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A case study on Knowledge transfer at Serneke

Master's thesis in Design and Construction Project Management

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CHALMERS UNIVERSITY OF TECHNOLOGY
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ABSTRACT

The dynamic model of knowledge creation is based on the critical assumption that human knowledge is created and extended through social interaction between tacit and explicit knowledge. Knowledge is created by individuals and is then passed on to the organization through the knowledge spiral. This theory implies that organizations are incapable of creating knowledge on their own. However, many organizations attempt to collect tacit knowledge and transform it into codified information - usually in forms of documents, procedures, and manuals. Therefore, it is essential for organizations to have a well-developed knowledge transfer process to utilize the knowledge that exists within the organization long-term.

In the context of the construction industry, there are many different disciplines interacting throughout the lifecycle of a project, making the industry knowledge intensive. Construction typically involves many processes and project participants, which is reflected in the highly fragmented nature of project implementation. A common method of knowledge transfer is to make knowledge explicit and store it in the form of computer programs and databases. Conversely, studies show that knowledge-based systems have difficulty transforming tacit knowledge into explicit knowledge.

This study is based on the interest to investigate how a large construction company in Sweden manages knowledge transfer at an organizational level. Serneke, the company studied, currently invests in digitalization and a digital business operational system called VLS, which they believe will improve knowledge transfer in the organization.

The study presents challenges with knowledge transfer in the construction industry, as well as challenges with the development of computer programs and platforms from the perspective of knowledge transfer. The results identify important elements in the process of improving knowledge transfer at Serneke. It is concluded that Serneke's investment in the development of VLS is an important step towards improving knowledge transfer within Serneke. VLS will facilitate knowledge transfer as it creates a common information structure across the organization. Furthermore, this study has identified that the SECI theory is applicable to many areas within the organization. Finally, it appears that the organization should work to promote factors that facilitate knowledge transfer.

Key words:

Knowledge Transfer, Knowledge creation and transfer, Knowledge transfer in Construction industry, Knowledge management in construction industry.

En fallstudie om kunskapsöverföring på Serneke

Examensarbete inom masterprogrammet Master of Design and Construction Project Management

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SAMMANFATTNING

Den dynamiska modellen för kunskapsskapande bygger på det kritiska antagandet att mänsklig kunskap skapas och utvidgas genom social interaktion mellan tyst och explicit kunskap. Kunskap skapas av individer och förs sedan vidare till organisationen genom kunskapsspiralen. Denna teori innebär att organisationer är oförmögna att skapa kunskap på egen hand. Organisationer försöker dock samla in tyst kunskap och omvandla den till kodifierad information - vanligtvis i form av dokument, förfaranden och manualer. Därför är det viktigt för organisationer att ha en välutvecklad process för kunskapsöverföring för att utnyttja den kunskap som finns inom organisationen på lång sikt.

Inom byggbranschen finns det många olika discipliner som samverkar under ett projekts hela livscykel, vilket gör branschen kunskapsintensiv. Byggbranschen omfattar vanligtvis av många processer och projektdeltagare, vilket återspeglas i den mycket fragmenterade karaktären av projektgenomförandet. En vanlig metod för kunskapsöverföring är att göra kunskap explicit och lagra den i form av datorprogram och databaser. Samtidigt visar studier att kunskapsbaserade system har svårt att omvandla tyst kunskap till explicit kunskap.

Denna studie bygger på intresset att undersöka hur ett stort byggföretag i Sverige hanterar kunskapsöverföring på organisationsnivå. Det studerade företaget Serneke, satsar för närvarande på digitalisering och ett digitalt Verksamhetsledningssystem kallat VLS, vilket de tror kommer att förbättra kunskapsöverföringen i organisationen.

I studien presenteras utmaningar med kunskapsöverföring inom byggbranschen samt utmaningar med utvecklingen av datorprogram och plattformar från ett kunskapsöverförings perspektiv. Resultaten identifierar viktiga element i processen för att förbättra kunskapsöverföringen på Serneke. Slutsatsen är att Sernekes investering i utvecklingen av VLS är ett viktigt steg mot att förbättra kunskapsöverföringen inom Serneke. VLS kommer att underlätta kunskapsöverföring eftersom det skapar en gemensam informationsstruktur i hela organisationen. Vidare har denna studie identifierat att SECI-teorin är tillämpbar på många områden inom organisationen. Slutligen framgår det av studien att organisationen bör arbeta för att främja faktorer som underlättar kunskapsöverföring.

Nyckelord:

Kunskapsöverföring, skapande och överföring av kunskap, kunskapsöverföring inom byggbranschen, kunskapshantering inom byggbranschen.

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The empirical findings form the foundation for the research in this thesis and are of primary importance. Therefore, my last and most sincere thanks are sent out to all interviewees who participated in the study. It is my pleasure and honor to have you participating in this study.

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Natasa Peric

List of Acronyms

Below is a list of acronyms which have been used throughout the thesis.

VLS	Verksamhetsledningssystem
SECI	Socialization, Externalization, Combination, and Internalization
PDCA	Plan, Do, Check, Act
HSEQ	Health, Safety, Environment, and Quality
SIS	Swedish Standard Institute

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1 Introduction

The dynamic model of knowledge creation is rooted in the critical assumption that human knowledge is created and extended through social interaction between tacit and explicit knowledge (Nonaka & Takeuchi, 1995). It implies that organizations are incapable of creating knowledge themselves since knowledge is created by individuals and then passed on to the organization through the knowledge spiral developed by Nonaka and Takeuchi (1995). However, many organizations attempt to collect tacit knowledge and transform it into codified information. Usually in the form of documents, procedures, and manuals (Seokyon, 2020; Fong & Chu, 2006).

Due to its nature, the construction industry is known to be a knowledge-intensive industry with many different disciplines interacting throughout the life cycle of a project. Given the highly fragmented nature of project implementation, tacit knowledge in the construction industry is usually spread across many processes and project participants. Once the project is completed, the project team disbands and the tacit knowledge remains with the individual (Egbu & Botterill, 2002; Seokyon, 2020). These circumstances create difficulties in collecting and sharing tacit knowledge in the construction industry on a long-term manner. Since most knowledge in the construction industry is experiential, it follows that it can be considered tacit. Nevertheless, the typical approach to knowledge transfer is to make knowledge explicit and store it in the form of computer programs and databases (Woo et al., 2004). Yet, knowledge-based systems face the difficulty of transforming tacit knowledge into explicitly documented knowledge (Hansen, Nohria & Tierney, 1999; Woo et al., 2004).

According to Josephson and Saukkoriipi (2009), there is no method acquired in the construction industry to fully exploit the experience and knowledge gained. A greater exchange of experience within the construction industry and a better understanding of how to utilize knowledge can reduce construction costs and increase productivity (Johansson & Lindström, 2008). With this context in mind, it is interesting to investigate the organizational level of knowledge transfer within a large Swedish construction company. Moreover, the studied company, Serneke, invests in digitalization and are developing a digital business operational system called VLS - which they believe will improve the knowledge transfer.

1.1 Aim

The overall aim of the study is to investigate Serneke's current processes and practices regarding knowledge transfer. Furthermore, the study intends to explore the development of Serneke's own digital platform for business operational system, which stands for *Verksamhetsledningssystem*, VLS in Swedish. This research will be performed in close collaboration with Serneke and therefore the main data concerning the current situation and future possibilities will be based on the experience of Serneke. The purpose of this study is to propose suitable solutions for the development of knowledge transfer and VLS. The thesis contributes to the construction industry by increasing the understanding of knowledge transfer, highlighting the current problems with knowledge transfer, and suggesting relevant improvements. Hopefully, this study can provide insights and suggestions for a more successful knowledge transfer in the construction industry.

1.2 Research Questions and Thesis structure

Based on the aim of the research, the thesis strives to answer the following research questions:

- Q1: *What are the content and purpose of Serneke’s VLS platform?*
- Q2: *What features are being requested from a knowledge transfer perspective?*

The structure of the thesis is illustrated below in Figure 1. The theoretical and empirical findings are collected and analyzed, and the research questions are answered using the interaction between theory and empirical data. Additionally, the results of the study are discussed, and finally conclusions are drawn.

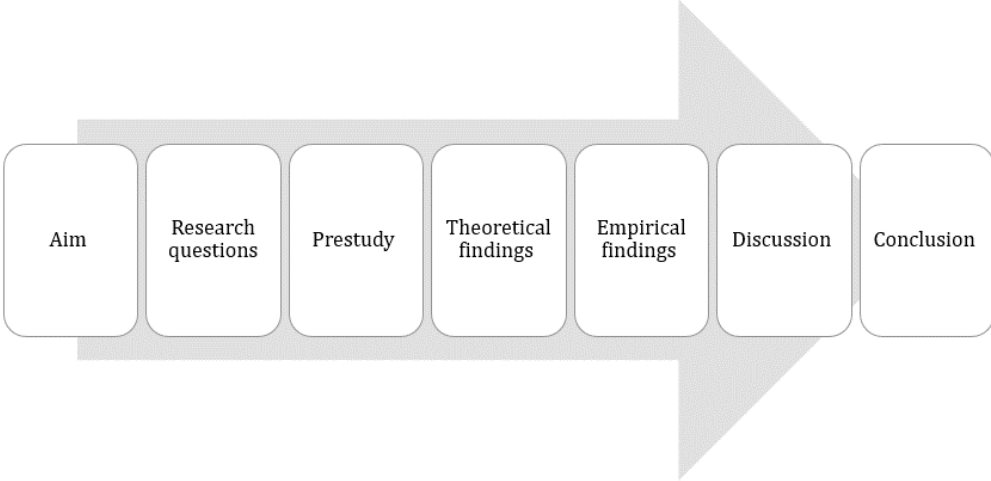


Figure 1: Illustration of the structure of the thesis.

1.3 Delimitation

Knowledge transfer in the construction industry is the focus of this study. There can be a variety of different definitions of knowledge transfer in the construction industry. In this thesis, knowledge transfer is defined in the following steps. Starting with the creation of knowledge, the use, followed by the transferring and sharing, and finally the storage of knowledge in a way that it is easy to retrieve for further use (Berg et al., 2011).

To have a clear purpose and scope, this research will be delimited to the construction industry in Sweden. Due to this delimitation, the study will be based on the Swedish laws and regulations. The study is contextualized within one Swedish construction company, Serneke. Since the research is conducted in cooperation with Serneke, the data, which is collected, reflects their working methods. Therefore, the results and conclusions of the study are adapted to Serneke's business context and are intended to help Serneke in future work for the development of knowledge transfer. Regardless, it can be considered that many construction companies might be struggling with similar challenges regarding knowledge transfer, thus the findings can potentially be applicable to the industry in general.

Specifically, the study examines the organizational level of knowledge transfer within Serneke. Accordingly, the primary emphasis is placed on the level of the organization, rather than the level of the group or individual. Nevertheless, the study does not provide an in-depth analysis or explanation of the organization's organizational structure.

A greater number of interviewees in the interview study might contribute to more nuanced conclusions. Additionally, a survey can be an appropriate complement to the study. A survey can be used to obtain a broader perspective on issues such as user behavior, preferred features, or other issues. It is something Serneke can do independently if they find it useful.

The study does will not go in depth on the following, Knowledge sharing, The capacity of the individual to assimilate knowledge or the presentation of information and knowledge, or other factors that may play a role in knowledge transfer and creation.

2 Methodology

The methodology chapter describes the way the research was conducted, and the methodological approach used. The research process will be described in detail along with the research methodology. Furthermore, the way the empirical data collection was conducted, including the process of finding interviewees will be explained. Finally, a discussion on the credibility of the research will be presented and a reflection from an ethical point of view will be outlined.

2.1 Research process

The study was based on an interest in the understanding of how a large construction company in Sweden manages knowledge transfer at an organizational level. For this study, a collaboration with Serneke was developed. At an early stage, Serneke described that the management of knowledge transfer at an organizational level is a widespread problem in the industry. To obtain a result that was both research-based and applicable in practice, the study was based on a literature review and an interview study, agreed upon with Serneke. Next, Serneke reported that it is investing in the development of digitalization in the company, as well as a digital business operational system called VLS, which they believe will improve the knowledge transfer in the organization. As a result, the research was narrowed down to focus on knowledge transfer and VLS within Serneke.

The following description simplifies the iterative research process. First, the research questions were used as the basis for collecting theoretical and empirical data. The theoretical collection served as a foundation for the theoretical framework, thus creating an understanding of issues and possibilities that could be explored further. This enabled a more specific focus to be chosen for the study and led to the formulation of the aim, as well as the research questions. Later, the literature review revealed challenges with knowledge transfer identified in previous studies. A pre-study was conducted to gain a deeper understanding of the research field and was essential for the understanding of the development of the VLS. The pre-study partially resolved some of the research questions. Following the results of the pre-study and the theoretical findings, an interview study was conducted to get a deeper understanding of the requested features within the VLS. The data was carefully evaluated and interpreted, resulting in a discussion based on the combination of both the empirical and theoretical findings. At last, all study findings were concluded.

2.2 Research methodology

The research strategy for the study was qualitative research, according to Bryman and Bell (2022) this implies focusing on words instead of numbers when collecting and analyzing data. When carrying out qualitative research, there are three different research strategies. *Inductive*, *deductive* or a combination of both called *abductive* (Awuzie & McDermott, 2017). The inductive research strategy includes collecting data to build a theory, while the deductive approach is when research is steered by theories. The abductive approach is a back-and-forth motion between data and theory to develop existing or new theories. This study is a product of

an abductive research strategy, where the studied literature and the empirical findings affect each other, in the sense that the analysis is carried out in iterations between the literature material and the empirical data (Bell et al., 2022). As such, the characteristics of qualitative research revolve around examining data that are not constructed by numbers, but rather the focus is on interpreting and analyzing works that represent different understandings and alternatives. For facilitating the process, the study was conducted using the steps of qualitative research described by Bell et al. (2022), as illustrated in Figure 2.

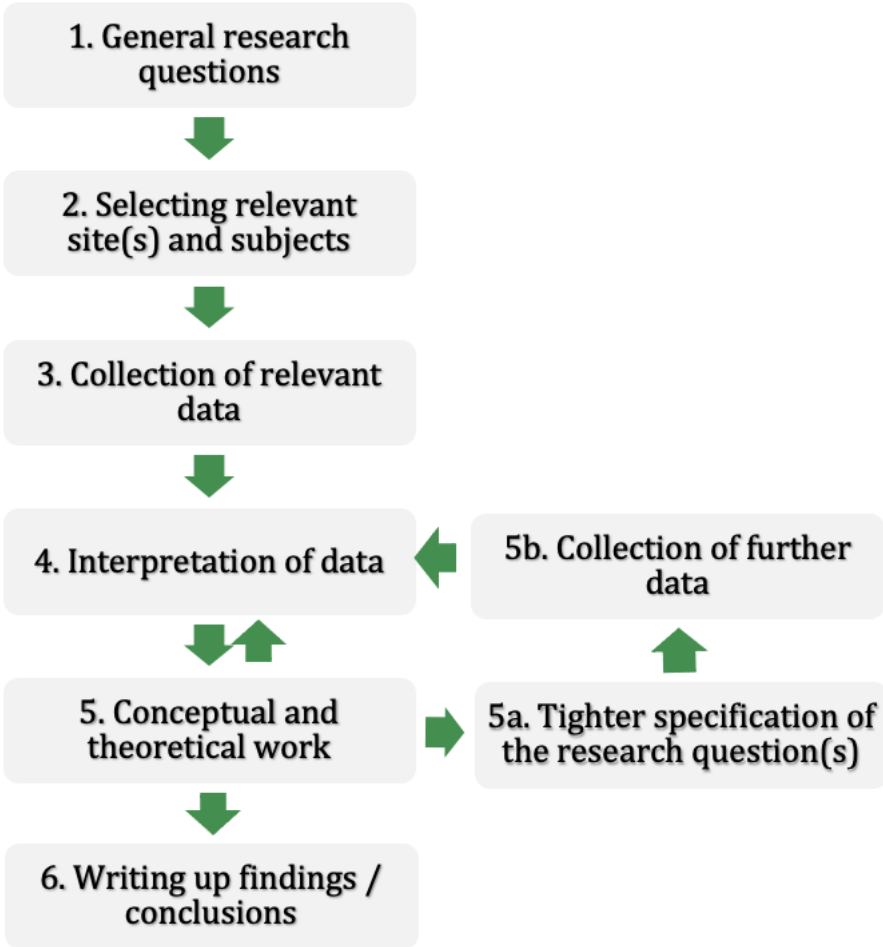


Figure 2: Main steps within qualitative research based on Bell et al. (2022).

2.3 Data collection

Here is a description of the data collection method. To begin with, a description of the steps involved in finding and creating figures and tables is presented. An overview of the literature review is presented next, followed by a description of the interview study.

3.2.1 Figures and tables

Nonaka and Takeuchi (1995) provide most of the figures that are presented in this study. All remaining figures and tables have been compiled by the author from the sources indicated in the figure texts.

3.2.2 Literature study

For the literature review, Webster, and Watson (2002) emphasize that the process of identifying relevant literature is a fundamental element of an academic study. It is crucial to develop theory and knowledge by conducting an effective literature review. Furthermore, Webster and Watson emphasize that a good literature review is not limited to any number of journals nor any geographical region. References in this study were identified through a systematic literature review, primarily using peer-reviewed databases indexing scientific publications to ensure a certain level of quality. Reliable sources were collected using databases such as Chalmers Library and Google Scholar. A wide search for possible data was initially conducted to gain a comprehensive understanding of previous research in the field. These sources were examined and further reviewed to add value to the topic studied. Scientific articles, reports, and books was the main sources of information. Additionally, previous well-known literature relevant to this subject has been used. The snowball concept of Greenhalgh and Peacock (2005) was also applied to further identify useful literature from useful sources. The geographical origin of the source was not a key factor in determining whether a piece of literature was considered relevant or not; instead, content and relevance were the key attributes.

3.2.3 Methodology for conducting interviews

As Fossey et al (2002) states, interviews are a common and appropriate method in qualitative research. Since the aim of this study was to understand how knowledge transfer is managed within Serneke, the study was conducted through interviews, strengthening the qualitative research aspect in the study. To conduct the prestudy and interview study, a semi-structured approach was applied (Bell et al., 2022). Furthermore, interview guides were conducted, providing interview questions, see Appendix. In the semi-structure approach, the interviewer is not limited by the interview guide but is rather flexible to ask follow-up questions depending on what the interviewees respond.

To find interviewees for the study, requests for suitable candidates were sent out by e-mail. Candidates were briefly informed about the topic of the study along with practical information on the settings at the time of interview. With inspiration from Bell et al (2022), the

snowball sampling approach was applied. Each contacted candidate was asked to recommend a colleague whom they considered to be a suitable candidate for the study based on the research topic. This was done to reach as many suitable candidates as possible. The interviewees are chosen regarding their professional roles and experiences in the organization. The goal of the interviews is to understand the interviewees' own perception, insights, and opinions. Furthermore, all of the interviewees in the study are employed by Serneke.

All interviews were conducted in Swedish as this was preferred, both by the interviewer and the interviewees to not encounter any language difficulties. Interviews were conducted via Teams and on site. Since not all interviewees work in the Gothenburg area, it was advantageous to have the possibility to conduct interviews via Teams. All interviewees received the interview questions in advance, to allow a more realistic discussion and obtain thoughtful answers.

3.2.4 Prestudy

The prestudy was based on an interview with two interviewees, referred to as *Interviewee 1* and *interviewee 2*, presented in Table 1. Together with internal documents explaining VLS and an internal training on the basics of the VLS. Both interviewees are part of the development team for VLS at Serneke. In accordance with Bell et al (2022), an interview guide, shown in Appendix A was used.

Table 1: Presentation of the interviewee from the prestudy.

	Profession of the interviewee	Interview duration	Interview conditions
<i>Interviewee 1</i>	Application manager	60 min	On site
<i>Interviewee 2</i>	Consultant	30 min	Via Teams

Following is a description of the two interviewees in the prestudy, which are employed to manage and further develop the VLS. Along with the help of two additional employees, and an external software developer, they oversee the development of VLS at Serneke.

Interviewee 1

Her previous experience includes developing business operational systems for other construction companies. Previously, she held similar positions in the automotive industry. She holds a degree in Industrial Engineering as well as a master's degree in supply chain management. It has been about two years since she worked for Serneke with VLS. Despite knowing the technology behind the platforms, she lacks construction expertise. In this regard, the content of the VLS is updated on a regular basis by a team of experts. She acts as a link between the employees' requests for features on the platform and the developer. For the developer of the platform to understand how to proceed, she interprets the new requirements. Together with interviewee 2, she is responsible for coordinating updates and developing new procedures. As part of her role, she also tests the new features and trains Serneke employees on how to use the new systems.

Interviewee 2

Interviewee 2 consults Serneke in the development of VLS and has been doing so for approximately 2 years. He has been building and developing business operational systems in the construction industry since 2007, like the one he is developing at Serneke. The interviewee 2 is the lead person of the VLS development work at Serneke.

3.2.5 Interview study

Next, the interview study was conducted with a total of five interviewees with different roles within the same company. The interviewees are referred to as *interviewee 3*, *interviewee 4*, *interviewee 5*, *interviewee 6* and *interviewee 7* which are presented in Table 2. For the interview study, the interview guide in Appendix B was used.

Table 2: Presentation of the interviewees from the interview study.

	Profession of the interviewee	Interview duration	Interview conditions
<i>Interviewee 3</i>	Site manager	60 min	On site
<i>Interviewee 4</i>	HSEQ-Manager	60 min	Via Teams
<i>Interviewee 5</i>	Business Development Manager	60 min	Via Teams
<i>Interviewee 6</i>	Project Manager	50 min	On site
<i>Interviewee 7</i>	Quality and Environment Strategist	50 min	Via Teams

In the following, the background and role of the interviewees are presented.

Interviewee 3

In Karlstad, he serves as a coordinating site manager and this year is his sixth with the company. His academic background is from Chalmers' "Väg och Vatten" program in civil engineering and his previous position was that of a foreman. As part of his responsibilities, he sets financial targets, coordinates logistics, and plans, predicts potential risks, schedules the workplace, and adapts to changing situations.

Interviewee 4

At Serneke, she is responsible for HSEQ (Health, Safety, Environment, and Quality) at the national level and has held this position for the past ten months. In addition to ten years of experience in central development, she has also worked as a production foreman, project design manager, purchaser, and other roles. Her academic background is in civil engineering from KTH's "Väg och Vatten" program. As part of her responsibilities, she coordinates the work of

the HSEQ managers at the regional level. This includes planning for next year's projects and conducting internal audits that provide baseline analyses.

Interviewee 5

His background includes a degree from the Civil Engineering program "Väg & Vatten", where he wrote his thesis on knowledge transfer. Prior to joining the company, he served as a technical consultant and a business developer. At present, he is Head of Strategy and Business Development, setting the company's vision. This involves describing the transition from the current situation to the company's vision, setting milestones, et cetera, and determining how these are to be achieved. He is responsible for overseeing several functions that support the overall operation of the company. A few of these functions include the procurement and tendering departments, the HSEQ department, the human resources department, and the digitalization development.

Interviewee 6

His construction career began as a carpenter. Following this, he studied at Chalmers in the civil engineering program "Väg och Vatten". Following ten years in the production phase, he has experience in various areas such as project calculation, purchasing, and project design. Although he is a project manager at the company, he is new to the position. He has also held similar positions in the past and has been aspiring to this position for some time. The responsibility for this role involves both personnel management and overall project management.

Interviewee 7

As a Quality and Environment Strategist, interviewee 7 deals with quality and environmental issues. She has twelve years of experience in this field in a variety of industries and has worked in the company for the last two years. In her role, she supports the national health, safety, and environmental manager, as well as developing processes and procedures within that context.

2.3 Data analysis

Thematic analysis is recommended by Bell et al (2022) as a method for analyzing empirical data. As a result, thematic analysis has been adopted as a method. Transcriptions of all interviews were completed within a few days of their completion. Initially, irrelevant information was removed from the interview data. After identifying the interview data, it was sorted into various topics relevant to the study. After separating the opinions and experiences of the different interviewees, the shared views among them were merged. The analysis phase began once the interview data had been compiled and summarized.

2.4 Research quality

The credibility of a qualitative study can be analyzed by examining four aspects: credibility, transferability, trustworthiness, and corroboration (Bell et al., 2022). Bell et al (2022) argues that each of the four aspects is equally important when deciding on the credibility of a study.

In a qualitative study, there is a risk that researchers will misinterpret the responses of the interviewees. Bell et al (2022) points out that it is important that researchers' interpretations are accepted by respondents to ensure that their social world is understood correctly. The interviewees confirmed the results before they were published, often referred to as respondent validation (Bell et al., 2022). Respondent validation eliminates the risk of misinterpretation and increases the credibility of the study. In addition, respondents were guaranteed anonymity, which enhances the credibility of honest responses. However, the company itself was named, so it is not entirely impossible to infer or guess the identities of the interviewees. Therefore, the possibility of this should not be completely ignored.

The qualitative study based on interviews in a regional office limits the aspect of transferability. The circumstances of similar companies may differ, for example in terms of cultures, projects, and other conditions. This makes transferability less possible, and the application of the results of this study is also not feasible and may not suit the needs of all construction companies. On the other hand, knowledge transfer is not limited to the construction industry but can be applied in many different industries and contexts. This increases transferability. However, there are special conditions relevant to the construction industry that have been considered in this thesis, and therefore it is not certain that it is fully transferable to other industries.

As the interviews were conducted by only one interviewer, they were recorded and preserved afterward. During the interviews, the interviewer was able to focus on taking in the impressions of the interviewees and ask questions. Transcribing the interviews increases reliability according to Bell et al (2022). Further, Bell et al (2022) points out that qualitative studies require a great deal of effort to review, which is correct for this study as well. Complete objectivity is impossible in social research according to Bell et al (2022). Therefore, the aim has been to interpret the interviews using the interview guidelines, so that as much objectivity can be attained as possible – nonetheless acknowledging the lack of complete objectivity. Furthermore, the thesis has been peer-reviewed to enhance credibility.

2.5 Ethics of the study

Throughout all stages of the research process, measures were taken to protect the identity and privacy of the interviewees and to obtain consent to use their information in the study. All the individuals interviewed are anonymous and are mentioned only in terms of their profession within the organization. The interviews were recorded with the permission of the interviewees and the recordings were used only by the author and were not shared in any way. To reproduce what the interviewees express in an accurate and truthful manner, the interviews were transcribed in their entirety. Where confidential information was used by the author, it was only done to gain a deeper understanding of the subject and was not shared in the thesis.

3 Theoretical findings

This chapter will present the theory and literature study in the field of knowledge creation and transfer in the construction industry. Moreover, issues related to knowledge transfer within organizations and in the construction will be examined.

3.1 Theory on Knowledge creation and transfer

Knowledge is a complicated concept to explain. According to the Swedish National Encyclopaedia, knowledge is "facts, understanding, and skills acquired through study and experience" (Nationalencyklopedin, 2022). There are different perspectives on what knowledge is, which makes the definitions vary. Both in academic and popular terms, there are disagreements about a consistent definition. However, before diving into theories regarding knowledge transfer or creation, allow this section to clarify the differences between data, information, and knowledge.

Data is defined by Liew (2013) as sets of characters, symbols, numbers and sound and image fragments which are represented and/or found in raw form. The term information refers to a message that contains relevant meaning, significance, or an input for decisions as well as actions. Nevertheless, Liew (2013) defines knowledge as the cognition or recognition (know-what), capacity to act (know-how), and understanding (know-why) that resides or is contained within the human mind. In Figure 3, data, information, and knowledge are illustrated as a triangle. The triangulation demonstrates the hierarchy between data, information, and knowledge.

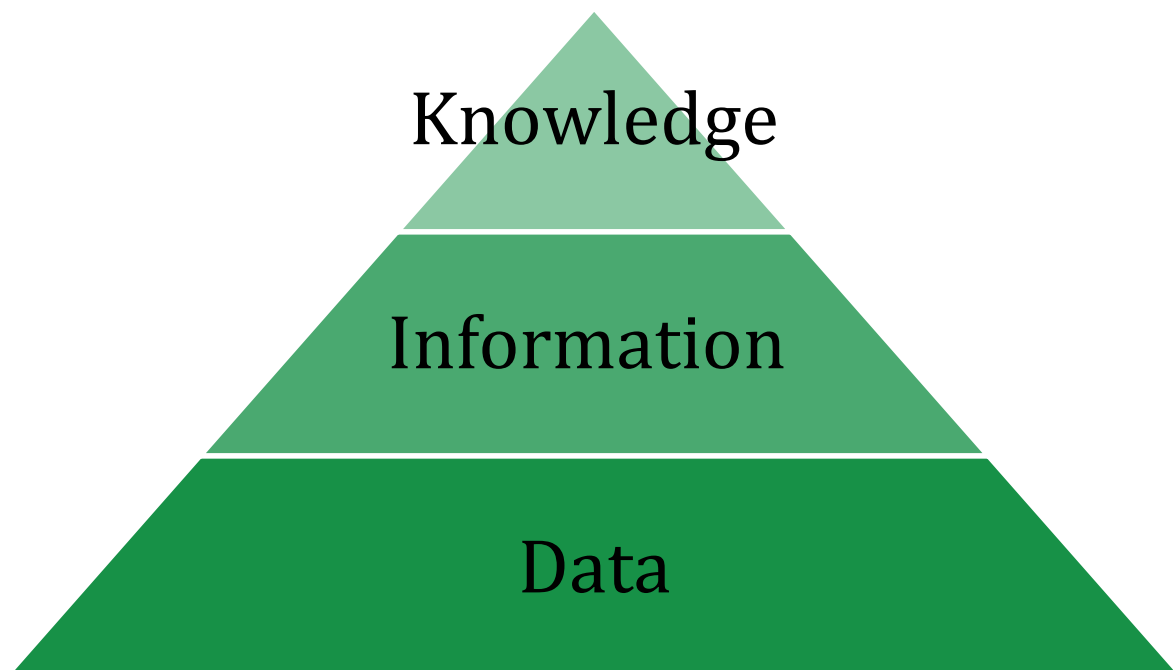


Figure 3: Illustration of the hierarchy of data, information, and knowledge. Inspired by the definition by Bali et al (2009).

Data are facts and figures on something specific but do not provide additional information on patterns or contexts. For data to become information, it must be contextualized, categorized, calculated, or condensed (Davenport & Prusak, 2000). Information gives a broader context; it is data with relevance and purpose (Bali et al., 2009). According to Bali et al (2009) Data is first level unorganised facts and figures on specific problems and Information is second level contextualised facts and figures on specific problems. Knowledge is third level know-how, understanding, experiences, and intuition. Furthermore, Bali et al (2009) argues for Data and information being Explicit knowledge, and Knowledge being Tacit knowledge.

Traditionally, knowledge is divided into two different categories: tacit knowledge and explicit knowledge (Nonaka et al., 1995). According to Polanyi's (1966) definition, tacit knowledge is context-specific and highly personal. Tacit knowledge is housed in the human brain and comprises understanding or professional insight formed through experience. Tacit knowledge is knowledge which is known by intuition. Consequently, tacit knowledge is hard to formalize and communicate – for example how to walk or ride a bike. Tacit knowledge includes both cognitive and technical elements (Nonaka et al., 1995). The cognitive elements in the sense of creating mental models of the world, such as schemata, paradigms, perspectives, beliefs, and viewpoints which helps the individual to perceive and define their world. The technical element of tacit knowledge includes concrete know-how, crafts, and skills. Explicit knowledge is codified knowledge that can be transmitted in a formal and systematic language (Nonaka et al. 1995; Polanyi, 1966). Explicit knowledge is knowledge that can be explained, documented, and easily transmitted to another person, and is easily transmitted by means of information technology (Woo et al., 2004). According to Nonaka et al. (1995) tacit knowledge is created “here and now” in a specific, practical context. Explicit knowledge on the other hand has already happened “in the past” and is oriented towards a context-free theory. Bateson (1973) referred to tacit knowledge as “analog” and explicit knowledge as “digital” activity.

The question that the concept of knowledge tries to solve is how to distinguish the things that we know by our own efforts, without being able to express them verbally, from the things that can be formulated, stored, and transmitted (Derarest, 1997). Some literature suggests that knowledge has additional properties that make it a useful analytical tool for management purposes. We can distinguish between internal and external knowledge. Moreover, there are different classifications of knowledge depending on its current form. Styhre (2009) emphasizes the difference between know-how and know-what. This differentiation is based on expert knowledge and local knowledge. Expert knowledge is theoretical, technically professional, and explicit. Such knowledge is equivalent to know-what and is aligned with explicit knowledge. As previously mentioned, explicit knowledge can be codified, defined, and documented. Local or tacit knowledge on the other hand is based on practice and related to practical reasoning. Tacit knowledge is stated by Nonaka et al. (1995), to be subjective.

Theoretical framework is starting off in the base of the two dimensions, epistemological and ontological, of organizational knowledge formation (see axes in Figure 5) (Nonaka et al., 1995). Within the epistemological dimension, graphically represented on the vertical axis, is the place where knowledge transformation takes place between tacit knowledge and explicit knowledge. In the ontological dimension, represented on the horizontal axis, the knowledge created by individuals is transformed into knowledge at the group and organizational level. Moreover, these levels are not independent of each other but interact with each other iteratively and continuously.

Although the theory distinguishes between tacit and explicit knowledge, tacit and explicit knowledge are complementary rather than separate (Nonaka et al., 1995). They interact with and interchange into each other in the creative activities of human beings. The dynamic model of knowledge creation is anchored to a critical assumption that human knowledge is created and expanded through social interaction between tacit and explicit knowledge. This assumption makes it possible to posit four different ways of transforming knowledge, referred to as socialization, externalization, combination, and internalization. In this context, the creation and transfer of knowledge can best be explained by the SECI model, developed by Nonaka et al. (1995). Table 3 illustrates how knowledge is transmitted through the four elements.

Table 3: Explanation of the four elements of the SECI model, together with an explanation of each concept. The theories in the table are extracted from Nonaka et al. (1995).

Type of knowledge creation	Element	Explanation of concept
Tacit to tacit	Socialization	<p>Socialization involves sharing experiences and thereby creating tacit knowledge, for example in the form of a shared mental model and skills (Nonaka et al., 1995).</p> <p>This knowledge often creates from just being around other people, such as through mentorship and apprenticeship (Berg et al., 2012; Yun et al., 2011). The person who is learning, gains new knowledge without ever thinking about it.</p>
Tacit to explicit	Externalization	<p>The externalization mode of knowledge conversion is often seen in the concept creation process and is triggered by dialogue or collective reflection (Nonaka et al., 1995). A much-used method for concept creation is to combine deduction and induction.</p> <p>Thus, at times when analytical methods of deduction or induction cannot adequately express an image, one must use a non-analytical method (Nonaka et al., 1995). Externalization is therefore often driven by metaphor or analogy.</p>
Explicit to explicit	Combination	<p>The combination is the process of systematizing concepts to create a knowledge system (Nonaka et al., 1995). It involves combining different aspects through such media as documents, meetings, telephone conversations or computerized communication networks. Learning performed in formal education usually takes this form.</p>
Explicit to tacit	Internalization	<p>Internalization is related to "learning by doing" (Nonaka et al., 1995). As experiences are internalized through socialization, externalization, and combination into individuals' tacit knowledge bases in the form of shared mental models or technical know-how, they become valuable assets. Internalization occurs when something is learned and then</p>

		repeated for a long period of time (Berg et al., 2012). People stop thinking about their actions and do them automatically, often referred to as learning by doing.
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Initial tacit knowledge of individuals is the basis for organizational knowledge creation since an organization is not creating knowledge by itself (Nonaka et al., 1995). An organization must mobilize tacit knowledge created and accumulated at individual level. The mobilized tacit knowledge is "organizationally" reinforced through four forms of knowledge transformation and crystalized at higher ontological levels; this is referred to as the "knowledge spiral". The knowledge spiral illustrates the interaction between tacit knowledge and explicit knowledge, which becomes larger in scale as it moves up the ontological levels, illustrated in Figure 5. Thus, socialization, externalization, combination, and internalization are not independent of each other, but their interactions produce a spiral when time is introduced as the third dimension, see Figure 4.

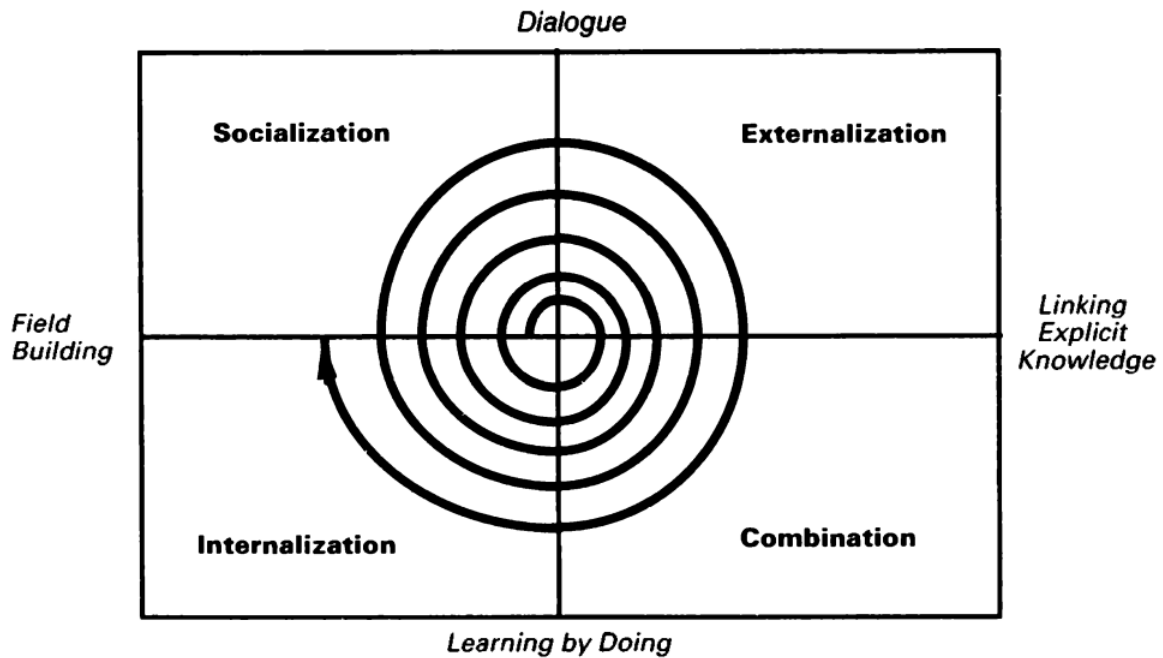


Figure 4: The knowledge spiral adapted by Nonaka et al. (1995).

Organizational knowledge creation is thus a spiral process that begins at the individual level and moves upward through growing communities of interaction, crossing sectional, departmental, divisional, and organizational boundaries (Nonaka et al., 1995). To further describe the spiral, in Figure 4 and Figure 5, the socialization mode usually starts with building a "field" of interaction that facilitates the exchange of members' experiences and mental models. Next, the externalization mode is triggered by meaningful "dialogue or collective reflection", where the use of appropriate metaphors or analogies helps group members to articulate hidden tacit knowledge. During the third stage, the combination mode is triggered by "networking" of newly created knowledge and existing knowledge from other parts of the organization. In the final stage, internalization is triggered by "learning by doing".

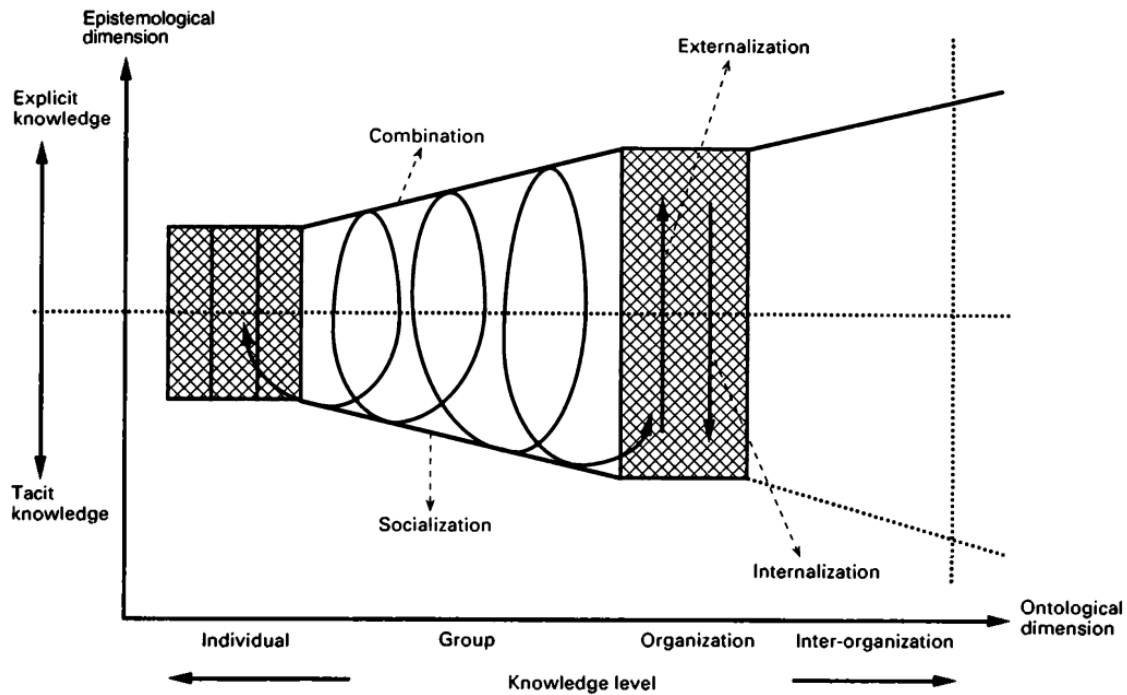


Figure 5: The spiral of organizational knowledge adapted by Nonaka et al. (1995).

Von Krogh, Ichijo, and Nonaka (2000) suggest that knowledge creation in the organization can be promoted by creating organizational conditions, examining barriers, and creating and enabling a context. A five-steps model of the organizational knowledge creation process emerged (Nonaka et al., 1995).

- 1) Sharing tacit knowledge
- 2) Creating concepts
- 3) Justifying concepts
- 4) Building an archetype
- 5) Cross-levelling knowledge

1. Sharing Tacit knowledge

As tacit knowledge held by individuals is the basis for the creation of organizational knowledge, focus is placed on the tacit knowledge, being the rich, untapped knowledge that is the source of new knowledge (Nonaka et al., 1995). Given that tacit knowledge cannot be easily transmitted or transferred to others, tacit knowledge should be shared among several individuals with different backgrounds, perspectives, and motivations. Individuals' feelings, emotions and mental models must be shared to build mutual trust. To accomplish this sharing, we need a "field" where individuals can interact with each other through face-to-face dialogues. It is here that individuals share experiences and synchronize their physical and mental rhythms. Nonaka et al. (1995) describes an example of this where a company's employees share their mental models and skills over informal activities such as having a drink of sake, out of the office.

2. Creating Concepts

In this second phase, the most intensive interaction between tacit and explicit knowledge takes place (Nonaka et al., 1995). Once a shared mental model has been formed in the interaction field, it is further formulated through continuous dialogue in the form of collective reflection. The shared silent mental model is verbalized in words and phrases and finally crystallized into explicit concepts.

3. Justifying concepts

In the theory of organizational knowledge creation, knowledge is defined as a justified true belief (Nonaka et al., 1995). Consequently, any new concepts created by individuals, or the team must be justified at some point in the process. Justifying involves a process of determining if the new concepts created are truly valuable to the organization and society. As such, the most appropriate time for the organization to conduct this review process is immediately after the concepts have been created.

4. Building an archetype

At the fourth phase, the motivated concept is transformed into something concrete and tangible, namely an archetype (Nonaka et al., 1995). An archetype can be thought of as a prototype for the development of a new product. To build a prototype, experts from different disciplines need to come together to develop product concept specifications.

5. Cross-leveiling knowledge

The creation of organizational knowledge does not end when an archetype has been developed, but rather is a never-ending process that is constantly evolving (Nonaka et al., 1995). The new concept, once created, justified, and modelled, moves on to a new cycle of knowledge creation at a different ontological level. This interactive and spiralling process, referred to as cross-knowledge, takes place both within and between organizations. In the organization, the knowledge which takes shape as an archetype can trigger a new cycle of knowledge creation.

3.2 Literature study

In this section, literature studies on the topic will be summarized. This is done to get a broader understanding of the issue being studied. First tacit knowledge in the construction industry is addressed. Next, the project orientation in the construction industry is presented and the way it can inhibit knowledge transfer. Then, results from a previous study on knowledge transfer in the construction industry are presented. At last, challenges with computer software and platforms are introduced.

3.2.1 Tacit knowledge in construction industry

Knowledge gained through the learning process is called tacit knowledge, as presented in section 3.1, and can be useful to organizations in different ways. For example, activated tacit knowledge helps project teams to identify and deal with problems that have arisen in previous projects in a more proactive way (Ni et al., 2018; Seokyon, 2020; Zhang et al., 2013). Using surveys, Somech and Bogler (1999) investigated the relationship between tacit knowledge and student learning and achievement. Results showed that students who scored high in tacit knowledge achieved higher academic grades than students who scored low in tacit knowledge. Therefore, it may not be surprising that tacit knowledge is considered one of the most important assets for most organizations (Nonaka et al., 1995).

Studies have previously shown that most of the knowledge gained at work is held in the human mind as tacit knowledge (Seokyon, 2020; Fong & Chu, 2006). However, many organizations attempt to collect tacit knowledge to transform it into codified information, usually in the form of a document such as a procedure or manual. Due to the extensive contextual information contained in tacit knowledge, the transformation is complex, time-consuming, and expensive (Nonaka et al. 1995). Knowledge seekers and knowledge owners often interact closely with one another across areas of expertise, which restricts the ability to collect, transfer, and disseminate such information. The involvement of employees in knowledge transfer practices is highly dependent on the organizational environment and the characteristics that influence these practices.

As for the way tacit knowledge is shared, it is typically done in two ways. It can be transferred directly from a knowledge owner to a knowledge seeker, or it can first be codified into explicit knowledge and then disseminated. Therefore, the individual employee's willingness to share knowledge plays an important role (Zheng et al., 2009). When it comes to the construction industry knowledge transfer is still underutilized (Asprey 2004; Addis 2016; Rezgui 2001; Seokyon, 2020; Yu & Yang, 2018). The planning and implementation of each project generate an enormous amount of tacit knowledge, and the construction project involves experts from different professional backgrounds and organizations. However, due to the highly fragmented nature of project implementation, tacit knowledge in the construction industry is usually spread over many processes and project participants. In addition, construction projects typically consist of a temporary project-based team that disbands when the project is completed. These factors all lead to difficulties in capturing and transferring knowledge within the organization. Team members are assigned to new and usually different projects, leading to a low degree of organizational continuity. After completion of the project, the project team is dissolved, and highly skilled individuals often become geographically dispersed in the construction industry (Bonner, 2000; Seokyon, 2020). In addition, tacit knowledge stays with the individual once

they leave the organization (Egbu & Botterill, 2002; Seokyon, 2020). These circumstances create difficulties in collecting and sharing tacit knowledge in the construction industry.

One of the aspects providing better conditions for successful knowledge transfer is an organizational culture that is supportive of new knowledge (Berg et al., 2012; Lindner et al., 2011). Such a culture can result in project team members who are motivated to teach, learn, and rely on knowledge from other people. Furthermore, it is important to have a tolerant environment within the project and the organization, comprising openness, cooperation, and a positive attitude as well as a permissive environment for mistakes (Berg et al., 2012). In such an organization, members of the project team find it easier to tell their colleagues and managers when things go wrong (Berg et al., 2012; Lindner et al., 2011). This allows the organization to reflect on the mistake and limit the risk of making similar mistakes in future projects. A third aspect that provides better conditions for knowledge transfer is that team members should be given time to participate in knowledge transfer activities. This has also been studied in the construction industry. The study *Knowledge transfer within and across organizational boundaries: A case study in the construction industry* by Berg et al (2012) indicates a comparable result. In the study it is shown that there are several factors that affect knowledge transfer within and across organizational boundaries. The study shows that it is not possible to point to one factor as the most important, but it is rather necessary to consider the importance of several factors for success. First, it is important to have an open and broadminded culture to facilitate knowledge transfer in organizations. Another finding of the study is that informal face-to-face meetings are good ways to transfer knowledge. For this reason, Berg et al (2012) remarks on the importance of having a decentralized structure and a culture that allows informal meetings. Thirdly, the media used to store and transmit knowledge has proven to be very important. It needs to be designed to facilitate the search and transfer of knowledge. This also implies the need for knowledge to be available in both short and long term. Furthermore, it is important to not only know how something should be done, but also to understand why something should be done in a certain manner.

3.2.2 Project orientation in the construction industry

In the analysis of *Det konstiga är att vi inte upptäckte felet tidigare* it is stated that errors are caused by everyone involved: clients, designers, material suppliers, production managers, contractors, and others, and therefore everyone has a responsibility to reduce error costs (Josephson & Larsson, 2001). Several studies indicate that approximately ten percent of the total annual production value in the construction industry is wasted on failures (Koch & Schultz, 2018). A better understanding of how to utilize the knowledge and transfer it, within the organization would give companies greater opportunities to streamline processes, minimize waste and increase profitability. Continuous improvement and a greater exchange of experience within the construction industry would reduce construction costs and increase productivity (Johansson & Lindström, 2008). It would improve the quality of the work performed by employees and help them avoid mistakes.

The construction industry is project-oriented and project organizations are temporary constellations of different skills working together. Knowledge tends to be temporary, situational, and otherwise tied to individual and local practices (Berg et al., 2012). The unique nature and short-term focus of temporary project organizations create barriers to knowledge transfer and can hinder the development of routines and organizational memory. According to

Josephson and Saukkoriipi (2009), there is no method in the construction industry to make full use of the experience and knowledge gained (Josephson & Saukkoriipi, 2009). Furthermore, it has been shown that knowledge gained rarely goes beyond the boundaries of the specific project (Koch & Schultz, 2018). A study by Koch et al (2018) highlights how the only time the experience of a construction project extends beyond the project boundaries is in the context of a fatal accident. Koch et al (2018) find it paradoxical that the consequences of failure must be of such severity to lead to a change in practices and social routines in the construction industry. It also stresses that while local actors gain greater knowledge from their experiences and mistakes, their knowledge of specific solutions is diluted as they either move to another project in the organization or change jobs after the end of the project. This implies that the skills and knowledge that the organization has gained over a period, may be lost if a person leaves the organization for any reason. To prevent the loss of this knowledge, organizations are looking for a way to transfer knowledge from individuals to an organizational level. Yet achieving this has proven to be difficult. In fact, transferring individual-level knowledge to organizational knowledge is a major challenge for organizations (Seokyon, 2020). Nonetheless, if a project is successful, an organization can apply the lessons learned to future projects. To achieve this, organizations are required to develop organizational memory (Lindner et al., 2011). The challenge in transferring knowledge from individuals to the core organization lies in the fact that everyone represents and interprets knowledge differently (Berg et al. 2012; Cacciatori, 2008).

3.2.3 Challenges with computer software and platforms

Given that most of the knowledge in the construction industry is experiential, it follows that it can be considered as tacit. The requirements for knowledge are dynamic and dependent on the task or problem to be solved. Nevertheless, the typical approach to knowledge transfer is to make knowledge explicit and store it in the form of computer programs and databases (Woo et al., 2004).

Hansen et al (1999) and Johannessen et al (2001) pointed out in the years of 1999 and 2001 that the benefits of IT are limited only to the transfer of explicit knowledge (Hansen et al., 1999; Johannessen et al (2001); Woo et al. 2004). Although this no longer seems as complicated today, it remains a challenge. Knowledge-based systems are facing difficulties since it is very demanding to transform tacit knowledge into explicitly documented knowledge. As a result, it can often be challenging to extend and improve a knowledge-based system with additional expertise after it has been implemented. Human experts must be sufficiently involved in a knowledge-based system for it to be successful.

4 Prestudy

Top management in a company is responsible for managing the business operational system, including its impact and ability to evolve. HSEQ (Health, Safety, Environment, and Quality) management team supports management in matters related to health, safety, environment, and quality. In accordance with ISO9001, Serneke's business operational system addresses quality systematically. According to the PDCA model (Plan, Do, Check, Act), the business operational system is designed to ensure the continuous development of working methods and practices as the business and the world change.

4.1 Quality management system – ISO9001

ISO standards are requirements and guidelines to help organizations around the world to act in a more consistent manner (SIS, 2022). Quality Management System, which is often referred to as a QMS, is a collection of policies, processes, documented procedures, and records. This collection of documentation defines the set of internal rules that will govern how the organization creates and delivers the product or service to the customers. ISO 9001 is a quality management standard for business processes in a company or organization. It describes how continuous improvement and adjustments in operations can be implemented to meet customer needs. The ISO 9000 series of standards is currently used by many services and goods-producing companies, in public and non-profit sectors throughout the world.

QMS is a tool for management to lead the business and support employees to ensure that the right action is taken at the right time with the right number of resources - while actively working on improvements and monitoring on an ongoing basis (SIS, 2022). ISO 9001 allows the organization to build an agreed structure and approach with management, employees, and sub-consultants for how work is to be carried out, so that relevant procedures are in place for the business. The system may include written documentation in the form of policies, manuals, procedures, guidelines, and checklists created by the organization to ensure that products and services maintain good quality and customer satisfaction. Organizations are free to choose the content and way their work is documented, but the most important thing is to keep the business operations system up to date and to improve it continuously.

4.2 PDCA- cycle

PDCA (Plan-Do-Check-Act) is a four-step iterative problem-solving model used to improve a process or implement change (SIS, 2022). When applying the PDCA cycle, it is important to include internal and external customers, as they can provide feedback on what is working and what is not. To ensure that customers are satisfied with the outcome, it would be appropriate to involve them in the process whenever possible and appropriate to ensure that they are satisfied with the result. Figure 6 illustrates the PDCA cycle; Table 4 explains it.

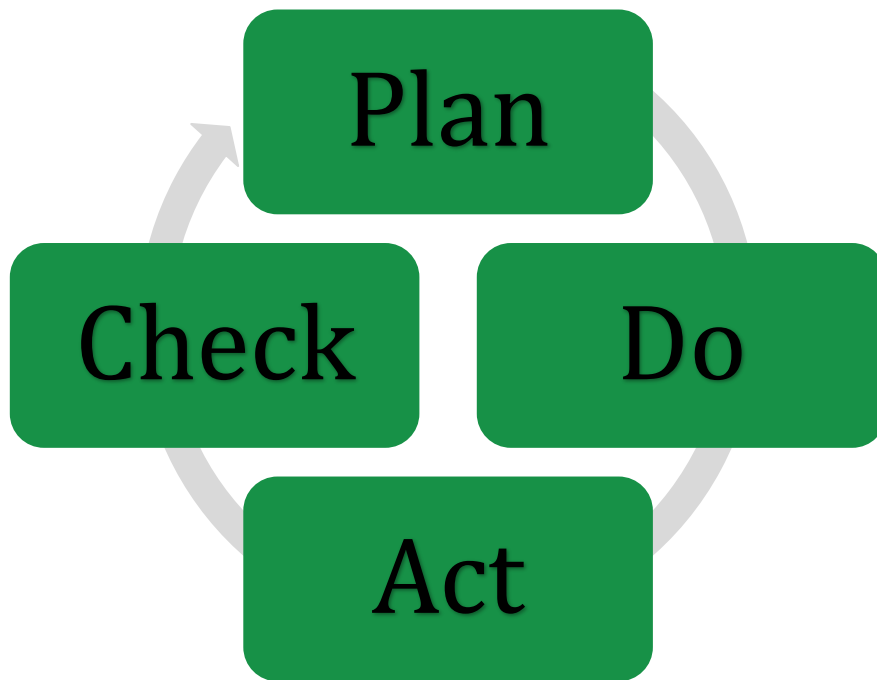


Figure 6: Illustration of the PDCA – cycle.

Table 4: The PDCA- cycle steps with description.

Plan	Investigate and Plan
	Examination and mapping of risks, issues, laws, and requirements. Measurable objectives, processes, and the actions necessary to create results that comply with policies and meet customer requirements.
Do	Implement
	Implement decisive actions and practices in the business.
Check	Follow up
	Supervise and meet the actions and processes based on policy, objectives, customer requirements, legal and other requirements and report the results.
Act	Improve
	Implement actions to continually improve operations and processes.

4.3 VLS – The Business Operational System

VLS stands for “*Verksamhetsledningssystem*” and is the business operational system at Serneke. The findings of the prestudy are presented below. The following is an introduction of Serneke and its initiatives for digitalization. Thereafter, interviewees of the prestudy are introduced. Followed by the development of VLS, its content and the future of VLS.

4.3.1 Introduction of Serneke

Serneke Group is one of the largest construction companies in Sweden and offers complete construction and project development solutions. The Group operates through three business areas. *Serneke Sverige*, which is the core business of the Group and includes construction contracting and project development. The business spans the whole of Sweden and is divided into five geographical regions: West, East, South, North, and Central. *Serneke Invest*, which consists of major development projects and investments. An example of a development project is Karlastaden in Gothenburg. *Serneke International*, manages international projects, collaborations, and investments.

The CEO of Serneke Group, Michael Berglin has a vision of taking Serneke to become the most digitalized construction company in the industry. As part of achieving this goal, Serneke has developed a modern business operational system called VLS. Through the VLS system, employees can now access procedures and documents via a web-based interface. The aim is to achieve improvements in terms of quality, efficiency, and profitability. As a result of the VLS development, Serneke expects to improve its knowledge transfer.

4.3.2 The content of VLS

The VLS system is a digital platform based on the previous project manual “*Projekthandboken*”. The Project manual “*Projekthandboken*”, was a business operational system in pdf format, which was transformed into the first version of VLS, called “VLS 1.0”. In terms of content between VLS 1.0 and the “*Projekthandboken*” in pdf format, the documents and procedures are basically unchanged. The difference is that the information is, now presented in a more user-friendly system that simplifies and provides better opportunities for exchanging experiences and working on improvements. In total, there will be three main updates, VLS 1.0, VLS 2.0 and VLS 3.0, all of which will be further developed, not replacing the previous version but updating existing versions. VLS 1.0 is a digitization of the Project Manual and a dynamic tool that is updated four times a year as well as if necessary. While VLS 1.0 is directly extracted from the Project Manual, the updates with VLS 2.0 will include a completely new project space where all information about the project is gathered - including information such as tasks, reports, document storage, and more. The upcoming update with VLS 3.0 will include data storage, as already applied in the VLS 2.0.

During the end of 2022, pilots will be launched to verify the performance of the platform, thereafter, VLS will be implemented in all new projects from the beginning of 2023. In the present situation, the procedures in VLS are the most effective method for Serneke to perform

work; however, the system is continuously evolving, and the procedures must be updated accordingly. In contrast to other construction companies, most construction companies in Sweden have some form of business operational system. According to Interviewee 2, Serneke will have an advantage when VLS 2.0 is released, since the organization will be able to use new technology through Microsoft Power Apps.

4.3.3 The “Suggestion for improvement” function

For each chapter, and process in VLS, there is an assigned process owner. The process owner is responsible for the development of the process and for handling incoming suggestions for improvements. Everyone in the organization is responsible for reporting errors in templates to the process owner so that they can be corrected. Reporting is done via the “Suggestions for improvement” function in the VLS platform. Once the investigation is completed, the person who submitted the suggestion receives feedback on the outcome of the action. Through the VLS, the user can also get in direct contact with the process manager. Through the submitted suggestions for improvement, Serneke can develop routines and working methods. The development group of VLS also meets quarterly to discuss proposals submitted and the necessary updates.

4.3.4 The development of the VLS

When VLS was first developed, inspiration came from other industries in terms of digitization. The platform choice depends on the organization's IT experience, its existing systems, and its long-term future. As a result, Microsoft SharePoint was found to be suitable for the organization's needs. According to interviewee 2, the VLS should function like Google. A searchable information database, which is solely devoted to the construction industry and based on Serneke's routines.

Generally, employees have not driven the shift toward a more digitalized organization. This is rather a result of management's recognition of the need to take steps forward in the direction of digitization. Otherwise, the organization will fall behind later. In other words, it is an investment that will benefit the organization in the future. The second driving force is the desire to have greater control and visibility over the processes of the organization so that all project information can be gathered at one place.

In terms of the content of the VLS, a survey has been carried out including both internal and external stakeholders. Focus group workshops have been carried out to generate new ideas when developing the VLS. The focus groups have discussed the content and presented proposals. After the proposals have been presented, discussion took place and feedback and suggestions for improvement were given. Interviewee 1 further explains that after each presentation to regional managers and others, there are always new suggestions that are collected and included. Through the "suggestions for improvement" function there are a lot of suggestions coming in as well. Certain suggestions are rushed through if it is seen that they will be of great benefit to many in the organization, while other suggestions must wait. Interviewee 2 really believes that they have been working with an involving process and that they have taken in many different perspectives.

4.3.5 The content of VLS

The VLS 2.0 is a project space which has gates, which guides the project through the process, so that important parts of the process are not missed. All project information will be in a single place. The VLS will keep knowledge and information together in a structured way. Interviewee 1 calls VLS 2.0 a "cockpit for the projects", because it gives them an overview of all the project elements. The VLS brings together everything related to the projects, and employees get a great overview of the project. The content of VLS in summary is presented in Table 5.

Table 5: The content of the VLS as of the 2.0 version.

Function	Description
Document storage	VLS will replace all other options there are in the organization for document storage.
Visualization and accessibility	Information will be displayed and visualized, making it more accessible.
Up-to-date information	Daily, information is retrieved from other digital platforms used in the project such as Dalux, ByggSam, and others. VLS presents and compiles the information so that it is available in one place in the project space. If changes are required to the project information, they are made directly in Dalux, ByggSam, and others.
Aggregating information	<p>Much data will be collected in VLS 2.0. Taking the user through different steps prevents the user from missing important aspects. The collected information can be aggregated up to project level, region level, or organization level depending on who needs to manage the information.</p> <p>By aggregating information, it is possible to analyze and draw conclusions from the information, creating knowledge. This allows decisions to be made on various issues. Knowledge can be created both at the project level and at the management level by analyzing information from multiple projects.</p>
Task management	In the VLS there will be assignments and follow-up of tasks in the project. The tasks will guide the user through the process. Tasks will be ticked off when they are completed, leaving the remaining tasks are clearly displayed.
Financial risk management	Replacing the old process of financial risk (and opportunity) management process of using Excel documents.
Project diary	Project diaries will be handled directly through the VLS.
Reports	Various reports will be provided through VLS. Reporting will primarily consist of the financial management report, purchase report, quality report, and cost report.
Scheduling	VLS 2.0 can also integrate with Microsoft Project, which makes it possible to work with time scheduling directly in VLS.

According to interviewee 1, the aim of VLS is to make it as easy as possible for projects to follow the processes of the organization. Furthermore, it is a way to ensure that procedures are followed and to improve the procedures continuously. Lastly, the aim is to ensure that Serneke meets the customer's requirements, making sure that Serneke delivers as good a product as possible to the customer. Interviewee 2 adds that VLS will meet these goals by guiding the projects team through the process. Often, key aspects are overlooked, such as forms that should have been filled out and submitted, and tasks that should have been completed. In VLS 2.0, tasks and checklists can be assigned. According to interviewee 2, this function is critical so that tasks that need to be completed are assigned before moving on to the next step.

In his interview, interviewee 2 mentions that he has been involved in the preparation of routine documents in the past, which have been discarded because they are stored in a folder and forgotten about. The reason for this, he believes, is that there is far too much information, and it is difficult to locate relevant information and gain an overview of the situation. To make it easy for the user to access the information, it is helpful to present it to them and compile the information in one place.

4.3.6 The future of VLS

The future work of VLS will include a continued review of what can be done to further develop and simplify the work process. Are there any applications that can be replaced? What is the current need? What steps can be taken to increase automation? Thus, the list continues. It will depend on what suggestions are made for improvement.

As per interviewee 1, there is a plan to make the tasks clearer. An example would be that if a user is late with a task, the software recognizes that it may affect the next task. A further proposal is that the VLS should in the future offer suggestions to users on, for example, "which three tasks are most important to complete during the day". It is simply a matter of incorporating more AI into the platform's design.

As well, motivating employees to use VLS will be a challenge, as it represents a change in their daily routine. Interviewees 1 and 2 agree that facilitating employees' work will be the primary motivation. The VLS gives employees a completely different level of control over the project. By understanding the data, aggregating it, and then analyzing the results, rather than searching for them. Employees will be able to analyze data and draw conclusions from reports presenting the aggregated data. Employees will also be guided and supported during their work.

An important aspect of VLS 2.0, according to interviewee 2, is that it is an ecosystem. If Dalux is the best at handling quality issues, VLS will only retrieve data from there and visualize it in VLS. If Dalux does not excel at quality issues management or any other feature, then that feature can be developed within the VLS, or another system integrated with the VLS can be developed. As an example, interviewee 2 would like to use VLS to integrate the process of costing and design. Interviewees 1 and 2 both believe that a VLS will be a great tool to enhance information flow, to collect knowledge and experience feeds in an organized manner, and to then be able to transfer it in an organized manner.

5 Empirical findings

This section presents the empirical data. The first part consists of an introduction of the interviewee's views on knowledge, knowledge transfer, the degree to which knowledge transfer is being performed in the organization, the sharing of knowledge, and the degree to which knowledge is being utilized. Further, the development of the VLS platform is discussed, including a section on motivation and implementation.

5.1 Knowledge

All the candidates found it challenging to define what knowledge is. Interviewee 3 believes that in general, knowledge is knowing how to perform a task. He exemplifies it by knowing how to ride a bike or how to set a time plan for a construction project. However, he also said that knowledge is learned, and learning can be done in different ways – e.g., through reading, watching YouTube videos, or experiencing things firsthand. Furthermore, interviewee 3 discusses that knowledge takes up a lot of brain capacity, describing the brain as a hard drive where information is stored. Interviewee 4 adds that knowledge can be pure theory behind how different things and systems work. Knowledge may also be the understanding of how to do something practically. Furthermore, interviewee 4 adds another meaning to knowledge, stating that it is the ability and maturity to absorb information and additional comprehension. She considers it essential to be open and responsive to knowledge. Interviewees 6 and 7 points to another dimension of the definition of knowledge. They consider expertise in a particular field to be knowledge. Nevertheless, they emphasize that knowing how to obtain the necessary information for a particular task counts as knowledge, regardless of whether you are an expert or not.

Finally, interviewee 5 considers data to be the foundation of knowledge, stating that numbers, statistics, and such information constitute data. Upon understanding the data, it becomes information, and upon placing it in context, it becomes knowledge. Therefore, the information presented has the potential to generate knowledge.

5.1.1 Knowledge in professional role

The interviewees were asked what kind of knowledge is required in their professional role. In general, all interviewees considered the knowledge of construction processes to be highly important. This is necessary for many reasons, such as determining and organizing the works to be carried out properly and to plan and develop the procedures. In the opinion of interviewee 6, an individual who is not familiar with the construction process will be working above their skill level if they do not have a comprehensive understanding of the process. Despite a lack of knowledge, it can still produce positive results. However, it will be very stressful and exhausting for the individual. For instance, if one does not have a general knowledge of the production process, one will have to look for information while one is holding the role. Here, it is critical that the project team works collaboratively and has a comprehensive understanding of the project. An individual does not need or should not have all the knowledge, but rather it is the group that must share the necessary knowledge.

Furthermore, interviewee 3 said that he needs both technical and practical knowledge – the technical knowledge to understand the rules and laws to perform the work correctly and by industry standards, and the practical knowledge (e.g., leadership skills) to get the employees to perform and build in the desired manner. Finally, he considers the ability to plan to be important, as he must be able to foresee what activities will take place in production ahead.

Furthermore, all interviewees need specific knowledge in different fields. For example, interviewee 4 needs very specific knowledge in Health, Safety, Environment, and Quality processes at the company. Since she works at the organizational level, she needs to be both a specialist and a generalist to be able to see how the process affects the whole company. As a manager, she must possess managerial skills and project management knowledge. Instead, interviewee 5 requires a very broad understanding of the construction process rather than specialized knowledge. He should have a general understanding of the various fields, such as financial management, quality, digitalization, et cetera.

5.1.2 Knowledge and information gathering

All interviewees consider themselves competent to perform their professional role to the fullest but there is always a lot more to learn. One interviewee adds that one is constantly exposed to new situations and must learn, even if one does not actively assimilate new knowledge. Moreover, the interviewees add that knowledge is an important asset for a company. One interviewee believes that in some ways it is possible to recognize when one has sufficient knowledge. It is when one is faced with new challenges, and one can use its experience to navigate and solve current problems successfully.

Interviewee 3 is keen to develop his leadership skills. Furthermore, he states that leadership is not a skill that one can pick up by reading a book. It's a skill that one needs to develop and practice. Some people have this skill more naturally and are more of a leader in a group, while others need to practice it to a greater extent. One can absorb theories dealing with the way groups and various personalities function together, and deal with different people. However, he sees the challenge in doing so as the theory needs to be applied to real-life events, and this requires the right situation to arise, to practice and apply the knowledge. He wishes to develop this skill either through a course or be exposed to it in practice during the project with current employees. In general, he thinks that no one is fully learned, as different projects and situations will require different knowledge. He mentions that for him, fact-based knowledge is easier to learn, whereas leadership skills and such will require more time to be invested.

When faced with a situation where they do not have enough knowledge, the interviewees work in slightly different ways to find a solution. Interviewees 4 and 5 mentioned using Google as the first step. They search for the problem and try to get an overview of how the corresponding system works. If it is a detail-oriented or factual question Google works excellently, and the search for information will end there. If the problem needs further investigation, interviewees seek support. Interviewee 3 always strives to base the decision on facts; therefore, he always seeks the information needed by asking a colleague or a friend. When asked about the basis of their choice of whom to ask, all interviewees said it depends on the situation. Generally, the person whom they consult needs to have experience and knowledge in the field. For example, interviewee 6 may ask his manager for advice on whom to contact. He can also search for

colleagues on the company intranet by clicking "Find colleagues", where he gets contact information. Interviewee 6 adds that he also seeks help from consultants outside the company.

Respondent 5 offered a different perspective. According to her, an experienced person can provide good information on the issue. However, if one asks a person with less experience, they may have a different perspective, which might be even more useful. The general tendency of experienced individuals is to follow the same line of thought, whereas inexperienced individuals tend not to do so. It is through the combination of both viewpoints that the most suitable solution will be derived. This provides insight into thinking outside the box. As she points out, relying solely on experience is not the best approach.

5.1.3 Desirable features to facilitate the work

When asked if any features or tools would facilitate their work, interviewee 3 replied that specialists in the organization and projects (especially large ones) are important. Interviewee 5 agreed and remarked that it is difficult to allocate resources, as one always must weigh the costs against the benefits. Expertise is important but costly. Ideally, it would be desirable to have expertise in all areas within a company but in practice it is not achievable.

Most of the interviewees see a need for a so-called "Reference library". This "Reference library" could be a digital database containing relevant information, where one can search for specific facts, technical information, or information in general. According to interviewee 6, similar questions often arise in most projects. An example would be the issue of sealing balconies in a way that meets both technical and accessibility requirements. Previous solutions can be collected in the "Reference library". Another interviewee wants a collection of "Tricky questions and smart solutions" to previous problems, including both design solutions and good examples from production in general. Further, interviewee 6 describes a similar concept, as he would like to see past engineering solutions of previously completed projects. He requests for a function where one can filter the results based on the type of project (school, hospital, housing, and so on), materials, geographical location, and more.

Not only within Serneke, but also in other companies in the construction industry, interviewee 5 has identified a lack of systems that guide projects through the respective processes – a system that guides production, as a kind of checklist, ensuring that the right forms or information needed at a particular moment in the project are available at the right time. Furthermore, he expresses he misses a system which aggregates information upward in the organization. He is stating there is simply no system for summarizing the progress of the project.

Interviewee 4 initially states that she does not miss any tools in her daily work, as her role does not require them. However, she then explains that she lacks support systems for several things. For example, a system is needed for assessing the climate data for the Sustainability Report (which is a part of the Annual Report). Currently, Excel files are used, which is problematic as the information can be misinterpreted when transferred from one user to another, and this is very vulnerable for the company. Also, she does not think that an Excel file will work in the long term as the company is growing.

5.2 Knowledge transfer

For interviewee 3, knowledge transfer entails taking advantage of what one learns, using it in the next project and spreading it to other employees in the organization. The remaining interviewees agree that knowledge transfer has to do with knowledge dissemination. Interviewees 3 and 7 emphasize the importance of evaluating the good and the bad after a project is completed.

In the opinion of all interviewees, Serneke does not have a good system for effective knowledge transfer. Interviewee 6 is certain that there is not a good system in the rest of the industry either, as he claims that every construction company faces this major challenge. Interviewee 4 problematizes the structure of the project organization. Knowledge is best disseminated to those in the project team. It is rare for knowledge and experience to reach outside the project group. According to her, this arises because of an overly project-based organizational approach. Decentralization is important in the construction industry, although the processes and the overall structure of the organization need to be managed centrally to ensure consistency.

5.2.1 The most efficient way to absorb knowledge

Generally, the interviewees absorb knowledge most efficiently by hearing, doing, and teaching. Interviewee 3 finds workshops with a case study in groups of three to four participants to be effective. Everyone gets to share their perspectives and use their previous experiences. Moreover, different perspectives on the problem are given, and the participants can come up with a solution to a problem together. He also finds pictures and moving images useful, for illustrating different problems and solutions. In addition, he thinks that seeing examples on site is an effective way to absorb knowledge.

Interviewee 4 states that it depends on the type of knowledge and that it is best to acquire information in various ways – perhaps in the combination of images, videos, texts, and others. It is more complex than saying that one way is right or wrong. Interviewees 4 and 5 state that it is less of a matter of how information is presented but rather whether one can find the relevant information one needs or not.

Interviewee 5 believes that Google is the best knowledge channel, as one seeks knowledge when one needs it. On the other hand, Interviewee 5 thinks that knowledge is spread most effectively by word of mouth. However, space and time are two important keys. The problem is that the information is shared in the present moment. Unfortunately, no one can access this information in the future because it is not stored. He and the other interviewees suggest that a database of aggregated knowledge would be useful. The database should have a search function that allows the user to search for the information they are looking for, just like Google.

Further, the interviewee describes the importance of a "just in time" perspective. As one is constantly inundated with information, it is essential to

"Only get the information one need when one wants it, not all of the time."

- Interviewee 5

Interviewee 4 agrees with this and argues that it is not a question of *how* knowledge is acquired, but rather *when*. When one is receptive and at a stage of being dependent on the information, is when the information is absorbed most efficiently. As construction projects are very rich in information, one needs to have the skill of focusing on the relevant information at the right time. Because at that moment, all other information is a distraction. One needs to find a way to focus only on the little knowledge that is important in a specific situation.

5.2.2 Knowledge transfer at Serneke

When interviewees were asked how well the knowledge transfer works in the company on a scale of 1-5, they responded as shown in Figure 7.

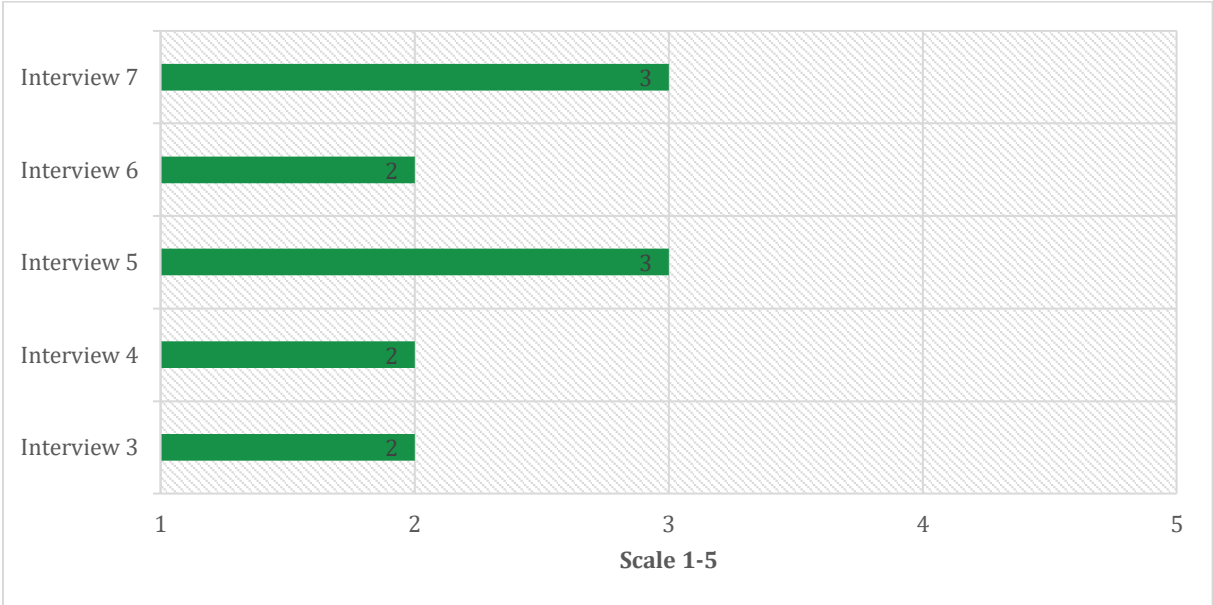


Figure 7: When asked how well knowledge transfer works in the company, the response was that three interviewees indicated 2 and two interviewees indicated 3 on a scale of 1-5.

Interviewee 3 indicates 2 on a scale of 1-5, which he justifies by saying

“I have never seen an example from a project in Stockholm or other regions in Sweden in my six years at the company. “

- Interviewee 3

Therefore, he argues that the knowledge transfer within the company is not working well. Knowledge transfer between projects is especially poor. This is agreed upon by the other interviewees. According to Interviewee 5, this is not unique to Serneke, but rather it is the general case in the industry.

However, when a serious incident occurs, knowledge is considered to spread quickly and well within the company. The dissemination of knowledge includes an explanation of what happened, what went wrong, and what to do to avoid the same event happening again. In this way, the employees discuss and reflect on the situation and grasp its serious consequences, in order not to repeat the same scenario. Furthermore, certain departments of the organization (e.g., the procurement organization), are very skilled at follow-up and feedback on projects. In this way, the knowledge gained is brought back and transferred. As stated by interviewee 4, effective knowledge transfer requires one or more committed individuals who are passionate about the issue. These individuals disseminate knowledge within the group, create routines, and pass that knowledge on to others through their commitment. According to some interviewees, not all employees are aware of the various resources available in the organization. There are times when employees are unaware of the importance of asking others for assistance. Further, it is considered that the after-sales department should be much more, and much earlier, involved in all projects, to see and inform the project team of relevant risks.

In the opinion of interviewee 5, people are happy to share their knowledge and experience. The problem is that the shared information and knowledge does not get a wide enough distribution. Finally, the conditions for good knowledge transfer within the company are considered to exist, but they need to be implemented. The quality of data collection and the way in which data and information are presented must be improved. If this is done, it will facilitate the analysis of information, and conclusions can be reached more easily. This can then be used to improve existing processes in the VLS and will enable employees to operate more accurately in their daily work.

When interviewees were asked how well Serneke makes use of the knowledge available in the company, the interviewees responded as shown in Figure 8.

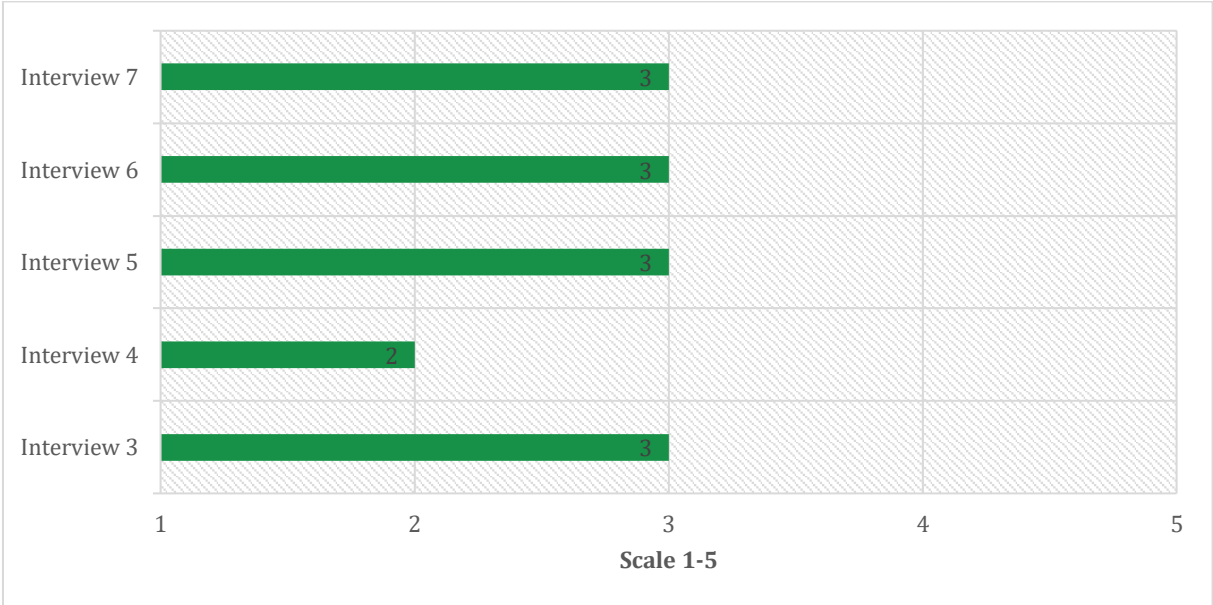


Figure 8: When asked how well Serneke makes use of the knowledge available in the company, the response was that one interviewee indicated 2 and four interviewees indicated 3 on a scale of 1-5.

One of the most significant common factors is the observation that all interviewees agree that knowledge is retained on an individual basis. A key employee leaving the company results in

substantial knowledge loss. Knowledge is often related to individuals rather than organizations or companies. The interviewees would like to see a system for successfully transferring this knowledge from individuals to the organization. Although they are aware of the difficulties associated with this.

5.2.3 Suggestions for improvement

The importance of meetings is a recurring point in all interviews. According to interviewee 3, it is important to meet with colleagues in similar roles, to create the opportunity to discuss issues with colleagues facing similar challenges. Interviewee 3 mentions so-called SM meetings (site manager meetings) which have been held before, but lately few site managers have attended. Part of the reason for this is that such meetings take half a day and require the site manager to prioritize this as there is no time for it in the schedule. He suggests shortening the duration of these meetings and selecting certain focus areas for each meeting. This way there is time to go in-depth into certain topics and ensure that more managers feel that they can prioritize these meetings in their schedules.

Interviewee 6 shares a dilemma that might arise, where he points out that it can be sensitive to share failures. Therefore, leading questions should be used to get the conversation going on the topic. Moreover, it is suggested that knowledge exchange must be put on the agenda and there must be time for learning in the schedule. Furthermore, Interviewee 6 discusses the need to establish clear routines regarding knowledge feedback meetings. The emerging information should also be passed on and disseminated in the organization. It is proposed that real-life examples should be brought up, ideally including visuals such as videos and pictures. Furthermore, gather tips and tricks, lessons learned, and good examples from previous projects. Lastly establish a forum to address greater issues, where discussion can also take place.

Finally, all interviewees argue that educational programs are important tools, and that further investment can be made in internal educational programs. In the future, interviewees see that VLS will become the primary channel of knowledge dissemination.

5.3 Development of VLS

All interviewees were aware of the VLS and indicated that they use it extensively in their daily work. They view the VLS as a system for "communicating the way things should be done" in the company, as well as providing supporting tools such as process and routine documents.

Interviewee 7 likes the fact that they can constantly improve VLS by submitting suggestions for improvement through the "suggestions for improvement" function. She adds that this follows the improvement cycle of "Plan-do-act-check" according to the ISO system. Interviewee 7 informs that in the environmental certification system there are additional points that can be earned in the project if suggestions for improvement are shared. She believes this is a good way to get employees to share knowledge and suggestions for improvement. Table 6 shows the interviewees' suggestions for future features of the VLS.

Table 6: Suggestions for future development of VLS.

	Function explanation
1.	A database of collected knowledge. The "Reference library" and "Tricky questions and smart solutions" as described previously.
2.	"Checklist " and "Guidance" through the steps, including highlighting the risks that may occur in the various stages of the construction process.
3.	A clear guideline on where and how to find information in projects and an improved overall structure of project documents et cetera.
4.	More checklists and templates for documents, protocols, and guidelines, facilitating the process.
5.	A function that shows all active projects in the company, including information on type of construction, size, and organizational structure, as well as contact information for site management. This would allow easy access to a colleague to facilitate knowledge sharing.
6.	Collect data during the project and evaluate the project at its end. Good and bad aspects and lessons learned must be collected and evaluated. Feedback can be used to develop the VLS documents and processes.

5.3.1 Motivation and Implementation

All interviewees reported that they are using VLS 1.0 daily. They believe that VLS 2.0 will facilitate their work to a greater extent by quickly presenting an overview and gathering all information in a single location. According to interviewees 4 and 5, following the procedures outlined in VLS 2.0 will allow employees to feel more confident performing their tasks. This is since they are aware that they are performing the procedure correctly.

For VLS to be successful, several interviewees believe that all employees need to receive training on how to use the program effectively. An understanding of how to navigate the program should be provided, as well as the benefits of using the program. In addition, the documents available in VLS must be kept accurate and up to date, so that users see the benefits of the platform. A second interviewee offers a different perspective, emphasizing the

importance of not updating too often. There is a tendency for excessive updates to be perceived as messy and time-consuming for relearning. Consequently, it is preferable to group the updates into larger releases. Moreover, it is imperative that the platform's design is simple and user-friendly.

Management must agree regarding the importance of the VLS and must be supportive of employees' use of the system. If so, the platform will become a natural source of information, and more data and information will be stored on the platform. It is believed by interviewee 5 that the platform is designed in a way that allows employees to focus on their core business because it creates value for the organization. There are times when people spend too much time on administrative processes, including searching for information, understanding the system, and obtaining an overview, but the VLS can facilitate these activities. He summarizes it as

"We should let computers do what they are good at, which is processing a large amount of data and information – so that people can do what they do best, namely analyze and draw conclusions from the information."

- Interviewee 5

Furthermore, interviewee 5 identified several barriers to the transition to working in VLS. The company will move from a not-so-digitalized state to a very-digitalized state (in terms of industry benchmarks, as he described it). As a result, change management and resource allocation are essential to deal with any challenges that may arise. Additionally, it is common for new platforms to experience errors. To prevent the introduction of VLS too early, it must be carefully checked beforehand. Unless this is achieved, the quality of the platform will be seen to be poor and the likelihood of using it will be reduced.

Lastly, interviewee 6 goes on to discuss how it becomes problematic when things become too directive and standardized. He has experienced this in a previous company, where the company had processes that were too controlling, which made it difficult for project management in production to deviate from this to meet project-specific requirements. He believes it is vital that flexibility is still there despite more standardized work.

6 Discussion

The overall aim of the study was to examine Serneke's current knowledge transfer processes and practices. Furthermore, the study has resulted in many good suggestions being highlighted from the interview study. Together with the help of the theory new ideas and suggestions emerged. This chapter will delve into the analysis and discussion of the findings. Furthermore, the discussion will compare the different perspectives, to identify the most suitable alternatives for developing the Knowledge transfer at Serneke.

6.1 The aim and research questions

The overall aim of the study was to investigate Serneke's current processes and practices regarding knowledge transfer. Furthermore, the study intended to explore the development of Serneke's own digital platform for business operational systems, called VLS. The study has investigated and explored how the development of the VLS is structured, and an understanding and overview of the process has been gained. Through the prestudy the understanding was explored, and the results were then used as a base for developing the interview study.

In the research, the following questions were asked:

Q1: What are the content and purpose of Serneke's VLS platform?

Q2: What features are being requested from a knowledge transfer perspective?

As the content of the VLS is presented in the prestudy, the first research question is being addressed. The empirical findings are then used to answer the second research question. In addition, interviewees 1 and 2 also presented some ideas for the future development of VLS in the prestudy. It is clear from the prestudy interviews that the content of VLS is determined by the suggestions received through the "suggestions for improvement" function. Consequently, the future will reveal what else will be included within the framework of VLS at Serneke. Moreover, interviewee 3 states that there are many new ideas that have yet to be explored. Considering this background, it will certainly be interesting to observe what the content of VLS will be in the future.

It has been observed that only a small group of employees (the VLS development team) decides whether suggestions should be implemented, as well as the priority order. This is a risk as they may be biased in selecting proposals due to personal or organizational preferences. This can lead to biased results. In contrast, in the prestudy, the development team utilized focus groups and involved many stakeholders, therefore this risk may have been thwarted. However, this aspect is beyond the scope of this study. Additionally, interviewee 3 in the prestudy is not knowledgeable about construction, so it is vital that the responsible process manager reviews the content to ensure accuracy.

6.2 Knowledge

Although all candidates found it difficult to define what knowledge is, they described and elaborated on its meaning in accordance with Liew's (2013) definition. Interviewee 5 defines it almost as literally as the theory, whereas the other interviewees use a variety of words and expressions. It is interesting that they consider an expert in a field to have knowledge or to be knowledgeable. Likewise, they believe that finding information about how to do something (even if one is not an expert) also qualifies as knowledge. Interviewees tend to believe that having experience is strongly related to having knowledge, as is being able to reach a conclusion. Therefore, one can argue that the interviewees describe an analysis in progress.

Interviewee 4 adds another dimension to the knowledge definition, stating that it is the ability and maturity to absorb information and achieve additional comprehension. For her, it is essential to be open and responsive to knowledge. Perhaps this is not what one would consider as part of a definition, even though a widely referred to and strictly common definition does not exist. However, her approach is important to consider since knowledge transfer is dependent on the recipient's willingness to receive the knowledge.

Not surprisingly, all interviewees considered knowledge of the construction process to be very important. This is in line with the general perception of the industry. Interviewee 6 contextualizes this very well. He says that "If one does not have a comprehensive knowledge of the construction process one will be working beyond one's skill level". He further argues that this will feel very stressful and exhausting for the individual. For example, if one does not have a comprehensive knowledge of the production process, one will have to search for information while in the role. In the terms of the SECI model this sounds like Internalization. Internalization is described as "learning by doing" and repetition over a long period of time, leading to learning things at the level that automatic action is achieved. Using the metaphor "the knowledge sits in the spine", it seems to be what Internalization is all about in everyday terms. If an individual does not know a task at this level, it will be exhausting for the individual as the knowledge does not come to mind automatically as interviewee 6 argues. Furthermore, one could say that an individual learns something in "theory" but does not understand it in "practice". This reflection adds value and understanding of why all interviewees consider the knowledge of the construction processes to be of highest importance.

6.2.1 Knowledge and information gathering

It is interesting to note that Interviewee 3 is eager to develop his leadership skills. However, he remains humble about the fact that it is a process that takes time to develop. Leadership is more difficult to acquire than factual knowledge, according to him. Based on the triangle of data, information, and knowledge, this makes sense. A person must apply leadership principles to actual situations to achieve leadership in practice. This is the process of transforming explicit knowledge into tacit knowledge, which is the process of internalization.

Furthermore, he believes that some people have an easier time developing their leadership skills than others. This translates to some individuals transforming knowledge from explicit to tacit more efficiently. Do some people progress faster in the Spiral of Knowledge than others? In that case, what are the reasons? Is it possible that the level of education of an individual may play a role in this? Is it due to Emotional Intelligence, which is a combination of personal,

emotional, and social skills and abilities, which increases one's ability to comprehend other people's emotions, leading to greater leadership potential? Does personality or charisma play a significant role? It is probably a combination of these factors as well as others.

6.2.2 Project team

Project teams are important, according to interviewee 6. In the construction industry, members of the team work closely with their colleagues and rely heavily on their input to complete the project. This means the project team needs to be sufficient so that together, the team has the necessary knowledge. There is no doubt that this is an important consideration. Hence, how can one ensure that the project team is formed in the most effective manner? This is a great challenge. Many times, two individuals appear to complement each other in terms of knowledge and therefore are a good match. Thus, if their personalities are not compatible or they have other issues that cause difficulties, the outcome will be unsuccessful. The question that arises here is, how does one balance these two things?

6.2.3 Knowledge transfer

Results indicate that the transfer of knowledge to Serneke and the extent to which Serneke utilizes knowledge available within the organization are not satisfactory. It is essential that an organization establishes a system for ensuring that post-project evaluations are carried out. A more frequent evaluation is recommended rather than a single evaluation at the end of a project. Evaluations should be conducted both at the beginning and at the midpoint of a project. It is also important to determine a system for storing and managing evaluation information within the organization and to make the evaluation information available throughout the organization so that it is not restricted to a particular project.

Employees must be motivated to carry out post-project evaluations for this to occur. A suggestion would be to include this as a step in the VLS. By implementing this strategy, the issue of establishing a system and disseminating it across the organization will be directly resolved. The VLS will provide everyone with access to the information.

Furthermore, the study found that the dissemination of knowledge was effective after a serious incident. For instance, when a serious workplace accident results in a fatality or accident on the job site, such as a fall from scaffolding or an accident caused by incorrect planning of the work. In line with the findings of the literature study, serious accidents must occur for changes to take place in the industry (Koch et al., 2018). According to Koch et al. (2018), although local actors gain valuable experience from their mistakes, their knowledge of specific solutions diminishes as they leave the project. The study supports this conclusion as well. The empirical findings suggest that some departments in the organization have a greater ability to transfer knowledge than others. Furthermore, one interviewee points out that an indicator of successful knowledge transfer is to have at least one committed individual within the department leading the gathering and transfer of knowledge. This is very interesting. It intrigues one to know what the process looks like. It is recommended that Serneke investigate this further, evaluate it, and use it to improve the knowledge transfer process, as well as to share the process with other departments within the organization.

6.2.4 How, Where and When

Based on the perspectives of two interviewees, it is not so much about *how* information is presented as it is about *when* it is presented. After some reflection, this statement is eye-opening. It is, however, necessary to provide a more nuanced explanation of the reasoning. A significant number of the problems identified in the empirical findings are due to an unstructured flow of information within the organization. To facilitate daily tasks, employees demand a more structured approach to storing information, accessing it, and determining its structure and format. This indicates the lack of information structure in the organization. Therefore, it is also a question of *where*. That is where the information is located. Clearly, VLS 2.0 will improve information structure. As stated by Interviewee 5, "When an individual is receptive and at a stage where they are dependent on the information, that is when the information is absorbed most effectively", and "one must find a way to focus only on the little knowledge that is important now, in this specific situation". Despite this, it is not an easy task for an individual to accomplish. One cannot know in advance which information is relevant and which is not. As a result, some software may be the solution for managing this information and navigating the user to the "relevant" information. It agrees with interviewee 5's view that a "Just in Time" perspective is essential in today's world of constant information overload. Both everyday activities in an organization and VLS development benefit greatly from the just-in-time perspective.

6.3 Suggestions for improvement

All interviews emphasize the importance of meetings. In the opinion of Interviewee 3, it is important to meet with colleagues who have similar roles. This provides him with an opportunity to discuss similar issues with colleagues who are facing similar challenges. In the theoretical sense, this is the process of Combination, turning explicit knowledge into explicit knowledge. At meetings, however, tacit knowledge is also exchanged for explicit knowledge. To make concepts understandable and visible, a person must use metaphors and similes to articulate their ideas with words. When the meeting conditions and setting are correct, this also creates a forum for the recipients for reflection and dialogue. During the interview, Interviewee 3 emphasized the importance of having a clear meeting structure. Meetings should be conducted this way to motivate employees to take part, as well as to ensure that the purpose of the meeting can be achieved and that issues can be addressed in depth.

Next, all interviewees emphasize the importance of educational programs. In this regard, the organization is encouraged to continue investing in the development of educational programs within the organization. Developing educational and mentorship programs could be facilitated by using Nonaka and Takeuchi's (1995) Theory and Models of Knowledge Transfer and Creation. They may also be interested in incorporating the suggestions made in this study into their future development efforts. Multiple methods of presenting information, for example, are considered critical by several interviewees. Workshops, the presentation of real-life cases, and the use of pictures, videos, or on-site visits are other methods that can be used to increase understanding and knowledge generation. The theory reflects this through socialization and externalization. For educational purposes, knowledge must be transferred from explicit to explicit in the design of knowledge systems.

Also, it is imperative that the organization provides a space and a "field" for knowledge creation and transfer. This could involve creating the conditions financially, through time, space, and context. It is suggested that this could be developed into a forum for starting discussions, as a new function at VLS – like a chat room with different topic threads. This way, any employee can join the discussion. Alternatively, it could be closed groups, based on, for example, professional roles. To allow people with the same role to consult each other regardless of time or space since they are working on different projects. As a result, time and space no longer serve as a barrier. Whenever it is convenient, individuals may participate in discussions.

Another aspect is that knowledge transfer needs to be prioritized in the calendar, both by employees and employers. The organization must recognize the value in the process by which employees create knowledge. According to the theory, the organization itself cannot create new knowledge, but rather knowledge is created by the individual and transferred to the organization according to the knowledge spiral. For this reason, it is important to create room for knowledge creation and transfer in the organization. Without this priority, knowledge creation and transfer will not develop within the organization.

Furthermore, according to previous studies presented in the literature review, there are certain factors that facilitate knowledge transfer – among other things, a business culture that supports new knowledge. Furthermore, it is important to have a tolerant environment within the project and organization, which includes openness, cooperation, and a positive attitude, as well as a mistake-tolerant environment. Clearly, this is something that needs to be addressed by the organization. It might be possible to implement this in the meeting structure as discussed previously. Literature studies emphasize the value of decentralized structures and cultures that allow informal meetings and activities. There have been a variety of examples of such activities used and developed in the past by companies. Excellent examples can be found in Nonaka and Takeuchi (1995), which exemplify informal activities that lead to the sharing of tacit knowledge. As soon as the first step of the five-phase organizational knowledge creation model is completed, the remaining four steps can be undertaken.

6.4 VLS and Knowledge transfer

As outlined in the pre-study, the VLS development team has utilized lessons learned from other industries. As such, experts (both internal and external) may be brought in at certain stages to assist in producing the best product possible, or when the development team lacks the expertise required. The literature study along with the previous studies on the subject contributes to a better understanding of the complexity of the construction industry. The situational and contextual nature of knowledge in the construction industry is a major barrier for the industry, not least when it comes to the vast flow of information and knowledge. The complexity and continuity of mistakes are arguments in support of improvements and developments being highly urgent.

Based on the theory of the Five-Phase model of the organizational Knowledge-creation process, some critical issues have been identified in the development of VLS. Such an issue is related to justification in step 3. Justification involves the process of determining whether the new concepts are truly worthwhile for the organization. Since the study has not examined this process in the development of VLS, no conclusions can be drawn as a result. It is recommended to review this process and ensure it follows the five-step model. For these concepts to be

successful, they need to add value. Additionally, it is unclear what criteria Serneke might employ for justification.

Serneke's development of VLS represents an important step in the direction of a more digitalized industry for the industry as a whole and Serneke as a company. Interviewees agree with this, as they see great potential in the development of VLS and digital tools in general. Additionally, they recognize how VLS can contribute to the development of knowledge transfer within the organization. Several useful and interesting ideas are presented regarding the use of VLS to promote knowledge transfer within an organization in the empirical findings.

6.5 VLS and problem solving

Although knowledge transfer is not the primary purpose of VLS, it can still play a significant role in improving knowledge transfer within the organization. Several of the interviewees suggested that VLS could be used as a primary method of knowledge transfer in the future.

The empirical findings showed that when interviewees are faced with a situation where they do not have enough knowledge, they work in slightly different ways to find a solution. Some use Google as a first step, where they try to get an overview of how the system works. The prestudy indicates that the intention of the VLS is to act as a search engine for job-related searches. This aligns well with the process that some interviewees use for problem-solving. The next step of problem-solving is generally to ask someone who is considered knowledgeable in the area. In contrast, while interviewee 7 believes that an experienced person provides good information on the issue, asking someone with less experience might give a different perspective which could be even better. Her reasoning is that experienced people tend to use the same thinking, in contrast to inexperienced ones. As such, they might think out of the box. She means that combining both points of view may result in the best solution. This is incredibly interesting in many aspects. However, it is in great conflict with the general perception of the industry. Where experience is the most important and significant asset one can possess. According to empirical findings, experience has a strong link to the concept of knowledge; one could say that experience equals knowledge. The same goes for theory, tacit knowledge in its purest form is experiential. According to the interviewee, having a lot of experience can lead to getting stuck in the same train of thought. Which, in this context, is a negative factor. She encourages bringing in other perspectives, which will break this pattern of habitual thinking.

According to the empirical findings, the "reference library" is in high demand, which is partly in line with what was said in the prestudy, which stated that more AI thinking should be established. Regarding the collection of "Tricky questions and smart solutions" to previous problems and good examples from production in general, it seems from the Empirical findings that the collection itself will not be the problem. Rather, the issue will be in transforming this information from tacit to explicit knowledge, which is referred to as socialization. In the literature study, construction-related knowledge is problematized as "contextual and situational", which also contributes to difficulties. On the other hand, it is very common for the construction industry to be portrayed as unique in nature and facing new situations with each project. This is partly true, but most times construction is carried out in a very similar process and therefore the same issues are repeated. Thus, there is great value in collecting solutions.

The "suggestions for improvement" function appears to be very appreciated. This is following the "Plan-do-act-check" framework according to the ISO system, which leads to compliance with the business operational system.

Concerning the "Checklist" function and "Guidance" through the steps of the processes, this is already in progress as stated by the Prestudy. With the launch of VLS 2.0, clear guidance on where and how to find information in the projects will hopefully be achieved. It will result in a generally improved structure for project documents and others.

An additional proposal on function was presented in the Empirical findings, i.e., allowing easier access to a colleague to facilitate knowledge sharing. The function can complement or replace the already existing "find colleague" function. Providing more information about colleagues in the company, such as details about the type of construction project the person is working on, size, and organizational structure.

6.6 Motivation

It is evident from both the prestudy and the empirical findings that it is not necessary to motivate employees to use the VLS platform of Serneke. This statement, however, does not align with the findings of the literature review. A challenge of creating computer software and digital platforms is the translation of tacit knowledge into explicit knowledge and the extension and improvement of a knowledge-based system after it has been implemented with additional expertise. Moreover, the literature review concluded that conditions in the construction industry are more challenging. However, since the VLS is constantly receiving input from exporters and evolving, these challenges can be minimized. The theory of knowledge creation and transfer developed by Nonaka and Takeuchi (1995) can also be used to facilitate the transfer of tacit knowledge to explicit knowledge. While these efforts can be made, there are still many challenges to overcome.

Based on the interviewees' responses, VLS appears to be implemented in the daily work at Serneke. All interviewees use VLS daily and see the value of VLS. Considering that VLS 2.0 has not been released yet, this is an impressive achievement. It appears to be a positive attitude within the organization regarding the use of digital platforms. The VLS development team has taken a very inclusive approach during development, which may have contributed to their success. By utilizing focus groups, choosing practitioners to serve as process owners, and including users through "suggestions for improvement", they have incorporated many individuals into the development process.

Considering the literature review, there are examples of digital platforms that have failed and remain unused. Consequently, this risk exists with the VLS. Many of the conditions that must be met to prevent this from occurring with the VLS are outlined in section 5.4.1. Additionally, the following should be emphasized. The first step is to avoid rushing any release, but to ensure all planned features are completed. In addition, it is crucial that employees are trained and introduced to the platform when a major change occurs, such as VLS 2.0. Then, it will be much easier for the implementation to take place.

In terms of motivation, the empirical findings demonstrate that it will not be a major challenge to convince employees to use VLS. The interviewees mention several conditions which must

be in place first. The key is to create a successful tool, and once employees see the benefit it can bring to their daily routines, then the product is self-selling. Ultimately, in terms of the overall development of the VLS, a high level of ambition seems to exist within the organization. It seems that both developers and employees are eager to start using VLS.

6.7 Reflection

Assuming the ideas presented by interviewees in the prestudy are realized, then VLS is likely to facilitate the process of moving up in the triangle of data, information, and knowledge. Rather than searching for data and information, individuals are presented with it within the project space within VLS, which allows them to begin analyzing data immediately. It allows for more efficient knowledge acquisition and conclusions to be drawn. In conjunction with Nonaka and Takeuchi's (1995) theory of knowledge creation and transfer, it implies that the spiral process is facilitated and accelerated.

A last reflection would be to use the SECI model as a basis and develop a guide that will guide the employees through the five steps of the organizational knowledge creation process. Based on its relative straightforwardness, Nonaka, and Takeuchi (1995)'s model should be conceptualized to fit the context of the construction industry, and then widely used in organizations. This conceptualization may be accomplished through a series of workshops, whereby a workshop structure is developed. As part of the workshop structure, it is important to explain the purpose of the steps, provide instruction on how they should be performed, and document the steps so that it is accessible to everyone within the organization.

7 Conclusion

There are a lot of challenges in knowledge creation and transfer in the construction industry. Desirable would have been to succeed convert tacit knowledge into explicit knowledge. Unfortunately, due to the highly fragmented nature of project implementation in the construction industry, tacit knowledge is spread across many processes and project participants. As it seems for now there is no method in the construction industry to fully utilize the experience and knowledge acquired in the construction industry.

The aim of the research revolves around investigate Serneke's current processes and practices regarding knowledge transfer, and to explore the development of Serneke's own digital platform for business operational system, also named VLS. The obvious conclusion is that there is room for improvement in knowledge transfer at Serneke. The following conclusions have been identified as crucial in this process of improving the Knowledge transfer at Serneke.

Firstly, this study demonstrated that SECI theory can be applied to a wide range of organizational functions. In terms of educational plans, Nonaka, and Takeuchi (1995) provide numerous examples of activities and framing of the SECI steps, as a means of promoting knowledge creation and transfer in organizations. Furthermore, SECI theory emphasizes the importance of experts as components of a successful knowledge transfer process. In the development of VLS, this should be kept in mind by the organization.

Next, Serneke's investment in the development of digitalization in general and in a digital business operational system, VLS, is a major step towards improving knowledge transfer within Serneke. If the ideas presented by the interviewees of the development team regarding the future of VLS become a reality, this will result in VLS becoming an important tool in facilitating the process of moving up the triangle of Data, information, and knowledge. In the VLS project space, data and information are presented to individuals without them having to search for them. Therefore, they can analyze the data and information immediately. In this way, conclusions can be drawn, and knowledge can be acquired more efficiently. With Nonaka and Takeuchi's (1995) theory of knowledge creation and transfer, the process of the spiral is facilitated and accelerated. Furthermore, by collecting information in a digital platform, which contains documents, protocols, guides, reports and so on, knowledge transfer will be improved. As a result, the company will most likely have a common information structure.

Furthermore, an overview of VLS is presented in Figure 9, with current content and future suggestions for content and development of the VLS.

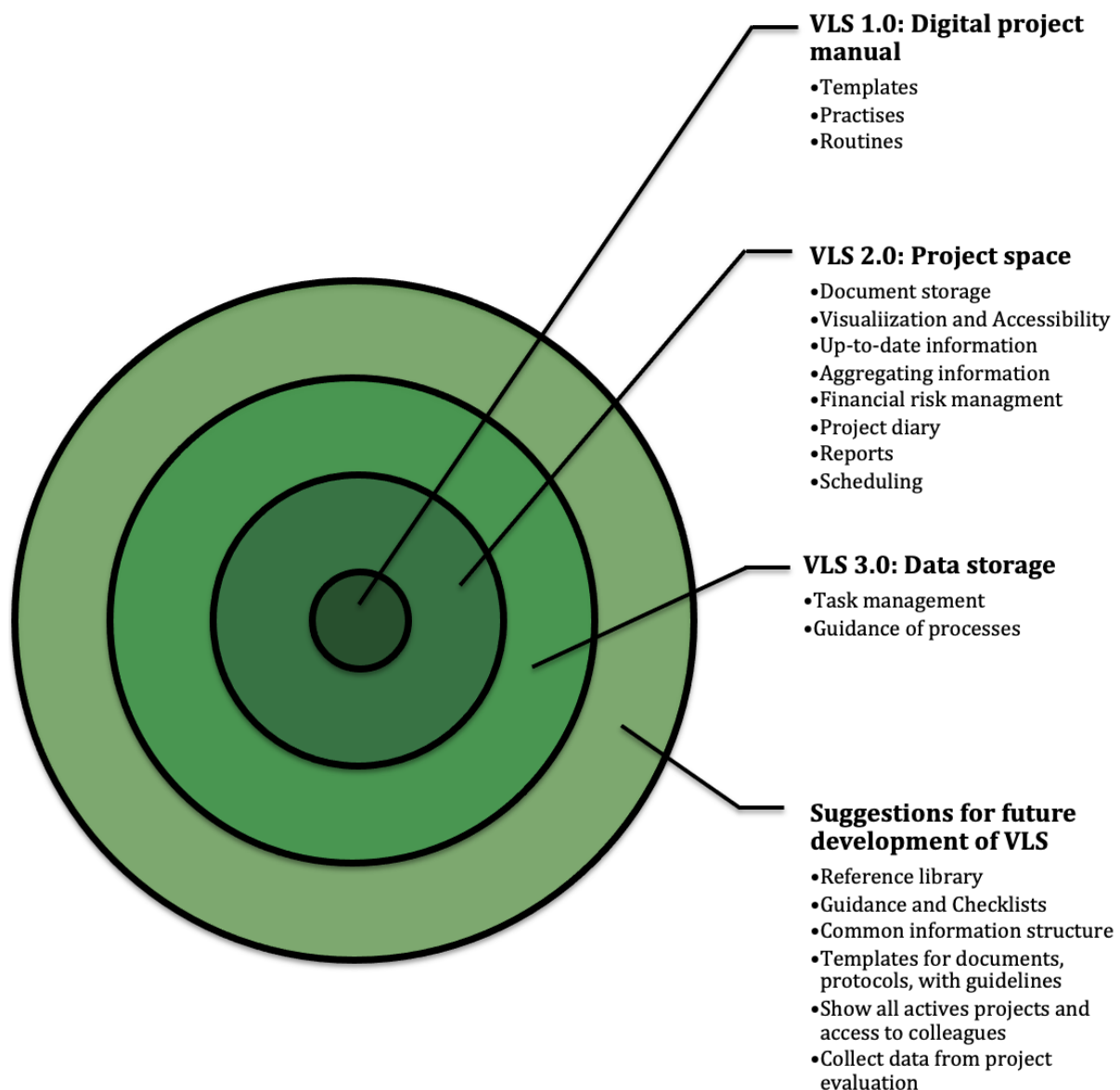


Figure 9: An overview of VLS with current content, and future content suggestions. Data is gathered from Table 5 (the content of VLS) and Table 6 (Suggestions for furture development of VLS).

Lastly, the combination of theory, literature studies, and empirical findings demonstrate that the organization should work to promote factors that facilitate knowledge transfer. These factors include an open and accepting culture. Time, space, and context conditions must be considered by the organization. Furthermore, employees and employers need to make knowledge transfer a priority in their calendars. Lastly, organizations should recognize the importance of the processes through which employees create and transfer knowledge.

7.1 Future studies

In general, several areas could be further studied to develop knowledge transfer in the construction industry. It should be noted that knowledge transfer depends on an individual's ability to perceive and manage knowledge, which is beyond the scope of this study, however, it may be of interest for future research. In addition, this study provides an overview of the development of VLS and its content in terms of Serneke specifically. The study does not address specific feature requests from the perspective of a procurement specialist, a site manager, or a foreman, for example. These perspectives would have been interesting to explore. In addition, future studies may be able to identify which professional role would benefit most from VLS.

Finally, other companies in the construction industry have also implemented digital business operational systems. To examine the differences and similarities between them, they can be compared with Serneke's VLS to create an interesting perspective.

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Appendix A

1. Intro of interviewee

- 1.0: How would you introduce yourself?
- 1.1: What is your academic background?
- 1.2: How long have you been working at Serneke?
- 1.3: What is your background at Serneke?
- 1.4: What does your current position entail?
- 1.5: What is your role in working with the VLS?

2. Intro of VLS

- 2.1: How did the idea of the VLS start?
- 2.2: What was the aim/purpose/vision of the VLS?
- 2.3: Who has been driving this work?
- 2.4: What is the purpose of continuing to develop the VLS?
- 2.5: Has the purpose/vision/goal changed over time, or do you still have the same goals as before you started?

3. Future development of VLS

- 3.1: Have you surveyed users on what they are looking for in the VLS? Or how did you decide what the content should be?
- 3.2: Have you found that there is a demand for a digital platform like the VLS?
- 3.3: What is the future of the VLS?
- 3.4: What features/facilities will the platform provide?
- 3.5: Is there any way to see statistics on whether and how much employees are using the LVS today?
- 3.6: How does the VLS create value for employees?
- 3.7: How will you motivate employees to use the VLS?

Appendix B

1. Introduction of the interviewee

1.1: Please tell us about yourself.

1.2: Please tell us about your role in the company. Describe the role, tasks, etc.

1.3: Please tell us how long you have been with the company and in the current role.

2. Knowledge

2.1: How would you define/describe "knowledge"?

2.2: What knowledge do you need to possess for your job role?

2.3: Do you think you have the knowledge you need to perform your work to the fullest?

2.4: If you encounter a situation where you do not have enough knowledge, how do you proceed? (If you have a ranking, indicate it in 1, 2, 3, etc.).

2.5: What type of feature would have helped you in your work?

3. Knowledge transfer

3.1: What is knowledge transfer?

3.2: How do you think knowledge is most effectively transferred?

3.3: How do **you** absorb knowledge most effectively?

3.4: What form/media etc. is desirable to absorb knowledge effectively (text/reading, video format, quiz format, Observe, practise in real life, be exposed to a problem or other).

4. Knowledge transfer at Serneke

4.1: On a scale of 1-5, according to your experience, how well does the knowledge transfer work in the company? (1= not at all, 5= very well)

4.1.1: What works well?

4.1.2: What does not work well?

4.2: How well do you think Serneke makes use of the knowledge available in the company?
(Scale 1 - 5, 1= not at all, 5= very well)

4.2.1: What works well?

4.2.2: What does not work well?

4.3: In which way is knowledge spread in the company?

4.4: What are your suggestions on how to improve the knowledge transfer?

5. VLS - platform

Serneke is developing a VLS platform, a business operational System to replace the previous pdf - Project Manual.

5.1: Tell us what you know about the VLS. What will the content be?

5.2: How likely is it that you will use the platform? (1 - not at all, 5 - very likely, will use it daily)

5.2.1: Why?

5.3: What features would you like to see on this digital platform?

5.4: How could the platform facilitate knowledge sharing in the organization?

6. Motivation

6.1: What would motivate **you** to use the platform?

6.2: If you could decide; what would you do to create a platform that employees find motivating to use?

6.3: What would you not do? What would not increase the motivation to use the platform?



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