company A's image of being innovative and attractive for clients due to the division of responsibilities. In the end, the decision was made to replace the start-up to solve these issues, leading to the start of Division A.

2.1.2. Problem Statement

Division A has been active since early 2020. The current structure and place of Division A in the overall organization, however, cause several issues that hamper the progress towards reaching the three goals. Based upon exploratory meetings with the manager at the beginning of this research, there seems to be an ineffective process of generating, sharing and integrating knowledge due to several reasons, as captured in the cause-effect diagram in Figure 2.1.

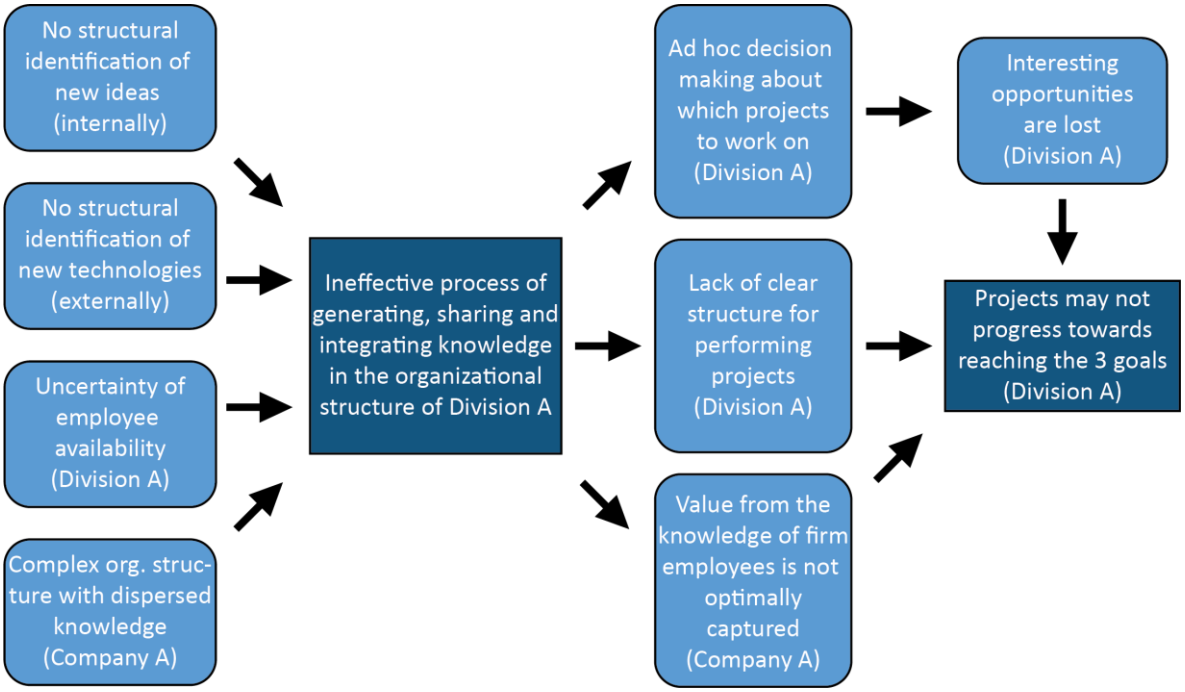

Figure 2.1: Cause-effect diagram of Division A

First, Division A currently does not enjoy a structural inflow of new ideas derived from Company A's employees situated in other branches of the organization. It would likely be beneficial for Division A if there was a way to collect input from all these people. Currently, the ideas that go into Division A are generated by the people who are already involved with the organizational unit. In early 2021, an internal idea suggestion app was released to collect ideas from more employees. However, there is still a challenge to make initiatives like these come to life in the rest of the organization since the people who have used the suggestion app were all involved in Division A already.

Secondly, Division A currently has no way to structurally identify new technologies to base projects upon. In parallel to the identification of new ideas, the technologies that are considered for new projects mainly arise from the employees that are currently involved in Division A. Again, it would be beneficial to have a backlog of promising technologies that can be used to commence new projects with. This involves a thorough scanning of new technologies, as well as structural externalization of tacit knowledge of employees that are involved in the newest trends in IT.

Thirdly, the setup of Division A causes uncertainties concerning the availability of employees. From Company A's viewpoint, this aspect is two-sided. On the one hand, a situation in which very few people are available for Division A means that all others are seconded or working on projects, meaning the firm is doing well in terms of business. On the other hand, situations where a large portion of people is available for Division A are paired with a relatively low placement on regular projects. Either way the circulation of available employees is something that currently has to be dealt with and although it impairs the capability to develop long-term teams, it does offer a wide range of employees the possibility to experiment with technologies during a Division A project.

Finally, the complex organizational structure of the firm itself causes for knowledge to be dispersed between all different branches. Naturally, having to deal with such a broad range of expertise and clients comes with a broad set of skills and knowledge that can become rather specialized. But even beyond the functional business units, several different knowledge institutions are not clearly linked yet to Division A specifically. One example within Company A is Division B, whose employees write reports about the latest technology trends like synthetic media and artificial intelligence. Other examples are the emergence of *expertise communities* where like-minded experts share their knowledge on specific topics, or Division C where global policy is written on the digital portfolio of Company A.

These four causes lead to the problem statement, which is formulated as follows:

Company A currently has an ineffective process of generating, sharing and integrating knowledge. This results in unstructured decision-making about which projects to work on, a lack of structure for how these projects can best be handled and general difficulties in extracting value from the knowledge of Company A's employees. Consequently, Division A's digital innovation processes do not always progress towards reaching their main goals.

2.2. Theoretical Background

2.2.1. Knowledge Management in Organizations

Knowledge is widely divided into two types: explicit knowledge and tacit knowledge (Polanyi, 1966). **Explicit knowledge** is relatively easy to process, transmit and store in the form of data (Hoe, 2006). It can be expressed in language and therefore stored in a database that allows for other individuals to access it and learn from it. **Tacit knowledge**, on the contrary, is highly personal and challenging to codify or transfer. Experiences, subjective insights and intuitions are forms of tacit knowledge, deeply rooted in "action, procedures, routines, commitment, ideals, values and emotions" (Nonaka, Yoyama & Konno, 2000, p. 7).

Management scholars view knowledge in an organizational context as "the know-how, experience, insight, and capabilities that assist teams and individuals in making correct and rapid decisions, taking action and creating new capabilities" to improve an organization's products and services" (Gorelick & Tantawy-Monsou, 2005, p. 126; Hoe, 2006). On an organizational level, however, teams and individuals often perform sub-optimally due to a lack of effective KM because they cannot access other employees' tacit knowledge and due to the lack of explicit knowledge in available databases (Gorelick & Tantawy-Monsou, 2005). This causes ineffective innovation processes that may lead to failure or diminished quality of projects.

Organizational knowledge generation can be viewed as a combination of knowledge creation and knowledge acquisition (Pandey, 2016). Knowledge creation requires a person or group of people to come up with new material like ideas or concepts (Ceptureanu & Ceptureanu, 2010), whereas knowledge

acquisition revolves around identifying relevant knowledge outside the boundaries of the organization and acquiring this knowledge (Shukla & Srinivasan 2002). In KM literature, knowledge generation involves a *people-centric* and a *technology-centric* approach (Pandey, 2016).

The **people-centric** approach emphasizes that although knowledge is a competitive advantage of firms, the knowledge is not created by the firms but by its employees. In other words, "firm-knowledge is composed of knowledge sets controlled by individual assets" (Foss & Mahnke 2003, p. 86). This way of looking at KM urges organizations to create knowledge through the interaction between explicit knowledge and tacit knowledge of its employees, called *knowledge conversion.* An influential knowledge conversion model is the SECI process model, as portrayed in Figure 2.2 (Nonaka, Yoyama & Konno, 2000). The SECI model distinguishes four modes of knowledge conversion: *socialization, externalization, combination* and *internalization.* In an organizational context, knowledge in the SECI model can be seen on three different levels: *individual, group* and *organization* (Pandey, 2016).

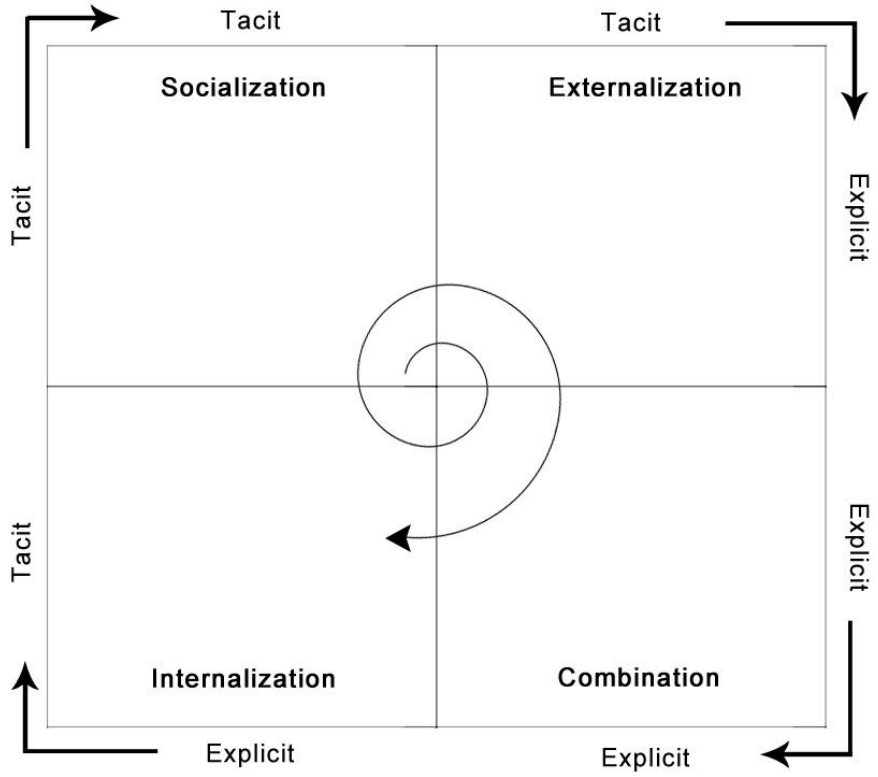

Figure 2.2: SECI model (Nonaka, Yoyama & Konno, 2000)

First, socialization revolves around sharing experiences to transfer tacit knowledge to someone else, like showing someone how to do a certain task. Some tasks are easier to understand from hands-on experiences than from reading about them. Secondly, externalization revolves around the conversion of tacit knowledge to explicit knowledge, like writing about your experiences so that someone else can learn from them. Externalization allows for tacit knowledge to be documented and

used by someone else in a later stadium. Thirdly, combination revolves around combining several pieces of explicit knowledge into a more complex piece of explicit knowledge, like collecting information from within or outside the organization to improve a process or model you are currently working on. Finally, internalization revolves around converting explicit knowledge into tacit knowledge by putting explicit knowledge into practice, like reading a manual on how to perform a certain task and then performing the task yourself. Learning by doing allows employees to build up tacit knowledge which, in turn, can serve as input for socialization or externalization in the future.

Following from the exploratory meetings, Division A was established to have an inefficient process of generating, sharing and integrating knowledge. KM theory can be used to analyze the current situation and evaluate the ongoing knowledge conversion on individual, group and organization levels (Pandey, 2016). The goal of Division A to serve as an environment where the innovative capability of employees is improved can be interpreted as a knowledge management goal, seeing as this is a matter of expanding tacit knowledge on all three (individual, group & organization) levels.

The **technology-centric** approach to knowledge generation involves acquiring relevant knowledge outside the boundaries of an organization. This involves a mechanistic method of examining databases and scanning for new technologies. Built upon established forms of strategic environmental technology scanning (Van Wyk, 1997), *digital evolution scanning* theory adds that in order to identify new opportunities for digital innovation, firms should gather intelligence about the progress of technology and associated usage patterns. Important elements to consider here are the capability of a firm to identify new types of hardware *devices* and their relative potential for the business, the capability to identify and evaluate new *channels* in the form of web services or platforms, and the analysis of the *behavior* of new customers in emerging new markets (Axelrod & Cohen, 2001).

Similarly, the notion of *absorptive capacity* builds upon organizational knowledge acquisition and conversion by focusing on an organization's ability to "recognize the value of new information, assimilate it, and apply it to commercial end" (Cohen & Levinthal, 1990, p. 128). It emphasizes that idea generation should eventually lead to the integration of said knowledge into the organization's business processes in order to reach its goals. By making a distinction between *potential absorptive capacity* (determined by an organization's knowledge acquisition and knowledge assimilation capabilities) and *realized absorptive capacity* (determined by an organization's transformation and exploitation capabilities), Zahra & George built further upon the notion of absorptive capacity by emphasizing that there are several ways to achieve successful knowledge management (Zahra & George, 2002).

2.2.2. Digital Innovation Processes

As established in the introduction, digitalization comes with transformative power and has shaped the way we do business. Digital innovation management literature

is concerned with the effective orchestration of digital innovation, including the way organizations manage their innovation processes (Nambisan et al., 2017). A *digital innovation process* is defined as "carrying out new combinations of digital and physical components", pertaining to both the use of digital tools to facilitate innovation processes and the innovation opportunities digital technologies can create (Abrell et al., 2016, p. 325; Yoo, Henfridsson & Lyytinen, 2010).

In terms of facilitating innovation processes by using digital tools, four key dimensions are identified, as portrayed in Table 2.2.

Table 2.2: Key dimensions of how digital tools facilitate innovation processes (Nambisan, 2003, adapted)

#	Dimension	Explanation
1	Process management	Digital tools can help to structure the innovation process, thereby bringing stability to innovation activities in the development process. Tools can range from prescriptive management models to flexible ones that can be configured by firms. (p. 7)
2	Project management	Digital tools can help to manage specific aspects of projects such as task coordination, scheduling and resource management. Tools can access all project-specific information but also integrate the project management strategy into the firm's process management. (p. 7)
3	Information/knowledge management	Digital tools can help to support a wide range of knowledge capturing and sharing by combining databases and visualization techniques. Furthermore, cross-project knowledge management can be incorporated to support organization-wide strategies. (p. 8)
4	Collaboration and communication	Digital tools can help to facilitate innovation processes by circumventing functional, organizational, cultural and geographical boundaries. (p. 8)

For Division A specifically, the most relevant dimensions are process management (to eliminate ad hoc decision-making about which projects to commence), project management (to devise a clear structure for performing projects) and information/knowledge management (to capture more value from knowledge of Company A's employees). Viewing these dimensions from a digital innovation process perspective in the context of Division A strengthens the validity of this research.

2.3. Research Questions

After introducing the current state of literature and the problem context, we can formulate a central research question: *'How can the management of knowledge be structured effectively to strengthen the digital innovation processes of organizations in the B2B IT sector?'.*

In order to answer this central research question, first several sub-questions have to be answered to get a better understanding of the problem at hand.

By an extensive literature review, the first sub-question will be answered:

1. *What does organizational literature imply regarding considerations and mechanisms that support the generation, sharing and integration of knowledge in organizations?*

By gathering and analyzing empirical data at Company A, the second and third sub-question will be answered:

2. *How is the generation, sharing and integration of knowledge currently structured in the context of Division A's digital innovation processes?*
3. *What are the strengths and weaknesses of the current structure in the context of Division A's digital innovation processes and does the structure allow the organization to reach its goals?*

Combining and evaluating the derived theoretical and practical insights will lead to an answer to the final sub-question:

4. *How can the insights derived from the literature review and empirical data be used to evaluate and effectively structure the generation, sharing and integration of knowledge in the context of Division A's digital innovation processes?*

3. Research Methodology

In this chapter, the research design that was followed throughout this research is explained. First, a general introduction about the origin and purpose of the design science methodology is presented. The following subchapters will explain in detail how the *theory-driven design science* and *practice-driven design science* strategies were carried out throughout this research. Next, the process of the creation, evaluation and selection of design solutions is explained. The final subchapter sheds a light on the research reliability and validity. An overview of the research design is portrayed in Figure 3.1.

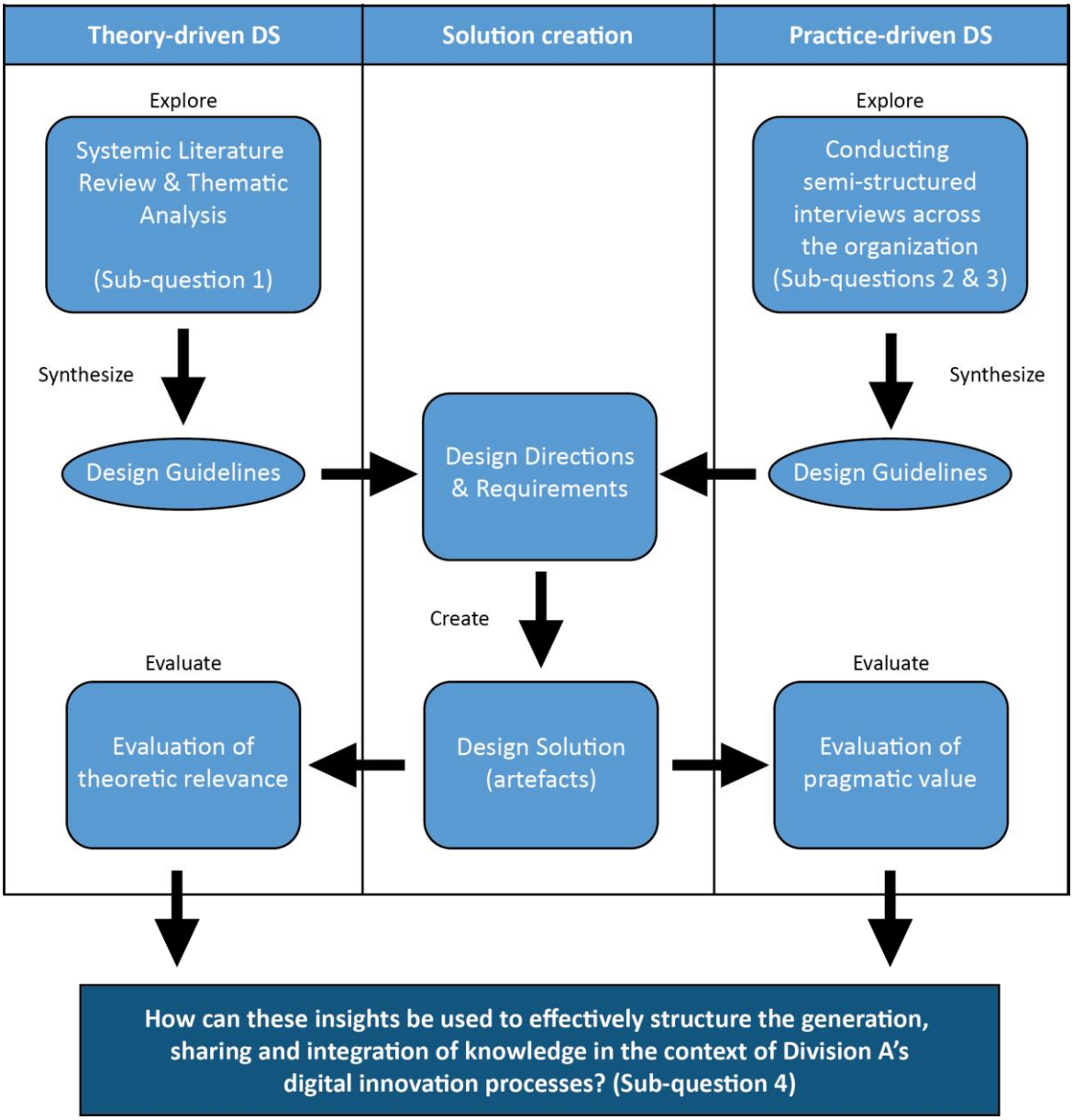

Figure 3.1: Research Design

3.1. Design Science Methodology

Since this research consists of both a theoretical and an empirical part, it followed a *design science methodology* approach. The mission of design science is to "develop general knowledge to support the design of solutions to field problems" (Van Aken & Romme, 2009, p. 8). This approach suits the purpose of providing a method to bridge the gap between theory and practice in the given problem context.

Design science links theory and practice through *design principles* and *design solutions*. Design principles "involve a coherent set of normative ideas and propositions, grounded in research, that serve to design and construct detailed solutions" (Van Burg et al., 2008, p. 116). Design principles follow CIMO-logic: "In this class of problematic **C**ontexts, use this **I**ntervention type to invoke these generative **M**echanism(s), to deliver these **O**utcome(s)" (Denyer et al., 2008, p. 395-396).

Design solutions are "representations of the practices being redesigned with help of the design principles" (Van Burg et al., 2008, p. 116), and thus practical outcomes that are more contextualized than design principles. Design solutions can also be seen as boundary objects that facilitate the exchange of knowledge between different fields, in this case academics and organizational practice. Boundary objects are useful since they do not require the practitioner to understand all of the science in order to understand the artefact, and vice versa (Tanskanen et al., 2017).

To move from design principles to design solutions, several in-between steps are needed. In summary, this research contains the following design science aspects:

- **Design principles** (CIMO-coding the current literature)
- **Design guidelines** (results of theoretical and empirical analyses)
- **Design directions** (based on empirical analysis)
- **Design requirements** (derived from the design guidelines)
- **Design solutions** (based on design directions and requirements)

To structure this research, a generic Design Science (DS) cycle was adopted (Keskin & Romme, 2020). It consists of four iterative phases: 1) *explore* the boundaries of the problem space and create an understanding of the context*; 2) synthesize* by combining insights to formulate design requirements and design principles; 3) *create* an artefact as a solution to the problem and thereby staying in line with the first two steps and 4) *evaluate* the pragmatic value of the artefact and derive theoretical insights from the process. The four steps are portrayed in Figure 3.2.

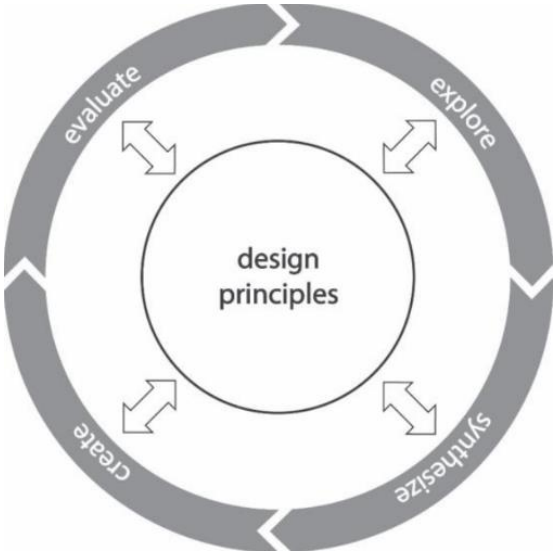

Figure 3.2: Generic DS Cycle (Keskin & Romme, 2020)

Although the design science approach is a useful methodology that aims to combine theoretical and empirical findings into a solution that is of both theoretical relevance and pragmatic value, it has its shortcomings. Practice-driven design science is characterized by high levels of uncertainty, a large number of iterations and low potential for generalization (Keskin & Romme, 2020). Furthermore, the form of the resulting artefacts (e.g. tool, process or framework) is not standardized and thus dependent on the creativity of the researcher. Although this is arguably also one of the strengths of design science research, it means that the method of testing and evaluating artefacts is not standardized and therefore the results of this type of research are always up for debate.

3.2. Theory-driven DS

Theory-driven design science is derived from rational problem solving (Simon, 1973). Researchers start by analyzing a business problem, likely leading to "a number of potential theoretical perspectives that can be used as guidelines for the design process" and then conduct "a systematic literature review of the existing knowledge base with regard to the theoretical perspective chosen for design" which leads to design principles (Keskin & Romme, 2020, p. 15).

In the theoretical part of this research, the first sub-question '*What does organizational literature imply regarding considerations and mechanisms that support the generation, sharing and integration of knowledge in complex organizations?'* was answered based on a systematic literature review. In order to secure scientific reproducibility, transparency plays a central role here.

Based on guidelines for performing a systematic literature review, this research followed a **six-step methodology** of identifying a search query, defining inclusion and exclusion criteria, selecting a suitable database, filtering and grouping the

results, performing a study quality assessment, and then making a final selection of the articles (Tranfield, Denyer & Smart, 2003).

First, a search query was defined by identifying key constructs and search keywords based on the theoretical background. The main constructs were *knowledge management (consisting of general knowledge management literature and digital evolution scanning)* and *digital innovation processes.* Before conducting the search, first several inclusion criteria were formulated and search criteria were formulated about the publishing year, language and document type. Since the SECI-model was introduced in 2000 and digitalization is a modern-day phenomenon, the timeframe of relevance that was taken into consideration is from 2000 to 2020. To improve the coherence of the research, only English publications and specifically peer-reviewed scholarly journals and reports were taken into account. The search was executed in a research database that focuses on both academic and corporate research: ProQuest. Table 3.1 shows the constructs, terms and results from the ProQuest search. The full search string, criteria and inclusion/exclusion factors that were used in this research can be found in Appendix A.

Table 3.1: Search constructs, terms and results

Constructs	Terms
General Knowledge Management	Knowledge management, knowledge sharing, knowledge generation, knowledge integration, SECI-model, socialization, externalization, combination, internalization, knowledge creation, tacit knowledge, explicit knowledge, absorptive capacity, organizational knowledge
Digital Evolution Scanning	Digital evolution scanning, strategic environmental technology scanning
Digital Innovation Processes	Digital innovation processes, digital innovation management, process management, project management, information management
Total search result: 95 articles	
Filtered search result: 82 articles	
Final selection using inclusion/exclusion criteria: 31 articles	

The search led to a definitive set of 31 articles that were considered in the systematic literature review. Based on the analysis-synthesis bridge model, this research followed a **four-step methodology** to analyze this definitive set of articles. The methodology consists of first identifying the state of the current

literature, then sorting and prioritizing these pieces of information to create an abstract representation of what is relevant and which pieces of information are related, then defining design opportunities based on the most relevant pieces of information, and finally turning these design opportunities into a prototype or design solution (Dubberly, Evenson & Robinson, 2008). This process is portrayed in Figure 3.3.

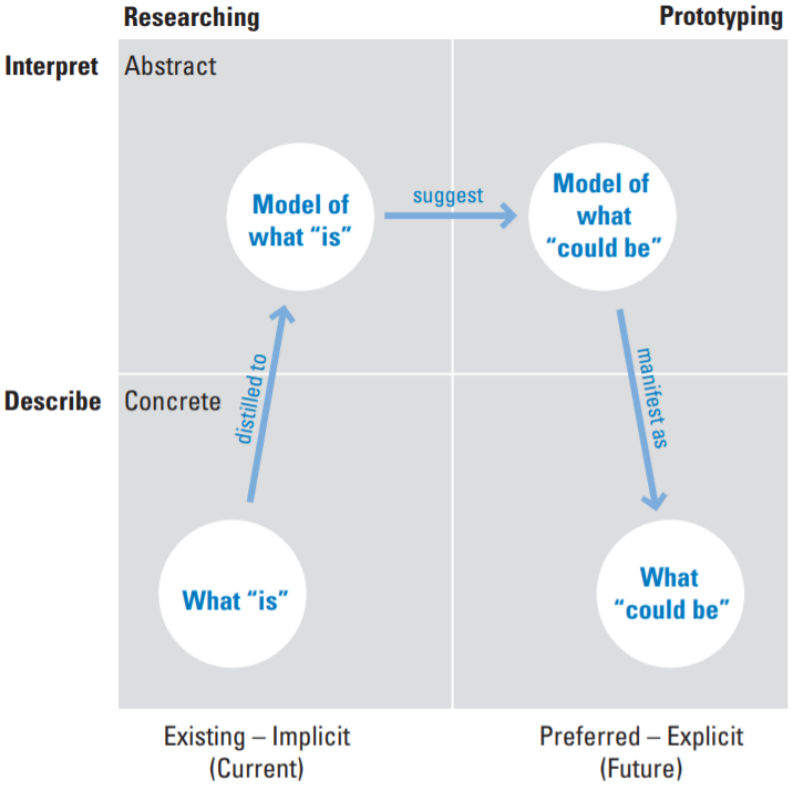

Figure 3.3: Analysis-synthesis bridge model (Dubberly, Evenson & Robinson, 2008)

During the analysis of these articles, a systematic CIMO-coding approach was performed in Excel to extract, sort and prioritize relevant pieces of information as a first step of the analysis-synthesis bridge model to collect concrete, existing information. This approach concerns the coding of individual articles by first noting the **C**ontext, then the **I**ntervention that was performed in the article, then the underlying **M**echanism that was invoked by the intervention, and finally the **O**utcome that was reached. The Excel file is attached as Appendix B.

Next, a thematic analysis was performed to systematically categorize the contents of the literature and determine which pieces of information are related. The contexts of the 31 articles were aligned through the division of these articles into five main theoretical themes: 1) *organizational knowledge management, 2) environmental technology scanning, 3) knowledge creation, 4) knowledge sharing, and 5) knowledge acquisition.*

Dividing the articles into these theoretical themes allowed for an outcome-based analysis where the results of the CIMO-coding approach were used to create thematic overviews of how desirable outcomes could be reached by implementing specific interventions and thus triggering underlying mechanisms. In the example of outcome-based analysis in Figure 3.4, organizations that want to reach *Outcome A* should aim to trigger the underlying *Mechanism A.* According to this example, these organizations can consider implementing either *Intervention A, Intervention B,* or both.

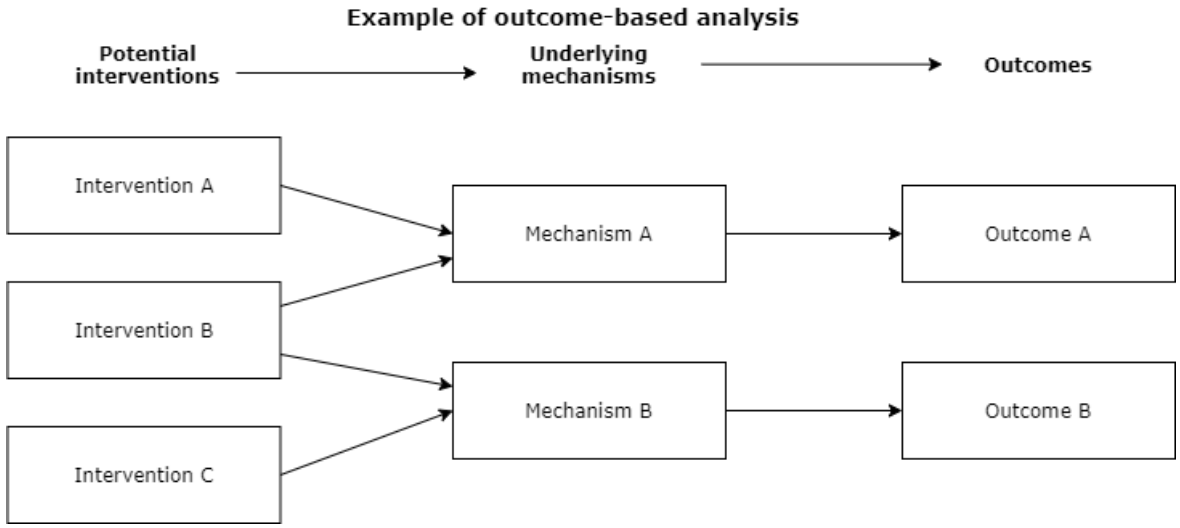

Figure 3.4: Example of outcome-based analysis

This method of performing an outcome-based analysis provided a starting point for the creation of design solutions by proposing design guidelines for organizational development based on these five theoretical themes.

3.3. Practice-driven DS

Practice-driven design science is based on situated problem-solving which is helpful in situations without a clear starting point or end goal and especially helpful in emerging knowledge domains (Dorst, 2006). This perspective contains a "deliberate process of engaging in multiple experiments, reflecting on their outcomes, and learning from those before deciding on subsequent steps" and derives design guidelines for a solution as a consequence (Keskin & Romme, 2020, p. 15).

In the empirical part of this research, the second sub-question '*How is the generation, sharing and integration of knowledge currently structured in the context of Division A's digital innovation processes?'* and the third sub-question '*What are the strengths and weaknesses of the current structure in the context of Division A's digital innovation processes and does the structure allow the organization to reach its goals?'* were answered based on interviews with all sorts of employees across the organization. To collect a wide array of responses, nine

employees from different parts of the organization and with different functions and experiences were interviewed. An overview of the functions and current involvement of these employees in Division A is shown in Table 3.2.

Table 3.2: Interviewee overview

E#	Function	Involved in Division A?
1	Division A manager	Yes
2	Development Intern	Yes
3	Scrum Master	Yes
4	Scrum Master	Yes
5	Development Intern	Yes
6	Senior Management Consultant	No
7	Division C employee	No
8	Division A captain	Yes
9	Sales Director	No

Due to the large differences between these employees, the author believed that the best way to guide these interviews was by conducting semi-structured interviews and thus preserving the possibility to ask follow-up questions based on the responses of the interviewees. Several questions to guide the semi-structured interviews are listed in Appendix C.

All interviews were recorded and their transcriptions (in Dutch) are presented in Appendix D. Several themes of importance surfaced during these interviews and served as input for the empirical analysis in chapter 4.2. To identify these themes and the concepts they are based on, the relevant snippets of the transcripts were indicated with codes in Appendix D. Based on these themes, the empirical analysis resulted in design guidelines.

3.4. Solution Creation and Evaluation

The solution creation process started with the definition of design directions and requirements.

To determine the design directions, the results of the empirical analysis were used to gauge how well Division A is currently organized in relation to the four quadrants of the SECI-model by Nonaka, Yoyama & Konno (2000). This decision was based on the SECI-model due to its prominent position in organizational knowledge management literature, seeing as it was often mentioned in the definitive set of articles in the theoretical analyses. The model also provides a clear overview of how day-to-day knowledge transfer occurs and conveniently pertains to three different levels (individual, group and organization) that all have the potential to make an impact in the organization.

Based on the design guidelines derived from the two DS strategies, a final set of design requirements was generated. Based on this and further consideration with Company A, the fourth sub-question '*How can the insights derived from the literature review and empirical data be used to evaluate and effectively structure the generation, sharing and integration of knowledge in the context of Division A's digital innovation processes?*' was answered by shaping and developing three artefacts according to the design requirements, that could succeed towards solving the problem statement.

The final step of the DS cycle was performed by selecting one of the three design solutions based on an evaluation of how well the design requirements were fulfilled and how much pragmatic value the design solutions had for Division A. Based on additional feedback and points for improvement, a final version of the selected artefact was created.

3.5. Research Reliability and Validity

Research reliability is ensured by documenting research in a way that it can be reproduced by someone else in a later stadium (Middleton, 2020). The systemic literature review served to ensure the usage of reliable sources to increase the quality and reliability of the project. Reliability was further ensured by taking a transparent stance regarding the systemic literature review and explaining the search criteria and inclusion factors so that the analysis can be reproduced at a later stage. In the official version of the thesis, confidential details will be omitted to safeguard the focal organization. This should, however, not have a large influence on how this research relates to the theoretical literature.

Ultimately, design science methodology presents an iterative cycle and therefore the evaluation was used to improve the research and its results as a whole in order to increase the validity of the research. Ensuring validity can be done by performing a systemic literature review in which sources are grounded in theory, devising a valid methodology that covers all important aspects you set out to research and discussing whether the results are consistent and reflect reality (Middleton, 2020), all of which were handled to the best of the author's extent.

Internal validity concerns the causality of a study, where a high internal validity means that a specific cause will certainly lead to a specific effect. In the case of organizational science, it is difficult to say for sure that a certain intervention will lead to a certain outcome because every organization is different. The outcome-based analysis used in this research, however, is an approach that takes an outcome and reflects on which interventions could be the cause of such outcomes. By basing the theoretical design guidelines on outcome-based analyses, an effort was made in this research to uphold the causality of the results.

External validity concerns whether the conclusions of a study can be applied in other contexts. A high external validity means the results of a study are highly generalizable. In this case, the selected artefact can certainly be generalized and used in comparable organizations in the B2B IT sector. Each organization that would decide to follow the framework would have to consider how to conduct internal and external research in their organizational context, as well as which criteria are most important to take into account during the portfolio deliberation sessions.

Construct validity concerns how well certain constructs are measured. In this research, the systematic literature review covered the constructs of *knowledge management* and *digital innovation processes.* In the case of *knowledge management*, four of the five theoretical themes provided a large number of sources that shaped a clear understanding of what knowledge management is. This is a form of theory triangulation, which concerns the collection of different theories to analyze and interpret data (Carter et al., 2014). The construct *digital innovation processes*, on the other hand, has a relatively low construct validity due to being supported by only one of the five theoretical themes.

4. Results

4.1. Theoretical Analysis

The contexts of the 31 articles were aligned through the division of these articles into five main theoretical themes: 1) *organizational knowledge management, 2) environmental technology scanning, 3) knowledge creation, 4) knowledge sharing, and 5) knowledge acquisition.* This allowed for an outcome-based analysis where similar articles were synthesized into theme-specific goals, as explained in chapter 3.2.

In the following subchapters, the contents of all articles are introduced according to their respective theoretical themes. Finally, these outcome-based analyses are synthesized into four design guidelines in chapter 4.1.6.

4.1.1. Organizational Knowledge Management

This chapter explains the separate findings of the first theoretical theme: *organizational knowledge management.* The interventions, mechanisms and outcomes found in the literature were synthesized according to an outcome-based analysis as shown in Figure 4.1.

A structural knowledge management system can be built by following a 12-step approach based on the four pillars of knowledge management, those being leadership, organization, technology and learning (Calabrese & Orlando, 2006). The goal of these 12 steps is to structurally "discover, capture, codify, validate, transfer, and convert knowledge into actionable information" (Calabrese & Orlando, 2006, p. 253) which ultimately should help to reach a collaborative organizational culture in which knowledge gaps are identified, allowing for better decision-making.

Alternative methods to shape the knowledge management system are to consider organizational knowledge to be composed of the three different fields of cognitive, emotional and spiritual knowledge (Bratianu, 2013) or to model knowledge as stocks and flows in the organization through system dynamics (Swart & Powell, 2006).

Arguing that effective organizational knowledge management already starts in the hiring process of new employees, a multiple mediator model study found that the relationship between human resource management practices and innovation performance is mediated by strategic planning, local networking and enterprise systems (Belso-Martinez, Palacios-Marqués & Roig-Tierno, 2018).

Social enterprise systems, when implemented correctly by taking into account the difference between explicit, tacit and potential knowledge, help in assisting local networking and social collaboration across the organization (Kumar et al., 2016; Smedlund, 2008).

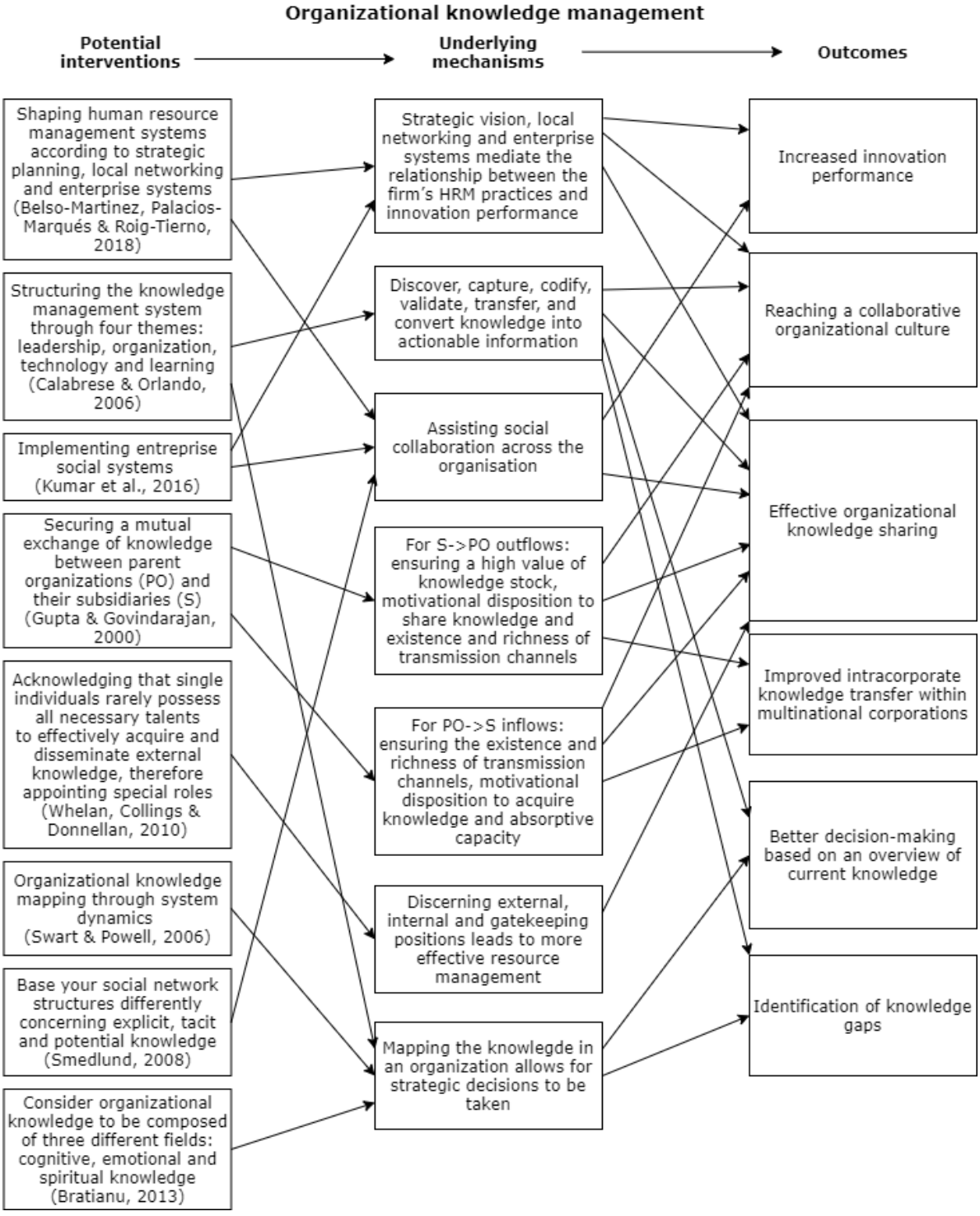

Figure 4.1: Outcome-based analysis – organizational knowledge management

Human resource management should also acknowledge that it is rare for single individuals to possess all necessary talents to engage in effective knowledge management practices by themselves. Special roles are therefore proposed by Whelan, Collings & Donnellan (2010) to split the responsibilities between acquiring external knowledge and disseminating the knowledge internally; being 1) the

external communication star, 2) the internal communication star, and 3) the gatekeeper (Whelan, Collings & Donnellan, 2010). By explicitly assigning these roles to employees, human resource management systems can play an important role in the inflow and dissemination of knowledge.

For multinational organizations specifically, effective knowledge exchange between a parent organization and its subsidiaries depends on several key determinants (Gupta & Govindarajan, 2000). For knowledge flows from the parent organization to subsidiaries, the most important determinants are the existence and the richness of transmission channels, the motivational disposition to acquire knowledge and the level of absorptive capacity. For knowledge flows from subsidiaries to their parent organization, the most important determinants are the value of knowledge stock, the motivational disposition to share knowledge and existence and richness of transmission channels. Ensuring a good quality of these determinants will lead to an improved intra-corporate knowledge transfer within multinational organizations.

4.1.2. Environmental Technology Scanning

This chapter explains the separate findings of the second theoretical theme: *environmental technology scanning.* The interventions, mechanisms and outcomes found in the literature were synthesized according to an outcome-based analysis as shown in Figure 4.2.

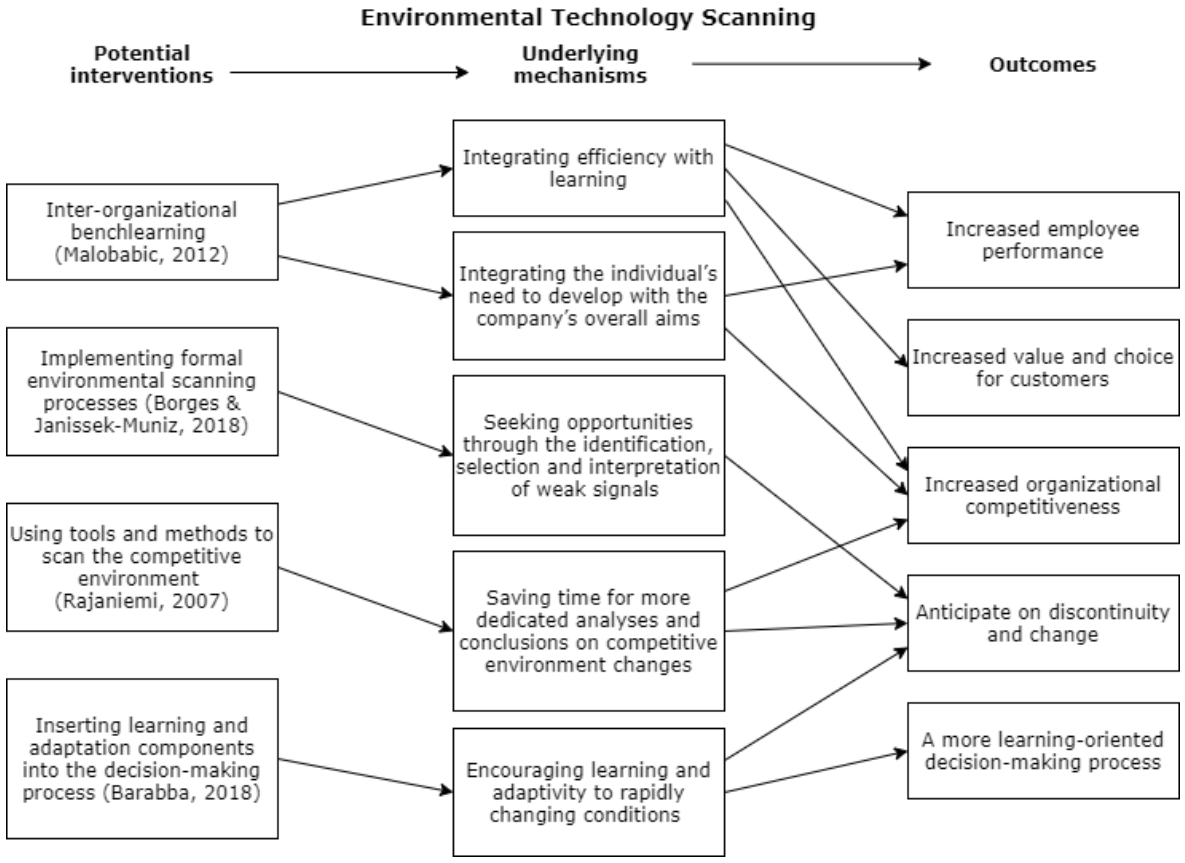

Figure 4.2: Outcome-based analysis – environmental technology scanning

Due to the accelerating pace at which information technology advances, collecting and interpreting information is more relevant than ever when predicting the evolution of markets and upcoming disrupting events (Barabba, 2018). Implementing organizational decision processes based on the most relevant knowledge, both internally and externally, is essential to become a knowledge-based, systemic learning organization that is adaptive to rapidly changing organizations.

In order to structurally scan the technological environment, organizations should implement formal environmental scanning processes (Borges & Janissek-Muniz, 2018), use tools such as patent databases and financial reports and methods such as the strategic knowledge cycle to raise the efficiency of the scanning processes to save time for more dedicated analyses (Rajaniemi, 2007) and insert learning and adaptation components into the decision-making process (Barabba, 2018).

The main goal of these interventions is to strengthen the ability of an organization to adapt to discontinuity and change through a more learning-oriented decision-making process. In the long run, adaptivity leads to organizational competitiveness through the ability to seek for opportunities and identify, select and interpret external signals.

Another take on environmental technology scanning is a method called inter-organizational benchlearning, which is about comparing your own organization against another organization and learning from this experience (Malobabic, 2012). Benchlearning consists of objectivizing your own organization, formulating the differences between the organization and another organization, and then devising a plan of action to improve your operations. The take-away is that in order to spot the differences, the organization itself must "articulate, codify and evaluate its own experience", which helps to create "a deeper understanding of your own business" (Malobabic, 2012, p. 54). Thus, it is a method to guide corporate development by scanning the environment.

4.1.3. Knowledge Creation

This chapter explains the separate findings of the third theoretical theme: *knowledge creation.* The interventions, mechanisms and outcomes found in the literature were synthesized according to an outcome-based analysis as shown in Figure 4.3.

Before implementing frameworks and knowledge repositories to improve an organization's knowledge management practices, the logical first step would be to gauge the current status of knowledge creation, for example by using a systematic measurement scale (Song, Yoon & Uhm, 2012) or by using the Six Sigma program as a checklist for organizations to "define what knowledge is, where it is located, who possesses it, and who needs it" (Wu & Lin, 2009, p. 925). Especially firms who are already using Six Sigma should be able to diagnose the current status of

knowledge creation accurately. Based on case studies, Wu & Lin (2009) also argue that Six Sigma allows for a data-driven approach to the creation of mainly explicit knowledge, although tacit knowledge should not be disregarded since it is often a source of discovery and creativity.

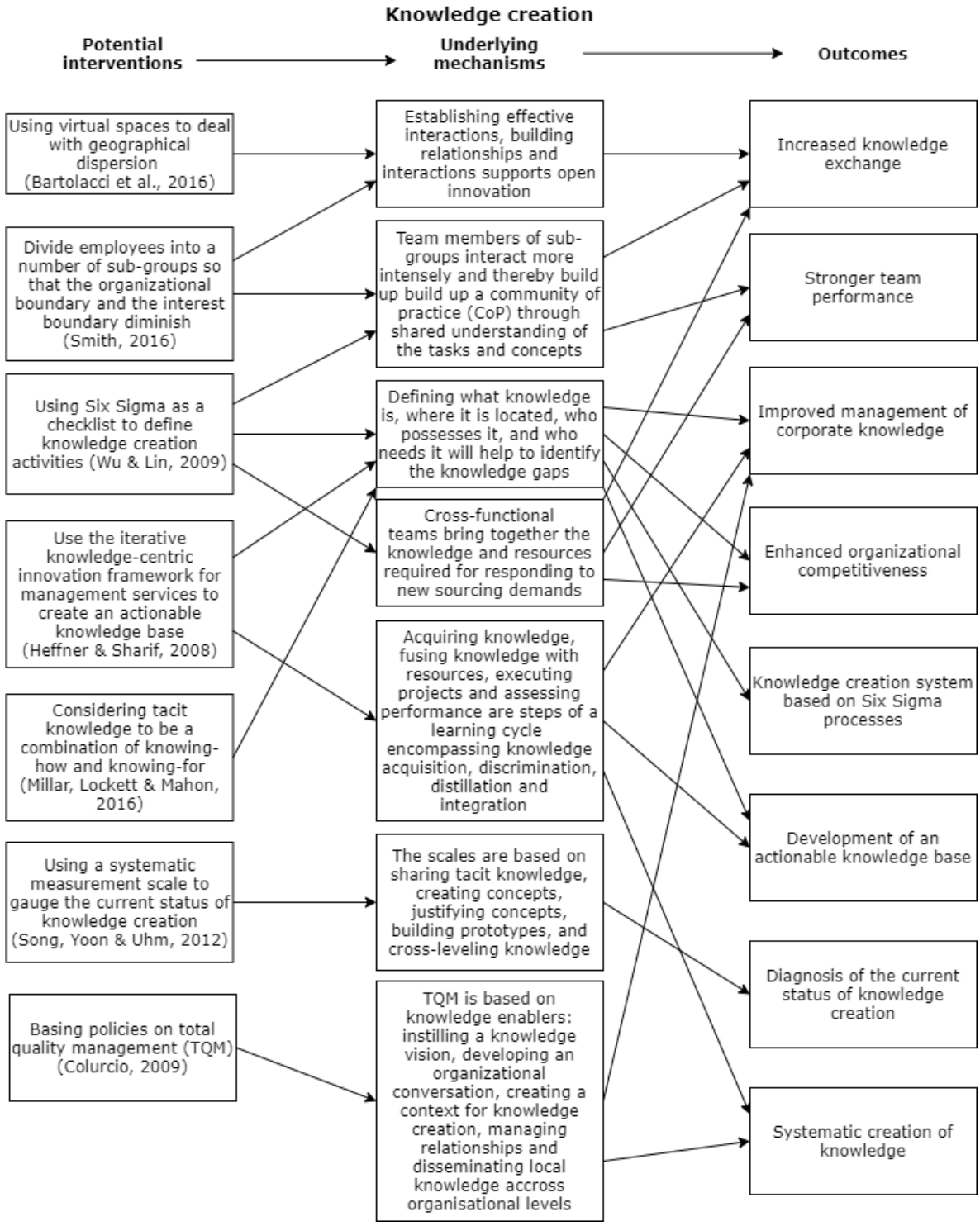

Figure 4.3: Outcome-based analysis – knowledge creation

On the subject of knowledge creation, a guiding framework was proposed to support the knowledge fusion process for technological innovations: the iterative knowledge-centric innovation framework for management services (Heffner & Sharif, 2008). They argue that an actionable knowledge base encompasses the acquisition, discrimination, integration and distillation of knowledge across the organization. Whereas the existence of an actionable knowledge base supports all separate innovation activities of an organization, these activities also add to the knowledge base itself. Therefore, it is placed in the middle of an iterative learning cycle. The other stages of the cycle concern 1) acquiring knowledge, 2) fusing knowledge with resources, 3) executing projects and 4) assessing performance respectively (Heffner & Sharif, 2008, p. 86).

Colurcio (2009) urges organizations that want to structure their knowledge creation and dissemination processes to base their policies on total quality management (TQM) practices like involving all employees organization-wide, working in teams and providing feedback through continuous communication (Colurcio, 2009). Doing so should lead to the systematic creation of knowledge. Dividing employees into subgroups, specifically, is an effective method to reduce the organizational boundaries and interest boundaries between employees (Smith, 2016).

By communicating and collaborating intensively, subgroups create a shared understanding of tasks and concepts and thereby build up a community of practice (CoP). Even geographically dispersed teams can reach a high level of mutual understanding through virtual spaces according to Bartolacci et al. (2016), supporting that even the socialization stage of the SECI-model has the potential to be executed effectively without the need for employees to be in close proximity (Bartolacci et al., 2016).

4.1.4. Knowledge Sharing

This chapter explains the separate findings of the fourth theoretical theme: *knowledge sharing.* The interventions, mechanisms and outcomes found in the literature were synthesized according to an outcome-based analysis as shown in Figure 4.4.

According to Farooq (2019), social capital is a determinant of an organization's capacity for knowledge management and therefore one of the sources of effective knowledge sharing. High social capital can be created by "ensuring a good learning culture and knowledge sharing in the long run" (Farooq, 2019, p. 156). Furthermore, Farooq argues that organizations should "develop strong ties with customers, buyers and employees to help them in creating, storing and disseminating the knowledge" (p. 156). The combination of good social capital and enterprise social media consequently strengthens the knowledge management processes, leading to a competitive advantage in the long run.

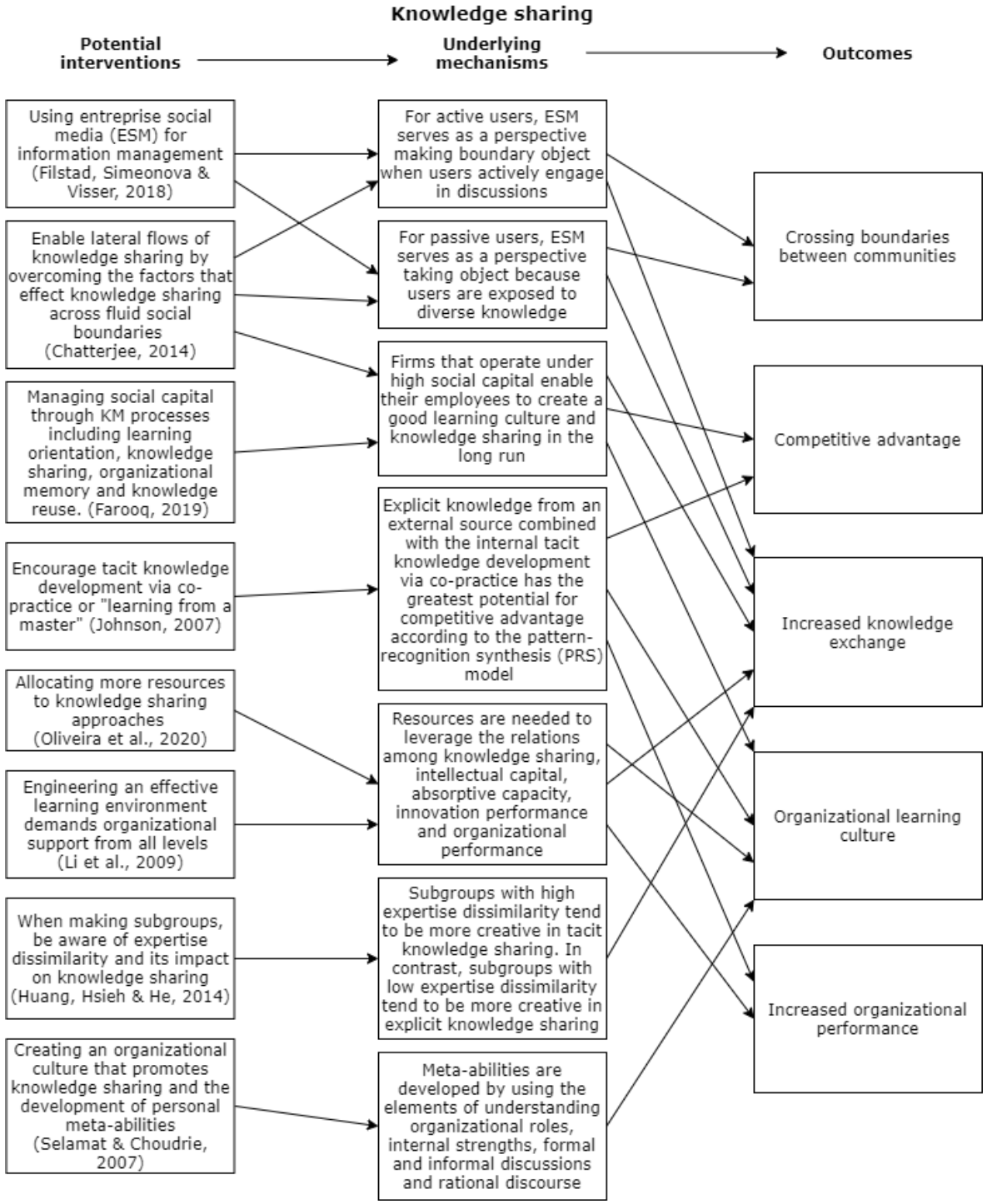

Figure 4.4: Outcome-based analysis – knowledge sharing

Expanding on social enterprise systems as introduced in chapter 4.1.4., a specific knowledge sharing approach presented in the literature is the introduction of enterprise social media channels to promote boundary-crossing between communities of expertise (Filstad, Simeonova & Visser, 2018). The authors make a distinction between active users who engage in perspective-making by participating in online discussions, as opposed to passive users for whom social media can serve as a perspective-taking approach due to exposure to new

knowledge. Either way, users will cross fluid social boundaries, which enables a more effective lateral flow of knowledge sharing (Chatterjee, 2014).

A theoretical model by Oliveira et al. (2020) found relations among knowledge sharing, intellectual capital, absorptive capacity, innovation performance and organizational performance; thereby urging the allocation of resources to knowledge sharing approaches for organizations that strive to reach a higher organizational performance (Oliveira et al., 2020).

Further emphasizing the need for an organization-wide knowledge sharing effort, a qualitative multisite case study found that support is demanded from all levels in the organization in order to engineer an effective learning environment (Li et al., 2009).

To reach a sustainable organizational learning environment, organizations should also focus on the development of meta-abilities of their employees on a personal level (Selamat & Choudrie, 2007). Four critical meta-abilities in organizational development are considered to be an employee's 1) cognitive skills, 2) self-knowledge, 3) emotional resilience and 4) personal drive. These meta-abilities can only be trained in an organization with "clear organizational roles, clear internal strengths, space for formal and informal discussions and rational discourse" (Selamat & Choudrie, 2007, p. 325). In combination with a suitable organizational culture, the development of these meta-abilities further promotes knowledge sharing.

Although cross-fertilization of knowledge in subgroups can be stimulated by leveraging on team diversity (Smith, 2016), it is important to keep in mind that the level of expertise dissimilarity has an impact on knowledge sharing. As such, subgroups with high expertise dissimilarity tend to be more creative in tacit knowledge sharing, whereas subgroups with low expertise dissimilarity tend to be more creative in explicit knowledge sharing (Huang, Hsieh & He, 2014). Organizations that want to encourage tacit knowledge sharing can therefore best resolve to a high expertise dissimilarity when forming subgroups. This ties into conceptual research suggesting that tacit knowledge development can best be managed via co-practice or 'learning from a master' (Johnson, 2007).

4.1.5. Knowledge Acquisition

This chapter explains the separate findings of the fifth theoretical theme: *knowledge acquisition.* The interventions, mechanisms and outcomes found in the literature were synthesized according to an outcome-based analysis as shown in Figure 4.5.

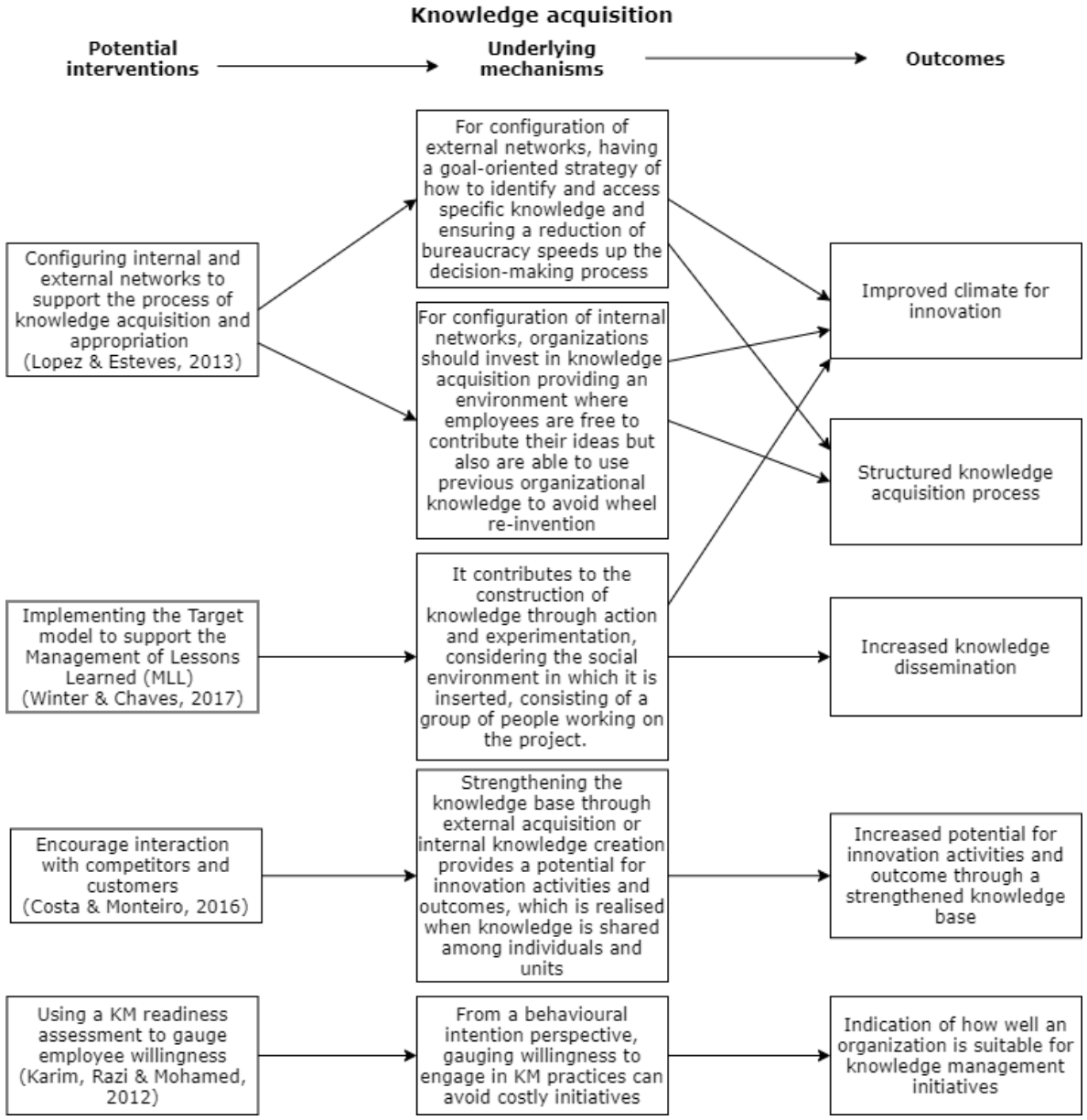

Figure 4.5: Outcome-based analysis – knowledge acquisition

In order to reach a structured knowledge acquisition and appropriation process, organizations have to deal with the configuration of their external and internal networks. Lopez & Estevez (2013) propose a framework that emphasizes the importance of well-organized external and internal networks. They argue that the inflow of knowledge from external networks should be based on a goal-oriented strategy on how to identify and access specific knowledge, as well as strong collaboration with partners in a lowly bureaucratic manner where employees are empowered.

The notion of encouraging interaction with competitors and customers leads to an increased potential for innovation activities and ultimately, a strengthened knowledge base (Costa & Monteiro, 2016). Internal networks, on the other hand, should be configured openly by promoting the freedom to contribute ideas, whilst

previous organizational knowledge should be stored structurally and easy to access. The advice of emphasizing the complementarities across and within departments in order to cross boundaries can be tied back to the concept of social boundary crossing, as discussed in chapter 4.1.4., and should lead to an improved climate for innovation.

Further research concerning the acquisition of knowledge suggests first gauging the willingness of employees to engage in knowledge acquisition and appropriation practices by using knowledge management readiness assessments (Karim, Razi & Mohamed, 2012) or implementing specific models to increase employees' knowledge awareness through action and experimentation (Winter & Chaves, 2017).

4.1.6. Design Guidelines

Based on the identified themes and the outcome-based analysis, four design guidelines for arranging knowledge management processes are proposed by the author.

1. **Building an actionable knowledge base**

As a critical factor that combines all five theoretical themes, an actionable knowledge base should be the heart of all organizational knowledge management practices, based on knowledge creation, sharing and acquisition. This allows for more effective decision-making based on current knowledge, allowing the organization as a whole to stay competitive and innovative.

2. **Configuration of internal and external networks**

In order to systematically acquire new knowledge and manage existing knowledge, organizations should configure their internal and external networks in a balanced manner. A goal-oriented strategy is critical to engage in mutually beneficial collaborations with external parties, whereas leveraging on the four stages of the SECI-model can benefit intra-organizational knowledge sharing.

3. **Organization-wide involvement and support**

Knowledge management practices only work well when taken seriously by the largest asset of each organization: its employees. Knowledge sharing can best be arranged through organization-wide involvement of all divisions and stimulating social and corporate boundary-crossing. Additionally, top management could explicitly be involved in knowledge management practices by funding these efforts and individually acting as champions, thereby setting an example for the rest of the organization.

4. **Ensuring an organizational learning culture**

Finally, a common theme across all theoretical themes is that employees should be given the freedom to come up with their own ideas and be given the ability to experiment. This helps to build up social capital which is a critical determinant for

an organization's success in knowledge sharing activities and therefore long-term competitive advantage.

4.2. Empirical Analysis

The main themes that surfaced during these interviews revolved around 1) the goals of Division A, 2) the need for dedicated employees, 3) effective knowledge sharing in the current setup, 4) a lack of centralized vision of trends and technology, and 5) the challenges concerning external reach and monetization. Whereas some themes were brought up more frequently than others, these five themes were most prevalent in the interviews. The main themes and concepts encountered in the interviews are shown in Table 4.1.

Table 4.1: Main themes and concepts encountered in interviews

Theme	Concepts	Code	Interview mentions
The goals of Division A	Employees have different perspectives on which goals Division A pursues	T1A	1,2,3,4,5,6,8,9
The need for dedicated employees	A lack of resources results in too much employee/expertise rotation	T2A	1,2,3,4,6,8
	Using re-integrating employees, young professionals and interns creates more reliable teams	T2B	1,3,4,8
	Partially available employees may have time to get involved more often to transfer knowledge to less experienced employees	T2C	3,8
The current setup allows for effective internal collaboration	The demo sessions are conceived to be effective in stimulating inter-team knowledge sharing	T3A	1,5
	Team members are encouraged to engage in knowledge sharing within their team	T3B	2,4,5,9
	Scrum of scrums sessions are conceived to be helpful for scrum	T3C	1,3,8

	masters to discuss their team's progress and challenges		
A lack of centralized vision of trends and technologies	The organization has several entities that research new trends and technology, yet there is no central place where this knowledge is collected	T4A	1,7,9
	The organization does not have someone responsible for making decisions on which trends and technologies to pursue	T4B	6,7
Challenges lie in external reach and monetization	Making profits with Division A by making deals with external parties is something that does not happen often enough, although it is tried often	T5A	1,6,8,9
	Business model innovation may be needed to create an effective business proposition for Division A	T5B	1,6,9

4.2.1. The goals of Division A

As indicated in chapter 2.1.1., the goals of Division A are threefold: 1) serving as an environment that allows employees to bond and work on exciting topics; 2) improving the innovative capabilities of employees in a practical setting, and 3) presenting valuable outcomes to clients leading to further acquisition and profits. When asked about the perceived goals of Division A during the interviews, the interviewees gave a wide array of answers that could always be linked to one of these three goals.

Concerning the first goal, the current setup of Division A succeeds in providing an environment that allows employees to work on exciting topics, according to interviewees #8 and #9:

> *E#8: The goal is to get together with available colleagues to collaborate on projects that otherwise would never have been executed, for example, due to a lack of time or resources. The thing I like about it is that it provides the opportunity to work on charitable projects for society on the one hand, but also efficiency-improving projects on the other hand.*

E#9: Division A is about technical exploration and making people enthusiastic, therefore generating some sort of exciting, innovative energy.

During the COVID-19 pandemic, a physical showroom has been constructed in the organization's headquarters. This physical environment could further serve as a bonding opportunity for project teams to come together and collaborate in a practical setting. However, the headquarters have not been accessible due to COVID-19 restrictions and therefore no research on the effect of this location was performed.

Concerning the second goal, the current views of those involved with Division A align with the goal of improving the innovation capabilities of employees, according to interviewees #3 and #5:

E#3: "The goal is to give employees a chance to be useful and engage in innovation activities. Useful in a sense of having something relevant to do while you're on the bench and waiting for a new assignment, but also for young professionals who enter the organization and are in need of some more experience. So it's about being useful and trying out new things."

E#5: "Division A is an innovative platform where people like interns and young professionals can add their two cents while working on their skills."

Most answers could be linked to the third goal of Division A of presenting valuable outcomes to external partners in an effort to make a profit or attain new clients. Here, presenting your skillset and large knowledge base to potential clients plays a central role according to interviewees #2, #4 and #6:

E#2: "The goal is to demonstrate knowledge and skill to potential clients of Company A."

E#4: "In the end, it revolves around coming up with innovative solutions that can be brought to Company A's clients."

E#6: "In my opinion, Division A should be an entity that is able to chain the different products and services of Company A together and that is also able to actually create something useful for a client. So it should be a generic entity with a clear function of innovation that makes it possible to create new propositions for both existing and new clients."

4.2.2. The need for dedicated employees

From the interviewees' perspectives, the main issue of Division A is the lack of and therefore the need for dedicated employees. Since the start of Division A, it has mainly depended on employees that are in between assignments and have time available to become engaged in project teams. This causes several problems, as interviewees #2, #3 and #8 put it:

E#2: "I continuously hear about the large flow of employees causing problems. I think it's a weakness to have teams that have been working on a project for a long time, but now have an entirely different team composition than when they first started."

E#3: "For each of our team members, there's always the possibility they suddenly leave the team after a successful intake."

E#8: "One point for improvement is the fact that you work with people who are currently available, so you miss structure in the teams. But that is difficult to improve upon. People who are doing well can suddenly be removed from your team and that's a shame because their replacement will need some time to adjust."

The lack of dedicated employees causes several other issues apart from the inconveniences concerning the availability of team members. For example, it has become difficult to estimate the completion time of deliverables (according to interviewee #1), sometimes the available resources do not fit the profile that fills the gap that was left by a leaving employee (according to interviewee #4), or Company A's employees avoid bringing their project ideas to Division A due to qualitative uncertainty (according to interviewee #6):

E#1: "One challenge is the rotation of employees within the company itself. As a consequence, we cannot promise whether a certain prototype will be finished in a month."

E#4: "A weakness of the current situation is that you currently have to deal with resourcing. How can you find team members when nobody fits the profile you are looking for?" … "It would be nice to have some more dedicated employees in the project teams, to bring more certainty."

E#6: "I would not step towards Division A with new project ideas because I believe there's not enough resourcing, since planning is leading. You need more dedicated employees to ensure a team functions like a well-oiled machine. Unfortunately, that is not the case yet."

To solve the issue of employee rotation, project teams are currently filled up with reintegrating employees, interns and young professionals who need more experience in the field. In time, most of these employees will eventually move on to execute projects for Company A's clients and therefore leave Division A, but in the meantime, it seems to be a stable and attractive environment to get started. Especially the deployment of reintegrating employees in project teams provides relative certainty of team members and also provides the opportunity for these employees to get back to work in a stimulating environment, according to interviewees #3, #4 and #8:

E#3: "In our team, we have two people who are reintegrating which is very nice because it means we have more certainty of involved employees for a longer term."

E#4: "I've noticed that employees that are in between two assignments cannot stay at the project teams for a long time, because they are quickly sent away after an intake. So instead, I really aimed to involve reintegrating employees because they are usually available for longer periods of time." … "We used to have a reintegrating developer who eventually turned out to stay with us for almost four months. For him, it was a nice way to build up experience again and it was nice to see him grow."

E#8: "Especially revalidating people are suitable for Division A's projects because it's an environment where you can work on something serious. On the one hand, you're dealing with scrum teams and sprint planning, but on the other hand, you do not have the pressure of a client who continuously asks you for progress. So it's a comfortable environment to get back to work again."

Two interviewees mentioned that aside from reintegrating employees, interns and young professionals, there is an additional group of people that could be more involved with Division A's projects in the future, namely partially deployed employees. Involving experienced employees for only a few hours per week can already be quite helpful, according to interviewees #3 and #8:

E#3: "Previous years I've had assignments for 32 hours per week, which gave me the option to work on a project for Division A in my spare time. I was not obliged to do so, but based on intrinsic motivation, I wanted to. Working on a Division A project is more fruitful than spending time at home."

E#8: "Sometimes, colleagues have some spare time in between assignments. Some people will go paint their walls at home and take some time off, but others immediately search for a new challenge in the meantime. What I hope is that more employees will consider doing something useful with that time period that would otherwise be wasted. For example, a charitable project at Division A."

4.2.3. Effective setup for internal collaboration

In the previous year, Division A has positioned itself as a centralized hub where project teams are initiated and inter-team knowledge sharing is stimulated. All project teams come together once every four weeks to share their progress and ask each other for feedback. External partners are also invited to these sessions to be inspired by the innovative projects that are executed. These demo sessions prove to be an effective source of information according to interviewees #1 and #5:

E#1: "Each team is asked to join the demo sessions once every four weeks. Teams have the possibility to demo their projects and the progress made in the previous sprint. Then they also have the option to see all other projects and have contact with each other."

E#5: "During the demo sessions we are always asked a lot of questions, but there's also positive encouragement and tips. Last time, for example, I had a certain task I did not know how to approach. When I asked about it in the demo session, three people immediately answered with ways to solve my problem. It's a very nice environment to be in due to the positive feedback."

Within the project teams, team members are encouraged to engage in knowledge sharing with each other. Interns are provided all sorts of information when needed

and even additional team members when needed (according to interviewee #2), people with different backgrounds such as testers and developers have the opportunity to learn from each other and broaden their foundation of knowledge (according to interviewee #4) and regardless of whether projects succeed or fail, they are considered to be useful sources of learning experiences (according to interviewee #9).

> *E#2: "My colleague intern and I work quite well together. Right now we're working together with a young professional from Company A: a UX designer who makes the front-end design for our final interface. Whenever we have questions, the people over at Division A provide easy access to all sorts of information within the organization."*
>
> *E#4: "In my project team, I try to look at what the developers make because it piques my interest. A little bit of extra knowledge is very convenient to have as a scrum master or as a tester because then I have a better understanding of how I can add value to the team. I'm interested in security so I need to have some understanding of development in order to be able to test it sufficiently. So as long as you try to learn from colleagues, you get a good enough foundation."*
>
> *E#9: "Projects of which you know beforehand that you will have a great time with your team members, regardless of whether the project succeeds or not, are always valuable. Moreover, sometimes you can cancel an experiment completely and it may still have been a successful experiment because you've learned from the experience. So emphasizing the motivation and eagerness to learn is more valuable to me than whether a project succeeds or fails."*

Apart from the demo sessions and intra-team knowledge sharing, one more feature of the current setup of Division A revolves around the weekly *scrum of scrums* sessions. Here, all project scrum masters gather to discuss their issues and devise solutions together. These sessions are conceived to be valuable according to interviewees #1, #3 and #8:

> *E#1: "Each week we have the scrum of scrums sessions where scrum masters come together to discuss the status of their projects and what problems they run into. We also discuss overarching matters there such as optimizing the planning sessions within Division A."*
>
> *E#3: "I was the scrum master of a project in one of our divisions, but I felt like a was alone and had nobody to contact for the questions I had. Then I came into contact with Division A and they had space for me to join the scrum of scrums sessions. There I could ask all my questions, especially regarding resources."*
>
> *E#8: "The project teams work quite autonomously. The main interactions between teams happen during the scrum of scrums sessions where all scrum masters come together to share their experiences. It works well. We discuss our methods and give each other feedback. This way, scrum*

masters can utilize their practical experiences to help each other solve ideas."

4.2.4. A lack of centralized vision on trends and technology

Due to the large size of the organization and its complex structure, it unsurprisingly has many different entries of new knowledge, according to interviewees #1 and #7:

> *E#1: "Within Company A we have Division B (a research institute) that we try to stay in contact with. Furthermore, we have the expertise communities where people talk about the newest trends, so we also try to include that information. And besides that, we have separate communities where people discuss the latest developments per area of expertise. So by stimulating cross-pollination within these areas of expertise, you often find new methods to use in your projects."*
>
> *E#7: "Division C is an international community which houses almost 200 thought leaders. Their thought leadership is shared via our website, where we try to upload a new blog, vlog or webinar every day."*

As indicated in the problem statement in chapter 2.1.2., all these different knowledge institutions were not clearly linked yet to Division A specifically. Upon further investigation, the problem seems to be rooted in the overall organizational structure as these knowledge institutions do not appear to be clearly linked at all in a centralized knowledge base. According to interviewees #6 and #7, this phenomenon can be explained by a lack of structural portfolio management and even the lack of someone responsible for making decisions on which trends and technologies to pursue:

> *E#6: "What we need at Company A is a very clear innovation portfolio and good portfolio management. We need a committed front man or front woman who is experienced in innovation management and able to develop organizational structures, to pick up a clear task of linking Division A's activities to Company A's strategy."*
>
> *E#7: We do not have a CTO in the Netherlands who is responsible for the contents of the organization. This role would involve scanning what technologies are next, what is new, and which ones we should start researching or investing resources in. CTO's look into what is relevant for our clients, but also consider the portfolio and decide which technologies to drop.*

Noteworthy to mention, the organization has recently started doing some portfolio management practices, albeit quite fuzzy at the moment, according to interviewee #7:

> *E#7: "Within Company A, we started with portfolio deliberation meetings. In these meetings, we consider which topics are worth considering to*

delve into. It sounds logical to arrange a direct connection between these people and Division A because it provides input for new projects."

4.2.5. Challenges in external reach and monetization

The first and second goals of Division A concern providing an inspiring environment and improving the innovative capabilities in a practical setting, and therefore have an internal perspective. The third goal, on the other hand, is to present valuable outcomes to clients, leading to further acquisition and profits. One way to do this is to involve external partners in the demo sessions, according to interviewee #8:

> *E#8: "During the demo sessions we also invite external partners. They can join to see the demonstrated projects and potentially see a link with their own problems. That is how we currently show what we're working on. Quite a lot of viewers attend these demo sessions, including colleagues who are working on an assignment for the clients, so that may also be a way in."*

Apart from presenting progress to external partners, the most challenging part is to involve these external partners in the projects and turn Division A into a profitable operation. According to interviewees #1, #6 and #9, this part proves to be challenging in the current setup:

> *E#1: "My biggest challenge is to successfully involve clients in our projects and ensuring we provide them the best quality of innovation to lead the way. Currently, we do not have direct client cases to use as a reference for new clients. On the other hand, it's challenging to find the true necessities of our clients."*
>
> *E#6: "Judging from my own experiences, Division A aims at many different themes and individual initiatives, but the experiments usually can't really transition into the next step."*
>
> *E#9: "I've been involved in making some aspects of Division A more commercial. The dilemma surrounding the current situation revolves around us doing work voluntarily, while we also want our clients to value our work and pay for it."*

Since the projects have experimental natures and thus unpredictable outcomes, it is difficult to make external partners pay for the projects just like they do in other parts of the organization. Monetizing the projects of Division A, and thereby reaching the third goal of the organization, is therefore challenging in a traditional pay-per-project setting. According to some interviewees, this unorthodox method of R&D may call for business model innovation in order to become profitable. For example, proactively approaching existing clients with solutions they did not even know they had (according to interviewee #1), moving away from private intellectual property and towards partnerships of open innovation practices and co-creation of new products (according to interviewee #6) and new opportunities thanks to the recent digitalization of businesses (according to interviewee #9):

E#1: "We perform well at innovating on a technological level, but I wish that we could be more business-oriented and discover the business challenges of our clients. It would be amazing if we would not only get asked to solve the challenges of our clients but instead could proactively approach costumers with solutions to problems of which did not even know yet that they were facing them."

E#6: "If you really want to monetize Division A, I believe that our business processes need to be reorganized first. I believe in open innovation and co-creation of new product and service development. I think that's the future of doing business and it will be needed to separate ourselves from our competitors. Moving away from private intellectual property should therefore be stimulated on a corporate level. That means talking about new partnerships and therefore business model innovation."

E#9: "If you look at what the previous period (COVID-19) has meant for the digitalization of businesses, you can state that we have gone through a digital revolution. What I am afraid of in the future, is that we as a company will grow and do more of the same, thereby neglecting new approaches. I think that would be a shortcoming, so we need to make out business activities more diverse. For us as an IT company, the foundation is solid and we will be fine. But we need to reconsider how to make a difference for our clients, concerning new challenges."

4.2.6. Design Guidelines

Taking the five main themes of the empirical analysis into account, this research aims to design solutions that solve the problem statement as presented in chapter 2.1.2:

Division A currently has an ineffective process of generating, sharing and integrating knowledge. This results in unstructured decision-making about which projects to work on, a lack of structure for how these projects can best be handled and general difficulties in extracting value from the knowledge of Company A's employees. Consequently, Division A's digital innovation processes do not always progress towards reaching their main goals.

When asked about the goals of Division A, all interviewees gave an answer related to one of the three official goals. Only two interviewees (#1 and #9), however, gave answers related to all three of the goals. Communicating the goals of Division A more clearly could help employees behave accordingly and work towards shared objectives. In order to reach a structural and effective knowledge management process within Division A, the solution designs of this research could play a role in communicating these shared goals.

The current setup allows for ample communication between the project teams due to the monthly demo sessions and the weekly scrum of scrums sessions. Also within the project teams, knowledge sharing is stimulated, seeing as interviewees often mentioned learning from each other and asking for additional information or knowledge when needed. Nevertheless, there are plenty of steps to take in the

structural collaboration with external partners. As such, the configuration of internal networks seems to be more refined than the configuration of external networks. The solution designs of this research could take the configuration of internal and external networks into account to fix this imbalance.

One of the main issues that cause the ad hoc decision-making process of which projects to initialize can be drawn back to an organization-wide lack of centralized knowledge management. As presented in chapter 4.2.4., the complex organizational structure includes knowledge acquisition divisions such as Division B, Division C and the expertise communities, yet it does not combine these pieces of information into a clear overview or sense of direction. Therefore, the solution designs of this research could centralize different sources of information and combine them into a prioritized overview.

Although the need for dedicated employees appears to be very pressing, this is a matter of funding and hiring policies and therefore it will not be included as a design guideline. Furthermore, the challenges in external reach and monetization and therefore considering business model innovations are also out of scope for this research, since this research takes an organization-oriented perspective instead of a market-oriented perspective.

4.3. Design Directions and Requirements

As introduced in chapter 2.2.1, a people-centric approach for improving Division A's knowledge management practices can be formulated by examining the SECI-model of knowledge conversion by Nonaka, Yoyama & Konno (2000), which distinguishes *socialization, externalization, combination* and *internalization* as the four modes of knowledge conversion.

Based on the empirical analysis, Division A performs well on the *socialization* quadrant. The current setup provides an environment that promotes learning-by-doing which is an important mechanism to internalize knowledge for individuals or, in this case, project groups.

The division also performs well on the e*mbodying* quadrant since the current composition of the project groups strengthens the socialization process by encouraging inter- and intragroup interaction and knowledge sharing.

For Division A, the challenges lie in the *externalization* and *combination* quadrants on the right side of the SECI-model. In the current setup, tacit knowledge is not explicitly documented such that it becomes useful knowledge for others (externalization), nor is there a structural combination of internal and external knowledge into a more valuable piece of knowledge for employees (combination).

Therefore, this research aims to provide specific designs that promote either the *externalization* process of making tacit knowledge explicit, the *combination* process of organizing and integrating explicit knowledge, or both. Figure 4.6 shows the design directions based on the SECI-model.

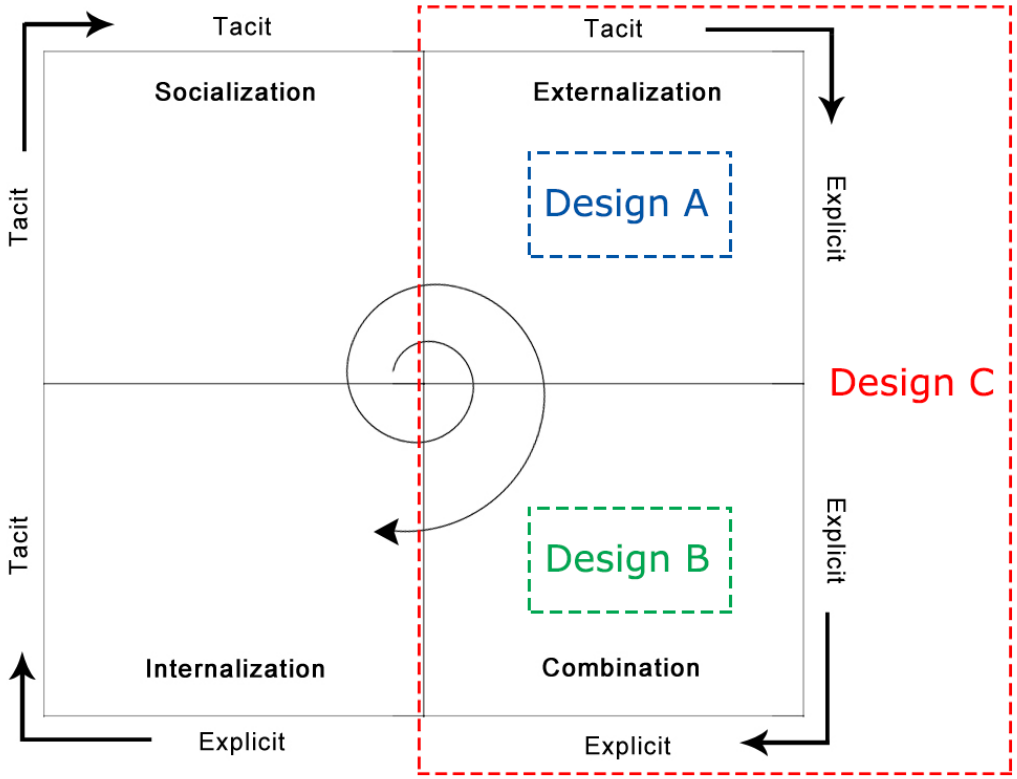

Figure 4.6: Design directions based on the SECI-model

Based on the design guidelines derived from the theoretical analysis, the following design requirements are proposed by the author:

1. **The design should work towards an actionable knowledge base, encompassing knowledge creation, sharing and acquisition.**
2. **The design should balance the configuration of internal and external networks.**
3. **The design should aim for an organization-wide involvement of employees.**
4. **The design should stimulate a sustainable and open organizational learning culture.**

Based on the design guidelines derived from the empirical analysis, additional design requirements are as follows:

5. **The design should help Division A progress towards reaching its three goals.**
6. **The design should help to structure the decision-making process regarding which projects to work on.**
7. **The design should be possible to implement in Division A within 1 year.**
8. **The design should be suitable for the dynamic pool of employees that are involved in Division A.**

9. **The design should involve employees from different parts of the organization.**

4.4. Design Concepts

In this subchapter, three design concepts are presented to help structure the digital innovation processes of Division A.

4.4.1. Concept A: Knowledge Repository

The externalization phase of the SECI-model revolves around turning tacit knowledge into explicit knowledge, or in other words, documenting one's knowledge such that it becomes a basis of new knowledge for others.

In the case of Division A, the projects converge completely in terms of contents and therefore employees may find it difficult to learn things from other projects that can be used in their own project. However, discussing how certain technologies were implemented in the solutions of other teams may inspire employees to discover new ways of problem-solving. The monthly demo sessions that are currently organized at Division A succeed at bringing employees together to discuss their progress with employees from other project teams. Although this is already useful, it only involves project teams that are currently active. Additionally, the logical next step would be to also provide detailed information about the projects of the past, as one employee emphasized:

> *E#8: "On the long term, it would be amazing to have a collection of which technologies were used in past projects, for example on the Division A website. It would be a way to get in contact with the scrum master of that past project to discuss their experiences and brainstorm about the present project. Even a talk of one hour with, for example, the developer of that project team, could be very helpful to exchange pieces of code to accelerate your own project."*

In Figure 4.7, a basic representation of a knowledge repository is proposed in the form of an app. The choice for an app is not decisive – this system could easily be implemented in the app that is currently used at Division A, but it could just as well be implemented in the website of Division A or in the shared Teams folder. In the end, it depends on the preference of the organization.

Employees who would like to receive more information about a project or a specific type of technology would be able to scroll through an overview of all active and finished projects. If all project teams document the technologies they have used in their projects, then the search bar could serve as a quick way to look up a specific technology by implementing tags. By not only showing the projects of Division A but also those of the comparable divisions in other countries, or even projects of the parent company of Company A and other relevant partners, users would have the possibility to get into contact with someone that might be able to help them.

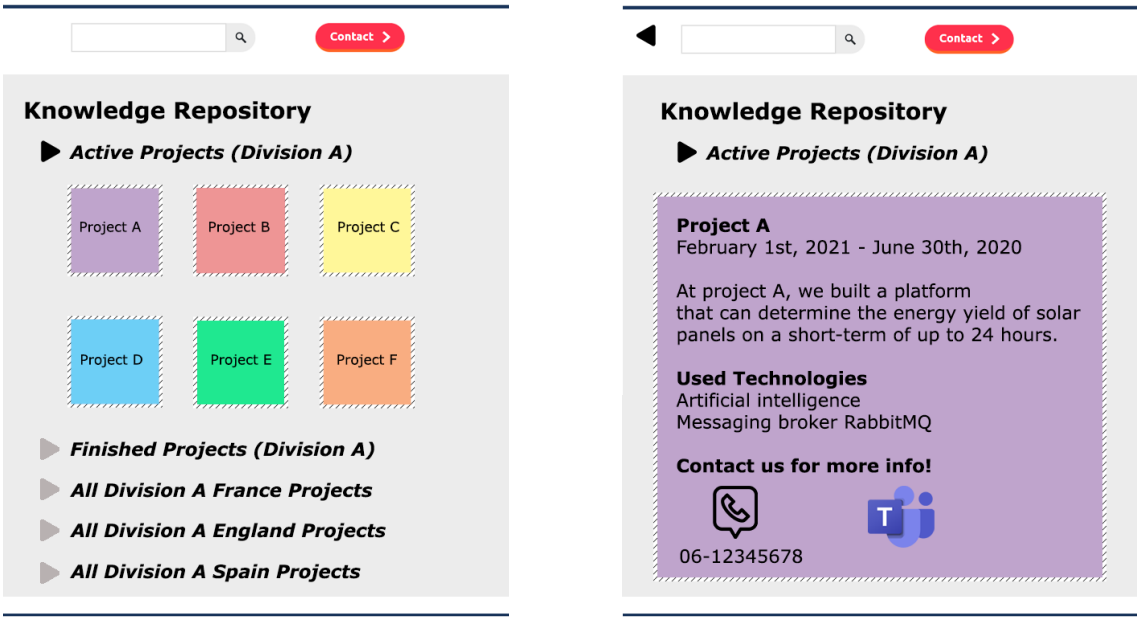

Figure 4.7: Concept A - Knowledge Repository

According to the theoretical analysis, this type of knowledge mapping should lead to a collaborative organizational culture and better strategic decision-making based on an overview of current knowledge and the identification of knowledge gaps (Calabrese & Orlando, 2006; Swart & Powell, 2006; Wu & Lin, 2009; Heffner & Sharif, 2008).

4.4.2. Concept B: Centralized Portfolio Management

The combination phase of the SECI-model revolves around organizing and integrating explicit knowledge into new forms of explicit knowledge, or in other words, combining pieces of knowledge such that it becomes a new piece of knowledge that an organization and its employees can act upon.

As presented in the design objectives in chapter 4.2.6., valuable pieces of information acquired by knowledge-intensive divisions of the organization are not yet combined into a clear overview or direction. Whereas some of the interviewees mentioned that the lack of a CTO may be the cause of this phenomenon, it could also be solved with a centralized vision of new trends and technologies through clear and inclusive portfolio management practices.

> *E#7: "I can imagine a practical solution such as a prioritized backlog for Division A which includes some topics, determined by someone from Division B and some consultants with broad knowledge to discuss the prioritization of said topics."*

In Figure 4.8, a framework for periodic portfolio deliberation in the case of Company A is proposed. Based on the quickly changing technological environment of Division A, it would be suitable to go through the stages of this framework once every 2-3 months.

The framework starts with simultaneous research inquiries about internal and external knowledge. Internal research should be conducted within all expertise divisions of the organizations to derive a comprehensive knowledge mapping of the current state of knowledge. Such an internal research could be performed by the head of each division but since tacit knowledge is challenging to quantify, the employees could also play a role in the identification of all present knowledge.

External research concerns environmental technology scanning by the different knowledge institutions and researchers, including Division B, Division C and the expertise communities. The goal of the external research stage is to collect knowledge about which trends and technologies are currently of importance, but also in the short-, mid- and long term.

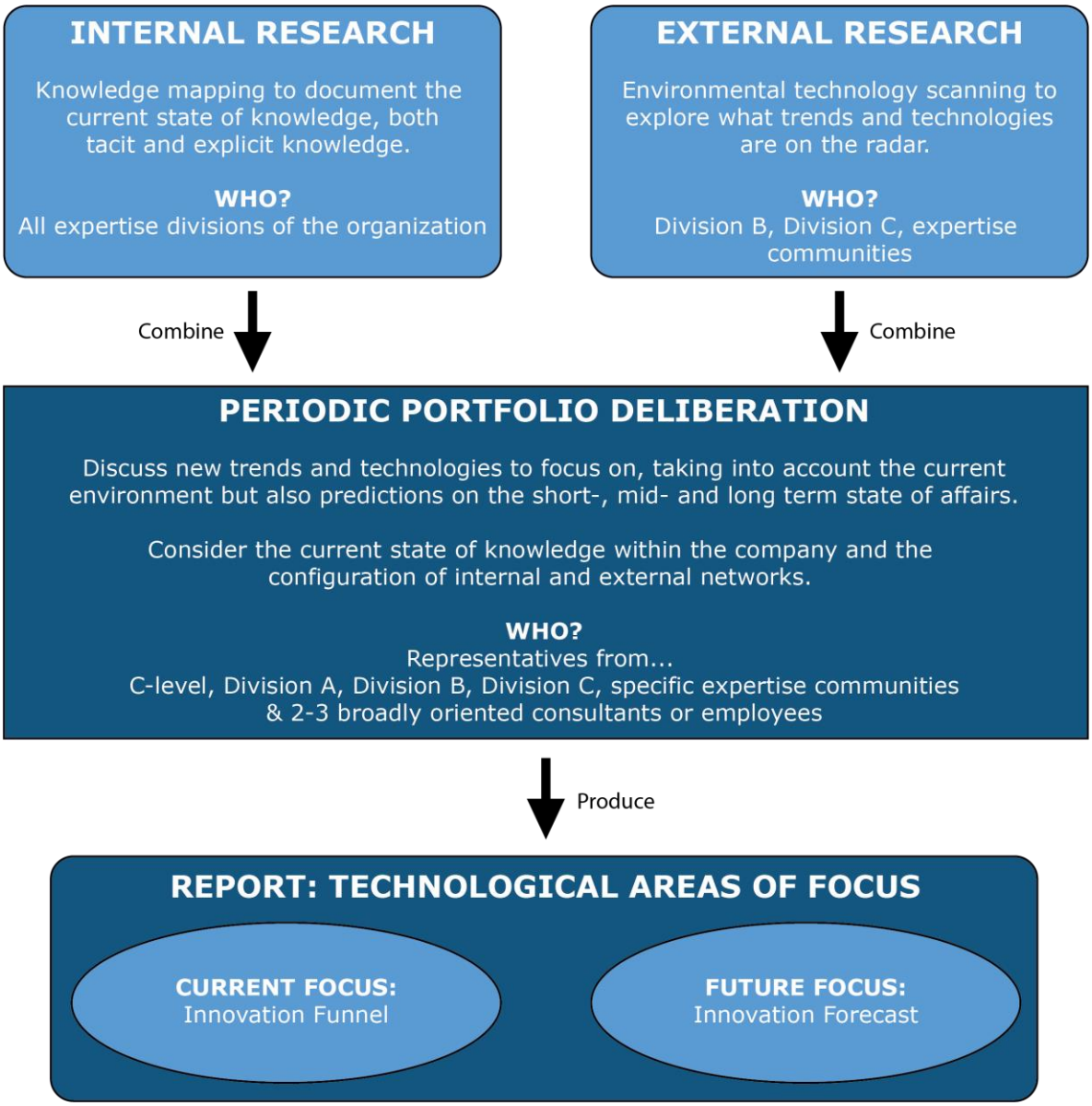

Figure 4.8: Concept B – Centralized Portfolio Management Framework

The next phase of the framework concerns the organization of a periodic portfolio deliberation with representatives with employees from all corners of the organization. In this case, that implies including a representative from C-level,

Division A, Division B, Division C and some specific expertise communities of relevance. Furthermore, the addition of two or three broadly interested consultants or employees, perhaps rotating each session, would bring more different perspectives to the group.

The goal of these sessions would be to discuss the trends and technologies Company A should focus on, taking into account substantiated predictions for the future. Criteria will have to be defined for choosing to pursue or drop a certain focal point, such as whether the current internal and external network configurations are well-suited and whether there is an opportunity to derive a business-oriented proposition. These criteria will have to be agreed upon beforehand.

The outcome of a portfolio deliberation session would be a report concerning the organization's technological areas of focus. This report can be divided into two parts: 1) an Innovation Funnel that shows the current state of focal technologies and trends; and 2) an Innovation Forecast that shows the predictions for which technologies and trends are upcoming. The reports communicate a centralized vision of trends and technologies that can be accessed by all employees. For Division A, it would become more evident which technologies to build project teams around in order to align the projects with the organization's vision.

4.4.3. Concept C: Assigning Communication Roles

Regardless of which model or method is used, the success of building an actionable knowledge base ultimately depends on the employees that are responsible for the acquisition and dissemination of knowledge. Design concept C focused on both the externalization and combination quadrants of the SECI-model by focusing on collecting information and thereafter combining it into an actionable knowledge base.

Knowledge can be acquired from many different sources and judging from the empirical analysis, all interviewees have different ways of attaining new knowledge, both internally and externally. According to Whelan, Collings & Donnellan (2010), however, it is rare for single individuals to possess all necessary talents to effectively attain all types of new knowledge. In an effort to structure the incoming knowledge flows they proposed the roles of external communication star, internal communication star and gatekeeper (Whelan, Collings & Donnellan, 2010). Assigning these roles to employees in Division A may help to structure the actionable knowledge base. In Figure 4.9, a model is proposed to assist Division A in assigning these roles.

In this model, external communication stars are responsible for venturing out of Division A's environment to acquire relevant knowledge. Two of these stars would be responsible for the collection of information within the rest of the organization, whereas one external communication star would have the freedom to collect any kind of information outside of the organization. These bits of information are then communicated to the gatekeeper who is responsible for the combination of knowledge and the implementation of an actionable knowledge platform, which in

turn will be accessed by the internal communication star whose role is to disseminate the contents towards all project teams.

According to Whelan, Collings & Donnellan (2010), people assigned the external star position generally are good in knowledge acquisition but lack the skills to disseminate them effectively; gatekeepers are generally structured, quite sociable and good at networking internally and externally; and internal stars are generally good at sharing knowledge and therefore often asked for advice. Using this model can help to put the right employees in the right positions to structure the knowledge acquisition and sharing processes.

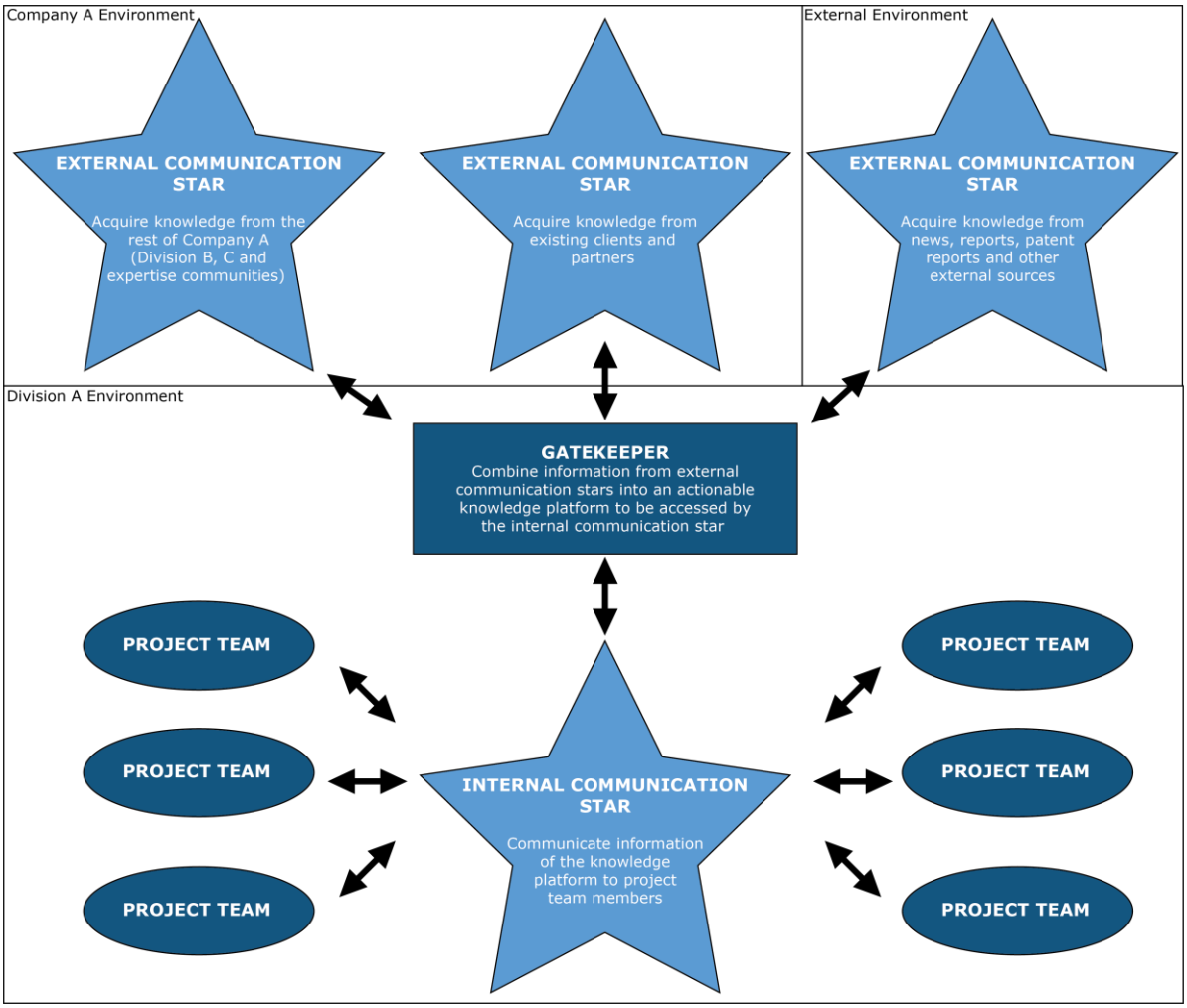

Figure 4.9: Concept C – Assigning Communication Roles

4.5. Final Design

4.5.1. Concepts Evaluation

To evaluate the three design concepts, they were all examined on how well they adhere to the design requirements set out in chapter 4.3.1., as well as discussed with the manager of Division A. The design concept evaluation is shown in Table 4.2. A more detailed version is presented in Appendix E.

Table 4.2: Design Concept Evaluation (extended version in Appendix E)

Design Requirement		A	B	C
1. Work towards an actionable knowledge base		+	+	+
2. Configure internal and external networks		+	+	+
3. Organization-wide involvement		-	+	-
4. Open organizational learning culture		+	+	+
5. Progress towards Division A's three goals	Environment to bond and work on exciting topics	+	-	+
	Improving innovative capabilities of employees	+	-	-
	External reach leading to profits and acquisition	-	+	+
6. Guide process about project selection		-	+	+
7. Possible to implement in one year		+	+	+
8. Suitable for a dynamic pool of involved employees		+	+	-
9. Involve employees from different parts of the organization		-	+	+

Concept A, the **knowledge repository**, is considered to be a relatively easily implementable solution to centralize information about past and current projects of Division A, making it useful for inexperienced employees who are in need of specific knowledge in particular. Linking it to comparable international divisions of Company A adds to an open and collaborative culture where anyone can be contacted for more information. However, the main issues are that it is non-prescriptive in the sense that it does not help with project selection, nor does it support cross-fertilization of divisions in the local organization and therefore it does not make an organization-wide impact. According to Division A's manager, the current setup of the Teams channel provides information about past projects

and people are already urged to collaborate and engage in knowledge sharing, and thus this concept is the least impactful of the three.

Concept B, the **centralized portfolio management** framework, does not target the organizational structure of the Division A specifically, but rather provides an overarching method that can be implemented on an organizational level. As interviewees #6 and #7 mentioned, centralized portfolio management may solve the deeper issues of the organization in terms of long-term vision and strategy. This framework combines internal and external research into a centralized deliberation session where technological areas of focus are defined, providing an actionable knowledge base through organization-wide involvement. According to Division A's manager, the current portfolio management sessions could use a better structure to derive stronger results and following this framework would help to succeed at improving the structure. Additionally, the concept design performs best with regard to the design requirements in Table 4.2, which further strengthens the case for this concept to be the most relevant of the three.

Concept C, **assigning communication roles**, specifically structures the inflow of external knowledge into Division A and further improves the dissimilation of this knowledge by giving employees extra responsibilities with the communication star positions and the gatekeeper role. According to Division A's manager, other divisions divide these responsibilities between an external head of division and an internal operations manager. The reason something comparable is not implemented yet in Division A is due to low availability of employees to assign these roles to. Splitting these roles into 5 new roles (3x external, 1x, internal, 1x gatekeeper) would alleviate the pressure but still requires 5 employees in total which is not feasible at the moment due to the lack of dedicated employees and high rotation. If Division A succeeds at fixing these issues first, concept C could be a valuable addition to the structural knowledge management, based on the evaluation in Table 4.2. In sum, concept C is currently less relevant for the organization than concept B.

4.5.2. Final Design Selection

Concept B, the **centralized portfolio management** framework, turned out to be the most suitable concept based on adherence to the design requirements and relevance for the focal organization. During the evaluation session, further points for improvement were collected with the manager of Division A and the current portfolio management representative. An updated final design can be found in Appendix F.

The points of improvement can be divided into *functionality improvements* (which have an influence on how the model works) and *completeness improvements* (which have an influence on whether anything is missing).

Functionality improvements:

- If the portfolio management team includes too many people, the sessions are at risk of dragging on due to the group size. For effective decision-

making, a rather small but knowledgeable group is necessary, and it is up to the organization to determine who to include.
- Third parties such as Forrester and Gartner provide valuable information which should be taken into account – therefore someone in the core team could be made responsible for tracking these sources and deliver updates based on them.
- Collecting input from all separate divisions can conveniently be done by approaching their respective operation managers (internal knowledge) and heads of divisions (external knowledge).

Completeness improvements:

- Employees working in sales have a direct link to clients and partners and are therefore valuable sources of external knowledge.
- The expertise communities are part of the divisions, therefore do not need to be included separately.

5. Conclusion and Discussion

5.1. Research Questions Answered

This project set out to research how the management of knowledge can be structured effectively to strengthen the digital innovation processes of organizations in the B2B IT sector. By following a design science approach, the research questions are answered through a combination of a systematic literature review and a case study at a related division called Division A.

The first sub-question addressed is as follows:

> *What does organizational literature imply regarding considerations and mechanisms that support the generation, sharing and integration of knowledge in organizations?*

A systematic literature review was performed in order to answer this sub-question. Following the theoretical analysis, five key themes within the knowledge management literature were identified: *organizational knowledge management, environmental technology scanning, knowledge sharing, knowledge creation* and *knowledge acquisition.* For each of these five themes, a separate CIMO-logic analysis led to an elaborate understanding of relevant considerations and mechanisms that support effective knowledge management practices. By synthesizing the results of these analyses and taking an outcome-based approach, the author proposed four guidelines that organizations should follow in order to improve their knowledge management practices:

1. **Building an actionable knowledge base**
2. **Configuration of internal and external networks**
3. **Organization-wide involvement and support**
4. **Ensuring an organizational learning culture**

The second and third sub-questions addressed are as follows:

> *How is the generation, sharing and integration of knowledge currently structured in the context of Division A's digital innovation processes?*
>
> *What are the strengths and weaknesses of the current structure in the context of Division A's digital innovation processes and does the structure allow the organization to reach its goals?*

To answer these questions, qualitative research was performed in the form of nice semi-structured interviews with a wide range of employees. These interviews served to explore the details of the current situation while allowing interviewees to share their personal opinion about the strengths and weaknesses concerning the setup. The empirical analysis yielded insights into several themes.

Employees have different perceptions of the goals of Division A, although the goals they named always could be attributed to one of the actual goals. The main strength of the current setup is that it allows for effective internal collaboration and knowledge sharing through active sessions where project teams give each

other feedback and scrum masters discuss their challenges together. Furthermore, employees are encouraged to ask for help when needed.

Clear weaknesses are the need for dedicated employees to ensure more reliable innovation processes, a lack of organization-wide centralized vision of trends and technologies, and that monetizing Division A through external reach is difficult due to several factors.

These empirical results ultimately led to design guidelines that were used in this design science research to frame the design solutions to the problem statement of Division A.

Finally, the fourth sub-question addressed is as follows:

> *How can the insights derived from the literature review and empirical data be used to evaluate and effectively structure the generation, sharing and integration of knowledge in the context of Division A's digital innovation processes?*

Through a solution design process in which three separate solutions for this business context were proposed by the author, the final sub-question is answered. The first design pertains to the implementation of a **knowledge repository** to provide an overview of past and current projects to stimulate knowledge sharing. The second design is a framework for **centralized portfolio management** in which internal and external knowledge is combined during periodic portfolio deliberation sessions to develop an organization-wide vision on trends and technologies. The third design revolves around **assigning communication roles** to specific employees to get a more complete and actionable knowledge base in the center of a specific division.

These three designs are examples of how B2B information technology companies can structure their digital innovation processes by managing the knowledge flows in their organization effectively.

5.2. Theoretical Implications

The theoretical gap that is addressed by this thesis is the lack of implementable strategies to improve digital innovation processes, adhering to the best practices of knowledge management. In an effort to fill this gap, a design science research was conducted to develop boundary objects in the form of artefacts based on a theoretical and empirical analysis in the B2B IT sector.

The centralized portfolio management framework resulting from this research contains theoretical value by being based on several theoretical concepts. The framework ties into several articles about knowledge mapping and the ability to make well-informed decisions when the knowledge gaps are evident (Calabrese & Orlando, 2006; Millar, Lockett & Mahon, 2016), formal environmental technology scanning (Borges & Janissek-Muniz, 2018) devising a learning-oriented decision-making process (Barabba, 2018) and configuring internal and external networks (Lopez & Estevez, 2013).

The resulting artefact is an addition to the organizational science in the form of a boundary object that allows practitioners to implement the best practices of knowledge management literature without having to perform a literature analysis. The final artefact can be implemented by B2B IT organizations that aim to structure their knowledge management processes more effectively, and is adaptable to the needs and constraints of whoever wishes to use it.

Furthermore, another theoretical contribution of this research to existing theory is that this research provides four guidelines that B2B IT organizations should follow in order to structure their digital innovation processes through effective knowledge management practices, those being:

1. Building an actionable knowledge base
2. Configuration of internal and external networks
3. Organization-wide involvement and support
4. Ensuring an organizational learning culture

These guidelines resulted from a systematic literature review in which 31 articles were synthesized across five knowledge management themes, as part of a design science approach. This research is an example of how to conduct design science research to relate theoretical insights to practical circumstances. After all, it is a methodology that allows for general knowledge to be synthesized into solutions.

From a knowledge management perspective, lots of research exists about different aspects of organizational knowledge management such as the creation, sharing and acquisition of knowledge. This thesis contains a systematic literature research that collected different concepts in the KM literature. Future research can treat this thesis as a meta-analysis that provides a theoretical overview of different KM concepts.

5.3. Managerial Implications

Accompanying the centralized portfolio management framework, the author proposes three additional points of focus for B2B IT organizations that plan to implement the final design (as presented in Appendix F):

First, ensure that those involved in the deliberation session have the mandate to communicate a centralized vision on trends and technology. A centralized vision can only be communicated when a trusted group of employees is empowered. This can be done by giving them sufficient responsibility, independence and power in the organization.

Secondly, overarching themes that are considered “too big” or “too long-term” may often not be tackled due to division-specific budgets. In order to become an adaptive organization that is prepared for radical changes, sufficient capacity and dedication are needed from top management in order to work on these overarching themes.

Thirdly, a key aspect of communicating a vision of trends and technology is to focus on the outcomes of the sessions. Try to prevent situations where long

discussions lead to nothing, and instead structure the sessions around yielding outcomes and action points. This should lead to a more organized and fruitful process in which clear objectives are reached by the portfolio management team.

5.4. Limitations and Further Research

The current research is subject to several limitations that should be kept in mind.

While performing the systematic literature review, the filtered search yielded a total of 82 articles. After excluding 37 articles for being conducted in unrelated sectors, another 14 were excluded because they were out of scope for this research. The decision to exclude these articles was based on their written abstracts. This method of excluding articles relies on the author's mental model of the concepts in the literature and may be prone to errors due to missed nuances. With the knowledge attained after performing this research, perhaps some articles would have been included and others excluded. Due to time restrictions, a second iteration of the systematic literature review was, however, not performed in this research.

The three concept designs proposed by the author were derived from the design requirements which were based on theoretical and empirical analyses and although they are developed by means of theoretical support, they were not tested empirically in a business context due to time limitations. Instead, only a discussion about potential improvements and further suggestions could be organized with the manager of Division A. Further research could validate the final design by implementing its steps in a real-life environment.

Furthermore, using a design science approach has specific advantages and disadvantages. On the one hand, the outcomes are practical from an organizational standpoint and often clearly implementable, which is valuable to Division A in this case. Drawing from management literature allows for grounded methods and tools to tackle an organization's challenges. On the other hand, however, the results of design science research are not conclusive from a theoretical viewpoint. Theoretically, the results of this research cannot be viewed as decisive answers to how an organization could **best** organize its innovation processes. Rather, it provides examples of how the gap between literature and practice can be bridged.

Finally, this research was entirely performed online due to practical limitations as a result of the COVID-19 pandemic. As a result, the practical environment of Division A where project teams come together physically to collaborate was not taken into account. An analysis of offline knowledge sharing may have resulted in different outcomes.

Although this research focused on the B2B information technology sector, it took an organization-oriented perspective instead of a market-oriented perspective. The empirical results indicated that ineffective knowledge management practices could lead to challenges regarding external reach and monetization. Future research into this subject could specifically focus on the collaboration with other

companies and explore mechanisms to stimulate cross-fertilization of knowledge through business model innovations.

6. References

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7. Appendices

7.1. Appendix A: Search query, filters and inclusion/exclusion factors

ProQuest filters:

- English language
- Range 01-01-2000 until 10-05-2021
- Peer-reviewed scholarly journals
- Full-text

Full search string:

noft(knowledge manag* AND ALL ((knowledge AND (shar* OR gener* OR integr*)) AND ((SECI OR (socialization AND externalization AND combination AND internalization) OR knowledge creat* AND (tacit OR explicit) OR absorptive capacity) AND (organizational knowledge)))) OR noft(knowledge manag* AND (digital evolution scan* OR strategic environmental technology scanning)) OR noft(knowledge manag* AND ((digital innovation process* AND digital innovation manag*) AND (process manag* AND project manag* AND information manag*)))

Inclusion and exclusion factors:

Excluded articles based on unrelated sectors (37)

Excluded articles based on topics that were out of scope for this research (14):

- Knowledge leaking (leading to loss of competitive advantage)
- Buyer-supplier relationship
- Specifically virtual collaboration
- Leadership styles
- Product ecosystems
- Online user communities
- Supply chain management
- Social identification and identity
- Transformational leadership
- Daily time management
- Skills needed in the job market
- Sustainability in product choice
- Sketching to communicate
- Child psychology

Included: (31)

7.2. Appendix B: Literature Review Excel

The literature review in Excel was attached as a separate document due to the large file size. It can also be requested through communication with the author.

7.3. Appendix C: Semi-structured interview questions

General

- Name
- Function / Department
- Years of employment

Division A general

- What is your experience with Division A?
- What do you think the goals of Division A are?
- What are the strengths of the current setup of Division A?
- What are the weaknesses of the current setup of Division A?
- What do you think Division A will be like in 5 years?
- Have you considered going to Division A when you have a new project idea? Why/why not?

Themed questions

- Where do you get specific expertise or knowledge in the organization when you need it?
- How much do you learn from colleagues?
- How often do you meet new people with different expertise in your work activities?
- How do you keep up with the newest technological trends?
- Do you incorporate technological trends into your projects? Why/why not?
- Do you document your knowledge for future use? Why/why not?
- Do you consider yourself to have a large internal network (professionals inside Company A)?

7.4. Appendix D: Coded interviews

The coded interviews were attached as a separate document due to the large amount of pages. They can also be requested through communication with the author.

7.5. Appendix E: Design Concept Evaluation

Table 7.1: Design Concept Evaluation (extended version of Table 4.2)

Design Requirement		Concept A	Concept B	Concept C
1. Work towards an actionable knowledge base		Provides an overview of available knowledge as input for knowledge creation	Includes a thorough knowledge mapping process to document the currently available knowledge	Specifically focusses on a centralized actionable knowledge base by combining external and internal knowledge
2. Configure internal and external networks		Stimulates internal knowledge sharing and directly involves international divisions	Explicitly involves internal research and external research, then balances these in deliberation	External and internal communication stars are tasked with the configuration of networks
3. Organization-wide involvement		No knowledge sharing outside Division A or involvement from top management	Organization-wide input is collected, a top management representative is involved in the deliberation sessions and the output report is shared with all employees	Although information is collected from other divisions, the consequences of this concept only pertain to Division A
4. Open organizational learning culture		Promotes knowledge sharing between employees by connecting them	Focus on the current state of knowledge while considering what knowledge will be relevant in the future for the organization	Provides clear roles to communicate where certain types of knowledge can be attained and urges employees to share their knowledge
5. Progress towards Division	**Environment to bond and work on exciting topics**	Specifically stimulates bonding with others through similar topics	No relation to this goal	Within Division A, the concept specifically urges bonding and

A's three goals				communication between employees
	Improving innovative capabilities of employees	Connects employees with others who possess specifically desired knowledge in order to learn	No relation to this goal	No relation to this goal
	External reach leading to profits and acquisition	No relation to this goal	The scanning process takes market demands on the short-, mid- and long-term into account	External communication stars outside of the organization are free to reach out to potential new clients
6. Guide process about project selection		No direct influence on decision-making processes for new projects	The forecast shows what trends and technologies project teams can choose to focus on	The internal communication star dissimilates the knowledge needed to start new projects
7. Possible to implement in one year		Yes, simple to develop and implementable on a website or app	Yes, this setup brings structure to the current efforts of the organization	Yes, simply assign the roles to suitable employees and structure the central knowledge base
8. Suitable for a dynamic pool of involved employees		Provides a central reference point for all employees, no matter their experience	The forecast shows different options so project teams can decide based on interest and team composition	Only possible when employees with these assigned roles can stay for longer periods of time, which is currently unpredictable
9. Involve employees from different parts of the organization		Only specified for Division A projects, not other divisions	The setup specifically involves all divisions of the organization	The setup specifically involves all divisions of the organization

7.6. Appendix F: Final Design