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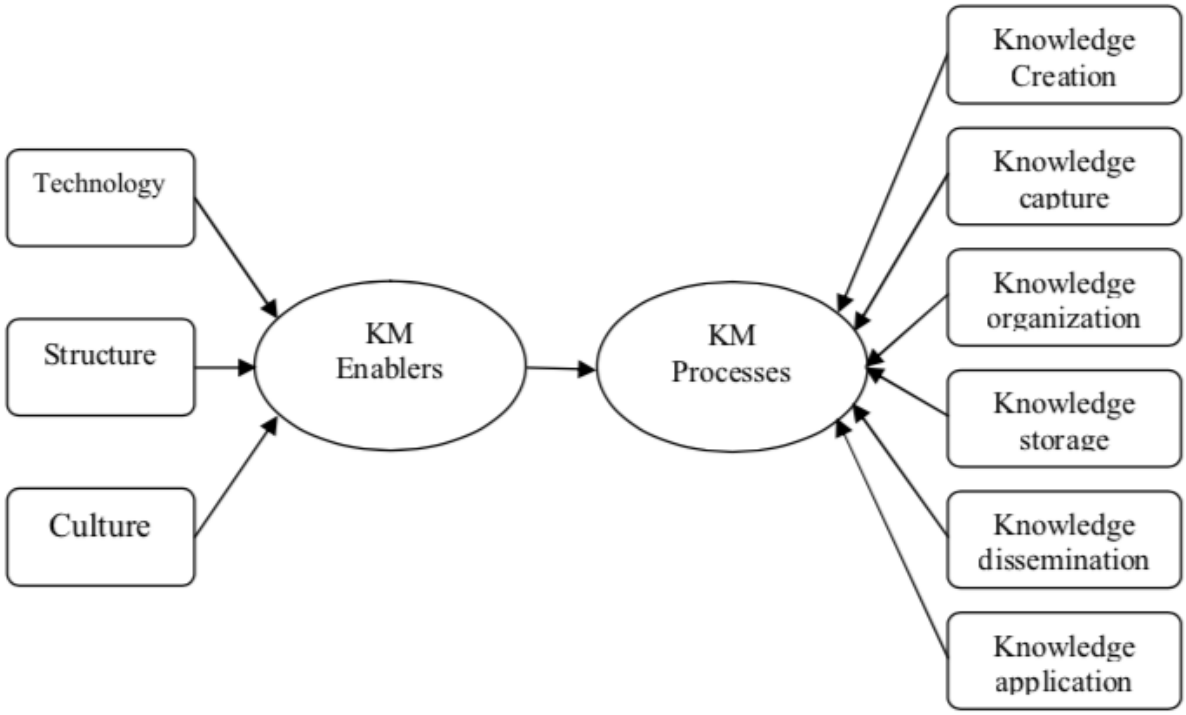

From project-based knowledge creation to organisational knowledge application

Creating a knowledge management toolbox for a mid-sized consulting firm

Master's thesis in Design and Construction Project Management

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Gothenburg, Sweden 2018

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Further explained at pp. 13-14

Department of Architecture and Civil Engineering
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Abstract

The construction industry consists of a large amount of projects with unique circumstances such as conditions, durations, budgets and resources. As a consulting project manager, the assignments are often project-based, and the processes are not seldom non-standardised. This creates an expressed difficulty to collect, save and apply knowledge. However, there is today a spectra of various tools within the knowledge management area that may contribute to collecting, saving and applying knowledge. This study aims to investigate what knowledge management tools that could be relevant to apply for Construction Management AB, a mid-sized consulting firm acting in the construction industry. Through interviews with the project- and organisational managers along with observations of the current knowledge management system and discussions at the office, an analysis of what knowledge is asked for and what possibilities there are to work with knowledge management was done. The result of this showed that Construction Management AB has a need to manage both tacit and explicit knowledge. It was also clear that the organisational management and the project management had different views on what kind of knowledge was important. The management strived towards leadership knowledge and managerial templates, extremely tacit and explicit knowledge. However, the project managers focused on building technological knowledge, knowledge varying between tacit and explicit knowledge. Moreover, the possibilities to work with knowledge management were large, as it was looked upon positively. What was a constraint was that there were unclear directives on how to work with it, and that time was a limiting factor. To meet this, tools that applies a structure which is easy to follow and tools that can be applied for tacit respectively explicit knowledge should be focused on. Thus, a taxonomy, AAR-meetings that can handle explicit knowledge, and workshops and knowledge cafés for tacit knowledge were proposed to create a knowledge management toolbox fitted for the resources and possibilities at the mid-sized consultancy.

Keywords: Knowledge management, knowledge cycle, project-based organisations, knowledge intensive firm, learning

Från att skapa kunskap i projekt till att tillämpa kunskap i organisationen
Att skapa en knowledge management-verktygslåda för en medelstor konsultverksamhet

Examensarbete inom masterprogrammet Design and Construction Project Management

GUSTAFSSON REBECCA
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Sammanfattning

Bygg- och fastighetsbranschen består av många olika projekt med varierande och unika förutsättningar, tidplaner, budgetar och resurser. Som en projektledande konsult är uppdragen ofta projektbaserade, och processerna är inte sällan icke-standardiserade. Detta gör att det finns en uttryckt svårighet att samla, spara och tillämpa kunskap. I dagsläget existerar det dock flertalet olika verktyg inom knowledge management-teorin som verkar för att förbättra möjligheten att samla, spara och tillämpa kunskap. Denna studie syftar till att undersöka vilka verktyg inom knowledge management som kan vara relevanta för Construction Management AB, ett medelstort konsultföretag inom bygg- och fastighetsbranschen, att tillämpa. Genom intervjuer med projektledare och chefer har en analys om vilken typ av kunskap som är efterfrågad, och vilka möjligheter som finns för att arbeta med knowledge management gjorts. Observationer av det befintliga ledningssystemet och hur diskussioner på kontoret lyder har även tagits i beaktning. Resultatet visade att Construction Management AB har ett behov av att behandla både tyst och explicit kunskap. Det var även tydligt att chefer och projektledare hade olika syn på vilken typ av kunskap som var viktigt. Cheferna strävade mot ledarskapsegenskaper och mallar, vilka är extremt tyst respektive explicit kunskap. Projektledarna fokuserade däremot mer på teknisk kunskap, som kan variera mellan tyst och explicit kunskap. Vidare så noterades det att möjligheterna att arbeta med knowledge management var stora, och att man såg positivt på begreppet. Något som dock urskildes som hämmande var att det existerade otydliga direktiv och en begränsande tidsfaktorn. För att bemöta detta bör verktyg som skapar en tydlig struktur, och verktyg som kan behandla tyst respektive explicit kunskap fokuseras på. Därav skapar en taxonomi, AAR-möten som kan behandla explicit kunskap, och workshopar och kunskapscafén som behandlar tyst kunskap, en verktygslåda passande för de resurser och möjligheter den medelstora konsultverksamheten besitter.

Nyckelord: Knowledge management, erfarenhetsåterföring, kunskapscykel, projektbaserade organisationer, kunskapsintensiva företag, lärande

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Acknowledgments

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Göteborg, December 2018, Rebecca Gustafsson, Linnea Lundblad

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1 Introduction

The following chapter describes the background of this study and discusses the problem that is investigated. On this basis the purpose and the research questions are presented thereafter.

1.1 Background

The construction industry consists of a large amount of unique projects with significant conditions, durations, budgets and resources. Therefore the companies acting within this industry are mostly project-based. Although, project-based organisations in the construction industry faces many different challenges such as non-standardised processes, new teams for every project, various contractual conditions etc. (Sharif & Saffarian, 2010; Bakri, Ingirige & Amaratunga, 2010). This constellation often possesses many stakeholders, creating various dissimilar objectives. Moreover, the fact that each construction project is unique makes it difficult to standardise the working processes. As it is today, construction companies tend to view each project as a sub-organisation, which is separate from the rest of the organisation, almost like a subsidiary and its parent company. Each project has its own directors, budget and time plan. This way the companies are divided and the lessons learned from one project stays within its sub-organisation, and are not brought into the next project. The strong focus on individual projects as autonomous sub-organisations in the construction industry creates a major obstacle for knowledge sharing in particular and the company development as a whole. Due to lacking actions to handle and store experiences, innovative solutions, data and other types of vital information, the construction industry is not as efficient as it could be (Styhre, 2009).

A specific problem within the construction business is how consultants has a complicated difficulty to apply knowledge management (KM) and particularly experience feedback. As each project is independent, and the consultant is entitled to the contractor, it is hard to economically argue the implementation of KM (Ljungström, 2015). The problem builds upon the fact that the cost to administrate the knowledge collected from project A will debit that project, but the knowledge will favour project B. It is therefore important to see that similar mistakes often occur, and that it is beneficial for the company, and the whole industry, to see the bigger picture and the value of evaluating projects and collecting information leading to their outcomes. This means that it can be more complex as a consultant to motivate the KM-application. Yet another problem is that if the obstacle mentioned above is passed, the structure of KM has to be applied. What tools are the most efficient for the specific firm? If the method is done without a plan, structure or a set workflow it is hard to systematically and administratively take care of the given information (Sjöström & Svedberg, 2010). It is therefore needed to invest time and effort to plan how the KM is to be applied in the most efficient way. Further, the information given from the chosen tools within KM has to be presented in a user-friendly way, so that the specifically demanded information can easily be taken

part of. As for consultants, KM is especially important as they represent knowledge intensive firms and their service is to provide knowledge (Sverlinger, 2000).

The concept of KM focuses on managing different types of information that can be valuable. It is defined as a way to create, share and apply knowledge to meet the objectives of the organisation. Knowledge itself has been described as information that has become a part of someone's knowledge-based experience and behavioural patterns (Kanapeckiene, Naimaviciene & Tupenaite, 2008). It is often looked upon as either experience, or coded and verbalisable information, known as tacit respectively explicit knowledge (Newell, Robertson, Scarbrough & Swan, 2010). As there are different types of knowledge there are accordingly several different methods and tools to apply depending on what type of knowledge is in question. The management can be conducted by using different tools such as knowledge inventory, pilot projects and after action reviews (AAR) (Kumta & North, 2018). There is a spectrum of KM methods to apply. It is therefore imperative to adapt the tools to fit the purpose by its implementer, since it can be conducted in different ways with differing outcomes. That is as different firms may find value in different types of information, various tools within the concept of KM are to be applied (Sjöström & Svedberg, 2010; Okere, 2017). Its practitioners believe that there is a human capital of knowledge within each worker, and that KM exploits the current knowledge from the human capital to meet existing and future needs (Clegg, Kornberger & Pitsis, 2016). The people form the core value, and to attain the knowledge a collaborative work is required (Bolden, Hawking, Gosling & Tyler, 2011). Furthermore, the aim is to convert mentioned knowledge into a competitive advantage (Kumta & North, 2018).

As the construction business is constantly changing, it is necessary to apply KM. If not applied, there is a risk that the loss of information will end in higher costs, lower quality and slow adaptation (Michailova & Gupta, 2005). Studies show that the industry is underachieving when it comes to time, cost and quality comparing to other industries, and is in need of optimising its intellectual resources (Styrhe, 2009). KM is also imperative to stay competitive to other firms (Ljungström, 2015). New use of material, new environmental regulations and new trending designs amongst other is information that would benefit from the use of KM, as the concept creates and transfers 'the best practices' for the action in question. Furthermore, as the industry works towards a more flexible and adaptive way to work, it is important to implement a strategically efficient concept that can support organisations experiencing that change. Yet another justification for KM within the specific industry is that it creates an ability to discard irrelevant knowledge, which according to Kumta and North (2018) is of great importance for knowledge intensive activities, being i.e. tasks done by construction consulting firms.

Even though there are studies on how KM should be applied to the construction industry, it has not fully been adopted. Sörqvist (2004) and Josephson (2013) claim that this is partly due to lack of interest and non-existing or unclear work. As KM contains several tools to use, it is understandable that the business expresses this. Ljungström (2015) concur, and claims that it is a great obstacle for the industry that there is a lack of instructions and standards on how to work with KM. Studies have shown that the construction business specifically lacks organisational procedures to manage

knowledge, and that there is generally a lack of time to execute projects which leads to abstaining KM (Ferrada, Núñez, Neyem, Serpell & Sepúlveda, 2016; Härngren & Sällström 2009). It is also shown that cooperation between professionals at the same company is difficult and slow given the diverse geographical placements of projects. Moreover, it is stated that the issue on how to manage knowledge in the construction business is not yet resolved (Ferrada et al. 2016). The majority of the studies made have been conducted on large and/or international construction companies placed in developed countries, thus lacking basis for small and mid-sized construction companies (Ferrada et al. 2016; Egbu, Hari & Kumar, 2003). Mats Williamsson, VP at Skanska, consents with the above while adding that the industry in Sweden has failed to embrace KM (Dagens samhälle, 2016).

As stated a company cannot solely apply KM, but also has to actively choose different tools to match the demand at the specific company (Sjöström & Svedberg, 2010). The type of company, its industry and its purpose plays part in the application of KM. Yet more interesting is how there is a lack of studies within the construction industries mid-sized firms. Furthermore, as stated by Sverlinger (2000), KM is of great importance specifically for the consultancy work. Hislop (2013) also describes today's society as a knowledge society where knowledge-intensive firms and knowledge intensive workers are becoming more important. It is therefore interesting to look at what would be an accurate toolbox for a mid-sized consulting company within the construction business.

Construction Management AB

The studied company, in this report referred to Construction Management AB (CM AB), has about 200 employees and specialises in project and construction management. As consultants they take on roles such as project managers, construction managers, design manager etc. The projects they are involved in include buildings, infrastructure and real estate projects of varying sizes.

CM AB’s main office is located in Stockholm, however they have offices in seven other cities in Sweden, where Gothenburg is one of them. The Gothenburg region, amongst other western regions, belongs to the business area of Construction Management West (CM West), which has about twenty employees. As CM West is a business area that belongs to CM AB, they apply to the management system of CM AB. Thus, the studied company is CM AB, and the observations and respondents belong to the business area CM West, illustrated in Figure 1.

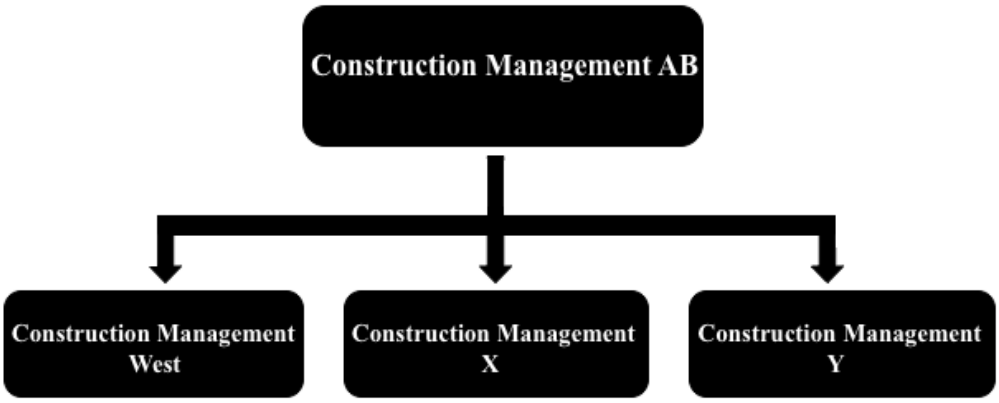

Figure 1: Organisational scheme of the investigated company CM AB

1.2 Aim

The aim of this study is to develop a pool of available tools within the concept of knowledge management that can be applied by Construction Management AB to convert project based knowledge to organisational knowledge.

1.3 Research questions

RQ1: How is knowledge management currently structured at Construction Management AB?

RQ2: What challenges and opportunities could be identified from the current knowledge management system at the firm?

RQ3: What knowledge management tools should be of interest for the firm?

RQ4: What knowledge management tools are appropriate to implement given the existing conditions?

2 Theoretical framework

The theoretical framework is structured in the way that it begins with a wide description of the type of company and the worker role that is investigated and its special characteristics. Thereafter the term knowledge will be described by using different well-established concepts. This part leads to a section about learning and the different levels on which learning can occur in an organisation. Finally, KM will be explained by using frameworks followed by an overview of some KM tools.

2.1 Project based organisations

Project based organisations, known as PBOs, refers to organisational systems that has its assignments carried out from the main organisation, and its aim is to achieve strategic business outcomes. PBOs are tightly connected to its stakeholders who are both those involved in the project team as well as the interested entities. The PBO often need to consider the claims from the stakeholders, and evaluate what actions are to be done with the stakeholders in mind during the whole life cycle. The characteristics of the life cycle contain the start-up, the organisation, carrying out the work and closing. A distinct example is the life cycle of a construction project (PMI, 2013).

The project practices can be viewed as loosely coupled systems to the organisational contexts through i.e. subcontracting and they are normally non-repetitive and time-bound (Sydow & Staber, 2002). Therefore they most often lack the strong ties and common identities that can be found in on-going and more routine work activities (Gherardi, Nicolini & Odella, 1998).

PBOs often consists of many types of roles, such as project managers, project staff in form of specialists and consultants and business partners etc. All with specific subject matter knowledge to carry the project forth (PMI, 2013). The specialist and consultants within the PBO often belong to a knowledge intensive firm, which is explicated further below.

2.1.1 Knowledge intensive firms

Knowledge intensive firms are firms such as consulting firms, who create a business around their knowledge. The success of these kinds of firms does ultimately depend on the competence of their professionals, relative to their rival firms (Sverlinger, 2000). Hence, it is important that the product, packed knowledge, is highly qualified (Kumta & North, 2018). Sharif and Saffarian (2010) mentions that the knowledge intensive firms often suffer from difficulties, as they need to deliver complex problem-solving services with non-standardized processes with a high level of creativity. Examples of this kind of organisational constellation are engineering firms, auditing firms of other types of consultancies where packed knowledge is sold (Kumta & North, 2018). Each project is custom-built according to the clients' demands, which is further evidence to its difficulty (Apostolou & Mentzas, 1999). The knowledge intensive firms are to provide the client with new ways and ideas to engage in (Block, 2000). Moreover, the knowledge intensive consultants are to perform tasks in teams, formed within PBOs. Therefore, knowledge and the sharing of knowledge are essential (Rasli, Asmi & Majid, 2006). It should be continuously shared to keep the team

informed and to avoid mistakes being repeated. As the knowledge-intensive firms generally have high turnover rates, it is a great challenge to keep the knowledge workers and facilitate the KM (Hislop, 2013).

The knowledge flow needs to be properly managed. A good measurement for the knowledge intensity in a firm is to see what added value the consultant brings to the project. This projects the value generated from transforming input, such as material, into output, which is valued by the client (Kumta & North, 2018). Case studies show that no matter the orientation of the knowledge intensive firm, its employees are compelled to develop new or adapt present knowledge to achieve the goal (Love, Fong & Irani, 2005). This is due to the fact that client invoke this kind of firm when the task requirements are highly demanding custom-made products. Many times the task is a turnkey project or a total solution, which craves significant knowledge (Kumta & North, 2018).

2.1.1.1 Consulting firms in the construction business

Consultancy services within the technical spectra engage in knowledge in a broad sense when describing their occupation. The process of creating business for construction organisations consists of creating knowledge resources (Okere, 2017). More specifically, the service in the industry frequently consists of theoretical and practical knowledge as well as experience and application terminology (Sverlinger, 2000). Thus, both so called tacit and explicit knowledge is attached to its services. A detailed presentation of these two concepts will be presented further on.

Moreover, the consultancy services have a target group consisting of clients many times in form of property owners. Other examples may be government agencies, industrial firms, municipal and county councils, and construction- and real estate firms (Sverlinger, 2000). The technical proposals and solutions produced within a project are many times developed cooperatively by the consulting engineer and the contractor/manufacturer. The detailed work is later on often transferred to the contractor with the practical knowledge on site. Sverlinger (2000) proceeds, stating that consulting engineers try to be more on the offensive in the execution phase of construction projects and obtain assignments as independent consulting engineers, as problem solvers at site, and to acquire project management assignments. Styhre (2009) proposes that the industry solely contains non-routine production processes. It is therefore a great need of an organisational management and a management that mobilises knowledge. The result of this is an industry with many decentralised project organisations. Hence, there is a need to act both horizontal and vertical in the firms (Styhre, 2009).

Within the industry, there are various types of contracts binding the project. Partnering, Design-bid-build, Design-build amongst others are all anticipated. This means that the conditions as a consultant may differ (Bakri et al., 2010). The lack of common goals can make project participants mainly focus on their task, disregarding the knowledge needed for the rest of the project. Different types of contracts create different types of incentives to minimise this problems, which makes each project differ from the other (Bakri et al., 2010). The teams are often assembled in a hierarchical

way, thus giving little power to consultant, unlike the client. This is yet another reason, Bakri et al. (2010) state, for a complex environment for the project group and its consultants.

A study by the Royal Academy of Engineering Sciences and the Swedish Council for Building Research, proposed that as the industry tend to focus little on learning, as there is no time for it during high business activity, and too expensive during recessions (Sverlinger, 2000). Okere (2017) develops the proposal stating that the industry is not lacking data to learn from, it does on the contrary have a great storage of data. However, it is many times lacking valuable content requiring much time to retrieve.

Kazi (2005) proposes that the business of consulting within the construction industry involves three different categories of interest when it comes to project generated knowledge. These are presented as technical, project management and project related. The technical category involves related techniques and work processes of specific elements within different disciplines. The project management category focuses on the knowledge of managing and executing projects, which is beneficial for all project managers and such that are connected to its aspect. Quality systems for instance. The third category, project related knowledge, may be the knowledge of the client, the client's history or the history of a project. Knowledge that may lead to acquiring jobs for a client or that may improve the resume of the company (Kazi, 2005).

2.1.2 The project manager role

According to Laufer, Little, Russel and Maas (2017) a project manager has to have competences such as planning skills, resilience, agility and collaborative teamwork. The first three contribute the ability to adapt to change and they can only be effectively implemented by using the fourth, collaborative teamwork. The planning role evolves throughout the project and is typically reviewed on a weekly-quarterly basis. The project manager has to make sure that the time plan is followed and if not, it has to be adjusted. The agility role is important for coping with unexpected events. The project manager has to be action-oriented and respond to problems with agility to be able to predict future issues. This is connected to the third role, resilience that focuses on proactively handle major problems that have potential to affect the project negatively. Finally, the fourth role is essential for the rest of the roles to function. The project manager has to identify “key persons” and make sure that the relationship with them is built on trust. That way they will collaborate and share information that helps predicting and preventing future issues.

Pandya (2014) also emphasises the importance of the project manager’s behavioural skills. Behavioural skills are divided into three categories; personal skills, interpersonal skills and leading change. Personal skills include skills that a successful project leader should possess such as decision making, basic technical skills, learning new things, innovative and manager complexity. Some examples of interpersonal skills that Pandya (2014) mentions are interactive, mentor, coordination, communication, team player, positive attitude and conflict management. Lastly, some examples of leading change are result orientation, ability to see the holistic picture, customer orientation and look at change process/improve process.

2.2 What is knowledge?

To understand the application and use of KM, along with organisational learning and KM tools, it is imperative to understand what knowledge is. It has been approached to be defined many times, with different definitions (Jonsson, 2012). Ibert (2007) stated that knowledge is something everybody knows what it means but have a difficulty with defining. Alvesson (2004) instead defined it as something broad containing knowing how to do things in theory, being able to practically execute the task, knowing why you do it as you do, and understanding the pattern of what you know. Furthermore, knowledge contains several subcategories and concepts, much easier to define and to use. This chapter will hence present the different forms of knowledge, and what stages it may exist in when trying to acquire it.

2.2.1 Tacit and Explicit Knowledge

Knowledge tends to be separated into two types that are tacit and explicit knowledge. This is important to observe, as tacit knowledge has to be managed differently from explicit knowledge. Tacit knowledge is explained as knowledge that is hard to verbalise or to put in words. It is not fully coded and its key to be acquired is experience. Newly examined students or adepts do receive their tacit knowledge by taking part of their mentors work by practicing and observing. Fagerberg, Mowery and Nelson (2006) argues that tacit knowledge is in need of trial-and-error learning where the new knowledge is to be applied in a new setting. An important factor of this type of knowledge is that people often knows more than what can be expressed (Newell et al. 2010). It is often expressed to be "know-how"-knowledge. However, Newell et al (2010) state that to solely rely on each and everyone's own experience would severely limit a company. As this experience-connected knowledge is not fully coded it is stated that it is difficult to transfer from one person to another via explanation. Yet another attribute possessed by tacit knowledge is its cognitive dimension, which makes it personal. People may have different approaches and explanations of what they do and how they do it (Sharif & Saffarian, 2010). One definition, by Wong and Radcliffe (2000) is:

- *Tacit knowledge is the knowledge component that is extremely difficult, if not impossible, to articulate, put in writing or codify.* (Wong & Radcliffe, 2000, s. 495)

Explicit knowledge on the other hand, is coded information that can be articulated and verbalised. It can therefore also be easily transferred, unlike tacit knowledge. Blueprints and manuals are apparent explicit knowledge. Polanyi (1966) develops the state of this type of knowledge, arguing that explicit knowledge tends to be more easily communicated through documents rather than by word. This is due to the argument that language is not sufficient enough.

Furthermore, Fagerberg et al. (2006) state that complex tacit knowledge can become more explicit as partners develop a wider bandwidth of communication. Thus, there is a learning curve of understanding the tacit knowledge. Accordingly, there is an opportunity to acquire information more effectively, as per Fagerberg et al. (2006). Hansen (2002) concurs, stating that tacit knowledge sharing is only possible in teams with strong ties. Hence, to share tacit knowledge across

an organisation, the team generating the knowledge need to have strong ties within the whole organisation. Moreover, it is argued that explicit and tacit knowledge is mutually consisted and should therefore not be looked upon as two totally different types of knowledge (Sharif & Saffarian, 2010). With above in consideration, it is essential to have a productive transfer of knowledge. This can be done when different parties combine their individual knowledge. When all participants deliver valuable information, there is a high commitment to the generation of knowledge that favours every participant (Fagerberg et al. 2006). According to Kazi (2005) shared and creative problem solving, adoption of new tools and formal and informal settings are also key activities to enlarge the capabilities of transforming tacit knowledge into explicit.

If tacit knowledge is a limiting factor in the transfer of knowledge, the cost of transferring knowledge is proportional to the type of knowledge transferred, Fagerberg et al. state (2006). Thus, knowledge that can be transferred easily comes to a lower cost, although that information seldom leads to innovation. With this considered, explicit knowledge is often cheaper to transfer but seldom leads to proportional gain for the company. Furthermore, tacit knowledge is costly and difficult to transfer. As the cost of transfer may exceed the value, there is a complexity to argue for the transferral of knowledge. As presented in Figure 2, there is a u-shaped relationship between innovation and codification Fagerberg et al. (2006).

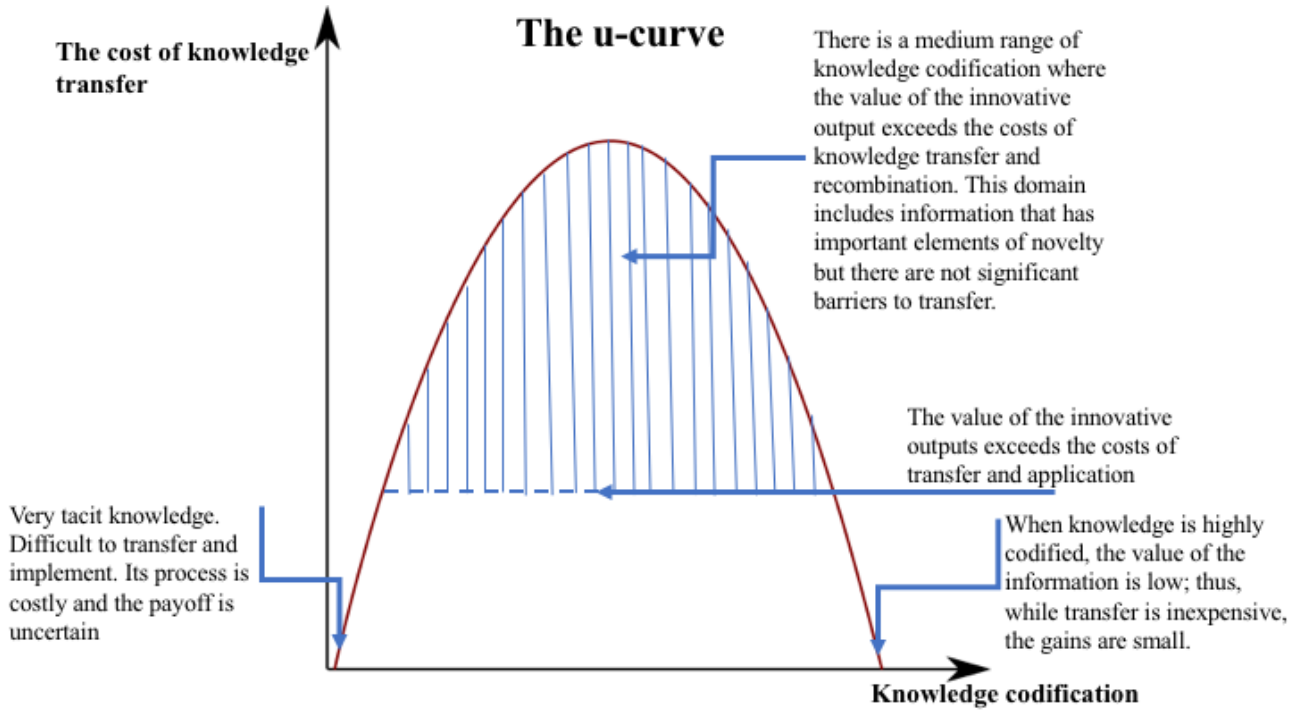

Figure 2: The relation between the cost of knowledge transfer and knowledge codification. The u-curve.

Nonaka (1994) proposes the structural perspective, which claims that the optimum way for a company to handle tacit and explicit knowledge is to localise key tacit knowledge, transform it to explicit knowledge and thenceforth convert it into tacit knowledge of other employees. This accumulation of tacit knowledge can be elucidated by the art of riding a bike, or swimming. As

someone with tacit knowledge expresses how to swim or ride explicitly, the recipient practices the task with the explicit knowledge in mind. This is then transferred into tacit knowledge (Newell et al. 2010).

Furthermore, as knowledge is in many cases a combination of tacit and explicit knowledge there is a degree of tacitness that plays a part in how difficult a tacit knowledge is to communicate. This degree is defined by four levels, which are (Ambrosini & Bowman, 2001):

1. Deeply integrated tacit skills
2. Tacit skills that can be imperfectly articulated
3. Tacit skills that could be articulated
4. Explicit skills

Accordingly, organisational knowledge is a combination of tacit and explicit knowledge, expresses in the degree of tacitness as level 1 is the highest degree of tacitness and level 4 the lowest. This is further visualised in Figure 3.

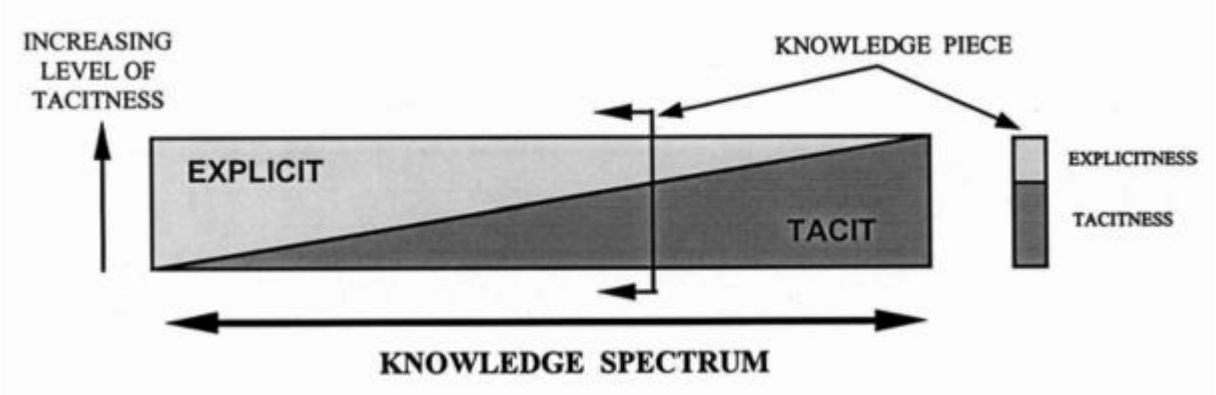

Figure 3: The degree of tacitness. (Source: Wong & Radcliffe, 2000, p. 497)

2.2.1.1 The SECI-model

Socialisation, externalisation, combination and internalisation are claimed to be the major movements of tacit and explicit knowledge. It is called the SECI-model, and explains how tacit and explicit knowledge act together, and how it is transmitted by different events (Clegg et al. 2016). The move of knowledge often begins with socialisation, spiralling forth in the knowledge spiral illustrated in Figure 4, progressing towards more complex knowledge with each step (Bandera, Bartolacci, Keshtkar, Neerudu & Passerini, 2017).

Socialisation is the conversion from tacit knowledge from one person to another. It is hence an approach focused on sharing skills and mental models. It is often acquired by mimicking or observing how others act (Clegg et al. 2016). For example when a new consultant joins a project group and acts accordingly. The key of this movement is to share experiences, and shared experiences are key to create value within a knowledge intensive firm. The knowledge transfer is seldom sense made if tried to be made into an abstract form, as emotions and context amongst other

prerequisites plays a part (Kumta & North, 2018). Traffic regulations are for instance often similar in many countries, but people still needs to adapt to the context as driving in Sweden may not be the same as in France (Clegg et al. 2016).

Externalisation is the transfer from tacit knowledge to explicit knowledge. The process articulated tacit knowledge into explicit concepts, such as providing lessons learned from one project to another to create better project conditions. Thus, the process may miss parts of the transformed knowledge due to the complex task of putting tacit knowledge in explicit formats (Clegg et al. 2016). Conducted tasks seldom perfectly match its written description. It is therefore not proposed to solely focus on but should rather be a basis for reflection of tasks and experiences. Often with the goal to formalise and further standardise tacit knowledge. It is a process that improves the possibility to make experiences accessible for the whole organisation (Kumta & North, 2018).

Combination is the move from explicit knowledge from one person to another. This is done by sharing and exchanging documents, drawings, communication networks etc. By sorting and combining knowledge, even more deep and complex knowledge can be obtained (Jonsson, 2012). Two presentations may for instance be combined to create a more developed one (Kumta & North, 2018)

Internalisation explains the move from explicit to tacit knowledge. Due to this, newcomers may be seen as a great source of knowledge as they can bring their explicit knowledge to an organisation and make an impact on the tacit knowledge used (Clegg et al, 2016).
This is embodied by for example reading a manual before conducting a practical task (Kumta & North, 2018).

It is closely related to learning by doing, and the tacit knowledge is later on spread by socialisation hence fulfilling the knowledge spiral presented by the SECI-model (Jonsson, 2012)

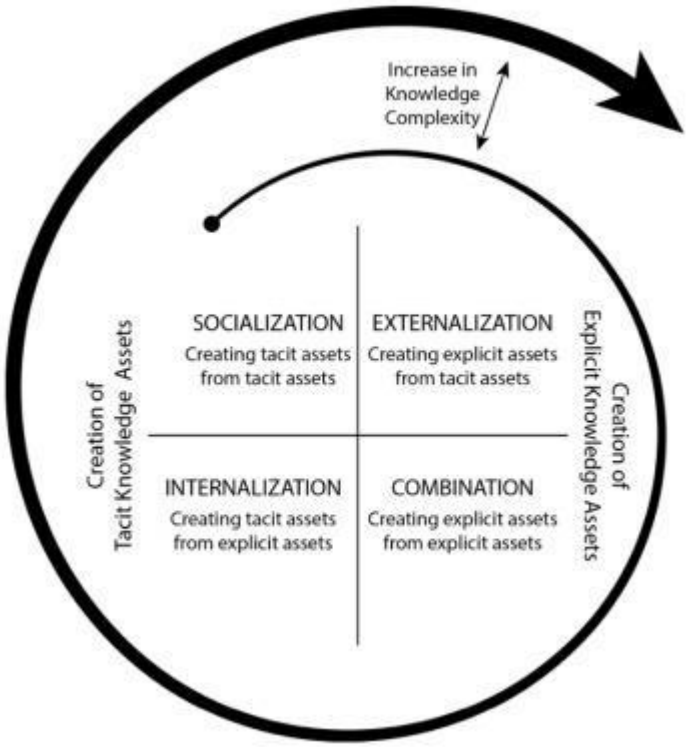

Figure 4: The SECI-model. (Source: Bandera et al., 2017, p. 166)

The aim of this model is to enhance the organisational knowledge and its value. According to the model, value is a creation through synergies between both individuals and teams connected to the organisation in mind, as presented in Table 1. Thus, the interplay of knowledge on various levels and during different actions is central (Sjöström & Svedberg, 2010).

Table 1: The SECI-model and its conversion types.

	Socialisation	**Externalisation**	**Combination**	**Internalisation**
Conversion type	Tacit to Explicit	Tacit to Explicit	Explicit to Explicit	Explicit to Tacit
Change in level of knowledge	Individual to individual	Individual to group	Group to organisation	Organisation to individual

2.2.2 Knowledge Processes

Knowledge have been shown to exist in different stages, or so called processes. These processes can be used to localise the knowledge, and to understand what is needed to be done to extract the key knowledge to an organisation, and to re-use it (Allameh, Zare & Davoodi, 2011). According to Lawson (2003) there are six processes that knowledge go through to be managed by an organisation. These are knowledge creation, -capture, -organisation, -storage, -dissemination and knowledge application. Moreover, Lawson presented this as the *knowledge management cycle*, or the *Lawson cycle*.

Knowledge creation process

This is the first step in the *Lawson cycle*, and focuses on creating knowledge and making sure that it cycles in the organisation (Nonaka, 1994). It is claimed that this is a centrepiece to create a successful organisational strategy, and that organisations must focus on consistently generating new knowledge. It is an dynamic act which considers tacit and explicit knowledge, deductive and inductive knowledge, organisational and individual knowledge (Lawson, 2003). Moreover, it is also a complex process with three central pieces, being the SECI-model, together with a shared context for knowledge creation and knowledge assets (Allameh et al., 2011). Egbu, Hari and Kumar (2003) presented a study with four out of twelve (33%) interviewees from small and medium sized enterprises (SMEs) claiming that knowledge creation is a learning curve not only for the organisation but for the individual as well. According to Kumta and North (2018), this process is also important to make sure that knowledge is developed in the most suitable place inside or outside the company and that it leads to innovation.

Knowledge capture process

This process has been defined as developing and replacing knowledge within an organisations tacit and explicit knowledge bank (Allameh et al., 2011). It is imperative to capture knowledge both inside and outside of the organisation in mind. To share information with partners and client, to get feedback or to hire new staff are examples of this (Lawson, 2003). It is stated that only 20% of the knowledge within an organisation is used, meaning that there is 80% not used (Egbu, Hari & Kumar, 2003). This is a great amount of available knowledge that can be captured. It is a complex act to capture tacit knowledge and to transform it into explicit though. Moreover, there are various tools to capture knowledge such as videoconferences, emails and other collecting software. Once the knowledge is capture it can be used internally (Lawson, 2003).

Knowledge organisational process
Organising, structuring and listing are central acts within this process. Acts that makes it possible to share the knowledge (Allameh et al., 2011). It involved three stages, stated to be: Selecting and evaluating, organising, and re-selecting. As knowledge may not be stored forever, this process is important to update and screen the content. This act creates a stock of valuable knowledge, thus, a standardisation for objects, type of knowledge, process among other things are to be used (Lawson, 2003).

Knowledge storage process
This process builds upon the organisational memory that stores the knowledge of the organisation, both electronically but also as tacit knowledge in individuals' minds (Allameh et al., 2011). This process point out key knowledge, that is worth storing and store this in an appropriate form. It may for instance generates a possibility to simply trace what is demanded, such as documents and blue prints. It is presented that a storage system must possess following factors (Lawson, 2003):

1. A simple structure
2. Set procedures based on the organisations need of knowledge
3. Precise presentation of the knowledge
4. On time and always available content

Knowledge dissemination process
The dissemination process focuses on transferring and sharing knowledge into the organisation, and to make sure that there is an optimum use of knowledge (Kumta & North, 2018). It is a process that can happen between individuals, teams or the organisation as a whole depending on what communication channels one chooses to use (Lawson, 2003). Therefore, face-to-face discussions are of great importance. Egbu et al. (2003) presented that 6 out of the 12 (50%) of the interviewees in their study on SMEs agreed that knowledge dissemination is a challenge. Often due to lack of time, lack of communication skills and rapid change in Information and Communication Technologies (ICT) were pointed out as few of the problems from the dissemination process.

Knowledge application process
It is key to make sure that the generated, collected, organised and transferred knowledge is applied within the organisation. This is the process that generated the value in form of efficient work and low costs due to smart actions made upon knowledge. As it has shown to be a problem for organisations to apply new knowledge, due to distrust, this process must work with actions to make sure that the knowledge is utilised (Lawson, 2003).

Furthermore, it has been shown to exist three enabling factors that impact the execution of these processes, illustrated in Figure 5. These are stated to be technology, structure and culture (Gold, Malhotra and Segars, 2001; Lawson, 2003). They are what stimulate the creation, sharing and protection of knowledge within an organisation (Lawson, 2003). Technology creates an opportunity to mobilise human capital, thus sharing and transferring knowledge. It also removes barriers within

an organisation due to communication systems. The structural enabler does, according to Gold et al. (2001), leverage the technical architecture, but also speaks for a flexible way to work. As it is shown that a set rigid structure may optimise one functional area within an organisation but simultaneously sub-optimise the knowledge sharing through the organisation as a whole. Thus, the structure contributes to a way to work with knowledge where this kind of situation does not occur. Lastly, culture creates norms that enable face-to-face conversations. It may also create possibilities for people to self-organise, which forces them to come up with new solutions to problems that generates new or updated knowledge. As previously mentioned, culture is also an important aspect when transferring tacit knowledge between individuals or when converting tacit knowledge into explicit (Gold et al., 2001).

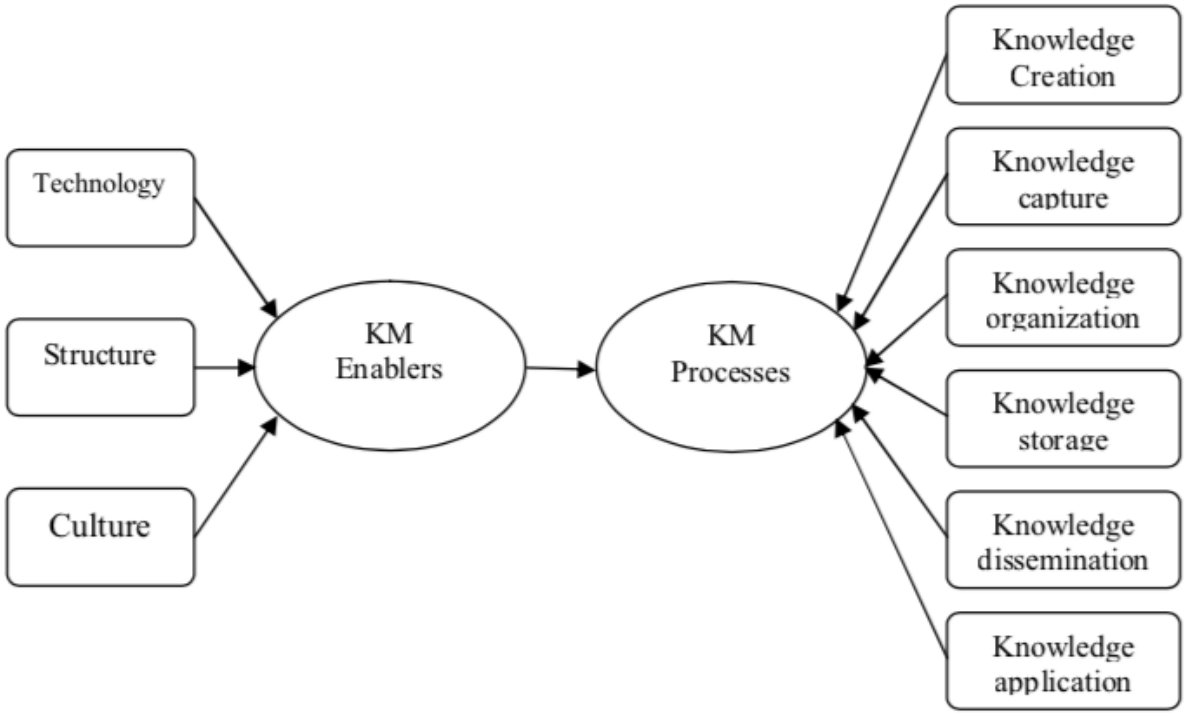

Figure 5: The knowledge management processes and enablers. (Source: Allameh et al., 2011, p. 1218)

2.3 Knowledge Management

KM is defined as a process, which identifies, captures, codifies, stores, disseminates, implements and measures knowledge for the benefit of an organisation (Okere, 2017). It possesses the objective to improve knowledge access and transfer, enhance the knowledge environment and to manage knowledge as an asset. Thus, it focuses on the knowledge processes and its cycle, and how to manage them to create value. Studies have shown that by managing knowledge organisations will leverage collaborations, disperse groups from reinventing the wheel, capture difficult to get knowledge and discipline groups who have been unable to share knowledge (Okere, 2017). As it may create immense advantages for organisations, it is important to be aware of the practical issues that are focused on when considering KM tools and frameworks (Newell et al., 2010).

Hislop (2013) describes several fundamental taxonomies to explain KM. The following section will shortly present one of the taxonomies called the seven schools of KM. Furthermore, the tools used to fulfil the Lawson model of the knowledge cycle will be covered, and how knowledge is created in projects and shared across projects. Finally a description of how KM is implemented in the construction industry today is presented.

2.3.1 The seven schools of knowledge management

The seven schools of KM framework was found by Michael Earl in 2001. These schools are divided into three broad approaches where the first one, called the technocratic approach, concerns three schools that are classified depending on the role of IT systems and Human Resource Management (HRM). The *Systems School* focuses on the codification of knowledge into databases. The collected knowledge within the database is an organisational resource where people can search for relevant information. Therefore knowledge sharing does not occur in face-to-face meetings. The *Cartographic School*, on the other hand, view databases as a directory to find people possessing the sought information. Thus, knowledge sharing occurs directly between people. Finally, the *Engineering School* concentrates on task and process oriented knowledge on operational processes and procedures unlike the *Systems School*. Apart from that, the two schools are very much alike. The knowledge is codified in a database where the concerned people can find it. (Hislop, 2013)

The second broad approach is the economic approach and it has only one school, the *Commercial School*. The one goal here is to achieve economic benefits by effectively commercialising an organisation's knowledge. In this school, the focus is on producing products and services that add value, and protect these knowledge assets with trademarks and patents. (Hislop, 2013)

Lastly, the third broad approach is the behavioural approach containing three different schools. In contrast to the technocratic approach, the focus is on people management practices and processes rather than managing knowledge with IT systems (Hislop, 2013). This approach is essentially centred on creating processes, spaces and mechanisms to facilitate interpersonal knowledge sharing. The first school is the *Organisational School*, which believes in creating networks or communities where people who have common interests can share their knowledge and experience. The value of these communities depends on the participating people and the trust they have to each other. It is easier for a group of people to share knowledge if they have developed a great amount of trust to each other beforehand. In the *Organisational School* knowledge can be shared both through face-to-face interactions and by using IT systems. In that case the IT-system is a platform where the community members can interact. The second behavioural approach is the *Spatial School* where knowledge is shared in both physical and virtual spaces. Some physical spaces are formal meeting and training rooms, but there could also be informal meeting rooms such as the kitchen. The virtual meeting rooms are not as well developed but virtual cafés have been used in some organisations. The final behavioural approach is the *Strategic School*, which focuses on people's' values and attitudes towards KM. This school believes that if the employees have a positive approach towards KM and understand the importance of it, they will voluntarily choose to participate in the KM processes. To convince the employees of that a successful KM can make a difference, the company

could use a wide range of mechanisms such as vision statements, business plans and communication programmes. (Hislop, 2013)

2.3.2 Knowledge management tools

There are different approaches to conduct KM, and to capture knowledge from projects, events, or other work to apply in similar situations (Ferrada et al., 2016). Some of these are presented below.

After action review (AAR)

After action review is a tool that is used by a team to capture the lessons learned from an event, regardless of success or failure. Its content is to reflect upon the completed event to pinpoint actions that will be successful in an upcoming event. It can also be used for evaluation during the project to learn while doing (Kumta & North, 2018). It is a tool that is a basis to learn from project and a starting point to improve future ones. Team members are allowed to speak up, and the knowledge is documented and made available for the whole organisation to improve their decision-making. It is important to conduct the AAR with all the team members available to avoid missing out on vital information. Thus, it is important to execute it close to the project closure. Furthermore, the right climate is important and there should be an environment where it is free to speak, without any hierarchy. Kumta and North (2018) stress the importance of not treating the team members after their personal performance. For example, problems are to be identified, not a sinner (Kumta & North, 2018).

The AAR is a tool to learn answers, not to 'have' answers. Thus, questions such as "What was supposed to happen?" and "What actually happened?" are central. This should be conducted for each activity of importance. Furthermore, the plan is to be compared to the reality, so that the team can see what they learned and why the things that happened actually happened. When doing this it is vital to note key points so that the knowledge can be understood by the organisation (Kumta & North, 2018).

Knowledge taxonomy

Taxonomy is a technique that organises information and documents. The information is hierarchically structured. This creates and efficient work path when acquiring knowledge. Due to the contextual/hierarchical structure individuals can easily find what is demanded. Furthermore, this type of structure makes it easier for other project organisations to acquire information even though they are not that familiar with the source (Kumta & North, 2018). To use this tool, it is necessary to break down knowledge by creating categories and subcategories. The difficulty with this is to make sure that these categories matched the expectations from the organisation so that the knowledge is easy to find afterwards. It can also be preferable to make sure to tag the maps and the knowledge with a maturity (Kumta & North, 2018).

Skill or Competence matrix

This tool is claimed to be widely proven to be a suitable method to structuring, evaluating and visualising the distribution of either skill or competence in a presentable form. Hence, it presents

where there is a lack of competence (Kumta & North, 2018). Therefore it may help localise where there are needs of training or to recruit new staff with the missing skill. The matrix is created by having names on one axis and skills and competences on the other. This visualised who knows what and how well they know it, which is evaluation individually. The matrix therefore makes it easy to see if there are any kinds of knowledge gaps within the organisation (Kumta & North, 2018).

Knowledge inventory

Kumta and North (2018) presents knowledge inventory as a kind of stocktaking to identify and localise knowledge assets within an organisation. This refers to both tacit and explicit knowledge. Therefore, it is proposed to screen what kind of information that is imperative and what is not to cleverly use ones resources as the identification of tacit knowledge may require comprehensive effort. To execute the method questions such as "What do we know?" and "Where is this knowledge located?" are central. It identifies gaps and shows what knowledge exists. Therefore it can be used to prepare for a more extensive intellectual capital report. The knowledge is to be mapped up under different categories and preferably, according to Kumta and North (2018), divided into tacit and explicit knowledge. For inventorying the explicit knowledge organisations can examine what kind of knowledge that exists today, where it is located and how it is used. The tacit knowledge is as presented much more complex to code, but can practically be inventoried by studying who knows what and what they do, which builds upon the skill or competence matrix.

Knowledge market

This tool proposes a knowledge market within companies based on the supply and demand of knowledge. The aim is to enable contact between the buyers and sellers, which in this case are those who are looking for knowledge and those who possess it. This is often conducted over the intranet or the company database, but can also be physically conducted, by stating what type of knowledge is searched for, or what can knowledge can be offered. It is a different way to exchange knowledge and experience rather than a presentation, as it is not one singular person presenting what they know but rather one person looking for something within the company's human capital, and thence being connected to someone that can answer that question. This may cause employees to explore colleagues projects, and further on create an organisational culture where sharing knowledge or asking for it is common. (Kumta & North, 2018)

Knowledge Café

The purpose of this tool is to collect people in an open and creative environment and to trigger conversation on the topic of mutual interests within the company. This environment should invite towards upbringing of ideas and experiences that should be promoted within the collective knowledge. This event should provide a space, which only focuses on creating discussions and reflection upon information that may be of relevance within a particular industry. The objective is that these cafés may lead to a better foundation for decision-making within the business, as people may share their knowledge within the attending group. Therefore, it is pinpointed that a great variation of people with different experiences are to attend. A knowledge café session may begin with a session leader explaining the objective of the meeting, as may be contractual issues or

knowledge sharing. Further, open questions connected to the theme are brought up. The group divides into smaller groups and discuss the mentioned questions. The groups may be changed after some time, and/or the discussions be presented within the groups. This event is thought to be a large brainstorming event, in a casual informal setting leading to valuable discussions over a cup of coffee. It is proposed that this event may bring up knowledge that would not have been brought up at a formal meeting of presentation due to its casual setting (Kumta & North, 2018). This type of event have also been developed in a digital, virtual, environment, where the discussions are held online which may be useful for companies with employees that are not able to physically attend.

There is, in project environments, a considerable amount of knowledge that is generated as the work is targeted at the needs of the clients. This is knowledge that often is of value to a successive project; hence the use of KM and its tools is often promoted (Love et al., 2005). A case study done on a large management consulting company, by Love et al. (2005) showed that applying KM tools creates a lot of value, but there is a dependence of the right conditions to exercise KM to create this value. As presented there are wide ranges of tools to apply, which will lead to identifying, capturing, codifying, storing, disseminating, implementing and measuring knowledge. The investigated case company did however show how culture plays a part in KM. The company worked with KM by using databases, but also by writing personal journals of executions, or review reports on conducted projects, and applying a yellow-pages system, similar to a skill or competence matrix, where employees could identify who knows what. The result from the case study showed how culture played the biggest part in creating good conditions. If there for example were a sufficient interest in the review reports, the report were to be developed into a practice document filled with lessons learned and AAR-information which later on were to be released in the database for all employees to see. The company had created a pressure to release these reports, and about 70% of the consultants had authored at least one document, and approximately 4800 copies were requested to be developed each week. This was described as a culture of codification of knowledge, combined with the fact that people want to follow the pack. Similarly, the skill matrix was frequently used and there was an expectation that colleagues should respond on a question within 24 hours. It was a resource that was encouraged to be used frequently, and one interviewee declared that he got questions from colleagues all over the world on a daily basis, where half of those were people, which he had had no previous contact with. Accordingly, Love et al. (2005) presents the importance of culture combined with whatever tool is used.

2.3.3 Project-based knowledge creation and learning

Skyttermoen and Vaagaasar (2017) categorise knowledge in complex projects into four different areas. The first one is technical knowledge which is about what task that should be solved. The second category is process-related knowledge, which is about how different project activities should be executed. The third one is strategic knowledge that covers how the project group relates to the main organisation and other projects. Finally, the fourth category is social knowledge that includes knowing who to look for help at and who are the relevant decision-makers.

According to Skyttermoen and Vaagaasar (2017) there are two common issues connected to KM in PBOs. One is that the project workers do not learn as much as they potentially can, because of limited time for reflection and a lack of learning systems. The time frame controlling the project results in stressful working environments and short-term thinking. Therefore Skyttermoen and Vaagaasar (2017) emphasise that the time frames should be expanded and there should be a clear expectation on the project team to reflect on their actions and results. After each milestone the reality should be compared to the expectation. The other issue is that the learning created in projects is only spread to the rest of the organisation to a limited extent. Because of a mutual memory loss at the end of the project, a lot of knowledge is lost and the risk to reinvent the wheel becomes larger. Skyttermoen and Vaagaasar (2017) opine that as long as the wish for improvement is central within the company, this should not be the case.

Project practices are unique for each project since they depend on the task and the composition of the project group. The task is usually complex and to produce a good solution it requires complementary competencies (Skyttermoen & Vaagaasar, 2017). This generates an efficient environment for learning within the project and developing new knowledge. Many situations are unexpected or requires knowledge that the project workers do not possess themselves. Skyttermoen and Vaagaasar (2017) describe these as opportunities for learning. When the project workers search for knowledge in specialists or other people that probably possess such knowledge, look for solutions to similar situations, and read reports and documentation, it is called ‘problem-oriented learning’. Further project-based learning continuously improve and develop routines and procedures for the working processes and contributes to the standardisation of those.

To facilitate learning in a project group the members should be physically localised at the same place (Skyttermoen & Vaagaasar, 2017). That way the group can effectively coordinate activities, share knowledge and create a feeling of solidarity among the project members. As the individuals get to know each other better, they know who possess what knowledge and are more willing to share and take part of experiences. In addition to that, they feel more comfortable in asking questions and jointly solve problems, which is an important way of sharing and creating knowledge. Physically working together also facilitates the sharing of tacit knowledge as project members can learn by observing and imitating each other. Skyttermoen and Vaagaasar (2017) mention another way of creating a learning environment in a project, which is to let junior workers be in teams with senior workers. The junior workers can then learn from the senior workers possessing more knowledge and experiences.

The creation of new project practices can also increase the division between the project group and the organisation (Newell et al., 2010). As project groups solve unique problems of varying difficulty, they overcome several knowledge boundaries. The more complex these knowledge boundaries are, generating new project practices, the harder it will be for the rest of the organisation to learn from the project. Scarbrough, Swan, Laurent, Bresnen, Edelman and Newell (2004) call this a ‘learning boundary’ because it is a product of learning within a project that results in a boundary to learn in the organisation. They suggest that a higher level of intra-project learning increases the

project autonomy from the remaining organisation. Scarbrough et al. (2004) also emphasise that learning at one level may inhibit learning at another level within the organisation. Therefore learning should be balanced between different levels and from an organisational perspective project learning should be seen as something that creates flexibility for the organisation to respond to environmental contingencies.

2.3.4 Cross project knowledge sharing

According to Newell et al. (2010) the collaborative settings that come with project based forms of organising support innovation. On the other hand, some problems arise from this way of organising, not least in the aspect of sharing knowledge across projects. It could be hard to collect knowledge and transfer it to other project groups considering they are working with other project practices. Skyttermoen and Vaagaasar (2017) describe several methods for sharing knowledge across projects. A project team can involve an expert or other competent people from other parts of the internal organisation. A good time for that could be the start-up meeting where someone with experience from a similar project could be invited. Previous research has shown that the greater a project workers' social network is, the less likely it is for that person to look for written sources (Skyttermoen & Vaagaasar, 2017). Further it is important that project-based companies strive to make every employee's knowledge and experiences visible to the rest of the organisation in order for everyone to know who to ask for a particular knowledge. Normally companies do that by uploading an overview of who has done what on the intranet. Other ways of sharing experiences across projects could be to systematically join each other's meetings, meet for updates or read each other's reports. One way of achieving this could be to have competence groups or networks in the internal organisation that meet for updates and discuss a particular knowledge area. A more informal method for sharing knowledge and experiences is the interaction happening by the coffee machine for instance (Skyttermoen & Vaagaasar, 2017). That requires the co-workers to be physically located at the same office.

Newell et al. (2010) describe that organisations are aware of the importance of exploiting knowledge that is created in projects. Maintaining project documentation and conducting project-learning reviews are usually part of the project-management methodologies. These reviews are typically in the form of lessons learned reports that are created at the end of the project or when a specific milestone has been met. Once the report is written it is uploaded on a database along with other project documents for the rest of the organisation to take part of. As colleagues can search for project titles, keywords or staff and learn from the project documentations, it is assumed that knowledge and learning is shared across projects and the risk for reinventing the wheel is reduced (Newell et al., 2010). However, previous research shows that these project reviews are not very helpful in the aspect of knowledge sharing (Keegan & Turner, 2001). Lack of time usually results in that no project reviews are uploaded on the database, which clearly means that no lessons learned can be shared across projects. There is also evidence that even when time is available and a database exists people do not seem to share lessons learned anyway. Another cause to why the project reviews are not helpful is that they tend to focus on what has been achieved by the project group, rather than how this has been achieved and/or why it either did or did not work. Some

examples of lessons learned from a project that might be useful for other projects are whether the project group was too small or too big, whether the frequency of meetings was adequate and whether the division of tasks was effective, which are all focused on the process (Newell et al., 2014).

Newell et al. (2010) bring up several reasons to why sharing learning across projects can be problematic. First of all individuals seem to believe that their learning in a project is unique and therefore not relevant to the rest of the organisation. Many times projects of a very similar nature are going on simultaneously in organisations, but still it is difficult for the workers to see the connections between projects. Secondly, some projects are viewed as standard projects, which may restrict the knowledge transfer. Newell et al. (2010) claim that there are many projects in the construction industry that are repetitive, such as warehouses where design routines are well established. These routines may work well when executing standard projects that fit the normal templates, but instead they may inhibit the project if it is different in some way. The project workers are also more reluctant to share knowledge that is different from the standard routines as the project is then viewed as unique and not applicable to the on-going standard projects. Further Newell et al. (2010) point out that most standard projects face unique circumstances and thus the knowledge sharing from these projects is very useful. A third reason that Newell et al. (2010) suggest contribute to individuals not sharing lessons learned is that they many times find it difficult to capture the so called softer learning. The softer learning is what has been learnt about the process of doing the work. Newell et al. (2010) give an example of this describing a project having trouble with an external consultant because they had not specified the requirements clearly enough. This type of learning about processes is normally not captured and shared and instead what has or has not been achieved by the consultant is captured. The fourth reason that Newell et al. (2010) bring up is that project reviews are normally not done systematically or with the focus on learning even though they are a part of the methodology. The final review meeting often occurs a while after the project is finished and people have moved on to new projects. Thus the project members are not that interested in reflecting on what they learned in the previous project at that time. The final reason that Newell et al. (2010) point out is that individuals are not aware of that knowledge transfer is needed until they face a problem. They will only seek out knowledge once they have recognised a problem and know they are in need of new knowledge.

2.3.5 Knowledge management in the construction industry

Sörqvist (2004) and Josephson (2013) claim that little application of KM in the construction industry is partly due to lack of interest and non-existing or unclear work. Ljungström (2015) elaborates this, claiming that it is due to lack of instructions and standards on how to work with KM. Additionally, there is generally little time to execute projects which leads to abstaining KM (Ferrada et al., 2016; Härngren & Sällström 2009). With a lack of resources there is also a lack of knowledge creation, which is an early step in the Lawson cycle (Egbu et al., 2003). Anumba, Carrillo and Kamara (2000) proposed that implementing KM in a structured manner is a huge commitment for an industry that is not prepared to quick responses to new ideas, such as the construction one. (Anumba et al., 2000). Moreover, it is difficult to share knowledge in an industry

with multi-disciplinary teams, especially as tacit knowledge tends to be looked upon as a personal property rather than an organisational property (Amara et al., 2000). Added to that, the cooperation between professionals at the same organisation is difficult due to various geographical placements of the projects (Ferrada et al., 2016). With this in mind, project teams within the construction industry need to collaborate to achieve a successful construction project (Bakri et al., 2010). The collaboration that is necessary intends idea- and knowledge sharing which supports the execution of the projects. Every participant in the construction oriented PBO can supply with unique knowledge collected from various people, processes and technologies, although at various degrees of value for the on-going project. Bakri et al. (2010) continues elaborating that it is therefore the management of knowledge within construction project settings is very important. The industry has acknowledged that KM is imperative for its development, and that the technique is required to emphasise and increase the innovation and business performance that the industry is currently lacking (Amara et al., 2000). As it is a competitive business, Thomas and Keithley (2002) claims that one great motive for its application may be that it enables firms to allure, educate and keep employees as well as procuring a steeper learning curve for the business oriented competencies. If not applied, Rönn (1991) elaborates that clients, consultants and contractors will end up conducting construction project without knowing the effects of a decision. No matter the type of project, whether it is new constructions, rebuilding or extensional work or updating of installations, the management of knowledge is significant. Not only to contribute to a learning organisation, but also to empower commonly used processes as stated by Lin and Tserng (2003), which explored and proved the importance of KM in lean construction.

Dave and Koskela (2009) propose that the construction industry has an ad hoc approach for each project, creating an inability to contain and recycle generated knowledge and lessons learned. Although this approach generates various successful, and unsuccessful, experiences, the industry have missed out on collecting these experiences, often given the PBO structure (Ferrada et al, 2016). Moreover, it is issued that KM problems are especially clear in an ad hoc nature such as the one in construction projects, making the industry continually reinvent the wheel. They have therefore suggested that a collaborative KM may be the most efficient way to preserve knowledge obtained from the PBO's. Rönn (1991) does however propose that the generated knowledge need to be emerged from people with influence on the construction process, and that the emerged knowledge is connected to the discovering professionals skills. For instance, the repairer knows better than the project manager on how to solve technical problems during a maintenance project. Moreover, this knowledge that is shared over mentioned diverse processes, teams and projects may be in various forms such as drawings, documents, and schedule along with experienced statements and evaluations. Hence creating an environment where professionals discuss and present both tacit and explicit knowledge (Bakri et al., 2010). Therefore, different collaborative methods are to be applied (Newell et al., 2010).

Hence, the implementation of KM is favourable. More specifically, the improvements for the industry due to a directorship that values KM have shown to be (Amara et al., 2000);

- Increase the team collaboration
- Improve access and understanding of lessons learned
- Improve reuse of successful principles and best practices
- Increase innovation and technology competence
- Create accessibility for all things related to projects for all employees

Case studies have shown that there is a challenge for the industry as it is a lack of integrated computer systems, and that the projects lack web-based applications. This limits the project generated content and knowledge to be saved, spread and used. This content may be contract documents, photos, videos, emails, project correspondence among many other forms a data. There have also been projects conducted where the project server has been shut down when the project is finished, destroying valuable information for the future. The case study showed that project team members saved copies of relevant information as personal backups or that members not part of the project began to "pick the brain" of the project team members to acquire relevant lessons learned from the project, given that these team members still were with the company (Thomas and Keithley, 2002). Thomas and Keithley (2002) state that this is very much related to reinventing the wheel in the construction industry.

Moreover, as the industry has various contractual ways to compose a project, there is a risk that the client or the lead company in a joint venture responses over the ICT systems, leading to the problem that the results and the knowledge stays within that client as it closes down. The case study shows that there is an adequate way to transfer the gained knowledge to the related companies, such as the consulting firms. Considering this, the study resulted in a proposal to focus more on an aligned IT system with KM in mind. It was also stated that there is a risk that current systems may hinder the KM, such as those used by the leading companies in a joint venture. Therefore, it is needed to inventory the possessed system to make sure that it will enable KM, and not hinder it (Egbu et al., 2003). Amara et al. (2000) elaborates this statement claiming that any technological system with the purpose to support KM needs to be tailored for the specific needs of the company, and not vice versa. As KM is a future oriented investment it craves fixed attention for a longer period of time, and the SMEs in the construction industry needs to put in more effort in this to evolve (Amara et al., 2000).

Further, studies have shown that SMEs within the given industry have fewer possibilities to use technologies with KM in mind. Despite the fact that the method can prevent errors and contribute to a more valuable work, knowledge is more frequently held within each workers mind than what it is at larger enterprises (Ferrada et al, 2016). More specifically, Ferrada et al. (2016) state that this problem of storing knowledge in the mind is especially central for SMEs in the construction industry. A major reason for the lack of KM implementation is that SMEs experience that they do not know what to store, where to store it and how to store it. There is in other words a lack of organisational procedures.

It is also stated that the geographical diversity of the different projects, not the least as for consulting firms' personnel, creates a difficulty to discuss and share knowledge. In addition to that, it is a time consuming task, which is easily not prioritised as the construction projects many times involve time-pressured projects (Ferrada et al, 2016). More specifically, SMEs are stated to not be able to transform tacit knowledge into explicit as easily as a large enterprise with more resources. Many times due to the time consuming act, and that employees leave the organisation before their experience is collected. A study conducted on 12 interviewees from SMEs showed that 67% thought that the knowledge capture processes was a challenge (Egbu et al., 2003). Egbu et al. (2003) adds that, as the KM tools map out the knowledge assets within the organisation, it is a crucial factor to stay competitive on the market, although its implementation is a key challenge. Thus, managing knowledge is especially difficult to implement in SMEs. In summary, the improvement KM may bring is most favourable for a SME, although it is also more difficult to implement KM in an SME environment. Egbu et al. (2003) proceeds stating that projects that involves training of managing knowledge assets should be conducted by these kinds of organisations as it is something that is nowadays lacking. Further, culture, structure and technology are important enablers for the SME (Amara et al., 2000).

Amara et al. (2000) demonstrates research, which brings forth several occasions to pay regard to while implementing KM to a construction-oriented firm. These have shown to be;

- Which phase on the project the firm engage in
- What mediums are to be used
- How KM is evaluated
- If KM has been introduced as a case before implementation or not
- If the organisation has in beforehand identified what areas that can gain vast benefit
- If resources for a pilot project has been allocated
- If KM originally was exercised on smaller projects relying on in-house knowledge
- Clearly mapping out the tools and the knowledge life cycle (capturing data to knowledge retirement)
- Identifying a strategy to deal with problems such as time and data validation
- Reviewing the strategy and making time for updates

Love et al. (2005) adds to that, claiming that key features for a successful management of knowledge are shown to be the use of IT and that the management significantly invest time and money in KM. Knowledge mapping and knowledge networking have also shown to be factors of success, which can minimise the reinvention of the wheel by knowing who to turn to and to creating the prerequisites for a dialogue to emerge. Love et al. (2005) adds that the strategic plan of KM needs to focus on the needs of knowledge for the organisation in question. This means interplaying processes, teams and assets within the organisation. To do so questions such as "How can we improve the transfer of competence between individuals in our organisation?" "How can the organisations employees improve the competence of customers, suppliers and other stakeholders,

and vice versa?" and "How can we improve individual competence by using systems, tools and templates?"
In project management terms, it is important that the team share a vision for the project and to share responsibilities to achieve the project goals, KM included. To manage the project-generated knowledge, lessons learned from AAR are a very effective tool. Kazi (2005) elaborated that groups should be encouraged by the management to discuss opportunities and problems within their field, or to use an experience database. Moreover, it is stated that it is not beneficial to define a complete detailed strategy for KM before the organisation has proceeded with the implementation of some KM steps. The potential areas for development are best identified at lower levels of the organisation, but should be coordinated between all of the offices.

Mentioned principles for firms that are to develop their KM work and to capture project generated knowledge to transfer it to their organisation are:

- Appropriate mixes of explicit and tacit knowledge are to be selected
- Systems that function with all types of projects
- Flexibility and customisability (as the industry may meet significant changes)
- Over all systems rather than groups of ad hoc pieces. Thus, Knowledge managers.
- Apply lessons learned
- Identify knowledge simultaneously as the project goes on, not in the end
- Sufficient direction to ensure degree of consistency. Pushed by management
- People must be in touch with each other and be encouraged to communicate

Love et al. (2005) does, in a case study on a consulting civil engineering firm, present that the senior engineers individually possess the most important organisational knowledge. Their knowledge is gained from multiple experiences of previous project, and often saved and collected either in their own mind or in personal libraries on their own computer, which is not accessible for the rest of the organisation. As these senior engineers are retiring the problem is even more obvious as a lot of knowledge disappear, as it has not been transferred to the junior successors. Love et al. (2005) point out that this is generally a perception of a right to a person's individual knowledge, rather than that it is something that belongs to the company. This should not be, as it is gained at the company's expense. More specifically, it is stated that the most things are learned because of mistakes. Mistakes that affect the company's turnover. Further, it is presented that the intranet seldom is used as a source of knowledge due to the difficulty of codifying knowledge such as lessons learned, and to acquire what is searched for. Documentation is proposed to seldom be stored with the effort to retain and re-use important knowledge and experiences, and the documents are hence unorganised and difficult to find. Thus, a loss of valuable knowledge occurs as projects are completed.

One method that is mentioned by Kazi (2005) is to reassign project managers from one project to another to spread it to the next project. This is however claimed to remain the knowledge within that person, and not its organisation. Thus there is a large risk that the knowledge disappears if the

person leaves. It is instead proposed that consulting companies in the construction industry should work with softer approaches such as informal discussions, storytelling or brainstorming sessions. If the senior consultants participate, there is a great opportunity to transfer knowledge of useful contacts, problems and notable success factors, where to find certain documents and codified tacit knowledge.

Face to face meetings also generated an opportunity of reflection, apart from what databases can. Although, the case study also found that senior consultants would rather not share their information with their successor, as there was no incentive to do so. As per Fong et al. (2005), there must be a cultural change within organisation towards one where knowledge sharing is obvious.

3 Methodology

This chapter presents the choice of methodology that has been used for this study. It is based on a literature review and an interview study conducted at the studied consulting firm. This chapter provides a critical evaluation of the study and makes it transparent to the reader.

3.1 Research approach

The first part of the research process was the literature review that gave an overview of KM. The literature review is based on scientific articles, books and previous case studies. Once the literature review was done, the empirical study began. It was executed at a company where observations were collected and interviews were performed. The approach was abductive, involving various phases with either inductive or deductive approaches. The literature review created a foundation to the interview study and contributed to the formulation of the interview guide, which suggests an inductive phase, in the abductive process (Davidson & Patel, 2015). Once the interview study was conducted, the answers were analysed on the basis of the literature. When analysing the answers, some new information was found and the purpose, research questions and theoretical framework were recreated accordingly. Therefore the study also involved a deductive phase. Moreover, feedback and evaluations of our progress were conducted in collaboration with our peer review group and our supervisors at both Chalmers and CM West. As presented in Figure 6, the abductive work is visualised in various loops.

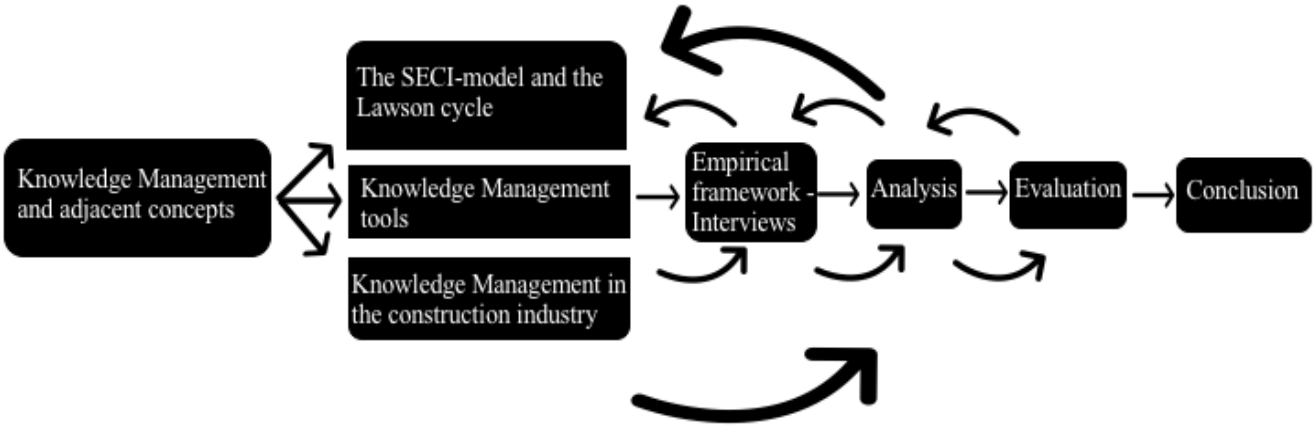

Figure 6: Illustration of the work process.

The empirical study is based on observations at the office and interviews with employees at the studied company. The observations are built on the authors interpretations of situations and the company, whereas the interview study provided data about the employees' feelings and own interpretations of how the company is working with KM. Therefore a qualitative approach was most suited for this type of study.

In line with an abductive study, changes of the research questions where executed to reach an as coherent result as possible. Thus, the original research questions where:

RQ 1: How is the knowledge management structured at the firm today?

RQ 2: What challenges with knowledge management exist today at the firm?

RQ 3: How are various knowledge management tools used today?

RQ 4: How is knowledge management managed between consultants and clients, from a consultancy perspective?

RQ 5: How could knowledge management tools be implemented?

The fourth research question was later decided to be divided into a client perspective in each RQ. Mainly due to the fact that the client perspective focuses on how the consulting project managers experience the client role, which is a small part of the study. Thus, it was decided to not be an own RQ. To present a more centred and focused conclusion, the remaining research questions where revised into more coherent ones, presented below:

RQ1: How is knowledge management structured today at Construction Management AB?

RQ2: What challenges and opportunities with the knowledge management exists today at the firm?

RQ3: What knowledge management tools should be of interest for the firm?

RQ4: What knowledge management tools are appropriate to implement?

3.2 Collection of data

This paragraph presents how the collection of primary and secondary data has been accomplished. Primary data is based on interviews and observations at the office. Secondary data is based on texts from literature and the operational system belonging to the studied company.

3.2.1 Primary data

The primary data consists of the interview study and observations at the office. The interviews were qualitative and semi-structured. Semi-structured interviews were chosen to enable supplementary questions. One interview guide was used for the project managers (Appendix 1) and another interview guide was used for the Operational Managers (Appendix 2). The same interview guide was used for all the project managers to help identify common denominators. The interview guides had to be adjusted to the role of the respondent to get the most relevant information and fulfil the purpose of the study. Therefore two different interview guides were used. The interview study is based on eleven interviews whereof seven are project managers and four are operational managers. The respondents have worked at the studied company for varying time periods, from two months to

four years. The selection of interviewees was done by asking employees at the company and whoever had time to participate was interviewed. The employees were asked to participate both through emails and personal interaction. Since the company is in the middle of a merging process, it was important to find respondents within both companies. This way a more accurate picture of the current situation could be produced. The interviews were recorded and lasted for about one to one and a half hour. Ten interviews were done through face-to-face meetings at the office in Gothenburg and one interview was done over a phone call. The respondents got the questions beforehand and could therefore prepare their answers.

All the respondents are anonymous in the thesis and therefore they will be called Project Manager A-H and Organisational Manager A-D. Project Manager H and Organisational Manager D are the same interviewee, because that respondent is part time project manager and part time organisational manager. In Table 2, the respondents and the time and dates of their interviews are presented

Table 2: Time and dates of the conducted interviews.

Title	**Time of interview**
Project Manager A	2018-10-15, 13:00-15:00
Project Manager B	2018-10-17, 09:00-10:30
Project Manager C	2018-10-22, 10:00-11:00
Project Manager D	2018-10-22, 08:30-10:00
Project Manager E	2018-10-11, 10:00-11:30
Project Manager F	2018-10-22, 14:00-15:00
Project Manager G	2018-10-30, 08:00-09:30
Project Manager H/Organisational Manager D	2018-10-30, 09:30-11:00
Organisational Manager A	2018-10-25, 09:00-10:30
Organisational Manager B	2018-10-25, 13:00-14:30
Organisational Manager C	2018-10-31, 09:30-10:30

3.2.2 Secondary data

For the literature review, books, scientific articles and journals from the Chalmers library was used. When searching for scientific articles and journals in Chalmers library's database some key words had been selected beforehand to find previous research connected to the problem area. The words were knowledge management, knowledge sharing, knowledge transfer, experience feedback,

project-based organisations, organisational learning and project-based learning. The literature was critically reviewed and the aim was to find relatively updated research.

3.3 Research ethics

The employees at the company were informed about the study during a breakfast meeting in the beginning of the process. Thereafter the purpose of the study was a part of the email asking the employees to participate in the study. Finally, all interviews began with an explanation of the background to the study. Thus, all participants were well aware of the background to the study. All interviewees were asked beforehand whether it was okay to record the interview and they were informed that their answers would be anonymous in the final thesis. All the interviewees have approved the final result before it was published.

3.4 Trustworthiness

The trustworthiness of a qualitative study could be analysed by investigating four aspects; credibility, transferability, dependability and confirmability (Bryman & Bell, 2007). Bryman and Bell (2007) argue that each of the four aspects is equally important when deciding the trustworthiness of a study. The following subchapter will analyse each of the four aspects to evaluate the trustworthiness of the study.

Credibility

When performing a qualitative study there is a risk that the researchers misinterpret the answers from the interviewees. Bryman and Bell (2007) point out that it is important that the researchers' interpretations are accepted by the respondents to ensure that their social world was correctly understood. The interviewees confirmed the result before it was published, which is often referred to as respondent validation (Bryman & Bell, 2007). The respondent validation eliminates the risk for misinterpretations and increases the credibility of the study. Moreover, the respondents were ensured anonymity, strengthening the credibility of honest answers. The company itself was also ensured anonymity, which minimises the plausibility of presented answers that may seem better than reality. However, the possibility of this should not fully be disregarded as this could still be to some extent.

Transferability

A qualitative study based on interviews at a small regional office makes the transferability limited. The conditions of various similar companies can differ, for example in form of projects, clients and cultures. This makes the transferability less possible, and the application of this studies outcome may not fit every construction company's need. On the other hand, KM is not bounded to the construction industry and instead it can be applied in many different industries and contexts. This enlarges the transferability. However, there are specific conditions that are relevant to the construction industry that has been considered in this thesis, thus it may not be completely transferable to other industries. Furthermore, the culture at the company has been described as to evaluate the ability to share experiences and knowledge, but culture may also involve other aspects

that have not been considered. Thus the culture is not described in detail, which may reduce the transferability according to Bryman and Bell (2007). Furthermore, the aim for this study is not to create a fully transferable result as the focus lies on one specific company and how that specific company should work with KM. It is however arguable that the result is generalisable within CM AB's organisation and business areas. The method on how to reach a result may however be transferable, as the KM cycles, KM tools and the evaluation of what may fit the conditions in question applies for more than the single investigated case. Therefore the result itself is not generalisable, but the method on how to reach a result is, to a larger extent.

Dependability

Since there were two researchers holding the interview, one could ask the questions and the other could transcript the answers. Thus the interviews were transcribed, which increases the dependability according to Bryman and Bell (2007). When making observations at the office field notes were kept to ensure that no thoughts and details were lost. The notes were not kept separate from the thesis, which decreases the dependability of the study. There is a separate list of research participants that also increases the dependability according to Bryman and Bell (2007). Bryman and Bell (2007) point out that qualitative studies requires a great effort to audit, which is accurate for this study as well. To transcript eleven interviews that each lasted for about one to one and a half hour is very time-consuming. Thus a lot of time was saved when transcribing directly at the interviews. The records could have been more detailed to increase the dependability, but given the time frame the dependability is sufficient.

Confirmability

As Bryman and Bell (2007) mention, complete objectivity is impossible in social research. The ambition has been to objectively interpret the interviews and the interview guides have helped in that regard. The thesis has also been peer reviewed to increase the credibility. In addition, KM is not a subject that is easily reflected by personal values in comparison to for instance gender equality.

3.5 Reflection

If this study would be conducted once more, it would be relevant to look at the outcome of a similar company which is not in the middle of a merge. We believe that the merge may have affected the outcome somewhat thus making the former interesting. It is also a difficulty to become read within a company's database and its content. We were provided with much material from the studied company, which was valuable for the study. However, time was a constraint, which influenced what was looked upon. Moreover, to gain full understanding of the intranet, database and the knowledge management work that is applied it would be preferable to work with it in a project, and not only conduct interviews and navigate through the information.

The choice of tools was done based on previous research. The time constraint once more influenced the study, as there was a limitation of how many tools that we could write about. This lead to a few

tools being disregarded in the conclusion. It would be interesting to in the future look at more tools applying to the same conditions, and distinguish what makes a tool acceptable or not.

3.6 Source criticism

It is clearly a complex situation to investigate a company that is in the middle of a merging process. The KM procedures differed between the two companies and therefore the answers had to be carefully evaluated. Some respondents were new to the current management system due to the merge. Thus, the reflection on the management system and the knowledge management directives may have been varying. However, as the system must be applicable both to senior and junior employees there is also a gain in having different respondents. In addition to that, the interviewees had generally been employed at Construction Management AB from two months to four years. Yet another factor which may have affected the thoughts on knowledge management and the directives. However, the same argument as the one before applies here as well.

Many of the interviewees had only worked at CM AB for a short time and therefore their knowledge on how they work with experience feedback and knowledge transfer was limited.

Moreover, some of the interviewees have worked at Skanska for a long time period and therefore their answers were somewhat reflected by their background in construction production. In some cases it was hard to distinguish what was accurate at the consulting firm and what was experience from other companies. There was also a large focus from the respondents' side on what a project manager need to prepare to simplify the work for the contractor. This may have affected the analysis on what the project managers focus on. On the other hand, it is a realistic representation of what types of employees a consulting company in the construction company may have, making the outcome from the interviews representative.

The number of project managerial and organisational managerial respondents was not the same. Thus, the statement from an organisational manager would weigh more than from a project manager. This was taken with grave carefulness, but not fully disregarded. Looking at a project management consulting company in the construction industry, the project managers are more than the organisational managers. Hence the distribution of respondents was representative.

The consultants have various experiences and perforations and do therefore do various task as consultant. This may have affected the answers during the interviews as some respondents were working mostly as design managers whilst other were construction managers.

4 Empirical findings

This chapter presents the empirical findings, and will explain the knowledge approach from the organisational-, project managerial-, and consultancy view on client perspective. Firstly, the expressed directives at CM AB will be presented, followed with statements on the current status of the KM work and what the objectives are. This is followed by a compilation of the consulting project managers' experiences and abilities to work with KM. Lastly, the experienced mandate of the client, and how that may affect the consultancy will be presented.

4.1 Organisational management

Presented below is an elucidation of the expressed directives from CM AB to its employees, how the organisational management at CM West experience and evaluate their KM work today, and what knowledge objectives and aims that the management at CM West possess.

4.1.1 Knowledge management directives

The management at CM AB have created directives as for how the organisation and its employees are to work with knowledge. This is explicitly expressed in the management system in form of a chapter about KM and particularly knowledge sharing and/or experience feedback. This management system focuses on how the company should work to fulfil their project objectives, and has a specific part about how projects are to be managed. This specific part has an attached timeline on what actions that should be done during the project lifetime, where "conducting an experience-sharing meeting" is the ninth out of the ten steps in the timeline. Other steps concluded in the timeline are i.e. project start up; create the organisation, risk management and inspection. Thus, the KM is referred to as an important step in the project. All interviewees with a managerial position mentioned the importance of taking care of gained knowledge and experience, pushing the importance of the ninth step in the project life cycle in the management system. It is even expressed as a requirement to work with it. Although, the directives does only apply for those projects with a budget, for the task that CM AB conducts, that goes over a specific set sum. If a project budget is below this set sum there are no expressed directives from the organisational management on how knowledge is to be managed. Further, none of the managers expressed any form of consequence if the requirement is not met. What was expressed as a consequence was instead proposed as a loss of knowledge, or that the responsible project manager would get a question on why this requirement was not met. All managers claimed that it was difficult to formulate how to ensure that the directives are met. There is however an ISO-certificate which requires that KM is worked with. This is investigated with various check ups and samples on projects and their KM work. This is mentioned as yet another incentive for the work to be done, however no clear consequences if it is not done is proposed, other than to make sure that it is done afterwards.

The management system includes various templates and documents to use during several of the steps during the project lifetime. One of these documents is a checklist to ensure that the required tasks are done and that relevant requirements are met. This checklist is divided into several phases,

as where the experience-sharing meeting belongs to the final stage. During this stage a final meeting should be held, where the management directive expresses that different customer satisfaction indexes (CSIs), and the client satisfaction should be discussed. The CSI is a measurement tool used to understand how the client experiences the project. Both grading of a scale and comments can be done, and the result will be delivered to the responsible project manager and its boss. The project manager have the possibility to send out various CSI questions related to different subjects such as the economic work, environmental questions, the project management etc. There is not a set directive on what specific subjects are to be sent out, as it may differ depending on what type of project and phase that has been managed. The questions focuses on whether the work was proactive, how the cooperation went, if the correct competence where distributed to the project etc.

Moreover, it is mentioned, as a directive, that the "experience digits" should be delivered to the calculation and economy department. Thenceforth the reader is directed to the template for experience-sharing meetings. This meeting is the practical directive that exists at Construction Management AB in connection with KM, and is only expressed to be held with the client. Hence, remaining project participants are optional to invite.

The purpose of these meetings is, according to the management, to commonly go through the task with the project group, to study good examples and also to discuss things that can be improved. Everyone with a managerial position within the CM West organisation adds that they do not want to reinvent the wheel, thus there is an incentive to work with KM. The template for this type of meeting is expressed to be a support for the meeting. Furthermore, it is proposed in the management system that the project manager could summon the project team for several separate meetings when there is a bigger project in question. This is proposed to be done in form of for example design knowledge- or procurement experience-sharing meetings. As for the specific template, it is only provided in one general arrangement with examples on questions for the different stages, not tailored for different themed experience-sharing meetings. Such questions are:

- How did the cooperation work with the client?
- Did the client provide clear directives?
- How were the meeting conditions?
- Was the project organisation optimum?
- How did the cooperation between the various designers worked during the design phase?
- Was the production conducted efficient? Did the collaboration with all the contractors work well?
- How did the procurement work?
- How did the economical work end up?
- Did the team work efficient with quality, environment and work environment questions?
- Did the team provide an efficient project closure.
- How satisfied was the client?
- Was the management system supportive during the project?

Thus, the template generally focuses on the cooperation and teamwork, the organisation and contractual and economical questions.

The management at CM West are to follow the directives expressed by CM AB but claim that this is not fully adapted yet. This is more specifically explained as that the directives are followed, but some projects are still in early stages since the directives were applied, thus some project have not reached the stage of KM. Organisation Manager C mentions that recent purchases of consulting firms that have merged into CM West are one reason for why the KM part of the directives have not been reached yet. It is although expressed by all managers that it is clear that they should work with the KM directive, in form of the provided experience-sharing meeting directive.

4.1.2 Organisational status and objectives

The management at CM West expresses that the collective knowledge within the organisation should be immense. Organisational Manager A stated that there are thousands of hours of construction project management experience in their office. Yet there are still actions that can be improved, stating that hence the need of KM and experience feedback is obvious. Organisation Manager B mentioned that recurrent deviations in connection with too many accepted projects got the management to wonder. *'Do we have enough resources or are people doing their best with what they got, still leading to a suffering result?'* By applying KM organisations can avoid deviations and assure the quality of the business and make sure that everyone can take part of the collective knowledge and the human capital. All managers agreed upon the aim to improve the knowledge work, and how valuable that is.

All of the managers expressed the objectives of KM to not only avoid reinventing the wheel, but to gain further knowledge that is of importance for the project management role. By the majority of the managers, this knowledge was referred to as knowledge about planning, coordination, monitoring and financial management, making sure that the correct roles are assigned, noticing when education within the project group is needed, pinpointing a fitting project manager for the client in question, knowing if someone needs an assistant project manager or not, and economical knowledge. Organisational Manager C added that not only this was important, but also legal knowledge on for example contractual issues. The majority of the managers showed no attention on technical issues and experiences generated on site, and only one manager, Organisational Manager C, mentioned the weight of this. Although, the weight of generated technical knowledge was mentioned in connection with contractual issues. Organisational Manager A pointed out that it may be good for a project manager to see whether the ventilation is incorrectly designed or not, but that is not their main task. All of the managers agreed upon the fact that the technical consultants and contractors within the project team are the ones that should possess the most technical skills. Thus, the most important knowledge for the organisation was therefore stated to be the knowledge connected to the project manager role, and what is expected to be delivered in that role. Moreover, all managers pointed out that the objective with KM at CM West is to develop further knowledge within the project management role, and to transfer the generated knowledge on earlier mentioned

experiences back to the organisation. Organisational Manager A pointed out that a project manager needs to be responsive, humble and determined, and that also these skills should be developed. The manager explained that there are often many insecure times during a project lifetime, and as a project manager it is important to be determined to make decisions even if they may lead to faults. In those cases the project managers can learn from their lessons and the project goes on, and in the better case time is saved due to decisiveness. Thus, the value of decisiveness was mentioned as yet another knowledge worth transferring to the organisation. It was also expressed that the project manager needs to be able to examine exactly what the client expects. Another type of experience that is valuable is to be able to determine whether the client's expectations are realistic or not. If the project managers are able to determine this, there is a possibility to generate a better organisational health where people are less stressed. Moreover, the managers generally expressed that the role of a consultant project manager in the construction industry need to have a holistic view of the project with all of the different contributing roles in mind.

The management have expressed the aim of having the project managers working in teams rather than alone together with consultants from other firms. This is proposed to generate a greater possibility to work with KM and more specifically to help transferring knowledge from the project to the organisation. It is thought that this will help the organisation to obtain their objectives; such as if i.e. one project has provided lessons learned about contractual issues or pinpointed actions that need extra education, this could be transferred into the collective knowledge and the human capital of the organisation. This is in reality stated hard to execute, as some assigned projects only demand one project manager, and some projects demand several assigned project managers but during different stages. Organisational Manager A mentions that the large projects that demands several assigned project managers often have a long time line, and that makes it hard to develop the KM work on those types of project. However, it is claimed that the knowledge generated in larger projects often is seen as more valuable as the project may encounter more complex problems. In smaller projects with only one assigned employee the generated knowledge is often lesser, and the task is often conducted quicker. It is therefore claimed, by the majority of the managers, that knowledge can be collected quicker from a small project, but the value of the knowledge is not as great. Accordingly, when applying to the organisational directives there may be input on what was good and/or faulty in the project to develop, but the outcome may differ depending on the size of the project. Larger projects will generally take longer time than smaller ones to reach the experience-sharing meeting in accordance to the organisational directives. The majority of the managers claim that due to this, KM processes are hard to develop.

The objective is to work in teams and by that optimising the KM work, but the tweaking of the KM work is easier done using projects with only one project manager, as those experience-sharing meetings generally will be held more often. This is especially clear at CM West, as all managers propose that the assigned tasks are generally smaller in their business area in comparison with the division in Stockholm where teamwork is much more frequent. Furthermore, Organisational Manager B, who agreed on the positive contribution to KM while working in teams, provided the study with an example that complicates the objective in connection with teamwork. The manager

mentioned that during one project there was several project managers engaged at the same time, which matched their aim of working in teams. The project managers did however not know each other that well, as some were newly employed, which created an insecure environment that affected the project negatively. In that way team collaboration was proposed to complicate the task that the consultants are hired for. With time the teamwork and collaboration enhanced, which Organisation Manager B implies was due to the fact that the group got to know each other. As this was not only showing the value of relations between colleagues, but were also knowledge that should be brought forth into the organisation, they were focusing carefully on the *knowledge dissemination* in that specific case, saying both:

'The project went terrible in the beginning, but with time it went better and better. As this was so clear we were extra careful to make sure that we used experience feedback in that case'

and:

'...does one not have a relation with the people one works with, there is a risk that one loses the gained knowledge as the communication is not at the same "wavelength". It is the relation between people that creates an understanding about what the other one thinks'

Thus, one objective with KM at CM West is to spread the knowledge about the value of relations, and to act accordingly. Additionally, there is a general perception that knowledge that is generated in a project group may disconnect that group from the organisation, if *knowledge organisation*, -*storage* and -*dissemination* are not applied. As it is expressed to be an environment where people are fond of talking about their projects and knowledge, it is thought that not doing so will create a disconnection. This is however avoided in those cases where only one employee attends a project, the majority of the managers state.

The organisation have not set specific goals with the KM other than that the employees should conduct the experience-sharing meeting. The majority of the managers state that this meeting needs to be conducted. Although it is not a set objective that a specific amount of hours has to be put on this type of meeting. What does exist is a possibility to be rewarded, as a project manager, for conducting the most CSIs or gaining the highest CSI score. The expressed objectives are however to transfer knowledge of project managerial value, from the projects to the organisation.

Yet another objective that is mentioned by all of the organisational managers is that the experience-sharing meeting is actually held. Every manager brings up the fact that the project schedules are tight and that the experience-sharing meetings are sometimes not held at all. Two thirds of the managers state that in some cases where a meeting is not held in connection with the closing project meeting, an experience-sharing meeting will be held much later. Hence, they point out the problem that all lessons learned will not be brought up as they are not remembered. The same managers pointed out that there could be an improvement of the KM work if there were more frequently conducted experience-sharing meetings. Organisational Manager B stated that *'there should be*

continuous experience-sharing meetings, but in the best case there is only one'. It is also stated by the same manager that it is problematic to have it that way, as not only does one forget what one has learned, but there is also a general conception of happiness that the project is over. Even if parties did not get along due to problems or complex situations, few want to bring that up in the end as everybody is happy that they survived the project. The managers stated:

'At one meeting the team of 25 actors praised each other during the experience-sharing meeting, while they in fact during the project duration of three years had had several additional costs and problems than planned. This was however not brought up. Everybody was just happy they survived.'

The general perception of the possibility to work with KM as a consultant is positive, as all the managers point out the weight of transferring knowledge from projects into the organisation. Hence, they all state that even if as a consultant the working hours should preferably be debited to a client, the incentive of gaining knowledge is large enough for the consulting company to take that cost in those cases it is needed. The majority of the managers brought up the fact that the work does not crave much time, and those few hours are well worth the money. There is although not a current fully systemised internal KM work at CM West, as most the directives and current status consists mainly of an experience-sharing meeting with the client. However, there are several internal action done with the potential for systemising the KM work. These are further explained in chapter 4.1.4. Moreover, the informal settings are claimed by all managers to be of great importance. These meetings is said to generate more dynamic discussions and questions, part of the *knowledge dissemination*, which are important for the development, extraction and keeping of competence. These words are proposed by Organisational Manager A to be the foundation of delivering work of quality. All the managers stated that informal meetings can bring up questions that may not be brought up in formal meetings, and Organisational Manager D proposed that the informal meetings may be even more important than the formal ones when it comes to KM. Organisational Manager B had observed that there is a culture of sharing experiences at CM West, but what is shared is more often information rather than lessons learned. While discussing work in informal settings the manager claimed that employees more often talk about the project in itself and not so much what went bad or good and how that was achieved. It was therefore an expressed wish from the manager that this was improved.

Furthermore, all managers see a profitability in focusing on KM, and that a consulting company may be preferred by the client if the work is successful. Organisational Manager A found that quality is to develop, extract and keep competences. Therefore one objective is to gain as much feedback as possible, which is stated to be more frequent when working frequently with one specific client. This is claimed to go hand in hand with the relationship-question, as not only a great relationship between colleagues but also between clients and other consultants are important for the work.

It is an expressed preference from the management that the employees attend at the office as much as possible. Organisational Manager B states that the employees themselves prefer to work at the office. There is although an understanding of the need for the project managers to be on site at their projects.

4.1.3 Organisational actions

The management at CM West has expressed a will to work with KM, and as presented in subchapter 4.1.3, it exists future visions of an improved use of knowledge. Moreover, there are various actions and systems available at CM AB that can be supportive to the KM work. These are however not developed with the one and only purpose to help the knowledge work, but have been noted to be able to support the knowledge work simultaneously to its main purposes. All managers present the company's email list as one of the given tools to use. This communication tool has sometimes been used to send out information about current projects and their success, in form of newsletters. This is however stated not to be done systematically, but rather used when a fitting project is given attention. CM AB does also provide its employees with an intranet and a database with information, where for example directives, named experience-sharing meeting templates and CSI questions can be found. This is also a channel that provides a possibility to share information internally, with i.e. news articles. Organisational Manager C stated that this site is often used similar to the information filled emails. The database has a collection of meeting protocols and other documents connected to each project that is available for all. There has also been a developed service at the intranet, with the employees' resumes/CVs online. Namely, it is possible to search for types of projects, names, or other types of metadata to find employees and their resumes. This service is however mentioned by both Organisational Manager B and C to mainly be used while setting a relevant project group in a procurement work. It is however information available for all employees, and not only those working with acquiring projects. Nevertheless, Organisational Manager B and C claims that it is not prioritised to be used to find someone with knowledge about something someone else is looking for.

4.2 Project management

The following chapter will present a compilation of the consulting project managers experiences and their experienced abilities to work with KM. The practical conditions, the value of informal and formal communication and how well the management directives are met will be elaborated.

4.2.1 The project managers' experiences and challenges

The role as a project manager at CM AB is usually about representing the client in a project. Therefore it includes creating project plans, descriptions of roles, leading the project group and coordinating tasks. The project managers could be involved in several small parallel projects or one large project. They are often working with more than one project at once and they could be in different phases, such as the design phase or the construction phase. Many times the project managers are only involved in one phase of a project. One of the greatest challenges in the construction industry connected to KM is that the design team is involved in the early phase of a

project and then they let it go and move on to the next project. Depending on what contract is used, the construction manager is involved in the design phase as well. Since it is expensive to have the construction manager involved already in the design phase it is not always the case. A consequence of that is that the project managers are not able to influence the building technological solutions but only some administrative tasks. Thus many issues arise in the construction phase that is a consequence of the design. The problem is that the design team worked with the project years ago and are most likely hard to get a hold of. This results in that the designers never gets the information about that their design was not possible to construct in reality and they most likely continue by making the same mistakes in other projects. The traditional processes in the construction industry inhibit a well-functioning KM.

All of the project managers have been in contact with knowledge management to some extent before. They all agree on that there are two factors that have a crucial impact on knowledge management in a project, which are the size and the client. The qualities of the experience-sharing meetings that the project managers have attended seem to have been very different depending on who has arranged the meeting and for what reason. The project managers with a background at large contractors explained how it was required to have meetings solely for the purpose of knowledge sharing, in form of an experience-sharing meeting. They described that the most efficient knowledge sharing has been exercised when they have performed repetitive projects with the same project group. In that case they had an experience-sharing meeting after the first project and had that experience in mind when building the next project. This way they collaborated better and made fewer mistakes in the second project. In the larger projects they have had experience-sharing meetings continuously, whereas in the smaller projects they have sometimes had a meeting in the end. Some project managers described that when the participants have got some questions to think of beforehand the meetings have been much more rewarding than when no one has been prepared.

The general knowledge of KM tools among the project managers was limited. The project managers have encountered newsletters, project presentations and study visits at other employers, but not at CM AB. Project Manager E mentioned that at a previous employer they had competence groups of three to seven people with a particular focus that met once a month. On their meetings they discussed regulations, updates and competence development. The other consultants could contact the group if they had thoughts or questions regarding the specific competence area. In addition to that the previous employer had the project managers present their on-going projects to their colleagues once a month, which was very good according to Project Manager E. While discussing KM on an early stage of a project some of the project managers mentioned making evaluations of other actors they have been working with. At other employers they have been asked to rate the companies they have been working with and if there are particular persons that are good to work with. That way they could share experience on who and what company to work with and not to work with. Apart from that knowledge gathering was just a tick in the box in the early stage of a project.

4.2.2 Management system

As previously mentioned, the managers use CM AB's management system when working with projects. The system describes each step of the project process, where knowledge management is one of them. The chapter is very limited, containing a template for experience-sharing meetings and an example of a completed protocol. Some of the project managers are aware of that KM is a part of the management system and only a few have used the templates for experience-sharing meetings. The Project Managers generally feel that the operational management has to make experience sharing a requirement in order for them to start working with it. Once knowledge sharing is a clear requirement from the organisational management, the work has to be followed up regularly. Most of the project managers feel that knowledge sharing has to be viewed as an obvious part of a project process, just like any other step in the management system.

The experience-sharing meetings are often conducted with the representative/-s from CM West together with the client. The general perception is that the experience-sharing meeting has to be performed once the project is finished. Many of the project managers claim that they have not had an experience-sharing meeting because of that they have not finished a project at CM AB. The general opinion though is that knowledge sharing often is forgotten and not prioritised, because people tend to rush into new projects before the meeting has taken place. Project manager E states that for a long time in the industry it has been told that KM is important, but it has not been managed to carry out in practice. Another project manager describe KM as very diffuse as it is something that should be practiced in each project, but it is always left for 'later', which never appears. Project Manager B explained that at the end of the project everyone is focused on the final inspection and experience sharing is out of the picture. Instead it would be good to plan a date for the experience-sharing meeting at the final inspection. Although many of the project managers use time consumption as a reason to why they choose to skip the experience-sharing meeting at the end of a project, they all say that time is not a problem when asked about the prerequisites for knowledge and experience sharing.

Project Manager F explains how it can be hard to bring up experiences on the bounce with no time to reflect. Many times the experience-sharing meeting has been arranged because it is required in the project plan and not because of the common impression that it could be useful to the people involved in the project. Once there has been an experience-sharing meeting it has been documented in a protocol and unfortunately lost in a database. This part of the knowledge and experience sharing chain has also been referred to as a bottleneck by many of the respondents. Project Manager C explained that in projects that last for a long time it is considered as more important to build good relationships and therefore KM is more prevalent in such projects.

One of the project managers states that it would be better to have an experience-sharing meeting early on in the project, but continues by explaining that it would probably be hard with all of the new people. The demand for previous experiences is highest in the beginning of a project and most experiences are created during the construction phase. The further into the project you get, the less important are previous experiences since it gets harder to influence the outcome. When estimating

time and cost for budgets it is useful to get information from colleagues and use experiences from other projects. For the building technological experiences Project Manager H explained how when he has been working with large projects, the project group has visited a similar project to collect knowledge and experiences beforehand.

4.2.3 Documentation of knowledge, internal database and intranet

CM AB has a database where all the files on each project are kept. There is also an intranet where the employees' CVs are collected and people can post news. In the database protocols from experience-sharing meetings and other types of KM documents could be uploaded. The intranet, on the other hand, is more of a short-term knowledge-sharing platform. Information about on-going projects that colleagues are involved in could be shared as well as a presentation of a colleague. It is a good tool to use to share information across the offices and increase the employees' affiliation to the company. The employees solely search for colleagues' CVs when submitting tenders and not to find colleagues possessing a particular knowledge.

None of the project managers consciously document experiences with the purpose of sharing it with their colleagues. Some of them mentioned that they make some notes for themselves when they face something that could be valuable in the future; most often this is related to building technology. Project Manager E gave examples of a private miscellaneous binder where such knowledge and experiences are collected. Another project manager described that experiences have been documented from experience-sharing meetings, but then the documents got stuck on the computer for no one else to read. The project manager continued by asking questions such as 'how do you select the right information? People do not know how to handle the information', implying that there is a lot of confusion connected to this topic. When people do not see the purpose of documenting experiences it is not prioritised. One of the project managers mentioned that the employee turnover is increasing and therefore it is even more important to document knowledge. Further on most of the managers agree on that documentation is the only way to ensure that there is access to previous experiences. The employees have to change their attitudes into a greater willingness of documenting and sharing knowledge. It is important to document both positive and negative experiences. One project manager expresses that the most important part of KM is that mistakes are brought up to reduce the risk for them to reappear.

It would be good for the project managers to take a moment and write down what went well and what went bad after finishing a project before rushing in to the next one according to Project Manager A. As previously mentioned lack of time is considered a bottleneck in the KM chain and that also applies to documenting valuable lessons. When gathering knowledge and experiences the project managers read on internal- and external databases and read books, but most often talk to colleagues. Project Manager B pointed out that there are not many documents about experiences to look for in the database and therefore it is not considered as an alternative. Each project is unique, which contributes to the complexity with experience sharing in the construction industry. Issues in one project can be completely different in another project. Thus it is important that the experiences that are documented are structured and up to date. Project Manager B suggests that it should be

possible to use keywords to search for special knowledge, such as window replacement, and who has been working with that. Together with the fact that the consultants work individually it is hard to find other people's experiences documented. There is knowledge that can be useful for other projects, despite the uniqueness of construction projects. Some examples of such knowledge are templates for protocols and decision lists. Project Manager C described how each client has its own process and systems. Therefore it is sometimes possible to use texts and documents from projects with the same client.

4.2.4 Formal knowledge sharing

CM West AB has formal meetings such as weekly breakfast meetings on Fridays, monthly market area meetings and business unit meetings. At the breakfast meetings everyone working at the office in Gothenburg participate as long as they do not have to be somewhere else, but usually most of the employees join. The subjects of discussion are on-going projects, requests for future projects and other questions. Some experience sharing is integrated in these meetings when discussing questions, but above all the employees are informed about what types of projects their colleagues are involved in. This is a great contribution to the knowledge sharing process, since it helps the employees know who to contact when facing an issue. Project Manager C emphasised that the formal meetings tend to be inefficient and people arrange meetings just to have a meeting. It is important that the formal meetings are short, efficient and have a clear purpose. Project Manager B has suggested that experience sharing could be integrated in a more structured way in the breakfast meetings. There are always two employees arranging the breakfast and they can bring up two or three good and bad experiences that they are facing in their projects at the moment. However, it has not been implemented since no one has taken the initiative to arrange it.

Another part of the formal knowledge sharing is that the newly employed project managers get a personal mentor. That person introduces the practical routines, such as time reporting and where the coffee machine is. The mentors are usually very busy though, which means that they are not as present as new the employees usually wish. In addition to getting a mentor, the new employees take a short introductory course about the company and how they work, including i.e. staff, economy and working environment. Project Manager A expresses a will to have a short guidance- or mentorship meeting once a month in the beginning of the employment. The project managers that had only been employed at CM AB for a short period of time described how they used the internal database to find checklists, tips and protocols from meetings. The documents helped the project managers to get a clear understanding of their responsibilities and some guidance on their new role. Their focus was more on knowledge gathering rather than sharing.

Experience sharing is also a question about cost. If the company have an internal experience-sharing meeting with about 20 project managers for half a day it would cost quite a lot. On the other hand, all the repetitive mistakes caused because of a lack of knowledge sharing are also costly. Project Manager D explains that if they make mistakes, it is the client that has to pay for it. Therefore the incentive for the project managers to become better at experience sharing is not high enough. Project Manager A expresses an interest in hopefully a cheaper concept where the

consultants involved in the same project phase have regular meetings. The smaller groups could contribute to the managers operating in a more equivalent manner and be a good forum to share experiences. If a consultant gets sick or has to be out of office for a longer time period, such a group could facilitate for a colleague to be able to move on with the project.

4.2.5 Informal knowledge sharing and culture

All the interviewees agree on that informal knowledge sharing is equally or more important than the formal knowledge sharing. The informal knowledge sharing happening every day by the coffee machine and in the corridors is the most widely used forum for sharing experiences. Project Manager C expressed a lack of senior consultants experience since they are usually overloaded with work. Some experience cannot be read about, it has to be explained by the more experienced consultants. The lack of support from senior consultants result in that the less experienced consultants do not feel comfortable in taking on challenges and in that way develop.

The project managers expressed how the informal knowledge sharing is a great way to discuss ideas and issues coming up within the projects. This experience sharing tends to be more about problem solving rather than actively preventing problems from occurring though. That is closely related to the fact that consultants tend to be satisfied with their current material as long as it works well. It is not until they face trouble that they will look for better material at their colleagues. Several observations were made by the coffee machine, where project related questions were discussed between colleagues that were not involved in the same projects. Project Manager B pointed out the importance of not making any decisions that involve others in informal settings since that could lead to misunderstandings and people missing out on important information. CM West AB has an open office space that invites the project managers to interact and share thoughts and experiences. If the subject or issue being discussed is of interest to anyone else at the office they can easily connect to the conversation. Many informal conversations where open questions on problems and how to solve them were brought up at the open office space were observed. Project Manager D mentioned that if the discussion is about something that is not directly relevant to him/her it could be hard to absorb the information.

In addition to spending time at CM West AB's office, the project managers work out of office and spend time at the projects their involved in. How much time is spent at the office differs depending on in which stage the project is. When it is the most intense, the project managers only have time to go to the office about two days a month, whereas during calmer periods they are at the office everyday. How much time is spent at the main office is of great importance for the informal knowledge sharing in the organisation. The project managers mentioned that people are more willing to share their thoughts when they know and trust each other. Thus it is important to create good and trustful relationship to encourage experience sharing. Project Manager E expresses how he loves sharing knowledge and experiences in informal settings and he double checks all the documents he sends to clients beforehand with colleagues. In addition, a great interest is expressed in looking at colleagues' protocols and documents to get a better understanding of their projects. The project managers do not have a problem with asking colleagues when problems arise, but they

feel that it is important to not interrupt each other as well. Therefore the questions have to be well thought through. All of them feel that they have a clear picture on what experience and competence everyone possesses. Most of the managers have the opinion that their knowledge and experiences are taken advantage of since they are often asked questions from their colleagues. One of the project managers describes the organisational culture as flat and prestige less.

In general the industry has a positive attitude towards knowledge- and experience sharing, but it is not prioritised. Project Manager B explains that there is some scepticism surrounding experience sharing. That is because it is time consuming and it is an unclear area of interest. Apart from that people seem to be very eager to share their knowledge and experiences. When asked if they believe that an efficient KM system could generate profit the joint answer was yes as it would result in a higher quality and efficiency. People with the mind-set that knowledge is power which can cause an obstacle towards knowledge sharing, are not that common in the industry. In general it does not seem to be a difference between junior and senior consultants attitude towards knowledge sharing either. Some project managers indicate that the junior consultants might have a greater interest in learning and thus have a greater interest in sharing knowledge and experiences. The impression is that the attitude is more related to the personality and the interest of KM varies between individuals.

When the project managers were asked about how they use experiences from other projects in their current projects, all of them gave an example referring to their own previous projects. It was obvious that they continuously collect experiences and learn new things in their projects to improve and develop as project managers. When they were asked about using experiences from their colleagues' projects, it was harder to answer and they highlighted that their role as project manager consultants is very individual. It is rare that they work in teams even though CM AB's intention is to make the employees work in teams. An explanation to that might be that at this moment they are too few employees at CM West AB. Project Manager F was the only project manager touching upon the subject of working in teams. The Manager was involved in similar projects as a colleague, which resulted in that they kept a very close contact with each other. The colleague was very fond of telling Project Manager F if something rare or complex came up. This way Project Manager F had a good idea of what could be ahead in the project.

4.3 Clients role in knowledge management

All project managers and organisational managers state that a consultant need to apply to the requests and demands from the client. The majority of these managers claimed that clients work in various ways, which craves extra effort from the project managers to adapt accordingly. They may, for example, have different organisational layouts, systems or processes. Organisational Manager B states that from a KM perspective, clients may be demanding at different levels. One client may have an experience-sharing meeting as a demand themselves, while others may not. It is claimed by the majority of the project managers that if a client demands KM work, it will ease the work for the consulting project manager as the client will ensure that the experience-sharing meeting is held, and is prioritised. Organisational Manager D elaborates, claiming that some clients may invite the

project team to study visits early on in the project to ensure that the best prerequisites are given, and that knowledge from earlier project are brought into the next one. The majority of the project managers and the organisational managers state that there is generally a great interest of working with KM from the clients, and more specifically conducting an experience-sharing meeting. When talking about it there is often an expressed interest, but when it comes to action it is sometimes not prioritised which leads to a suffering result. Sometimes the meeting may not even be held. Thus, the interest that the client possesses about KM may affect the work. Organisational Manager B states that as the client is the one paying for the meeting they are in charge of its layout, however, CM AB are willing to pay for it to have it done, if it is done internally.

More than half of the project managers argued that in those cases a client keep the same project group for similar projects there may be a significant positive development of the work. Several examples were proposed of a project A that had setbacks, which were later on avoided when the same project team executed a similar project B. Project Manager D stated:

'When we were the same people from one project in another one, we already knew how we should structure our meetings, and succeeded to find a good level right away. We also already had a great client relation and the client had a good relationship with the contractors. We succeeded to share our tasks and responsibilities, and the lines between our works were not so distinct. The good relationship helped the project work a lot.'

In addition to that, Project Manager D argues that the client mandate on the KM work is yet larger in those cases the client procures the whole project team. This procurement can lead to project members, which are more or less fond of the KM work. The project manager proceeds arguing that the larger contractors are example of members that may have larger knowledge ambitions and possibilities. Project Manager E proposes similar ideas joint with the value of the client knowledge. Some clients may possess very little knowledge compared with others, as the spectra of clients for a consulting project manager may be everything from small housing cooperatives, to municipalities or larger real estate companies. When working with KM on a project owned by a client with little knowledge on how to work with it, the effort required from the project managers becomes larger. Thus, Project Manager E states that the experience from knowledge work that a client possesses plays a part in the knowledge outcome of projects. Moreover, two thirds of the project managers argue that some clients tend to provide the consultants with various documents that may rather hinder the project development rather than to aid it. One example of this is when clients think that they will provide the project team with useful information from earlier projects, but the information does many times lack useful information or do consist of that but is surrounded by much more information that is not relevant. If the client has done little work on screening useful knowledge it may sometimes fall onto the project manager role. This means that in those cases clients with little effort or knowledge wants to work with KM it may instead lead to a setback for the project as a whole. Project Manager B argue that other types of information given from the client may also differ, which for example is supportive information in the beginning of the project or the distinctness of the expectations. Some client may estimate that a project takes X hours but the

consultant estimates Y hours. The manager elaborated that as time often is an imperative factor, other work than what is completely necessary may not be prioritised. As the client has the last word, and often has an expectation of how long time a project will take, it may lead to skipping various actions such as the KM work. Thus, the administrative knowledge from the client side is important.

5 Analysis and discussion

The following chapter contains the analysis where the literature is used to scrutinize the empirical material. The structure follows the research questions presented in chapter 1. Accordingly, first how knowledge management is structured today. Secondly, what challenges and opportunities there are with the current knowledge management system. This is followed by an evaluation of tools that can improve the knowledge management work. Finally, tools that should be prioritised and implemented are presented.

5.1 How knowledge management is structured today

As knowledge intensive firms depend on the competence of the professionals, KM is of great importance to consulting firms such as CM AB. The common understanding at CM West is that KM is important but nobody knows how to effectively work with it. This chapter analyses the current situation with respect to the management system, current database and intranet, formal knowledge sharing and informal knowledge sharing.

Organisational management and the management system

Previous research suggests that project practices can be viewed as loosely coupled systems with a lack of strong ties and common identities compared to other businesses. CM AB has developed a management system to ensure that the project managers work consistently. The aim is to make the project managers work in teams, but most often they work individually. Thus, the management system has an important role as it ensure that the company's services are more uniform. KM is chapter nine out of ten in the management system, solely containing directives on AAR-meetings and a template for those.

The literature claims that the motive for applying KM should be that it enables firms to allure, educate and keep employees as well as procuring a steeper learning curve for the business oriented competencies. The organisational management at CM West agrees with this motive but it is not clearly communicated to the project managers. They seem confused about the purpose and have experienced that the KM cycle tend to be incomplete in practice. The literature explains that the project manager role includes skills such as leadership, collaboration, result orientation and basic technical skills. The *Engineering School* suggests that business processes can be improved by giving managers the best practice knowledge. Therefore the KM should focus on the process-oriented knowledge. The organisational management describe these skills when asked about what type of knowledge is important to share at CM AB. The project managers, on the other hand, are more focused on the technical skills when discussing KM. According to the literature, the project managers only need basic technical skills because the specialists should possess the specific technical knowledge. Thus, there is a gap between the organisational managers and the project managers' perception of what type of knowledge should be focused on.

The literature proposes that AAR-meetings should be conducted in connection to the project. The KM procedures in the management system include the only directive to have an AAR-meeting when a project is finished. In this regard CM AB's directives might result in that the AAR-meetings does not occur in connection to the project, as it should according to the literature. However the AAR-meeting is only conducted if the budget for the project management task is over a specific set sum, which may lead to a loss of lessons learned. It is imperative that all team members attend, which is something that is not mandatory at CM West as the main focus lays on the client and its satisfaction. Another common understanding among the project managers is that KM solely is an AAR-meeting, since that is the only concrete directive connected to KM at CM AB.

Documentation, internal database and intranet

Previous research proposes that project managers write KM documents without the purpose of learning and that other people will read it. As the consultants work individually they tend to use their own knowledge exclusively. Many of the project managers confirm this as they describe how they make notes for themselves to develop in their role. On their own computers they have folders with documents from previous projects that are useful in on-going projects and could be useful in future projects. There are currently only a few documents uploaded on the internal database, such as protocols of AAR-meetings. Some of that knowledge is more written for the project group rather than for other project managers. The project managers generally have a positive attitude towards using the database to find knowledge, but since there are currently a limited amount of documents there, it is problematic.

In the *Cartographic School* the IT-system is a tool that can be used to find the people possessing the demanded knowledge. CM AB has all the project managers' CV available to all the project managers on the intranet. As they are selling their competence, the CV is a proof on what competence each manager has and a foundation for all the businesses. The CV are therefore more used when doing business rather than to find a specific knowledge internally. According to previous research the intranet is seldom used as a source of knowledge due to the difficulty of codifying knowledge. This is accurate at CM West as they rarely use the intranet to share knowledge.

Formal knowledge sharing

The behavioural schools described in the seven schools of KM emphasise that personal interactions are important to share knowledge. To facilitate the interactions the company has to create processes, spaces and mechanisms. CM West has breakfast meetings, which could be viewed as a mechanism, on Fridays that facilitate knowledge sharing. The project managers are encouraged to join the meeting every Friday unless they have something important they have to attend. During the meeting there is usually no time intended for knowledge sharing exclusively, but the colleagues get an understanding of what projects everyone is involved in. Thus they get a good idea of who has competence within what area and the organisational managers can identify if there is a lack of knowledge. Hence these meetings could be a good foundation for creating a skill or competence matrix.

The *Organisational School* believes in creating networks or communities where people who have common interests can share their knowledge and experience. At CM AB the project managers are divided into different business areas that continuously have meetings. These could be viewed as communities where some knowledge is shared. The value of these communities depends on the participating people and the trust they have to each other. In addition the new employees take an introductory course and get a mentor during their first time at the company. That is a short-term way in which more senior project managers can share their experience with junior project managers.

Informal knowledge sharing and culture

The *Spatial School* focuses on both physical and virtual spaces where knowledge can be shared. As CM AB currently lacks virtual spaces for knowledge sharing, the physical spaces are to be considered. The physical spaces are at the office and therefore a foundation for this type of knowledge sharing to function is that the project managers are at the office regularly. Depending on in what phases the project managers' projects are, they will spend time at the office accordingly. At the moment many of the employees are new and therefore they do not have full occupancy. Thus they can spend more time at the office, which facilitate the informal knowledge sharing. For informal knowledge sharing an example of a physical space is the kitchen where many of the project managers share knowledge over a coffee. CM West has an open office space that also facilitates informal knowledge sharing. The project managers described that the informal knowledge sharing usually consists of problem solving, implying that it is focused on tacit knowledge. Thus, the informal knowledge sharing normally arises from problems that have already occurred, instead of preventing future issues. Since the informal knowledge sharing is not documented in any way it will stay among the people participating in the conversation. For the knowledge to be shared, the people have to further share it with other colleagues or document it. The project managers that cannot directly apply the shared knowledge have trouble with taking in the information. In order for the tacit knowledge sharing to function the employees need to trust each other and have good relationship. The project managers described that they have a culture where people trust each other and are willing to share knowledge.

It is important that the explicit knowledge is shared as well, but it is not as common. The explicit knowledge is usually shared over mail rather than through informal conversations. As the project managers mentioned, they will not be looking for a new template or checklist before the shortcomings appear in their own once. Thus the sharing of explicit knowledge also occur when there is an issue with the current document and not preventively.

5.2 Challenges and opportunities with the current knowledge management system

This chapter analyses the challenges and possibilities with each with the current knowledge management system. Firstly, the project managers' prerequisites and the clients' impact will be analysed, followed by the organisational management and the management system. Thenceforth the documentation of knowledge, internal database and intranet is scrutinised, followed by formal knowledge sharing. Lastly, informal knowledge sharing and culture is analysed.

The project managers' prerequisites and the clients' impact

Previous research indicates that project workers in the construction industry often believe that their learning in a project is unique and therefore not relevant to the rest of the organisation. They have trouble seeing connections between projects that many times are of a very similar nature. This seems to be the case at CM West as well since the project managers mention how KM is difficult in the construction industry because every project is unique. The literature states that every project will face unique circumstances but there are many similar aspects as well. It is identified as a challenge to make the project managers see the connections between different projects. On the other hand, the project managers have experience from working with KM at previous employers, which facilitate the KM work at CM West and could be viewed as an opportunity.

The literature emphasise that the conditions as a consultant may differ depending on the contract. Project members can be solely focused on their own task if there is a lack of common goals. Some contracts, such as partnering that are becoming more common, may increase the incentive to collaborate. The project managers agree with the fact that the more traditional contracts, such as design-build and design-bid-build have inhibited KM. Thus as contracts like partnering are becoming more popular the KM work might improve accordingly, which is a great opportunity.

Previous research shows that knowledge intensive firms generally suffer from difficulties, as they are involved in projects that are custom-built according to the clients' demands. The organisational managers at CM West emphasise that they are very dependent on the requirements from the clients and they most often decide if there will be KM or not. The clients are usually interested in KM, but the knowledge and budgets differ. The literature emphasise that there is generally little time to execute projects, which leads to abstaining KM. Project workers do not learn as much as they potentially could due to limited time for reflection and a lack of learning systems. Therefore it is suggested that the time frames are expanded and there should be a clear expectation on the project team to reflect on their actions and results. The project managers at CM West agree with this as they point out that if the client sets a short time frame for a project, they may have to avoid actions that are not completely essential. Therefore the client can be viewed as either an opportunity or a challenge in the aspect of KM.

Organisational management and the management system

The literature describes PBOs as loosely coupled systems that may lack strong ties and common identities. The managements system at CM West is an attempt at reducing the gap between the organisation and its projects. It is obvious that the management system is created for the company structure at the main office where there are significantly more employees and the projects are larger. Thus one challenge may be that the management system is not formulated for CM West that has a smaller business.

Previous research describes that in knowledge intensive firms the knowledge flow has to be properly managed and especially in construction projects the management of knowledge is important. Managing knowledge has been shown to leverage collaborations, disperse groups from reinventing the wheel, capture difficult-to-get knowledge and discipline groups who have been unable to share knowledge. The organisational managers at CM West have a positive attitude towards KM despite that it is costly. They believe that a well-functioning KM could generate profitability by reducing the amount of repetitive mistakes and increasing the quality of their services. The literature shows that there is little application of KM in the construction industry due to lack of interest and non-existing and unclear work. There are limited instructions and standards on how to work with KM. Further there is a lack of organisational procedures in SMEs within the construction industry. Many of the project managers at CM West do not view KM as a requirement and thus believe that if they are going to work with it, it has to be a clear directive and it has to viewed as an obvious part of the project process. In addition to that the KM has to be systematically followed up. At this moment there are no consequences if KM is not practiced and the work is only followed up according to the ISO-certification system at times. This provides no real incentive for the project managers to make an effort and engage in KM work. The organisation as a whole does not have any concrete goals connected to KM, apart from that the AAR-meetings are conducted. It may be hard to formulate concrete KM goals but it would be easier to evaluate whether the company is improving with some sort of goal. Thus, there are many challenges connected to KM at CM West, such as making KM a clear directive and an obvious part of the project process, and setting a goal for KM.

To share information with partners and clients, to get feedback or to hire new staff are examples on how to capture knowledge, which is one of the knowledge processes mentioned in the literature. Maintaining project documentation and conducting project-learning reviews are usually part of the project-management methodologies. The SECI-model calls transferring explicit knowledge to tacit knowledge from the organisation to the individuals, internalisation. The management system concludes explicit knowledge that make an impact on the tacit knowledge that the project managers use. KM is chapter nine out of ten in CM AB's management system that is formulated as a timeline. Thus, KM is supposed to enter the project close to the end of the project according to the management system. KM in the management system is only about conducting AAR-meetings that

have to be performed if the project is greater than a set sum. The meeting has to be conducted with the client and it is free of choice to let other actors join, which can result in that a lot of knowledge is not captured according to previous research. By simply adding some more people to the AAR-meeting apart from the client, more valuable knowledge could be captured. It is challenging for the project managers to arrange meetings with the whole project group close to the end of the projects, as people tend to move fast between projects. Lack of time is normally the reason to why the AAR-meetings are not conducted. The literature also brings up that it can be challenging to create the right climate when conducting an AAR-meeting and because of a mutual memory loss at the end the project, a lot of knowledge is lost. The project members should be free to speak and they should not be treated after their personal performance. The organisational managers at CM West have the same understanding, as project members want to be on good terms and thus do not want to bring up any negative experiences once the project is finished.

Further the literature states that after each milestone the project group should evaluate the real outcome in comparison to the expected outcome. The AAR tend to be more focused on what has been achieved, rather than how this has been achieved and why it either did or did not work. Some examples of lessons learned that has been shown to be useful across projects are whether the project group was too small or too big, whether the frequency of meetings was adequate and whether the division of tasks was effective. All these examples are focused on learning about the process, which is usually more difficult to capture. Thus it is important that the questions in the template for AAR-meetings are restructured accordingly so that the result is useful across projects and that AAR-meetings are arranged regularly throughout the project. That would also contribute to more positive and negative experiences being captured from the projects. Changing the template to produce more valuable knowledge and arranging AAR-meetings continuously throughout the project process are viewed as challenges for CM West.

According to previous research, some examples of knowledge that is important to share are knowledge of managing and executing projects, knowledge of the client and the history of a project. The latter may increase the possibility of acquiring jobs for a client. The literature also proposes that the project manager should have skills such as planning, decision-making, basic technical skills, innovative, resilience, agility, interactive, mentor, team player, conflict management, ability to see the holistic picture, customer orientation and look at change/improve processes. The organisational managers seem to be on the clear with what type of knowledge is important to share across projects. They believe that the important knowledge to share is about planning, coordinating, monitor, financial management, distribution of roles, identify educational needs, identify whether a project managers needs assistance and knowledge about laws for contracts. This is very similar to what the literature suggests. The focus on building technological factors is very small both according to the literature and the organisational managers. The project managers on the other hand seem to be confused about what type of knowledge that should be shared. When discussing KM the

focus is almost solely on building technological skills. Thus, another challenge at CM West is to ensure that all the employees have the same understanding of what type of knowledge that should be shared.

The u-curve suggests the relation between the cost of transferring knowledge and its codification. The extremely tacit knowledge, presented as A in Figure 7, is the skills that both previous research and the organisational managers state that project managers should possess. Such are leadership, planning and collaboration skills. Moreover, the explicit knowledge, presented as B Figure 7, is the templates and checklists previously mentioned. In contrast, the project managers themselves are more focused on point two and three in the degree of tacitness-scale, presented as C in Figure 7; tacit skills that can be imperfectly articulated and tacit skills that could be articulated. These points could for instance include building technological knowledge. The knowledge located in area A in Figure 7 is claimed to be the most difficult to transfer, but is at the same time claimed to be valuable both by literature and the management. Hence, the use of knowledge management tools are specifically important, to contribute to a possibility to transfer the knowledge that is striven towards. The knowledge located in area B in Figure 7 is on the other hand knowledge easy to transfer but may not be of great value. However, the management expresses that this type of knowledge is what they want to focus on. Thus, tools that help to save, find and distribute this knowledge is important. Moreover, the difference between the project managers and the organisational management is obvious. Therefore, the directives of what knowledge should be strived towards are important to make sure that the chosen tools are applied as they are thought to be.

One example of unclearness is that the templates for experience-sharing meetings, AAR-meetings, provided in the management system are more focused on questions connected to point one and four on the degree of tacitness-scale. The problem is that the questions are closed questions where the answers could only be yes or no, or good or bad. Consequently the protocol is more of an evaluation and has no value for the rest of the organisation. As the knowledge located in area A is difficult to handle, correct usage and application of the chosen tool is arguably imperative. To extract knowledge from an evaluation of extremely tacit knowledge may be either misinterpreted or not possible to understand. Therefore, once again, it is a challenge for the organisational management to rephrase the questions to ensure that they result in more rewarding AAR-meetings and protocols.

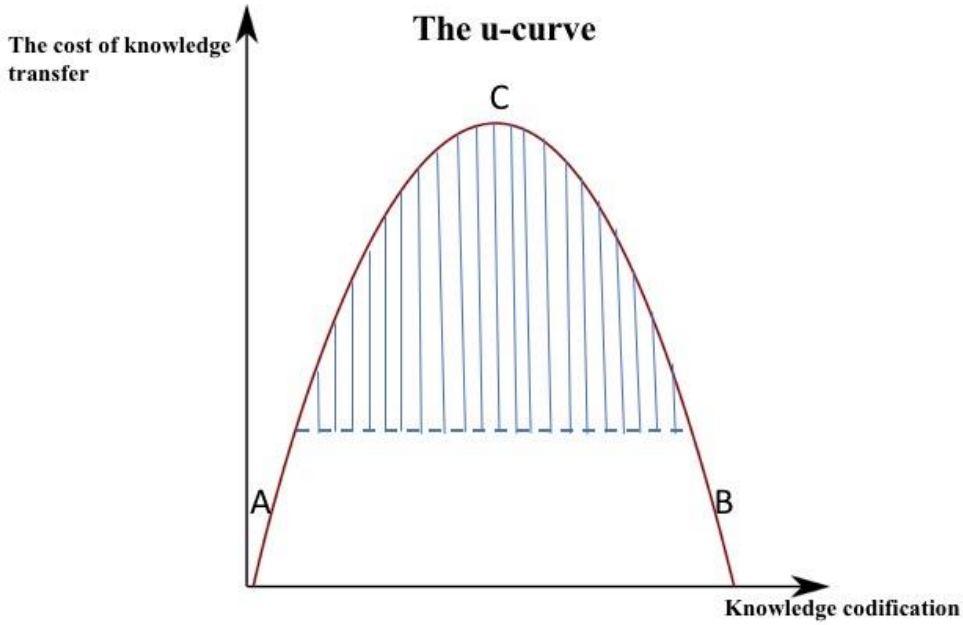

Figure 7: Localisation of various types of knowledge on the u-curve.

The literature proposes that managing knowledge is especially difficult to implement in SMEs, but the improvements that KM might bring is most favourable for SMEs. There are several occasions, which are especially important to pay regard to during the implementation process. Thus KM is not only about formulating a protocol for AAR-meetings; there are many other factors that have to be considered as well. One of the challenges for CM AB is to develop their management system and formulate a strategy with their KM work, reviewing all the occasions brought up in the literature. The organisational management needs to invest more time and money in KM.

Documentation of knowledge, internal database and intranet

Previous research states that the industry generally has a great storage of data, but it lacks valuable content requiring much time to retrieve. That is the opposite of what the project managers describe is the case at CM West. They have very limited documentation on the internal database. The literature further shows that knowledge is more frequently held within each workers mind in SMEs, as they do not know what to store, where to store it and how to store it. This is the case at CM West as all the project managers make notes for themselves, both on their computer and on papers. Consequently there is a great amount of data spread out in the organisation, but it is not collected on the internal database. The project managers have to start documenting lessons learned for others to take part of, not just for themselves. The documentation should be about both mistakes and successful experiences as they are equally important. It is a challenge to make the co-workers change their way of working and collect more data on the internal database, rather than in their personal stocking.

The knowledge market tool enables contact between those who are searching for knowledge and those who possess it. It is important for PBOs to strive to make every employee's knowledge and experiences visible to the rest of the organisation so that everyone knows who to ask for a particular knowledge. The intranet at CM West could be viewed as a knowledge market. The employees can ask questions to the rest of the organisation and they can find people possessing a particular knowledge by looking for CVs. The literature shows that the intranet is seldom used as a source of knowledge due to the difficulty of codifying knowledge. Also at CM West the intranet is normally not used for sharing knowledge. It is challenging for the company to make the project managers use the intranet for knowledge sharing to a greater extent. In addition, the project managers do not use the possibility to find people possessing a particular knowledge through searching for CVs. They believe that they know who knows what at CM West, but to take part of the knowledge in the whole organisation, CM AB, the CV-function could be a great tool. It is identified as an opportunity that everyone's CV is available and the function could be developed to an important knowledge market tool.

Formal knowledge sharing

The literature describes combination, which is a part of the SECI-model, as the transfer of explicit knowledge between the project groups and the organisation. This could be achieved by exchanging documents, drawings, systematically join each other's meetings or communication networks among other things. One way of achieving this could be to have competence groups or networks that meet for updates and discuss a particular knowledge area. CM West has breakfast meetings on Fridays where they discuss their on-going and upcoming projects. The project managers believe that KM could be integrated in a more structured way in those meetings though. Some project managers could for instance present a few positive and negative experiences in their on-going projects. The project managers also express a will in having regular meetings with colleagues that are working with the same type of projects. Both to be able to cover up for each other if someone has to be out of office and to improve the KM work. This could be compared to the competence groups mentioned in the literature. Thus the Friday meetings are a great opportunity where more KM could be implemented.

Tacit knowledge has been found to be very hard to transfer, as it is hard to verbalise. One way to transfer tacit knowledge that the literature describes is by letting new employees take part of their mentors work by practicing and observing. At CM West the new employees get a mentor that shows practical stuff, such as how to debit working hours, where to find the coffee machine and where to get a key to the office. In addition to that they get an introductory course that provides more information about the company and the working processes. As the mentoring concept exists and it could be expanded it is an opportunity. On the other hand, in order to transfer more project-related tacit knowledge it would be preferable to have a mentor within some of the projects as well. In order to have mentors in projects they would have to work in teams of one more senior

consultant and one junior consultant. The company's aim is to work in teams of at least two project managers, but that is more of a one-time event at CM West since the projects are not large enough and there are not enough employees for it to be profitable. The literature states that the senior consultants individually possess the most important organisational knowledge. Some of the project managers expresses that there is a lack of senior consultants at CM West. Thus, working in teams and having a mentor in the project group is a challenge for CM West, as well as the lack of senior consultants.

Informal knowledge sharing and culture

The collaboration that is necessary to achieve a successful construction project creates an efficient environment for innovation through idea- and knowledge sharing. On the other hand it could be hard to collect knowledge and transfer it to other project groups considering they are working with other project practices. The literature proposes that consulting companies should work with softer approaches, such as informal discussions. Due to various geographical placements of the projects it is difficult to discuss and share knowledge in the organisation. Previous research proposes that to share tacit knowledge, the organisation has to be characterised by strong ties. Co-workers have to imitate and observe how their colleagues act to share tacit knowledge between individuals, also referred to socialisation in the SECI-model. Sharing experiences is described as the key of this movement and the key to create value in a knowledge-intensive firm. At CM West the project managers are expected to be at the office on Fridays, but the organisational management still has an understanding of that the project managers have to prioritise being at their projects sometimes. How much time the project managers spend at the office varies depending on how intense the projects they are working with at the moment are. The geographical distances that naturally exist in the construction industry are a challenge, but as the project managers are encouraged to be at the office the opportunity for informal knowledge sharing increases. There are informal discussions constantly going on at CM West, by the coffee machine and in the open office space. The project managers at CM West expresses that it could be hard to absorb knowledge that is not directly relevant to what they are working with at the moment.

The *Strategic School* believes that if the employees have a positive approach towards KM and understand the importance of it, they will voluntarily choose to participate in the KM processes. Previous research shows that culture is the most important parameter to create good conditions for knowledge sharing. As the individuals get to know each other better, they know who possess what knowledge and are more willing to share and take part of experiences. An important way of sharing and creating knowledge is to ask questions and jointly solve problems. There must be a cultural change within the organisation towards one where knowledge sharing is obvious. The organisational managers emphasise the importance of good relationships and without the strong ties their work will not be good enough. According to the project managers the industry is somewhat sceptical towards KM, but everyone wants to share their knowledge no matter if they are junior or

senior. At CM West there is a good culture where people are willing to share knowledge and ask questions. As people are busy they feel it is important to not interrupt if the question is not that important.

The organisational managers at CM West claim that informal meetings are often more important than the formal meetings. They have experienced that the informal meetings are often about information about the project rather than what has gone well or bad. The project managers also believe that informal knowledge sharing is important for problem solving. Thus the informal knowledge sharing solves problems once they have occurred rather than prohibits problems from arising in the future. One of the challenges with sharing knowledge across projects that has been shown in previous research is that individuals are not aware of that knowledge transfer is needed until they face a problem. They will only seek out knowledge once they have recognised a problem and know they are in need of new knowledge. The project managers claim the same as they express that they do not search for something better unless they are unsatisfied with what they got. Thus, it is a challenge to change the informal discussions towards being more focused on knowledge sharing connected to the project processes. On the other hand, the culture could be viewed as an opportunity that can facilitate the knowledge sharing at CM West.

5.3 Evaluation of tools that can improve the knowledge management work

This chapter analyses the previously presented tools within KM, and evaluates how they may improve the KM work at CM AB. The *Lawson cycle* is used to evaluate which KM processes that are lacking, and hence which tools that can improve the KM work.

As per literature, projects that involve training of managing knowledge assets should be conducted by SMEs, as it is something that is nowadays lacking. Thus, arguing for the knowledge of which tools that are applicable to achieve the objectives. This is not met in the empirical findings, as the experience-sharing meeting, an AAR-meeting, is the only tool presented. As there is only one tool that is specifically used for the purpose of KM one can argue that the training of managing knowledge assets is not conducted. Moreover, as previous research proposes, the practitioner must apply the correct tool for the organisational purpose. Thus, there must not be a set rigid KM structure, which is solely applied to, as there are many different paths to choose. This is however not done in practice, as the AAR-meeting much related to the *knowledge dissemination* is the only directive that is set and executed in relation to KM. One can argue that various tools may have different focuses on specific knowledge processes, together with easier applications for a specific type of knowledge such as tacit or explicit. Therefore, organisations such as CM AB, and its sub organisation CM West, should create various directives that can be applied depending on different occasions. Furthermore, as the management have expressed a strive towards knowledge at level 1

and 4 in the degree of tacitness scale, namely *deeply integrated tacit skills* and *explicit skills*, it should be apparent that different tools should be applied to handle the two different knowledge types. Yet another motive for this is how CM West expresses some difficulties to apply to the directives of CM AB. If more tools are available within the directive, the adaptation of CM West may arguably be easier as more alternatives that may fit their prerequisites may appear.

As per the presented SECI-model, socialisation is the action of individual to individual, which converts tacit knowledge to explicit knowledge. This may appear in many types of informal settings, which is well met in practice. Due to an expressed social culture with many discussions by the coffee machine and such, problems are solved while talking to each other. Considering this culture, as per previous research, the possibility to convert tacit knowledge is simplified comparing to two individuals doing the same with no or little relation. The externalisation should deliver explicit knowledge transferred from tacit, which can be looked upon as the formal communication conducted during the Friday meetings where employees may talk about their projects. This is well meeting the previous research. As for combination, the explicit knowledge should be delivered as explicit knowledge at the deliverer, done from group to organisation. For example either CM West delivering knowledge into CM ABs knowledge bank, theme or competence groups delivering knowledge to CM West or CM AB, or project groups delivering knowledge to CM West or CM AB. As the teamwork not is a great possibility at CM West, it is difficult to achieve the latter. Thus, CM AB may look over opportunities for CM West to still deliver explicit knowledge to CM AB. Other than that, CM West has forums to fulfil the combination when using and exploiting the theme or competence groups. Lastly, the SECI-model presents internalisation, which converts explicit to tacit knowledge from organisation to individual. This can be looked upon as the management system, which delivers directives toward the individuals, which will turn the directives into tacit knowledge once practising them. Once more, clearer directives are called upon and the diffuseness of the internalisation is yet one more motive for this. Hence, for optimum result taxonomy is arguably to prefer if working with meeting templates, but a knowledge café is favourable for leadership skills. If leadership skills are to be presented in templates on how to perform and act, there may be a risk for higher entropy, which is to avoid. In other words, tacit knowledge may need one type of tool and explicit another. Moreover, it is stated that it is not a benefit to define a complete detailed strategy for KM before proceeding with the implementation of some KM steps. The potential areas for development are best identified at lower levels of the organisation, but should be coordinated between all of the offices. Thus, CM West is to provide input for the strategy to be used by CM AB. This input has been shown to be 1. To handle extremely tacit knowledge in form of leadership skills and 2. Explicit knowledge in form of planning tools and templates. To be able to execute what CM West proposes, literature once more proposes that it is important to develop different tools to fit the purposes. Furthermore, as there is an expressed will to have clear directives applying to the KM work, these tools which may vary depending on the type of knowledge, should have attached explanations on what to apply and how, making sure that the tools are used as requested.

As the literature express, technology, culture and structure are to be focused on, and as presented culture is well set in the organisation. Thus the focus on technology and structure could create more opportunities from KM tools to the organisation. Nevertheless, culture is yet an important pillar in the KM work, and should not be avoided. Especially as knowledge intensive firms in the industry encounter various types of knowledge that needs to be communicated between different parties. Extra input and focus on the two latter should however be, as previous research states that all three are important, looked upon. As there is an expressed will to have more distinct directives from the organisation it can yet stronger be argued that structure is vital to focus on in practice. The technology creates the basis of which many of the existing tools rely on, such as an intranet for the CV-function or a database, which follows certain taxonomy, and should also not be forgotten.

The *knowledge creation process* must consistently be conducted and create new knowledge to be applied by the organisation. This is stated to sometimes be a complex act having the SECI-model in mind, as externalisation for example may be difficult to conduct in the construction industry. Case studies have shown that this is a difficult stage, but CM West did however not see this stage as a hinder. As they are a knowledge intensive firm and are, as project managers, used to cooperate with various specialist the SECI-models difficulties could be argued to be not as difficult as the literature proposes.

The *knowledge capture process* is to develop and replace knowledge within the organisations knowledge bank. It is partly conducted in form of CSIs, which provides feedback. This information is however not as developed as the information solely goes to the project manager in question and its supervisor. Thus, the possibility to replace the collected knowledge from the CSI with existing knowledge in the organisations knowledge bank does not exist. Thus, as the literature proposes, the reinvention of the wheel occurs. Moreover, case studies have shown that knowledge, and more specifically tacit knowledge, is looked upon as a personal property rather than an organisational property. This should not be as the tacit knowledge is often gained on behalf of the organisation, and that tacit knowledge many times has been created during faulty projects, which have affected the organisations revenue. With the CSI execution at CM AB there is hence a risk that various supervisors collect the same knowledge or feedback and miss out the recurring pattern. As CM West is a small part of CM AB it may be difficult to see this pattern without the knowledge gained from the whole organisation. However, it is understandable that some feedback may be secret for all to see. On the other hand this could easily be prevented if the CSI input was filtered in one stage before being public knowledge for the whole organisation. Additionally, it is expressed that the organisational management want to put the right person on the right project. By not coherently analysing the outcome from the CSI it is possible to miss out on an opportunity to do so. Thus, the knowledge capture is not optimum. The contribution from the AAR-meeting is similar to the CSIs. The AAR-meeting does open up for more elaborated inputs as there are conducted discussions. As stated, there is however as risk that this given input is not honest as the project team may only want to be done with the meeting, and avoid negative discussions. The given directives are as presented vague questions, which may not open up for discussions of the valuable information that is

preferably collected. As some questions or statements that are valuable may not fit the template, it may also be a risk that it is not written down.

The *knowledge organisational process* contains selecting, organising and re-selecting knowledge so that it is possible to distribute correct and up to date knowledge that is collected throughout the organisation. Little of these steps are conducted in practice. The selection of knowledge is not done as the collection is done during an AAR-meeting following a given structure. Thus, all that fits the given questions in the template is used. However that may be interpreted as selection to some extent. The organising of the knowledge is not focused upon, as the AAR-meeting protocol is either saved on the project manager's computer, in the mail or in the project database. Lastly, the re-selecting is not conducted at all, except for the re-selection that may appear in one's mind.

The *knowledge storage process* is touched by the CV-system that is applied within the organisations intranet. Previous research proposes that this process should allow knowledge to be easily found, by for example applying a taxonomy system or tags. In practise this is however mentioned to mostly be used when putting together a project group and creating an offer to a client. Meeting protocols are also stored in the database, but with little effort on making them easy to find, rather focusing on saving the information. Hence, not optimum fulfilment of the process.

The sharing and transferring of knowledge, in form of the *knowledge dissemination process* is proposed do be difficult to apply to due to lack of time in the industry, and also due to changes in things such as ICT. This is brought up during the empirical study pointing out that the problems stated in the literature apply in practice. It is believed that there are difficulties as a consultant to put time and effort into the dissemination as project managers may be put into another project as soon as they are done with the first one. It is obvious that the company is focused on the fact that KM processes should be done at the end of each project, which is the contrary to what previous research states. All processes are claimed to be done consequently and simultaneously as the project goes on to achieve the best result. As this is not done in practice, and the sharing and transferring is thought to be done in the end, the company misses out on many opportunities to do so. However, as time and geographical placements are a difficulty in practice, it is hard to fully apply to what the literature proposes.

The *knowledge application process* is in the literature focused on applying the newly gained or adapted knowledge. As this is the last step in the knowledge cycle, what has been produced in the earlier steps is utilised here. As the investigated company has not fulfilled all of the steps, the cycle is not complete and the knowledge that should be applied in this step is lacking. What may be done in this process is to try out new templates in practise. This is however found to be done separately, depending on the project manager. As there are little directives from the management this application differs between the various employees. Moreover, what is applied is hence what one have learned and gained during the knowledge cycle, meaning that the knowledge is not looked upon as an organisational property but rather a personal one. This, according to the literature, is a reason to why project related knowledge is not turned into the organisational knowledge capital.

Due to this there is a risk that much knowledge is kept in the mind or on the computer. Many of the respondents state that the lacks of organisational directives and procedures have made the project managers try out new ways, which makes the knowledge applications not coherent.

AAR:

This is a tool to learn answers, not to 'have' answers. Thus, questions such as "What was supposed to happen?" and "What actually happened?" are central. This should be conducted for each activity of importance. Furthermore, the plan is to be compared to the reality, so that the team can see what they learned and why the things that happened actually happened. When doing this it is vital to note key points so that the knowledge can be understood by the organisation. This is not how AAR-meetings are executed today. The meeting template does solely involve yes/no or good/bad questions, with little room for developed answers. Thus, avoiding answering the imperative questions such as "What was supposed to happen?" and "What actually happened?". Therefore the outcome of the meetings is not of great knowledge value. As the questions are formulated as they are today there is for example a risk that the answers are unclear for a 3rd party to read, making the document useless for spreading knowledge across the whole organisation. It may thenceforth also contribute to the risk that the *knowledge application* is only done individually, which in turn can contribute to a greater feeling of knowledge being a personal property and not an organisational one. As the meeting should be held for each important activity, it should arguably be in connection with a finished design phase, construction phase etc. This is however not the case, as the meeting is planned to be at the end of the project. In practice, it is stated in the management system that one meeting per important activity should be held, although the only directive about when to have it is to have it in the end of the project. As a project manager it may then be interpreted like the AAR-meeting for the design phase should be held at the end of the project that may contribute even more to the risk that the meeting is not held at all. As appeared, it is also a risk that late conducted meetings tend to only bring up the positive aspects, as the project team is glad that it is over. However, the AAR is an existing tool at the company that, if developed, can contribute to a better *knowledge capture process* which have been discussed being poor. By creating stimulating questions, valuable and usable knowledge can be created. It is also a place that possibly can contribute with feedback on planning and planning tools, which are two favourable focus areas for CM West. This feedback could be explicitly formulated and stored to spread the knowledge on how the planning should or should not be conducted. It is also an area that can give feedback on the more tacit requested leadership skill. What could be problematic is the great generation of knowledge, as literature proposes that each project member generates specific area focused knowledge depending on its belonging. As it is the project managerial knowledge that is of greater value for CM West, it is arguably important to develop an AAR-template that structures the meeting after the greater need at the company. However, on one hand the knowledge except from project managerial knowledge is also important as the project manager works with cooperating with all the skills. On the other hand, this knowledge is not demanded to be possessed by the project manager as it is only stated that some technical skills should be possessed.

Furthermore, the tacit knowledge may be difficult to write down, but the forum allows discussions that can help the project managers evolve their tacit knowledge. What is important then, is that the climate is set and that the phenomena of only positive feedback is removed, as the consulting project manager should achieve honest reviews of the work to bring back to its organisation. This may vary depending on the project team, and may be more difficult for CM West who often has one representative from the company in a project group. If there were to be several representatives, the climate would be easier to change. It is also arguable that various other tools that focus on tacit knowledge could be used in combination with the AAR, to enlarge the outcome from the AAR. However, how to create the environment where honesty is highly valued in the AAR-meeting could also be argued to be one of the highly tacit knowledge the management from CM West expressed a need to save.

On one hand, one could look upon the CSIs as a form of AAR-input, which is arguably a forum where it is easier to be honest. On the other hand, the CSIs are easier to avoid or to provide with short or unclear answers as one can answer them alone. Furthermore, case studies have shown that a culture where an employee wants to be the one providing the knowledge generates an easier environment to work with KM. In some cases that material was looked upon as the most important delivery. If the management succeeds to create that impressiveness on delivering documents with valuable knowledge the *knowledge capture process* and the *knowledge organisational process* may be improved in line with AARs.

Knowledge Taxonomy:
In the literature this tool helps organisations to structure their knowledge, which in this case especially is explicit. It is in practice a good idea as a more structured map structure is requested. Much knowledge is kept in the mind, or on the own hard drive. Many times because there is no other obvious place to put it. This could be avoided with a structured taxonomy. There is a stated problem in the literature that knowledge may be kept in the client's database during a project, and is later shut down, deleting all the coded knowledge. It is arguably an idea to use a client-focused taxonomy so consultants can save that information in their own database, avoiding that problem. Especially as the management stresses the importance of knowing the clients, and that the work may differ with them. However, this may request maintenance as new knowledge may replace out-dated. As there is a risk that old knowledge may stay within the taxonomy there is a need for extra effort if creating this system. On one hand, the AAR-tool already exists, which argues for a distinct system where the protocols from the AAR-meetings can be placed. If that does not exist, the outcome from the AAR-meetings may be lost. Thus arguing for the application of the knowledge taxonomy, as it may enhance the *knowledge storage process*. On the other hand, SMEs are stated to have little resources to be placed on KM as the employees are working in projects most of the time. It would be favourable to have a KM manager that can make sure that the documents are up to date. As it is an SME, the documents streaming into the taxonomy are arguably not to many to handle. However, as there already are difficulties with applying KM to a consultancy, creating a new role may be difficult. Especially since it is preferred to create a spectrum of various tools to apply and not only one or two. It should be ensured that this structure is set by the management, creating the

pattern of clear directives and making a statement that KM is to be worked with. Further, it is presented that the intranet and the database seldom is used as a source of knowledge due to the difficulty of codifying knowledge, and to acquire what is searched for. It is therefore important to make sure that the implemented tool is actually exploited, and manufactured in a user friendly way so that the employees easily will know where to store their knowledge. Moreover, the problem of codifying the knowledge may be solved by one tool which outcome can be placed within the taxonomy system. Thus, the tool may not solve the specific problem, but enhance the probability that the stored knowledge is found.

Skill/Competence Matrix or Knowledge Inventory:

These tools map out what skills and competences that exist within the organisation. One prerequisite for this is that the culture is set and that the habit to take contact with people possessing the skills. Otherwise the purpose of the tool is not fulfilled. As shown, there are thousands of hours of knowledge within the knowledge intensive firm that is looked upon, thus a matrix mapping out who possesses what, or an inventory may contribute to a *Lawson cycle* that is fulfilled. It may contribute to a clear holistic view of what competences are in house and what should be strived for. A difficulty may be to keep the matrix up to date, and to create the norm to take contact with each other. Thus, a CV-function like the one provided at CM AB is a knowledge inventory that could easily be applied at an organisation with several employees. One idea may be to create a feature in the CV-function that can show what competences and experiences that are lacking and which are most possessed to get this mentioned holistic view. This may not be a full matrix, but something that fulfils the similar purpose. To provide a full matrix may be difficult when there are many employees, even at an SME. What could then be considered is to provide a matrix that compiles the competences and experiences at each business area or office. This will however diminish the possibilities with the tool, and the work with connecting the various offices such as CM West will be counteracted. As presented, case studies have succeeded applying this tool together with the culture of contacting one another, even without knowing who it is this should be striven against. The CV-function requires a culture where employees will note what knowledge is possessed. This should although not be a problem as the need to have a CV that is up to date is especially important as a consultant, as the client may have specific requirements for the project group to be purchased. This tool is especially good at capturing tacit knowledge, as it is possessed by the employees. By keeping it there and contacting those who possess it once its needed, misunderstandings that can occur when trying to codify the tacit knowledge to explicit knowledge in text may be avoided. It can for example be used when approaching various clients, and to ask employees that have worked with that client beforehand on how the project should be conducted in the best way in the client's perspective. It is also a possibility to ask each other for explicit knowledge that is not obtainable in the company's database, by knowing who have experienced what. Furthermore, the database that collects the project documents is another example of an inventory that is used, mainly for explicit knowledge. There is however a stated challenge to have employees add their documents there, and once again it is important that the directives about this are set and clearly communicated by the management. What is positive is that if the documents are uploaded, the knowledge is easily acquired. Much like as for AAR, the knowledge taxonomy may contribute to enhancing the use of

this tool. Thus, knowledge inventory may be applicable for both tacit and explicit knowledge depending on its use.

Knowledge Market:

Literature proposes that knowledge markets should be looked upon as a supply and demand-tool, where the demand of knowledge should be matched with a supply. There do exist theme- or competence groups, which may enact this market. The conducted Friday meetings could also be developed into a knowledge market, systematically integrating story telling and discussions about project processes. It does however not open up the possibility to invite the sum of all knowledge in the company as the market only is within the given group. Moreover, the focus on these groups is not prioritised on spreading the knowledge, but rather to discuss certain subjects within the group. However, it is stated that it is possible to ask open questions in the company intranet which points toward an open culture with the possibility to develop the knowledge market focus. This does on the other hand not happen often, meaning that there is greater work needed. If succeeded it can be a useful tool to get a hold of answer quickly. Nevertheless, a filter or directive is needed so that, as in other tools, information is updated and that no wheel is reinvented. With the right technical, cultural and structural conditions literature explains that the cause may be that employees explore colleagues projects, and further on create a yet greater organisational culture where sharing knowledge or asking for it is common. This in practice means that CM West may have a greater opportunity to exploit the knowledge within CM AB.

Knowledge Café

A knowledge café has the objective to create a stimulating environment that can trigger conversations, which often occur in informal settings. This tool could be argued to simplify the *knowledge dissemination* as the setting may create better relations between the participants that create better possibilities for the socialisation step in the SECI-model. Hence, tacit knowledge could be argued to be easier transferred into explicit knowledge when using the knowledge café tool, or other tools that focuses on the informal setting. What is to be utilized in the already observed informal culture, which should be exploited for the better of this kind of tool. This already existing culture also speaks for a possibility to implement it with little resistance. One difficulty for this is that the more participants there are, the better the outcome, as the knowledge is received and shared by more employees. As the geographically spread projects cause many project managers to stay out of office that may be hard to achieve. However, there are already a set time for a common Friday meeting, showing that there are possibilities to see to that as many employees as possible attend in the office simultaneously. If that is not possible, yet another alternative is to conduct a virtual knowledge café, where the informal discussions could be conducted in an online environment. There is unfortunately an expressed value of face-to-face meetings by the coffee machine and such at CM West, which may not appear in an online chat. Nevertheless, as there already are problems with the use of the ICT system, a new implementation of an online tool may not be used as much as the management may wish. However, digitalisation and the industry rapidly move forward and adaptation is necessary to stay competitive. Therefore the consideration of a virtual knowledge café should not be ignored. To make sure that the tool is used correctly, it is arguable that real life

knowledge cafés should be conducted to elaborate and iterate the purpose and its outcome before applying a more expensive digital system.

5.4 Tools that should be prioritised and implemented

Previous research brings forth several principles to have in mind while implementing KM to a construction oriented firm, and transferring project-generated knowledge to the organisation. These principles are in this chapter used to evaluate which tools that should be prioritised at CM AB, given their conditions.

The principles to have in mind while implementing KM are presented below, and should be kept in mind while evaluating what prerequisites CM AB possess.

- Appropriate mixes of explicit and tacit knowledge are to be selected
- Systems that function with all types of projects
- Flexibility and customisability (as the industry may meet significant changes)
- Over all systems rather than groups of ad hoc pieces. Thus, Knowledge managers.
- Apply lessons learned
- Identify knowledge simultaneously as the project goes on, not in the end
- Sufficient direction to ensure degree of consistency. Pushed by management
- People must be in touch with each other and be encouraged to communicate

As appropriate mixes of explicit and tacit knowledge are to be selected, literature speaks for various tools to be applied as some tools may only select tacit and vice versa. As the systems or tools need to work with all types of projects, some tools may be disregarded. However, the tools that are presented in this study are all somewhat applicable in the construction industry hence none is rejected based on that principle. As the construction projects vary and they all are unique there is although a possibility that some tools may fit less well in some projects than in other. Nevertheless, this can be avoided as by tools that are customisable. For instance, the AAR-meeting template can consist of several different types of questions depending on the project, and a knowledge café can change theme. There is however a difficulty within the organisation as the wish is to have clear directives. The directives must hence not be as strict so it harms the flexibility of the tool, but still exist to fulfil the requirements from the project managers. This flexibility principle affects the skill/competency matrix, as the matrix needs to be fed with types of skills, which the employees then insert whether they possess it or not. As the request is to have clear directives, the feeding of the skills should preferably be done by the management to avoid entropy. The difficulty is then that the tool will be out-dated as new skills or varieties of skills develop. Especially as the industry may meet significant changes. Thus, the management of this tool is craving for an SME with little resources and the purpose it fulfils should arguably be found in another tool. This may be found in the knowledge inventory in form of the CV-function that may handle changes and developments of new skills. As the *knowledge storage*, *knowledge dissemination* and *knowledge application* craves very little to be processed, the changes can be handled smoothly. The storage is within an

employee's mind, and the dissemination may occur during a phone call. If changes within the industry do appear it is solely the employees knowledge that will change according to that, and if necessary an update of its own CV, thus not craving large efforts to adapt.

Furthermore, there is an importance of creating over all systems, and not ad hoc actions that may appear in groups or various offices. Therefore, the tools that are applied should be applicable in CM West as well as it is in CM AB. This is possible with the remaining AAR-meetings, Knowledge Taxonomy, Knowledge Inventory, Knowledge Market and the Knowledge Café. The meeting have the same possibilities to follow a template whether it's an employee from CM West or the main office. The same applies for the taxonomy, as it is a structure that may be set in the database, which is available for all employees. Likewise applies for the knowledge inventory and the knowledge market, as those tools are actions connected to the database and intranet, which is available for all. The knowledge market can however also be conducted physically, as do the knowledge café. This means that there may be varying results depending on the location it is used in, but no matter its geographical placement they are executable. Hence, the principle of avoiding ad hoc solutions does not discard any remaining tool. Moreover, the knowledge café can be conducted in a virtual world, which expands its possibilities. This should however not be prioritised as literature claims that several tools should be looked upon rather than specialising in one. In addition to that, previous research proposes that the industry is slow to adapt and accept changes that may lead to the implementation of virtual cafés may be too early to apply and prioritise now. Hence, virtual knowledge cafés are not to be implemented directly. Lessons learned are by the AAR-meeting arguably handling the *knowledge creation, knowledge capture* and the *knowledge organisational processes.* As presented however, the outcome of this tool is not well distributed, and as per the lessons learned principle, knowledge taxonomy is an additional tool that can proceed the knowledge management cycle with the *knowledge storage*, *knowledge dissemination* and *knowledge application processes*. Thus, fulfilling the cycle, ensuring a greater knowledge management of the lessons learned, especially for explicit knowledge. Hence a combination of these two tools should not be disregarded. A knowledge inventory, knowledge market and knowledge café does also manage lessons learned, both explicit and tacit. However, as these tools often include face-to-face discussions, the SECI-models transitions are very available and the transfer of tacit knowledge is possible to a great extent. Literature also specifically stresses the importance of relations and face-to-face discussions to handle tacit knowledge, pointing out an importance of these three tools, as the coverage of processing tacit knowledge is significant.

The principle and importance of identifying knowledge simultaneously as the project goes on is expressed, not only by the literature, but also by CM West. It is a known problem that the current ways to work only covers knowledge management in the end of a project, but the time to do more than so have been found hard to find. Thus, a tool that fulfils this principle should not be very time consuming to apply to CM AB. This aspect is however very project focused, which disregards overall tools such as the taxonomy tool. As argued, the taxonomy is looked upon as an enhancing tool rather than one that should be applied on its own. Thus the taxonomy is still reasonable to focus upon even though it does not specifically on its own identify knowledge as projects go on. A tool

that does that is the AAR-meeting, which could easily be combined with any other meeting during the project. There are already directives, or proposals, in the management system that stresses this. They are however not practiced, and if focusing on executing more frequent AAR-meetings, the directives should be developed. Moreover, the CSIs, which are sent out already, have the questions structured into various stages and phases such as the design phase or the production phase. It is therefore a possibility to send out these CSIs during the project. On one hand most of the work to fulfil this principle is already done, it is only the execution that is needed. On the other hand, the principle is not fulfilled even if the tools needed already exist. It is however as stated not a clear expressed directive on how to work with KM parallel with the projects. As the project managers said that more clear directives are needed to enhance their KM work that may be the missing piece to make sure that the AAR-tool fulfils this principle. Thus, the tool is not disregarded. Knowledge inventory, knowledge market and knowledge café are neither project related, but rather general activities for the company to conduct. As there is a possibility that the conducted tool distributed a project manager with knowledge, or that the project manager distributes knowledge, during these events none should be rejected with the parallel work-principle in mind. Knowledge inventory could be argued to be somewhat project related as a project managers can find someone with the requested knowledge at any time during a project. The same applies for the knowledge market. Knowledge café is on one hand more planned than the other two, which makes it hard to conduct parallel to every project. On the other hand it is creating stimulating discussions that can be connected to any stage of a project, and still generate valuable knowledge. Much like how the taxonomy not is directly project connected but still not disregarded, the knowledge café tool is still significant. The principle of sufficient direction to ensure degree of consistency, something that is pushed by management, is possible to apply on all remaining tools and goes hand in hand with the requested clear directives expressed from the employees. Thus, the implementation of the directives is arguable well met, as it is something that is asked for.

The last principle is that people must be in touch with each other and be encouraged to communicate, which is a culturally focused principle. As per the empirical work, the social environment is found to be open and talkative, much like the request from the principle. It is also argued that the prerequisites for the SECI-model and for handling tacit knowledge are good, which also are pointing towards a fulfilment of the principle. The remaining tools are thenceforth AAR-meetings, knowledge taxonomy, knowledge inventory, knowledge market and knowledge café.

Literature proposes that human knowledge is created and expanded through social interaction between tacit and explicit knowledge through conversations. It is also argued that various tools are preferable for varying purposes. Hence, CM AB should focus on several of the remaining tools. The AAR-meetings are already implemented, and the changes needed to be done are very small. Something that may be possible even for an SME, not only proposed by literature but also expressed by the organisational management. An organised taxonomy within the company's database is yet another tool which craves little effort. Once again there is already an existing database and the problem is to make sure that the files actually are uploaded. This is something that should be more explicitly expressed in the directives. The implementation of a taxonomy is

therefore relevant. For knowledge inventory, knowledge market and knowledge café, the effort needed to be put in is not much, which is preferable for an SME. The updating of CVs is something that is claimed to be imperative as a consultant and is not inhibiting the project managers' work. A knowledge market and knowledge café are both efforts, which are very flexible and easy to adapt after the abilities as an SME, and time outside of a project. Hence, CM AB can create directives on how to conduct them but adapt the execution to the current possibilities. Considering this, and that literature proposes that organisations should focus on several various tools and not specify in few, a toolbox that can help CM AB to create and collect knowledge from projects and make it an organisational property that is applicable, contains the following:

- AAR-meetings
- Knowledge taxonomy
- Knowledge inventory
- Knowledge market
- Knowledge café

Further, as literature proposes that tacit knowledge is difficult to codify in combination with the little resources possessed within the organisation of an SME, it is arguably important to create a toolbox that provides dialogues that can transfer the knowledge. That may also influence the culture further, which is claimed to influence the behaviours, which are central for *knowledge creation*, *sharing* and *application.* Previous research also shows that shared and creative problem solving; adoption of new tools and formal and informal settings are imperative activities to improve the skill to transform tacit knowledge into explicit knowledge. It is proposed that consulting companies in the industry should work with softer approaches such as informal discussions, storytelling or brainstorming sessions. Arguing yet further to apply the above presented toolbox. For the use of CSIs during AAR-meetings, the questions that exist today may need to be modified to fit the purpose of the meeting rather than collect evaluating information. This, however, is a small modification easily done in the management system. To adapt to the expressed wish from the project managers, clearer directives applying for the CSI should be of interest to apply. Previous research also points out that the lack of clear instructions is especially visible in SMEs. It is also a possibility to create CSI questions that focuses on the knowledge and skills that the management want the employees to evolve. Especially as the project managers should understand the various team members' knowledge, not be able to apply it. In other words, the generated knowledge need to be emerged from people with influence on the construction process, and the emerged knowledge is connected to the discovering professionals skills. For instance, the repairer knows better than the project manager on how to solve technical problems during a maintenance project. Lastly, as case studies on consulting firms have shown, it is possible to codify tacit knowledge and spread it within the organisation. Hence, the presented toolbox will provide possibilities for both tacit and explicit knowledge processes that are manageable for CM AB and its CM West.

6 Conclusions

We have found that CM AB has good conditions for creating an efficient KM system. The company already got some KM work on place but there are several challenges and opportunities connected to them. It is important to be aware of them and consider them when improving the KM system. The study has shown that many of the project managers have experience from working with KM at other employers and thus are comfortable with practicing KM and have ideas on how to improve the work. This is identified as an opportunity as it makes it easier to implement the KM work in the organisation. Contractual forms, such as partnering are becoming more frequently used in the industry, which also seems to facilitate KM. The project managers are still very steered by the client's demands and different clients value KM more or less. Therefore the client can be identified as either a challenge or an opportunity.

The current structure of KM at CM AB is mainly connected to the management system. One chapter in the management system is solely directed at KM, including some directives on conducting an AAR-meeting and a template for such a meeting. One challenge that we have identified is that the management system is based on the conditions at the main office, which creates some issues. We suggest that it is adjusted to the conditions at CM West. When discussing KM with the respondents they were very locked in mind solely focusing on the AAR-meeting. An explanation to that is most likely that the expressed KM at CM AB is explicitly concentrated on the AAR-meeting. CM AB's directives are that the AAR-meeting should involve the client and be conducted at the end of each project, as long as it is above a set value. It is free of choice to let other actors join the meeting. Thus, another challenge is that a lot of knowledge cannot be captured when only the client participates in the meeting. If the AAR-meeting is conducted at the end of each project it will most often be skipped, as actors tend to rush into new projects. Therefore it is identified as a challenge to have the AAR-meeting at the end of the projects.

One remarkable finding was that not all of the project managers were aware of that KM is a part of the management system and only a few had used the template for conducting an AAR-meeting. Thus, the internal database does not contain that many documents at the moment, which means that the project managers cannot gather knowledge there. The fact that many of the project managers avoid conducting the AAR-meeting and do not view it as an obvious part of the project process was identified as a challenge at CM West. The template for the meetings also needs to be reviewed so that it results in useful knowledge about the process rather than what was achieved. It was shown to be a challenge at CM West that the project managers are not aware of what type of knowledge that should be shared across projects. The intranet provides a good setting for finding colleagues possessing a particular knowledge as it contains all the project managers' updated CVs. As all the project managers' CVs are available to the rest of the organisation, it is identified as a great opportunity if used in a way that supports KM.

During Fridays the company has breakfast meetings, where they discuss their on-going projects. There is no structural knowledge sharing integrated in those meetings and thus it is identified as an opportunity to practice KM in a formal way. All the project managers are encouraged to join the meeting and spend time at the office during Friday mornings. How much time they normally spend at the office varies with the intensity of the projects they are working with. The project managers describe that they have an open culture where everyone is welcome to ask questions and share knowledge, which makes the culture an opportunity at CM West. On the other hand, the common approach towards KM can be improved, as the project managers need to start conducting the AAR-meetings and document more knowledge. We believe that once CM West changes the project managers view to KM being an obvious part of the project process, and sets clearer directives on when and how to conduct the meeting and what type of knowledge that should be shared, the common approach will transform into one where KM is of higher value.

We found that all of the presented tools can improve the management work. AAR is already focused upon and needs little effort to be more efficient. A knowledge taxonomy is imperative as it is an existing struggle to find what is searched for. It may enhance the knowledge storage process, which is now lacking. The tool is especially helpful to structure explicit knowledge such as meeting templates and planning information that is one of the two kinds of knowledge both previous research and the organisational management think should be prioritised. Knowledge markets and Knowledge Cafés are both important tools that can contribute with methods to handle tacit knowledge, such as the leadership skills, which is expressed as the second type of important knowledge. Skill/competence matrix or knowledge inventories are similar tools, which may improve the company's management work. However, looking on what tools that should be prioritised and implemented by CM AB, a skill/competence matrix may demand much time and resources to be conducted. Thus it is disregarded as a tool that should be focused upon. Moreover, the following principles are important for KM tools to follow when being implemented, which the remaining tools do.

- Appropriate mixes of explicit and tacit knowledge are to be selected
- Systems that function with all types of projects
- Flexibility and customisability (as the industry may meet significant changes)
- Over all systems rather than groups of ad hoc pieces. Thus, Knowledge managers.
- Apply lessons learned
- Identify knowledge simultaneously as the project goes on, not in the end
- Sufficient direction to ensure degree of consistency. Pushed by management
- People must be in touch with each other and be encouraged to communicate

The investigated company shows to express a will to work with KM, as it is a part of the directives and orally mentioned to be of great importance. However, we found that the objectives of KM where divided into two different thoughts. What the management aimed towards, and what the project managers aimed towards. The knowledge that was aimed towards by the management is in line with what previous research have found being important knowledge for project managers.

The tools which are presented are all contributing to the construction project management company in some ways, but as literature states, this type of SME often have little resources for work other than project management. Our study proposes that it is needed to focus on various tools to cover the spectra of varying knowledge types, but also prioritise the choices so they are manageable for the firm. We found that skill/competency matrices are able to present the knowledge capital, but could be replaced by knowledge inventory, which have a similar purpose. There is a large request for clear KM directives, which is hard to execute with the matrix-tool as it is to be filled in by the employees themselves. The difficulty lies in that the tool will be out-dated as new skills or varieties of skills develop, and the updating of that is hard to manage. Especially as the industry may meet significant changes

Moreover, our study shows that knowledge cafés can be conducted in a virtual world, but should however not be prioritised. Firstly, several tools should be looked upon rather than specialising in one. Secondly, the industry is slow to adapt and to accept changes that may lead to the implementation of virtual cafés is not used. Hence, virtual knowledge cafés are not to be implemented directly. What should be focused on is the development of the CV-function, as it is compatible as a knowledge inventory. We propose that CM AB should focus on the technology in form of the function, the structure in form of directives on how to use it and the culture that confirms that people use it. Our study shows that the technology for the knowledge inventory exists, and so does the culture. These two pillars are only to be enhanced and formed with the knowledge inventory in mind. The structure however is something that does not exist now, and is to be developed. What exists today is the AAR-tool, which we did not found to be used in an optimum way.

Given the current situation that CM AB is in, the following tools should be applied;

- AAR-meetings
- Knowledge taxonomy
- Knowledge inventory
- Knowledge market
- Knowledge café

It is important to notice that these tools are suggested for the current prerequisites and therefore they should continuously be reviewed as the company develops. Nevertheless, the proposed tools for a KM toolbox, and our approximated applicability towards various degrees of tacitness are illustrated in Figure 8.

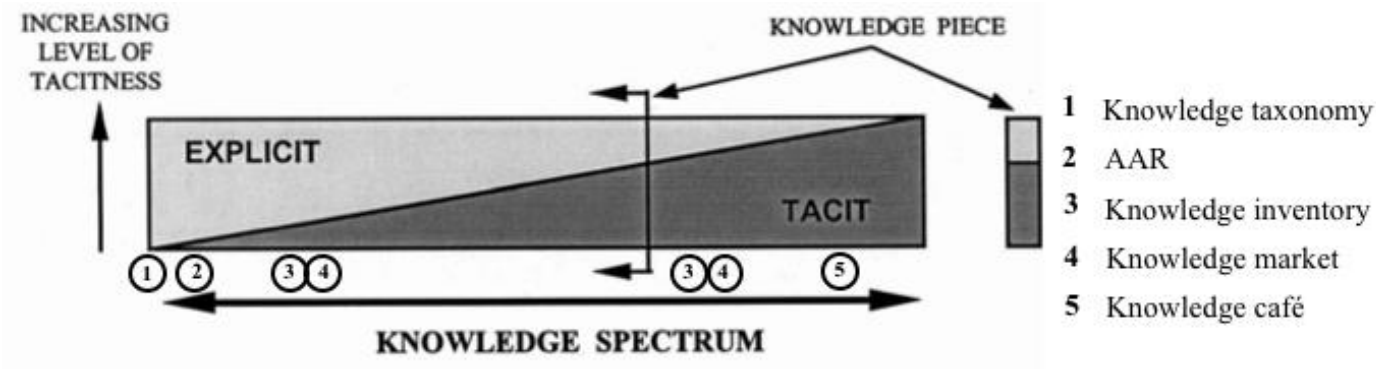

Figure 8: The degree of tacitness and the proposed toolbox.

Future studies

Throughout the process of conducting this study several areas of interest have been found. It has been showed that the client has a great impact on how the actors in the construction industry are working with KM. Thus, we suggest that future studies should further investigate the client's role and its impact on KM.

During our study we also got an understanding of that different contractual forms create varying incentives for working with KM. Therefore it would be interesting to study the different contracts, particularly partnering as it seems to create the highest incentive for focusing on KM in a project.

Finally, a great challenge in the construction industry has been shown to be that the project phases are not interacted and rather separate from each other. The construction managers usually find mistakes made by the design team but cannot reach them once the mistake is recognised. Thus the design team continues making the same mistakes, without knowing that the design is not possible in practice. Hence it would be interesting to investigate KM between different project phases. This study could be combined with the study on contractual forms.

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Appendix

Interview guide - Organisational Management

1. *What is your role at Construction Management AB?*
2. *What routines or directives exist at your company for knowledge management today?*
3. *How has the development process for those been? When did this topic become important to you?*
4. *How come you developed these from the start? What is your purpose and goal with knowledge management?*
    - *Is there a concrete internal goal on knowledge management?*
5. *What type of knowledge and experience do you believe is important to share at Construction Management AB?*
6. *What is your perception on the co-workers' response to the knowledge management routines? Do you think they are being used as intended?*
7. *Do you follow up or evaluate the co-workers' work with knowledge management? What are the consequences if the routines are not followed?*
8. *Do you encourage the co-workers to spend time at the office in any way?*
9. *Do you know of any knowledge management tools? What tools do you use internally?*
10. *Does the knowledge management work differ depending on the characteristics of the project?*
11. *What would an optimally functioning knowledge management system be like accourding to you? A culture where everyone exchange experiences? A minimization of the number of repeated mistakes?*
12. *Have you ever experienced that in a project where a lot of new knowledge is created, the gap between the project group and the rest of the organisation grows larger?*
13. *How do you make use of external actors experiences, such as the client?*
14. *Does the client affect the Project Manager's mandate to work with knowledge management?*
15. *What is your perception of external actors attitudes towards knowledge management?*
16. *How is the organisational management's attitude towards knowledge management?*
    - *How clearly do you feel that you are pointing out the importance of knowledge management?*
17. *How is the co-workers' attitude towards knowledge management? Is there a knowledge sharing-culture at this company?*
18. *How do you affect the knowledge sharing culture in a mid-sized company? How do you create a culture where people are encouraged to contact each other to share experiences no matter if they do not know each other? Have you actively worked with creating a knowledge sharing culture?*
19. *Is there a difference in attitude towards knowledge management between the young/junior co-workers and the old/senior co-workers?*

20. *Have you met people in the industry that are less willing to share their knowledge because of the attitude that knowledge is power?*
21. *What are the possibilities of working with knowledge management like as a consultant at a mid-sized company? Considering time, money and quality?*
22. *Is there time for the Project Managers to write reports on lessons learned when finishing a project?*
23. *What would you think of a Project Manager continuously performing knowledge management throughout a project?*
24. *How do you ensure that there is access to previous experiences?*
25. *What is the greatest challenge to create a successful knowledge management system?*
26. *Do you believe that a successful knowledge management system could generate profitability in the future? Would a successful knowledge management system make you more competitive?*
27. *What current communication tools exist at your company today? Do you believe that knowledge management could be more integrated in these?*
28. *How are new employees introduced at your company?*
29. *Do you encourage your co-workers to work in teams? Do you believe that it affects the knowledge management work?*
30. *What is the purpose with the CV-function on the intranet?*
31. *What is the purpose with the internal technique groups?*
32. *Do you use other forums to work with knowledge management?*
33. *Do you use any kind of reward system? Could that be used for knowledge management?*

Interview guide - Project Managers

1. *What is your role at Construction Management AB?*
2. *How often are you at the office?*
3. *Do you feel that informal meetings are as important as formal meetings considering knowledge management?*
4. *How would you define knowledge?*
5. *Are you familiar with the term knowledge management?*
6. *In what way do you work with knowledge management? Do you document any experiences?*
7. *Does the knowledge management work differ depending on the characteristics of the project?*
8. *Can you describe a way in which you use experiences from another project into one of your current projects?*
9. *What type of knowledge do you demand the most in your role? Who's knowledge and experiences are the most important/missed?*
10. *What is your view on collecting experiences versus using already collected experiences? Is there any step in the knowledge management chain that you think is a bottleneck?*
11. *Do you know where to turn when you demand a particular type of knowledge? Is it usually to a colleague or a database?*
12. *Have you experienced that former knowledge or experiences have obstructed the work in a project?*
13. *How do you make use of external actors experiences, such as the client?*
14. *What is your perception of external actors attitudes towards knowledge management?*
15. *How is the organisational management's interest in knowledge management? Are there pronounced directives/strategies/routines or encouragements connected to knowledge management?*
16. *How is the co-workers' attitude towards knowledge management? Is there a knowledge sharing-culture at this company?*
17. *Is there a difference in attitude towards knowledge management between the young/junior co-workers and the old/senior co-workers?*
18. *Have you met people in the industry that are less willing to share their knowledge because of the attitude that knowledge is power?*
19. *In which phase of the project are previous experiences the most demanded, and when are the most experiences created?*
20. *Is there any phase of a project when previous experiences are less important?*
21. *Do you know of any knowledge management tools?*
22. *Have you used any knowledge management tools?*
23. *What are the possibilities of working with knowledge management like as a consultant at a mid-sized company? Considering time, money and quality?*
24. *How do you ensure that there is access to previous experiences?*
25. *Do you feel that your knowledge and experience is taken care of? How?*
26. *What is the greatest challenge to create a successful knowledge management system?*

27. *Do you believe that a successful knowledge management system could generate profitability in the future?*
28. *At which meetings do you discuss knowledge management?*
29. *Do you prefer a text-based source or a practical way to share knowledge and experiences?*
30. *What current communication tools exist at your company today? Do you believe that knowledge management could be more integrated in these?*
31. *How are new employees introduced at Construction Management AB? Is there a mentorship program or anything alike?*
32. *Are you a part of a technique group? How do they work?*
33. *Do you usually work in teams or individually in a project?*
34. *How do you use the CV-function on the intranet?*
35. *Do you feel that you can send questions via mail to all the co-workers if you face issues?*