Knowledge Reuse in Product Development Projects

How a Sub-Process such as Purchasing can Utilize Existing Knowledge

Master's Thesis in Quality and Operations Management

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Gothenburg, Sweden 2019

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Abstract

Knowledge is often highlighted as one of the most important assets for an organization. By reusing knowledge, one can avoid wasting resources by redoing the same job or mistake twice. Thus, knowledge reuse is a competitive advantage. The purpose of this thesis was to analyze how product development projects can reuse existing knowledge.

This was done using a combination of literature reviews and a case study, concentrating on the sub-process of purchasing within product development projects. Focus has been on methods and practices that promote knowledge reuse, barriers that can hinder knowledge reuse, which barriers are intertwined and how barriers can be managed. In total 19 interviews and 6 observations were conducted.

The main conclusion was that tasks related to knowledge reuse must internally motivate employees, to create well working knowledge sharing and reuse between projects. An example of a practice that creates internal motivation is sharing knowledge face to face. Sharing knowledge face to face have certain dimensions that makes it internally motivating. Those dimensions are that the knowledge provider gets direct feedback and realize the value of the knowledge sharing. When designing methods and practices that promote knowledge reuse an organization must take the motivational aspect into account.

In total, three groups of methods and practices were studied. These were organizational methods, meetings and knowledge management systems. Furthermore, eleven clusters of barriers were identified:

- Trust
- Fear of job security and competitiveness
- Time availability and prioritization
- Value of knowledge reuse is not realized
- IT-systems
- Organizational culture
- Organization and its processes
- Motivation and incentives
- Individual differences
- Geographical and cultural distances
- Multitasking

The motivational barrier is the barrier that is intertwined with the highest number of other barriers. Some barriers have concrete ways of managing them, for example one aspect of the barrier IT-systems is low technological know-how, which can be managed by educating employees. Some barriers can likely be managed by using internal motivation, due to them being intertwined with the motivational barrier.

Keywords: Knowledge Management, Knowledge Reuse, Knowledge Sharing, Knowledge Transfer, Knowledge Barriers, Product Development Projects, Purchasing

Acknowledgement

First of all, we would like to thank Dan Paulin, supervisor of this Master's Thesis. He has contributed with invaluable support, feedback and advice. The best support was perhaps given when we were struggling with the literature review:

"Frustration is part of the process"

- Dan Paulin

This quote has been with us ever since, and we will take it with us after Chalmers as well.

Furthermore, there are several persons at the case company that we want to thank. Especially Therese, Linda and Lennart for great ideas, input and for always taking the time to answer our questions in times of confusion. We would also like to thank everyone at the case company who we have interviewed or who in other way has contributed to our Master's Thesis. We are grateful for everyone that has made us feel welcome (and for all the fika).

Lastly, we would like to thank our friends and family.

From Anne: Thanks for being there for me, even in my grumpiest moments. I love you all.

From Sofie: Mum and Dad, thank you for always supporting me, encouraging my curiosity every time I have wanted to try new things. Thank you, Emil, for being a role model my whole childhood and always including and explaining everything from how to ride a unicycle to any complicated formula. And of course, Mikael, you are my safe place, I do not know how I would have managed everything without you. Lastly, there is not enough space to mention you all, but you know who you are. You are always there for me and for that I am truly grateful. Love you all.
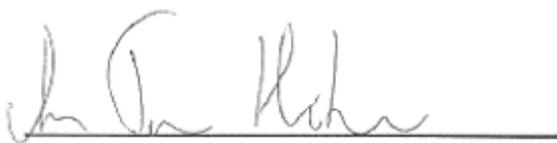
Anne Tarnow Håkansson
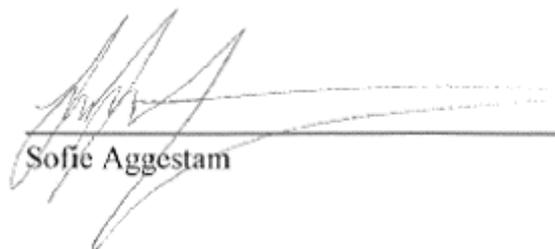
Sofie Aggestam

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1   Introduction

This chapter scopes the Master's Thesis. Firstly, a background motivating why the presented subject is of interest to study is presented. From this, the purpose of the Master's Thesis emerges. Thereafter follows a problem analysis, which results in four research questions. After this, the scope of the Master's Thesis is defined and lastly, the report's disposition is described.

Within any organization knowledge is a critical asset that can determine whether the organization succeeds or falls short. However, even though the importance of knowledge is widely known, many companies are struggling with knowledge management. One crucial aspect within knowledge management is reusing knowledge that has been previously gained. If this is not done the organization faces a risk of redoing the same mistakes over and over again. In addition, many organizations today work project-based. With every new project there is often a new constellation of individuals who should work together during a limited time. That can make it even more challenging to reuse knowledge from previous projects. When working in projects there is a need of a structured process for knowledge reuse.

1.1   Background

"In an economy where the only certainty is uncertainty, the one source of lasting competitive advantage is knowledge" (Nonaka, 2007, p. 162). Nonaka (2007) further writes that markets shift, new technologies emerge, and existing products quickly become outdated. To stay competitive is hence challenging. There is however, as mentioned, one source of lasting competitive advantage, knowledge (E.g. Lee & Choi, 2003; Nonaka, 1991). Riege (2005) state that *"better and purposeful sharing of useful knowledge translates into accelerated individual and organisational learning and innovation through the development of better products that are brought faster to a target market, thus enhancing market performance* (p. 18). Nevertheless, to move from theory to practice and truly exploit the value of knowledge is sometimes tough (Nonaka, 1991).

It can be argued that knowledge reuse can be even more challenging when working in projects. Kasvi et al. (2003) write that *"project organisations require particular systematic and effective knowledge management if they are to avoid knowledge fragmentation and loss of organisational learning"* (p. 571). Consequently, project-based organizations need to prioritize work related to knowledge management. Further Kasvi et al. (2003) conclude that knowledge management within project-based organizations in the beginning of the millennium was largely underdeveloped. Much research within the field of knowledge management in project-based organizations has been done since then (E.g. Hartmann & Dorée, 2015; Williams, 2007; James Bryde, et al., 2018). However, James Bryde et al. (2018) state that there still exists a need for developing knowledge management within project management.

One area where knowledge transfer between projects is of extra importance may be in product development projects. Lindkvist (2001) write that to ensure survival, a company needs to bring attractive products to the market over time. To be able to do that, companies continuously strive to develop existing products and create new ones. If a company can reuse knowledge from one product development project to another, the company can avoid that a job that has been done once is redone again, duplicating the effort. This frees resources that can work on something else. In addition, reuse of technical solutions between product development projects can enable economies of scale.

To exploit the value of well working knowledge management, for example between product development projects, is a process including several phases. The process has been described in various ways, as written by Schacht and Maedche (2016), who themselves describe five phases. These are knowledge acquisition, knowledge documentation, knowledge transfer, knowledge reuse and knowledge protection. It is first when knowledge is being reused that it adds value (Schacht & Maedche, 2016). Cheuk et al. (2017) also emphasizes the importance of knowledge reuse, when they, grounded on Baxter et al. (2008) and Liu et al. (2013), conclude that *"a KM [Knowledge Management] initiative should be considered a success only when it leads to knowledge reuse"* (p. 196). Hence, one could argue that knowledge reuse is one of the most important steps in the knowledge management process. Despite the conclusion that knowledge reuse is one of the most important phases in the knowledge management process, "*there exists only little work on knowledge reuse*" (Schacht & Maedche, 2016, p. 41).

In summary, many organizations work with product development projects, and it is of value for them to, as Lindkvist (2001) writes, have a well-working knowledge exchange between product development projects. However, research on how to integrate knowledge management and project management is "*an area where research is still in its infancy and hence theory is still fairly immature*" (James Bryde, et al., 2018, p. 555). Furthermore, an important step in the knowledge management process is knowledge reuse, where there also exists a need for further research (Schacht & Maedche, 2016). This thesis follows those calls for research, and the researchers hope to contribute with some new insights in the area, by studying knowledge management in a project-based setting focusing on product development.

1.2   Purpose

Analyze how product development projects can reuse existing knowledge.

1.3   Problem Analysis and Research Questions

The focus of this thesis is product development projects, a project type where several functions within an organization normally work together in cross functional teams. One of those functions is typically the supply chain, and its sub-functions such as logistics and purchasing (Tolonen, et al., 2017). Tolonen et al. (2017) have studied how to create a well working supply chain sub-process in a new product development process. They write that the main target when creating a supply chain to support the development of a new product is to enable smooth and efficient product ramp up according to the supply chain strategy. Hence, it can be argued that the purchasing sub-process is important for a well working product development project.

However, to the researchers' knowledge, there exist limited theory on how knowledge can be reused within a purchasing sub-process of a product development project. Consequently, a study with such focus could contribute with new insights. Therefore, the research questions will focus on purchasing as a sub-process of product development projects. As starting point, one need to consider what available methods and practices that are used today.

> *RQ1: Within a purchasing sub-process, what are suitable methods and practices to reuse existing knowledge during a product development project?*

Even though many organizations work consciously with methods and practices to enable knowledge reuse between projects, one can argue that there must be something hindering knowledge reuse. This since many organizations struggle with exploiting the value of knowledge management. In literature, some of these hinders are referred to as barriers (e.g. Riege, 2005). To enable efficient usage of methods and practices

identified in RQ1, the barriers are of interest to analyze. The first step to enable an analysis of the barriers is to identify which barriers exists.

RQ2: Within a purchasing sub-process, what are common barriers that hinder knowledge reuse during a product development project?

In the existing research authors argue that barriers are intertwined (e.g. Riege, 2005). However, the researchers have not been able to identify any research on which barriers are intertwined.

RQ3: Within a purchasing sub-process, which barriers that hinder knowledge reuse during a product development project are commonly intertwined?

Lastly, it is of interest to study how to manage barriers brought up in RQ2 and RQ3.

RQ4: How can one manage barriers hindering knowledge reuse during a product development project within the purchasing sub-process?

1.4 Scope

This study has been delimited according to the following aspects:

- Purchasing as a sub-process
- Knowledge reuse within a company's boundaries and at one site
- The stage gate process
- Knowledge as a subjective contextual construction
- Knowledge (not data, information or wisdom)
- Reuse in the knowledge management process

All delimitations will be elaborated upon in the following sections.

1.4.1 Purchasing as a Sub-Process

The research has been delimited to only studying the purchasing sub-process of a product development project, that is, activities involving purchasing within product development projects. Activities only involving other functions in the project team (e.g. Engineers) were not studied in detail. However, if they appeared of interest to the purchasing function, the activities were included in the scope. As an example, when there was a method used by another function, that the purchasing sub-process could benefit from using as well, the method was studied. Figure 1 below clarify what is meant in this Master's Thesis when referring to either the sub-process of purchasing or the purchasing sub-process. It is a simplified picture where some sub-processes included in a product development project are shown. Some of these are not a part of every project, and in some projects, there are other functions present as well.
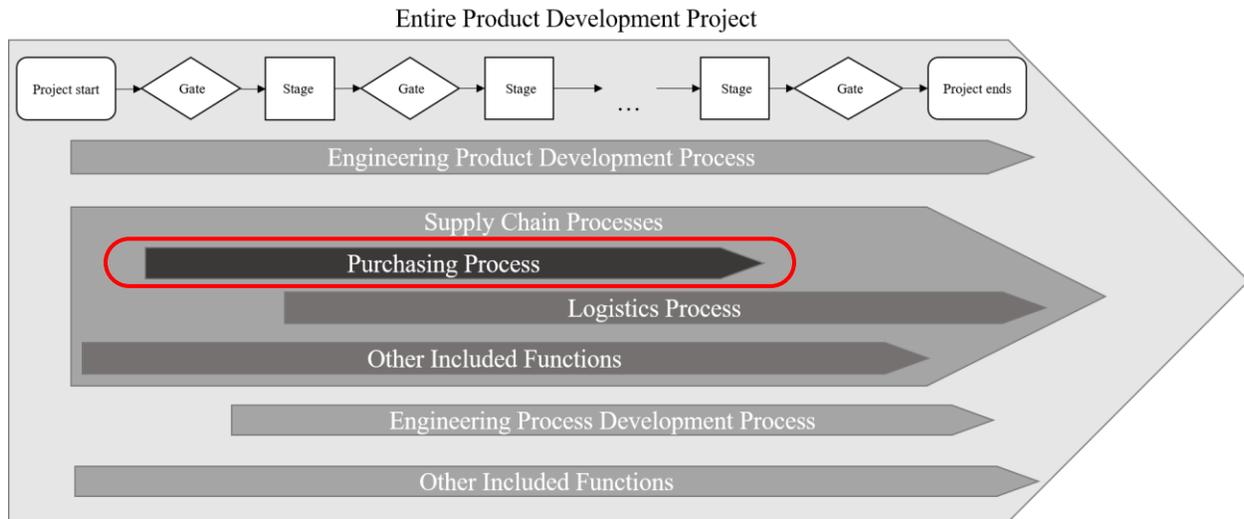
Figure 1 The scope of this study was delimited to consider how the sub-process of purchasing could reuse existing knowledge within a product development project.

1.4.2 Knowledge Reuse within a Companies Boundaries and at a Single Site

Another delimitation of the scope was that the thesis only focused on reuse of knowledge that exists within a company's boundaries. Hence, reuse of knowledge from suppliers or other actors outside the company was not included. In addition, methods and practices that enable knowledge reuse between different sites was not included in the scope.

1.4.3 Stage Gate Process

There are different processes that can be used in product development projects, where the stage gate process is relatively common (Cooper, 2008). This study has been delimited to consider development projects that are carried out using the stage gate process. Cooper (1990) explains the stage gate system as a process that is divided in different stages of work. Between the stages there is a gate, which works as a check point, where the project needs to deliver certain pre-decided deliverables to be able to proceed to the next stage. Otherwise, the project stays in the current phase or gets killed. A simplified version of the stage gate process is shown in Figure 2. However, as Cooper (2008) write, the process is not always as linear as models (such as Figure 2 below) depict. Stages can overlap when projects for example must iterate back or begin with tasks in the next phase before closing a previous one.
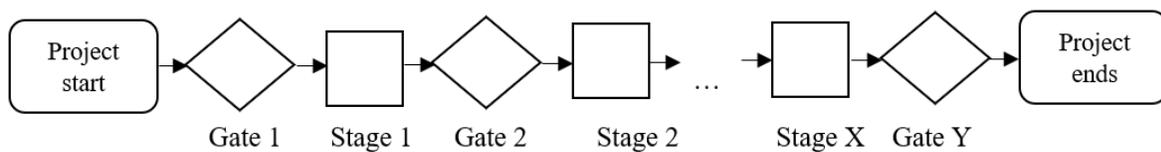
Figure 2 A generic and simplified version of the stage gate process, inspired by Cooper (1990).

1.4.4 Knowledge as a Subjective Contextual Construction

Furthermore, during this thesis, knowledge has been seen as a subjective contextual construction. This view on knowledge is based on Polanyi (1958) who according to Sveiby (2007) argue that knowledge is constructed in a social context, and that it cannot be separated from an individual, it combines the knower and the known. With this view follows consequences. For example, if seeing knowledge as a subjective

contextual construction it cannot be transferred but must be redeveloped by each individual (Paulin & Suneson, 2012). An implication of this view of knowledge is that in order to develop the organization's knowledge, the knowledge needs to be redeveloped by everyone.

1.4.5 Data, Information, Knowledge and Wisdom

This research has furthermore been delimited to study knowledge. Often the concepts of data, information and knowledge are defined in subsequent order (Zins, 2007). Rowley (2007) describe it as a Data, Information, Knowledge, Wisdom (DIKW) hierarchy, where the concepts are placed in a pyramid where data is the foundation, thereafter information, which is followed by knowledge, and wisdom is added on top. Within the existing definitions, Rowley (2007) states that data is often defined as something that is unprocessed, unorganized and has no value in itself. This is according to her comparable to how Ackhoff describes it: as symbols. Rowley (2007) furthermore writes that information is often explained as processed and organized data that, by being placed in context, turns into information and becomes meaningful and valuable. After information follows knowledge, where Rowley (2007) write that the definition is a bit less consistent. However, she concludes that *"knowledge might be viewed as a mix of information, understanding, capability, experience, skills and values"* (Rowley, 2007, p. 174). Lastly, when it comes to wisdom, the top of the DIKW hierarchy pyramid, the definition presented is relatively vague, *"It perhaps has more to do with human intuition, understanding, interpretation and actions, than with systems"* (Rowley, 2007, p. 174).

1.4.6 Reuse in the Knowledge Management Process

According to Alavi and Leidner (2001) the knowledge management process in an organization involves distinct but interdependent phases. The phases have been described and named in various ways, but the idea behind them are similar, as written by Schacht and Maedche (2016). Schacht and Maedche (2016) have themselves divided the knowledge management process in five phases. These are knowledge acquisition, knowledge documentation, knowledge transfer, knowledge reuse and knowledge protection. As have been described in the introduction the focus of this thesis has been on reuse of knowledge. The process is summarized in Figure 3 and described in more detail below.

| Knowledge Acquistion | Knowledge Documentation | Knowledge Transfer | Knowledge Reuse | Knowledge Protection |
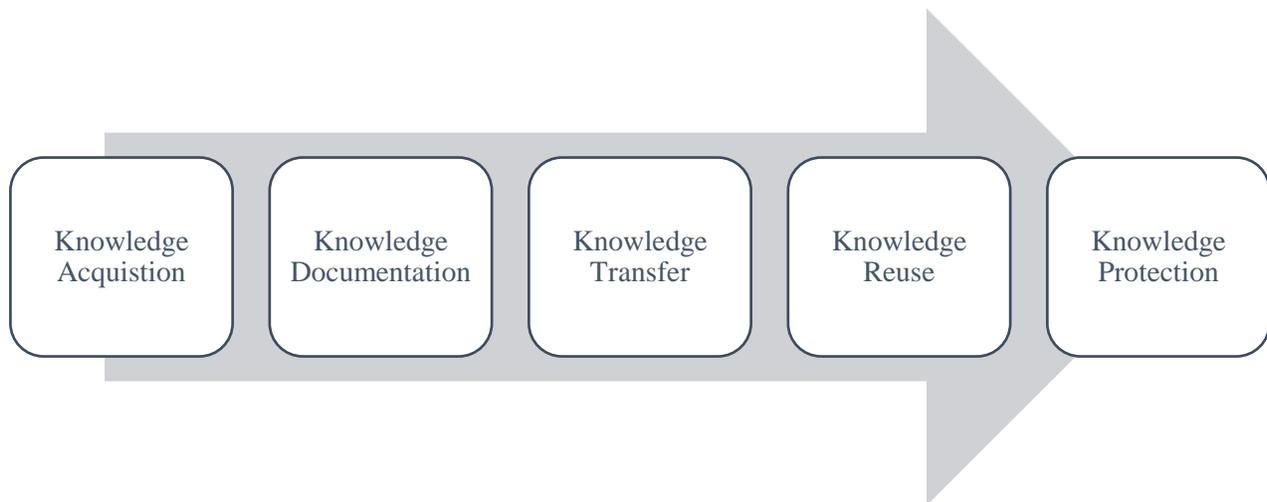
Figure 3 The Knowledge Management Process, inspired by Schacht and Maedche (2016)

Knowledge acquisition includes for example the development of new content and replacing existing content. Schacht and Maedche (2016) refer to the model described by Nonaka (1994) when describing knowledge creation, in which organizational knowledge creation takes place through four different conversions. These are socialization, externalization, internalization, and combination.

Schacht and Maedche (2016) call the next phase knowledge documentation. They write "*unless knowledge is not stored in a way that it can be retrieved by others, it is useless*" (Schacht & Maedche, 2016, p. 23). Phase three, knowledge transfer, is about transferring knowledge from the knowledge source to the knowledge receiver. The fourth phase is called knowledge reuse, which begins when the transferred knowledge is used. The fifth phase in the knowledge management process is about knowledge protection. According to Schacht and Maedche (2016) only few researchers consider the activities in the fifth phase an essential part of knowledge management.

Alavi and Leidner (2001) state that the source of competitive advantage resides in the application of knowledge rather than the knowledge itself. Thus, knowledge reuse was the phase that this Master's Thesis focused on. However, a presumption for knowledge reuse is knowledge transfer, which therefore also was studied, as a basis for knowledge reuse. In this report the terms knowledge transfer and knowledge sharing are used interchangeably. Knowledge documentation was briefly touched upon, as it also can be a presumption for knowledge reuse. The thesis was further delimited to not study knowledge creation nor knowledge protection.

1.5 Disposition

This Master's Thesis is divided into seven chapters. The first chapter, that this section finalizes, is the introduction. The chapter includes the purpose, research questions and scope of this study. The second chapter describes the methodology, ethical considerations and a discussion about the methodology's trustworthiness. The third chapter is the theoretical framework, in this chapter the theory of existing knowledge in the field is presented. After the theoretical framework follows the fourth chapter where the empirical findings made during the study described. The fifth chapter is the analysis, where theory is analyzed in comparison to the empirical data. Thereafter follows a discussion, which broadens the result of the analysis and brings in other perspectives. In addition, some propositions for future research are presented. Lastly, the seventh chapter is the conclusions. In this chapter, the research questions are answered.

2   Methodology

This chapter describes the methodology that has been used to answer the research questions. The chapter begins with an overall description of the research strategy and design. Thereafter, the choice of empirical case that has been used is motivated. It is followed by section which includes a brief presentation of data collection methods that have been used to answer the research questions. In the next section the data collection methods are presented in detail. The chapter furthermore includes sections about ethical considerations and lastly, trustworthiness.

2.1   Research Strategy and Design

To enable answering the research questions a qualitative approach has been used. Bryman and Bell (2015) explains that when using a qualitative approach, instead of a quantitative, one *"usually emphasizes words rather than quantification in the collection and analysis of data"* (p. 38). Since the research questions focuses on identifying methods, barriers, which barriers are intertwined and strategies to manage these barriers a method emphasizing words more than quantitative data was decided to be more appropriate.

Bryman and Bell (2015) schematically show that a qualitative approach often ends up as an iterative process where theory, research questions, and empirical data are continuously analyzed. This can be compared to what Dubois and Gadde (2002) refers to as systematic combing, which they describe as: *"a process where theoretical framework, empirical fieldwork, and case analysis evolve simultaneously"* (p. 554). Furthermore, Dubois and Gadde (2002) refers to systematic combining as an abductive approach which continuously goes back and forth between the theory and the empirical data in an iterative way. This way of working has been used in this study, which is schematically described in Figure 4. With this approach, the research questions were revisited and revised as more knowledge about theory and empirical data was gained. Hence, the research questions presented in previous chapter have been modified during the study.
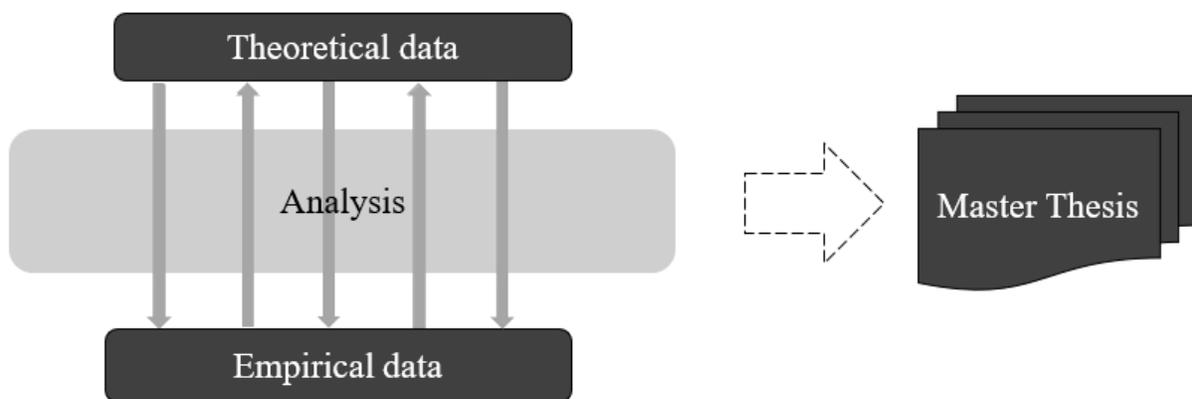
Figure 4 The abductive approach that have been used in this study is schematically presented in the figure. There has been an ongoing analysis throughout the study where the focus has shifted back and forth between the theory and empirical data.

The research design chosen in this study was a case study design. According to Bryman and Bell (2015) a case study *"entails the detailed and intensive analysis of a single case"* (p. 67). In addition, to ensure that the research questions were answered, a literature review was conducted in parallel with the case study, which aligns with the abductive qualitative research strategy.

2.1.1 Choice of Case Company

When finding a case there were some predefined requirements stated in the purpose, research questions and scope that the case needed to fulfill. One requirement defined was that the case organization should work project-based with product development projects using cross functional teams involving purchasing. In addition, the product development projects should be conducted using the stage gate process. When choosing case to study it was furthermore of interest to find an organization which conducted product development projects where there existed a high need for reuse of knowledge between projects. This since such organization likely would have developed methods or practices that enabled reuse of knowledge between projects, and therefore provide data that could contribute to answer the first research question.

A company that fitted that description was Company X. Company X is a multinational manufacturing company. At one of the sites in Sweden product development projects, where cross functional teams work together, are conducted. The projects are structured using a stage gate process. Furthermore, as mentioned in the research questions, focus in this thesis has been on the purchasing function. Purchasing at Company X is represented in the cross functional product development teams, more precisely each product development project includes a Project Buyer (see role description in *4.1.1 Functions Involved in Product Development Projects*) as team member.

In addition, Company X has a product development project type where the need for reuse of knowledge is high. When Company X develop products that have a customer commitment, it is common that they develop an existing concept to make the new product, or product application, meet the new customer requirements. That type of projects has a need of reusing knowledge from previous projects, since the development partially is based on an existing product.

In short, Company X fulfilled the predefined requirements and conduct product developments projects which benefit from reusing knowledge from previous projects. Purchasing at Company X was therefore chosen as case.

2.2 The Structure of the Study

The study was divided into two parts. Firstly, a pre-study resulting in the purpose, scope and formulation of research questions. Secondly, the main study, which resulted in answers to the research question. The structure is presented in Figure 5.
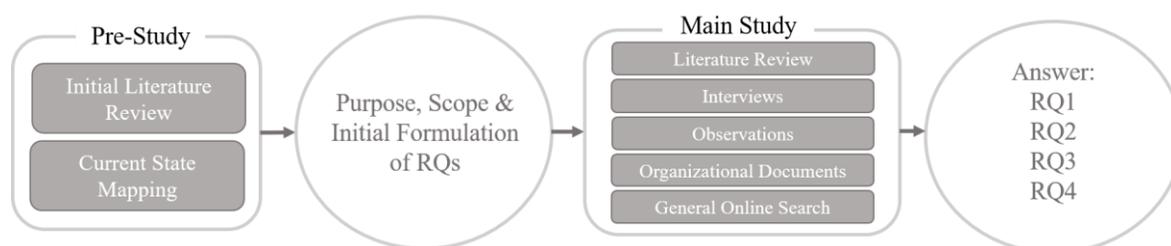

Figure 5 The study has been divided into two parts, a pre-study and a main study.

The pre-study included an initial literature review, see *2.3.1 Literature Review*, which was conducted to get an understanding of the basic theory in the field of knowledge management. In addition, a current state

mapping was performed. The purpose of mapping was to understand how Company X's processes are designed, to be able to for example ask relevant questions during semi-structured interviews in the main study. The current state mapping was done in an iterative way, where knowledge gained from one interview was summarized in for example a process map and then brought to the next interview for more input. One method used for the current state mapping was informal unstructured interviews. In addition, everyday observations and organizational documents also contributed to the current state mapping. All empirical data collection methods are described in *2.3.3 Empirical Data Collection.*

After the initial mapping was done, the main study followed. The main study consisted of different data collection methods, more precisely, a literature review, observations at Company X, reading of company documents, interviews with employees and a general online search. Which methods that were used for respective research question is explained in the following section. Thereafter, the methods are described in detail in section *2.3 Data Collection Methods.*

2.2.1 How the Research Questions Got Answered

Table 1 presents what methods have been used, to what extent they have been used, and which methods have been used to answer each research question. Below the table an explanation of the choice of methods for answering respective question can be found.

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Table 1 Methods used for the different research questions.

Method	Quantity	RQ1	RQ2	RQ3	RQ4
Literature Review	76 references	X	X	X	X
Interviews	19 interviews	X	X	X	X
Observations	6 observations	X	X	X	X
Company X's Documents	N/A	X			
General Online Search	N/A	X			X

The first research question aimed at finding methods and practices that could be used to reuse existing knowledge. Methods and practices have partly been found in theory, by conducting literature reviews. In the literature review the search has been broader and it did not only include the purchasing sub-process. In addition, a general online search was conducted. It is likely that there are ways of working that has not been documented in academic literature, consequently it will not appear in a literature review. However, it can be documented in sources less "academical" that can be found using other ways of searching, such as Google and Blogs. Therefore, a broader search online that not only included research papers have been part of answering the first research question. Furthermore, methods and practices used at Company X's purchasing department within a product development project have been studied. This have been done in three ways. Firstly, by looking at standard documents at Company X to see how they theoretically describe the processes they use. Secondly, by interviewing employees at Company X's purchasing department to

get a better understanding of how they practically work with the processes. Thirdly, the authors of the thesis have conducted observations of meetings.

The second research question aimed at identifying barriers that hinder reuse of knowledge. During the initial literature study, it was noted that there exists relevant research regarding barriers that hinder knowledge reuse which could be used as a starting point to answer the second research question. However, the answer to the second research question have not only been based on the literature study. By interviewing and observing employees at Company X, it has been possible to identify what barriers can exist when working specifically within product development projects in a purchasing sub-process. Company documents describing standardized processes and likewise was however not used as a source when answering the second research question, since they normally not describe barriers.

The third research question aimed at seeing which barriers are intertwined. Here, mainly empirical data have been used, since it to the researchers' knowledge do not exist much theory that specifically analyses how barriers are intertwined. However, literature was used to get a deeper understanding of the barriers which enabled an analysis of how the barriers affected each other.

The fourth research question aimed at finding ways to manage barriers that hinder knowledge reuse. Here, data from both the literature study and the general online search have been used. In the case, the data collection method that have been used to answer the third question is firstly interviews. The interviews have focused on how employees at Company X themselves think that the barriers found should be managed. In addition, ways to manage barriers have been observed during observations.

2.3   Data Collection Methods

The data collection methods within this study have been theoretical literature reviews, empirical methods and lastly a general online search. All data collection methods will be further described in the following sections.

2.3.1   Literature Review

A purpose with a literature review is to get an understanding of what theory and knowledge already exists in an area (Bryman & Bell, 2015). The literature review in this thesis have been conducted using three different procedures, namely an initial overall literature review, a narrative literature review and a systematic literature review, all of which are described in the following sections.

Initial Overall Literature Review

The aim with the initial literature review, which was a part of the pre-study, was to get a brief overview of what knowledge existed in the fields of knowledge management and knowledge reuse. To conduct the literature review two different approaches were used.

The first approach was of ad hoc nature, where the researchers searched in various databases. Some search words used were "knowledge management" and "project management". The used databases were Scopus, Google Scholar and the library at Chalmers University of Technology.

The second approach was based on the papers found in the ad hoc search. In the papers there were references to other articles. If it was likely that the reference would be of interest to study, the article that was referenced to was searched for.

The initial literature review provided the researchers with a brief overview of existing theory, which enabled the scoping of the thesis. Consequently, it did not create in-depth knowledge within any specific area. After the scope was defined, more in-depth knowledge was however needed, which the narrative and systematic literature reviews were designed to provide.

Narrative Literature Review

The narrative literature review has been used as part of the iterative process, going back-and-forth between theory and empirical data, and has therefore been ongoing throughout the project. The aim with the narrative review was to gain understanding, which is one of the benefits according to Geertz (1973) (Bryman & Bell, 2015). When a knowledge gap was identified, literature aiming at filling that gap was searched for. Hence, the narrative literature review has not been of a structured nature, instead it has been need-oriented.

One approach that has been used, which was also described in the initial literature review, was to find articles by searching for references from previously read articles. This was done to increase quality, by going back to the primary source.

However, Bryman and Bell (2015) argue that the narrative review does not have distinct directions of what texts to use and what to exclude. Therefore, this approach can be subjective, which is an issue that also has been highlighted by Tranfield et al. (2003):

> *"However, traditional 'narrative' reviews frequently lack thoroughness, and in many cases are not undertaken as genuine pieces of investigatory science. Consequently, they can lack a means for making sense of what the collection of studies is saying. These reviews can be biased by the researcher and often lack rigour."* (Tranfield, et al., 2003, p. 207)

To deal with the subjectivity a systematic literature review was conducted, which is presented in the following section.

Systematic Literature Review

To strengthen the thesis and minimize the risk of subjectivity which can occur in a narrative review, a variant of a systematic review has been conducted. The systematic review is, according to Bryman and Bell (2015) often used to avoid bias. The benefits of a systematic review have also been highlighted by Tranfield et al. (2003) when they refer to Cook, Mulrow and Haynes, (1997):

> "Systematic reviews differ from traditional narrative reviews by adopting a replicable, scientific and transparent process, in other words a detailed technology, that aims to minimize bias through exhaustive literature searches of published and unpublished studies and by providing an audit trail of the reviewers decisions, procedures and conclusions (Cook, Mulrow and Haynes, 1997)" (Tranfield, et al., 2003, p. 209)

The systematic review was conducted after the scope of the study had been defined, and it was ongoing during a limited time (one month). That is a contrast comparing to the narrative, which was ongoing throughout the study.

The steps of a systematic review have been summarized in the article by Tranfield et al. (2003) with a picture from NHS Centre for Reviews and Dissemination (2001). In the picture, a systematic review is divided into three stages, each of which consist of different phases. The three stages presented are:

1. Planning the review
2. Conducting a review
3. Reporting and dissemination

A systematic review can be extensive. To make it manageable within the settings of this Master's Thesis the stages have been adapted to be appropriate for this study and to fit into the time limitations. The following sections explain how the systematic review was conducted in this Master's Thesis by relating it to the three stages and different phases shown in the picture from NHS Centre for Reviews and Dissemination (2001) presented by Tranfield et al. (2003).

Planning the Review

The first stage, planning the review, consist of three phases. Firstly, the researchers need to identify an area where there is a need for a systematic review. The next phase is to develop a proposal for a review. As a last phase, a review protocol should be developed.

Several of the activities connected to planning the review was done when conducting the pre-study and when defining the scope. By referring to Clarke and Oxman (2001) Tranfield et al. (2003) explain that the initial stage can be an iterative process. That was the case for this study, where the scope was set, then revised and reformulated several times. Tranfield et al. (2003) also describe that experts should be included in the planning stage. In this case, the supervisor, the researchers, employees from Company X and literature were consulted when the scope was defined. After the scope was defined, the researchers concluded that they needed an understanding of existing knowledge within the research area. To fill the knowledge gaps, a systematic review was decided to be conducted.

Thereafter, key words connected to the knowledge gaps identified were defined. The key words were: "knowledge management", "project management", "product development", "knowledge reuse", "knowledge barriers", "purchasing" and "sub-process".

The last phase of the planning stage is to develop a protocol for the literature review. The protocol was created using an excel-file in which different search word combinations were listed. The protocol of the systematic review can be found in Appendix A.

Conducting the Review

The second stage presented in the picture by NHS Centre for Reviews and Dissemination (2001) as described by (Tranfield, et al., 2003) concerns the actual conduction of the review. The stage is divided into five different phases. All these phases will be described and related to the systematic review conducted in this Master's Thesis in the following paragraphs.

The first phase when conducting the review is to identify the research, that is, to identify for example keywords and search terms which can be derived from the scope. Within this Master's Thesis the key concepts were a part of both the proposal and protocol developed in the previous stage.

The second phase is to select studies. It is emphasized that one should describe the procedure to make the search replicable, a description that is done for this Master's Thesis in this chapter and Appendix A. To conduct the systematic review the database Scopus was used. While using Scopus the setting used was: *"Article title, Abstract, Keywords"* in the search field type. Before the actual literature search different search words that all are key words in the purpose and the research question, were identified, as described earlier. These main search words were: "knowledge management", "project management", "product development", "knowledge reuse" and "knowledge barriers". These search words were then combined in all possible combinations and searched for in Scopus. The number of results were noted and are to be found in Appendix A. Thereafter, the result was sorted on *"Cited by (highest)"*. The title and abstract of the ten most cited articles were read, and a qualitative decision was made by the researchers whether to move on

with each the article or not. For each article that was used, the title, authors, number of citations, a short summary of the article and some comments were listed in an excel file. After this was done, a new search was conducted, with the same search words but were also "purchasing" were added. By doing so, a more narrow and specified result was reached. With this new result the same procedure was done, that is, the result was sorted on cited, then the abstract of the 10 most cited articles were read. Thereafter, the same procedure was done, but "purchasing" was changed to "sub-process". When both "purchasing" and "sub-process" had been searched for, the next combination of main search words was searched for and so on.

The search resulted in 268 articles, before the title and abstract were read. After the qualitative evaluation of the abstract and title some studies were excluded, and 131 studies remained. However, within these 131 articles some doublets existed, which were excluded. After that exclusion 95 articles remained, see Figure 6.

The third phase within this stage is to evaluate the selected studies' quality. To ensure that the chosen studies were of good quality, the inclusion criterion of sorting *"Cited by (highest)"* was used. That many authors have chosen to cite the article in question should be a mark of good quality. Some articles found did however have only few or no citations, but since their content was relevant for this study, and they were found in a database were all articles have been peered reviewed, the quality was deemed to be sufficient and they were included despite the low number of citations. Furthermore, the quality of the studies was assessed when they were more thoroughly read.

The fourth phase is about data extraction and monitoring progress. In this Master's Thesis this was done ongoing throughout the review, as mentioned above, when a study matched the inclusion criteria details about the study were written in an excel file.

Lastly, the fifth phase is about data synthesis. By referring to Mulrow (1994) Tranfield et al. (2003) formulates research synthesis as: *"the collective term for a family of methods for summarizing, integrating, and, where possible, cumulating the findings of different studies on a topic"* (p. 217). During this phase, one main approach was used. However, when synthesizing data about barriers, the approach was slightly changed.

The starting point for both approaches was the list of articles that were gathered in the excel file. In the excel file the articles were sorted depending on which search they had shown up in. The researchers read all articles that had appeared when searching for a specific combination of words. After that was done, themes that occurred in several articles started to emerge. The themes were shortly summarized, before the articles from the next search were read. After a while, the summarizing paragraphs could be linked, and the final result of the search emerged.

When synthesizing articles about barriers the approach was slightly changed. That was because different barriers were not named the same in all articles, but they were similar. When reading articles about barriers, all barriers described were written down on a post-it. By writing down all found barriers on post-its these could then be clustered. When clustering post-its with barriers, groups with barriers emerged.

When reading the articles, some articles that was earlier thought to be relevant were shown not to be applicable to the context. These ones were therefore excluded. After this exclusion 14 articles remained. In Figure 6 the result of the search in terms of numbers of articles are presented.

Search Boundaries
- Scopus Abstract and Citation Database (Peer-Reviewed Material)
- English

Search terms

Main terms:
Knowledge Management
Product Development
Project Management
Knowledge Barriers
Knowledge Reuse

Sub terms:
Purchasing
Sub-process

Search with Citation Sorting
Included in top ten most cited among the search results

268 Articles

Exclusion Based on Title and Abstract
Title and Abstract reveals that article is not relevant

Exclude Doublets

95 Articles

Exclusion Based on Content
Opened and quickly scanned. If deemed relevant, used in the theoretical framework

14 Articles
Articles used in Theoretical Framework

Figure 6 The result from the systematic literature review in numbers of articles matching the inclusion criteria.

Reporting and Dissemination

The third stage in a systematic review is, according to the picture by NHS Centre for Reviews and Dissemination (2001) as presented by Tranfield et al. (2003) about reporting and dissemination. Tranfield et al. (2003) write that *"A good systematic review should make it easier for the practitioner to understand the research by synthesizing extensive primary research papers from which it was derived"* (p. 218). The stage consists of two different phases, where the first phase considers report and recommendations, and the second one is about how the evidence is getting into practice.

After the actions that were described in the previous step were done, the data was summarized into separate paragraphs that were not linked to each other. The researchers used the derived paragraphs as a basis for the theoretical framework. However, to make the data *"easier for the practitioner to understand"* (Tranfield, et al., 2003, p. 218), as the aim for this step implies, the paragraphs were combined with each other, but also with other literature that had been found as a part of the narrative review.

After the content from the systematic literature review was summarized and structured as described above, it was noted that many of the articles were old. There was consequently a risk they the gathered knowledge was not up to date, especially concerning knowledge management systems, since the technology has evolved during the last few years. The reason behind this is likely that the articles were sorted depending on citations, and that newer articles have not had the time to get as many citations as older ones. However, it was evident that there was a need for more recent literature. To ensure that the gathered literature enabled the researchers to present an up-to-date theoretical framework the researchers made additional searches for more recent literature in general, and regarding knowledge management systems in particular, as part of the narrative literature review.

2.3.2 General Online Search

Since there can be ways of working that are not documented in scientific articles a wider search online has been conducted. The search engine Google and the site YouTube were used. The search was of ad hoc nature and the researchers searched for successful cases and methods used for knowledge reuse. When searching, the researchers ended up at articles in magazines, blogs, companies' webpages and videos with for example interviews. The general online search made it possible to find more data that could be used in the analysis to enable answering the research question. However, the method has some risks, which are discussed in *2.6 Trustworthiness*.

2.3.3 Empirical Data Collection

This section describes empirical data collection methods that were used in the in-depth case study. The data collection methods were interviews, participant observations and studies of organizational documents.

During the empirical data collection, it was of interest to study both tacit and explicit knowledge (read more about the knowledge types in section *3.1.1 Tacit and Explicit Knowledge*). Explicit knowledge can be fully captured, shared and reused by being formalized, but the tacit cannot (Nonaka, 2007). It can therefore be argued that it is harder to study tacit knowledge reuse. To enable "capturing" also the tacit knowledge in this study, measures have been taken in both the formal interviews and the observations. The measures are described under two separate headlines describing respective data collection method.

Interviews

Within this study, two main kinds of interviews have been conducted. These were informal unstructured interviews and formal semi-structured interviews. According to Bryman and Bell (2015) unstructured and semi-structured interviews are the most common ones within qualitative research.

A summary of all interviews conducted can be found in Table 2 below. Both kinds of interviews will be described more in detail in the following sections, after an explanation of how the interview sampling was done.

Table 2 Summary of conducted interviews.

Interviews		
Structure	*Type*	*Quantity*
Informal Unstructured	Planned	9
	Unplanned	*Ongoing throughout study*
Formal Semi-Structured	Project Buyers	7
	Department Manager	1
	Commodity Buyer	1
	Process Developer	1

Interview Sampling

The sampling of whom should be interviewed differed in the pre-study and the main study. In the pre-study, when knowledge gaps appeared, an informal unstructured interview was scheduled with the purpose to fill the gap. When there was no new knowledge relevant for the pre-study arising from interviews, the data collection in the pre-study was considered done.

In the main study, firstly, it was decided that all Project Buyers mainly working with the studied type of development projects at the local site were to be interviewed. Hence, the sampling was dependent on available Project Buyers. When interviewing the last Project Buyers at the local site, the same themes occurred as in previous interviews, and not much new knowledge was gained. This can be compared to Marshall (1996) who states that *"An appropriate sample size for a qualitative study is one that adequately answers the research question"* (p. 523), which he continues to explain is when no new themes relevant for the research questions emerges from the data, something that can be referred to as data saturation.

In addition to the interviews with the Project Buyers, interviews were scheduled with other functions at Company X. This was done in similar way as in the pre-study, that is when knowledge gaps appeared, an interview was scheduled with the purpose to fill the gap. When there was no new knowledge relevant for the research questions arising from interviews the data collection was considered done, since data saturation was reached.

Informal Unstructured Interviews

Several informal unstructured interviews were conducted with the purpose of gaining understanding about the company and its processes. Informal unstructured interviews were used frequently in the pre-study, and in some occasions during the main study. An unstructured interview was chosen because it allows the respondent to speak freely about a subject of their expertise, which was preferable since the interviewers' knowledge was limited, especially during the pre-study. If the initial interviews would have been semi-structured some aspects could have been missed due to limited knowledge of the interviewers defining the questions. When conducting informal interviews notes have been taken. No recordings have been made, which in this study is one aspect that classifies it as an informal interview. The informal unstructured interviews that have been conducted could be divided in to two types. These were planned ones and spontaneous, unplanned ones.

Planned informal unstructured interviews have been meetings with a predefined topic of interest, conducted to create a foundation for writing interview questions for semi-structured interviews or to fill knowledge gaps. During the meeting the respondent was asked to freely explain e.g. a certain process. In total, nine planned informal unstructured interviews were conducted. Each one lasting for approximately one hour.

The other type of informal unstructured interviews has been spontaneous, unplanned ones, which filled knowledge gaps that became apparent during the study. They can be compared to conversations where the researchers asked employees questions during for example a coffee break. This type of spontaneous interviews has been ongoing throughout the study.

Formal Semi-Structured Interviews

In addition to unstructured interviews described in the previous section, 10 formal semi-structured interviews have been conducted. Semi-structured interviews were used because it allowed the respondent to speak relatively freely, and the interviewer could ask follow-up questions when appropriate, at the same time as there is an interview guide that ensures that respondents are asked the same main questions (Bryman & Bell, 2015). Hence, the use of semi-structured interviews benefits from the flexibility of an unstructured interview and the comparability of a structured one.

In these interviews extra measures were taken to study the use of tacit knowledge. Goffin et al. (2010) write that typical examples of tacit knowledge are e.g. intuition, insight, rules of thumb and practice. To study this, questions about respondents' background were asked, which indicated how much "know-how" (tacit

knowledge) it was likely that the respondent possessed. In addition, the interviews included questions regarding how frequent the respondent used his or her intuition versus for example searching for answers in standards.

Seven out of ten semi-structured interviews were conducted with Project Buyers. The other functions interviewed were a Department Manager, a Commodity Buyer and a Process Developer. How the interview guides were developed will be described in the following sections.

Developing and Pilot-Testing the Interview Guide for Project Buyers

When developing the interview guide used when interviewing Project Buyers, the systematic literature review and the data that had been collected from informal unstructured interviews worked as a basis. From the systematic literature review certain theoretical themes had emerged. From these themes, various questions were formulated. Since the questions in the interview were formulated based on the theory, answers to the interview could more easily be related and analyzed in comparison to theory later in the process.

When the first draft of the interview guide was developed it was sent to the supervisor at the university. The supervisor reviewed it and thereafter gave the researchers feedback. The researchers did some modifications to the interview guide grounded on the feedback given.

Thereafter, the interview guide was tested by one of the researchers on the other one of the researchers. The researchers realized that some background questions were missing, and hence added them. In the next step, a pilot interview with an employee at Company X was conducted. The importance of piloting the interview guide is emphasized by Bryman and Bell (2015). The data from the pilot interview was used in the analysis, in addition the pilot interview provided further insight in how the interview guide could be developed.

The revised interview guide, which included the changes from the pilot interview, was yet again reviewed by the supervisor. Based on comments from the supervisor some last changes were made, mainly the researchers assured that all questions were open-ended. According to Gill et al. (2008) *"In a qualitative research, good questions should be open-ended"* (p. 292). The open-ended questions gave the respondents the possibility to develop their answers.

During the first interview some minor flaws of the interview-guide was detected. Therefore, some minor adjustments were done after these findings. However, it was only changing of words and order of questions to enable a better flow during the interview. The final interview guide used to interview the Project Buyers is presented in Appendix B.

Developing Interview Guide Other Functions than Project Buyers

When the interview guides for other functions than Project Buyers were developed the researchers discussed what knowledge they aimed to gain during the interview. From this, questions were formulated, and new interview guides were created for each interview.

Interview Techniques

Before interviews were conducted interviewing skills or techniques were studied to strengthen the quality of the data collected. Kvale (1996) presents 10 criteria for the interviewer, which are: knowledgeable, structuring, clear, gentle, sensitive, open, steering, critical, remembering and interpreting. Measures were taken to ensure that these criteria were fulfilled by the researchers. As an example, to increase the researcher's knowledgeability the pre-study was conducted. Another example is that the interview guide

for the Project Buyers was tested and revised several times, as explained earlier, to ensure that the questions were clear and easy to understand. In addition, the researchers were flexible during the interview and changed the direction of the interview if the respondent was more knowledgeable in another area, something that relates to the criterion 'open' presented by Kvale (1996). This was done for example when a relatively newly employed Project Buyer was interviewed. The respondent's knowledge about the processes and procedures at the company was limited, and therefore the researchers adjusted the interview and spoke about other aspects in which the respondent had in-depth knowledge.

Conducting the Semi-Structured Interviews

All semi-structured interviews were recorded, and notes were taken. The software used for both taking notes and recording was Microsoft OneNote. When using OneNote, the notes taken are automatically connected to the recording at the time when the note is taken.

The two researchers divided tasks during each interview. Researcher A was the interview leader, asking all questions and steering the interview. Researcher B was taking notes and was also responsible for the recording. Researcher B also asked follow-up questions if something came to mind.

As mentioned, all Project Buyers at the local site working with the studied product development process at a daily basis were interviewed. Hence, seven semi-structured interviews with Project Buyers were conducted, each of which lasted for approximately one and a half hour.

Interviews were held in Swedish, all quotes are freely translated.

Observations

The observations have been divided into two types, ongoing everyday observations and planned participant observations. A summary of the conducted observations can be seen in Table 3. Both types of observations will be described more in detail in the following paragraphs.

Table 3 Summary of conducted observations

Observations		
Structure	*Occasion*	*Quantity*
Ongoing Everyday	N/A	*Ongoing throughout study*
Planned Participant	Department Meetings	3
	Project Purchase Tracking Meetings	3

Ongoing Everyday Observations

The first type of observation has been the ongoing everyday observation. These observations have been ongoing from day one throughout the study until the day when writing the final conclusions. The observations have been done by the researchers spending most weekdays at the company, participating in meetings, having lunch break and coffee break with colleagues and likewise. Furthermore, this has made the researchers part of the group, which leads to that the employees are relaxed in the presence of the researchers. This enabled the researchers to conduct planned participant observations without affecting observed meetings.

The second type of observations were conducted at specific occasions, those where department meetings and project purchase tracking meetings. They were observed more actively, compared to everyday observations. Observations were conducted until data saturation was reached.

Bryman and Bell (2015) describes different ways of taking field notes, within these observations what Bryman and Bell (2015) call *jotted notes* have been used. That is *"very brief notes written down on pieces of paper of in small notebook to jog one's memory about events that should be written up later"* (Bryman & Bell, 2015, p. 462). To ensure that as much as possible was being gathered from the observations the time directly after the observations was used to write down a more detailed description with clarifications of the jotted notes.

One aim of planned observations has been to look for the knowledge barriers that are described in literature, this to investigate whether they occur in the case, and if they are dealt with in any specific way. In addition, during the observations, methods to ensure that also tacit knowledge is considered have been used. Goffin et al. (2010) write that mechanism for generating and sharing tacit knowledge include e.g. story-telling and usage of metaphors. When observing the researchers have therefore taken extra notes if any of these mechanisms occur.

Documents

Another source of data has been organizational documents such as standards describing different processes accessed via Company X's intranet. These were compared to the interviews and participant observations.

2.4 Analysis

The analysis was done in two steps. One preparatory step were the empirical data was categorized, and thereafter the main step were the empirical data was analyzed using the theoretical framework.

2.4.1 Categorizing Empirical Data

Data was, as described, collected through observation and interviews. After each interview or observation, the researchers reflected on the collected material by reading and clarifying the notes. The researchers in addition noted if any of the collected material could be significant for answering the research questions. This was done by writing comments in the transcript or making a certain part bold. Some patterns started to appear after a few interviews and observations, however the researchers did not categorize the collected data until all planned interviews with the Project Buyers (except one, due to it being postponed) and observations were done. Coffey and Atkinson (1996) write that "*many analyses of qualitative data begin with the identification of key themes and patterns*" (p.26). When all observations and interviews were done, the identification of themes and patterns began, hereafter called categories.

The categorization was done at one occasion. Graneheim and Lundman (2004) write that creating categories is the core feature of qualitative content analysis. They refer to Krippendorf (1980) who states that a category is a group of content that shares a commonality. To find commonality in the collected data, the researchers began by reading through the transcripts and writing takeaways on a post-it. In this step the text that was made bold and the researchers comments in the transcripts were helpful. In the next step, the researchers put the post-its in groups based on themes that occurred in the data. The groups defined the categories.

After categorizing the data, the researchers realized that there were some other professionals that could contribute with valuable input. Firstly, a Department Manager, to get a better understanding of how Company X worked with knowledge management on a higher level, and secondly a Commodity Buyer, since Commodity was mentioned in many interviews with Project Buyers. After those interviews were conducted, the new data was processed. At large, the new data fitted into the existing categories, however some minor changes were made. The categories built up by the collected data are the basis for chapter *7. Result.*

2.4.2 Analysis of Empirical Data and Theory

The categories that emerged were thereafter analyzed using the theoretical framework in the report. The researchers wrote down theoretical concepts on post-its and compared to the empirical data that already was written down on post-its (from the empirical data categorization). By doing this, new categories appeared, although they were in many occasions similar to categories created earlier which only included empirical data. The new categories were grouped in two categories on a higher level, more specifically methods for knowledge reuse and barriers.

2.5 Ethical Considerations

Within every research project ethical aspects need to be taken into consideration. Bryman and Bell (2015) summarizes four aspects regarding ethical considerations that was originally formulated by Diner and Crandall (1978), namely: Harm to Participants, Lack of Informed Consent, Invasion of Privacy and Deception. This section will further elaborate on ethical aspects and describe how these have been handled within this research project.

2.5.1 Harm to Participants

This principle states that any study should never risk harming the participants of the study (Bryman & Bell, 2015). Harm includes several aspects such as stress, physical harm, harm to career etcetera (Bryman & Bell, 2015). One action made to avoid harm was to be as transparent as possible before conducting an interview, so that respondents could asses if they wanted to participate. During the introduction of the interview, after the researcher had described the purpose, how the data would be further used and the structure of the interview, the respondent was asked if he/she were sure that he/she wanted to participate.

Furthermore, all respondents in formal interviews were informed that they could chose not to answer any question if they did not feel comfortable doing so. In addition, they were informed that they had the possibility to end the interview at any time, without having to explain why. Another measure taken to ensure that no harm to participants would occur was that all respondents were offered to be anonymous. However, they were asked if they felt comfortable with being referred to as their role, e.g. Project Buyer.

All means taken to ensure that there was no harm to the participant during formal interviews were not done in informal interviews. This was because informal interviews did not have the same structure, since they mostly aimed to let the researchers gain understanding of the processes in place. Furthermore, information gathered in informal interviews were not recorded, consequently no quotations were included in the report. Therefore, the risk of causing harm for a respondent participating in an informal interview was low.

Another thing that can be offered to respondents to ensure that they are not being harmed is to have respondent validation which, as Bryman and Bell (2015) put it, *"is a process whereby a researcher provides the people on whom he/she has conducted research with an account of his or her findings"* (Bryman & Bell, 2015, p. 401). However, by having respondent validation the trustworthiness can be affected, both in

positive and negative ways, which will be further discussed in section *2.6.1 Credibility*. In this study two respondents were offered respondent validation.

There were two underlying reasons why two respondents were offered respondent validation. One related to ethical aspects, and one related to trustworthiness, the latter will be elaborated on in section *2.6 Trustworthiness*. The reason related to ethical considerations was that in some cases the respondent had a unique role in the company, and by referring to the title of the respondent, the identity would be known by the ones familiar with the company. Having no respondent validation in such case would have created a risk of harming the respondent. Therefore, in such cases, the respondent had the possibility to read through key takeaways from the interview and decide whether the respondent should be referred to as "the respondent" or his/her title.

2.5.2   Lack of Informed Consent

The second consideration is informed consent which Bryman and Bell (2015) explain as: *"prospective research participants should be given as much information as might be needed to make an informed decision about whether or not they wish to participate in a study"* (p. 139). To deal with this ethical issue all participants have been as informed as possible about the study before starting the interview, as described above. However, Bryman and Bell (2015) underline the difficulties of giving a participant all information needed to make an informed decision. This have been especially true in this study due to the research strategy that outlines an iterative process where the research questions and purpose have changed during the project, and therefore not even the researchers knew where the project would end up when the data was collected.

An ethical issue occurred when participant observations were conducted, regarding whether the employees should be informed when they were observed. By letting people know that they are being observed, one can get informed consent. On the other hand, letting someone know they are observed risks changing their behavior. To avoid the risk of changed behavior, but still taking the ethical aspect into consideration, the Department Manager was consulted and confirmed that observations could be conducted. Another dimension that made it more ethically defendable to conduct observations during meetings was that all participants in the meetings knew that the researchers were writing their thesis, and that the researchers were continuously gathering data.

2.5.3   Invasion of Privacy

The third ethical consideration listed by Diner and Crandall (1978), via Bryman and Bell (2015) is invasion of privacy. According to Bryman and Bell (2015) this aspect is similar to informed consent, and therefore many actions described that enable informed consent also helps avoiding invasion of privacy. One mean taken to avoid invasion of privacy was that all respondents in the formal interviews were being informed that they did not have to answer any question if they did not feel comfortable doing so. In addition, providing anonymity was a measure taken against invasion of privacy.

2.5.4   Deception

The last one of the ethical considerations is deception, which "*occurs when researchers represent their research as something other than what it is"* (Bryman & Bell, 2015, p. 144). To ensure that deception did not occur the researchers have transparently described the research to all respondents. Another part of avoiding deception is by correct use of references.

2.6 Trustworthiness

To ensure that conclusions made in this study can be trusted, an evaluation of the methods used is made in this section. The evaluation is based on Lincoln and Guba's criteria for trustworthiness (Bryman & Bell, 2015). They write that trustworthiness can be divided into four parts: credibility, transferability, dependability and confirmability. In the following sections the four criteria for trustworthiness will be discussed in relation to this study.

2.6.1 Credibility

Bryman and Bell (2015) describe credibility as the research's *"acceptability to others"* (p. 401). According to Shenton (2004), who refers to Merriam, credibility relates to the question *"How congruent are the findings with the reality?"* (p. 64). During this study several actions have been taken to ensure credibility:

- Respondent validation
- Triangulation
- Anonymity
- Categorized of empirical data firstly performed after saturation
- Made risks with general online search visible
- Use of checklists
- Awareness of the risk of going native
- Processing of interview data

These actions will be further described in following paragraphs.

Firstly, one action that can be done to strengthen the credibility of a study is respondent validation, which has both positive and negative aspects. On one hand, the respondent who provided the data gets to confirm that the data is correct, which ensures that the researchers understood the respondent correctly. On the other hand, as Bryman and Bell (2015) explain, respondent validation can cause defensive reactions from the respondents. It was therefore not done in this study, except in two occasions, as described above. Furthermore, Bryman and Bell (2015) question whether the respondents are the right ones to evaluate the analysis. In this study, the ones offered respondent validation due to ethical considerations, as described earlier, only had the possibility to validate the result from the interview and not from the analysis. In addition, in cases where interviews were conducted to enable mapping of processes, for example mapped methods that enable knowledge reuse used at Company X, a respondent validation was performed. This was because that kind of information was not sensitive, but factual. Respondent validation was therefore done to ensure trustworthiness.

Secondly, triangulation was done, which Bryman and Bell (2015) argue increase credibility. The describe triangulation as confirming data from one method with data from another source. As an example, in this research standards were compared to what was being said in interviews and observed in observations. In addition, barriers identified during the interviews have been confirmed during the observations, and vice versa.

Thirdly, another action to strengthen the research from both an ethical and a trustworthiness perspective was to provide anonymity when conducting the formal semi-structured interviews. This has been described in relation to ethical considerations but can also be mentioned in relation to trustworthiness, and more

specifically credibility. By letting respondents be anonymous they are more likely to tell exactly what they think, even if it is critical towards the company or likewise.

Fourthly, the researchers chose to not categorize the data from interviews and observations until saturation was reached. This was to not let the data collected in early observations and interviews affect the categorization to a disproportionate extent.

Fifthly, another aspect that affect the quality of the thesis is the "general online search". It led to two sources that were used in the thesis. The sources were two experts in the field of knowledge management. Interviews with the experts were watched, and the website of one of the experts was studied. The sources found are not as reliable as peer-reviewed scientific articles. When using such sources in this thesis the authority of the author has therefore been examined. For example, if looking at an interview with a person on YouTube, a search on who the individual is have been done to be able to evaluate his/her credentials. Furthermore, such experts are less likely to describe weaknesses in the methodologies or recommendations they provide, since they are dependent on marketing themselves and their methods as successful. Information from those sources is therefore less trustworthy. When using information from such sources in the thesis, it has been explicitly written so that the reader is aware of the risk that the source is less trustworthy. In addition, information from such sources has been compared with other theoretical and empirical findings.

Sixthly, checklist provided by Bryman and Bell (2015) have been used, to ensure that actions that should be done in different phases of a research study were not missed. The used checklists were:

- Criteria for evaluating research questions
- Planning a research project
- Ethical issues to consider
- Issues to consider for your qualitative interview

Seventhly, a risk occurs if the researchers spend much time at a company, as during this study. The risk can be referred to as going native, that is that the researchers stop being objective and start seeing everything from the organization's point of view. Mays and Pope (1995) describes it as *"Once "inside" there is the problem of avoiding "going native"; that is, becoming so immersed in the group culture that the research agenda is lost"* (p. 183). To deal with the risk of going native the researchers had a frequent communication with the supervisor at the university. In addition, the researchers analyzed all empirical data in comparison to theory. By doing so, the conclusions should be less affected by the organization's point of view, since it has been analyzed using objective theory.

Lastly, another credibility aspect of the interviews that could be questioned is that the interviews were not transcribed. The risk is therefore higher that the researchers missed something relevant that was said. However, due to that the researchers thoroughly went through their notes directly after the interviews with the support of the recorded audio, the risk was decreased

2.6.2 Transferability

The second criterion of trustworthiness is transferability, which is about whether the research and its findings can be applicable and used in other situations, both at the same organization but at a different point in time, and at another organizations (Bryman & Bell, 2015). The empirical findings of the thesis are based on one company, and within this company only one group of employees have been studied. What the findings indicate are barriers and recommendations for how to manage those barriers can therefore be argued to be valid only for the studied case. The transferability of the findings can thus be discussed.

However, the transferability has been increased by comparing and analyzing collected data in relation to theory. Another thing that have been done to increase the transferability is by describing the case in which the findings have been made, which can be related to a *thick description* presented by Geertz (1973) (Bryman & Bell, 2015). By thoroughly describing the case in with the conclusions have been drawn, anyone can read the description, which makes it possible for the reader to make an evaluation whether the conclusions are valid in other cases or not.

The transferability of the findings is discussed in detail in section *6.2 Transferability of Findings.*

2.6.3   Dependability

Dependability relates to reliability, which is about ensuring that if the work would be done all over again, using the same procedures, the result would be the same (Shenton, 2004). The importance of dependability is emphasized by Bryman and Bell (2015) when they discuss the aspect that qualitative research is difficult to replicate, as a critique against qualitative research. To ensure the dependability within this study all methods used has been written down throughout the project in this report. Describing how the study has been done and how all data has been gathered is one way to ensure the dependability (Shenton, 2004). Bryman and Bell (2015) also emphasize the importance of keeping records throughout the process.

2.6.4   Confirmability

Bryman and Bell (2015) write that one should recognize that "*complete objectivity is impossible in business research*" (p. 403). Further they write that the researcher should strive towards being as objective as possible and emphasize the importance of not letting personal values influence the conclusions. One action taken to ensure this has been described earlier, namely triangulation, which according to Shenton (2004) can increase confirmability. Bryman and Bell (2015) also state that another risk with qualitative research is that it can be too subjective. The actions made to ensure the confirmability, also decreases the amount of subjectivity. In addition, as described previously, the researchers conducted the systematic literature review to decrease subjectivity in the literature review.

3 Theoretical Framework

In this chapter the result from the literature study is presented. It is divided into six parts. The first part shortly describes concepts within knowledge management. The second part presents theories regarding individual learning, which is followed by theories about motivation. Next, three methods and practices for knowledge reuse are described. Thereafter aspects of knowledge management systems are presented. The last section focuses on knowledge barriers.

3.1 Knowledge Concepts

This section is a brief introduction to some knowledge concepts. Firstly, the terms tacit and explicit knowledge are explained. Thereafter follows a presentation of knowledge push and pull. Lastly, roles involved in knowledge management are introduced.

3.1.1 Tacit and Explicit Knowledge

Two fundamental terms in the field of knowledge management are tacit and explicit knowledge. The concept of tacit knowledge was described by Michael Polanyi in his book *Personal Knowledge: Towards a Post-Critical Philosophy* in 1958 (Polanyi, 2015) and popularized by Ikujiro Nonaka in an article from 1991 (Nonaka, 2007). Nonaka (1991) describes explicit knowledge as formal and systematic. It can therefore be communicated and shared, some examples of such knowledge are product specifications or a scientific formula. Further, Nonaka (1991) describes tacit knowledge. Tacit knowledge is hard to make formal, it is deeply personal. It can consist of technical skill or a craftmanship which is hard to communicate to others, it is a certain "know-how". Nonaka (1991) cites Polanyi, *"We can know more than we can tell"* (p. 165). Tacit knowledge in addition has a cognitive dimension, based on mental models and perspectives that are so deeply rooted in an individual that they are hard to articulate By Morgan and Liker (2006) tacit knowledge is described as hard to transfer or sticky.

Tacit Knowledge in Product Development and Purchasing

Tacit knowledge is according to Zammit et al. (2018) important in product development:

> *"In today's global marketplace, employee knowledge is seen as a crucial asset for organisations, which enables them to gain a sustainable competitive edge over competitors. Much of the knowledge generated during new product development and testing can be categorised as tacit, developed from employees' personal experiences and perceptions during product development projects; this makes it more difficult to capture and document for future sharing and reuse"* (Zammit, et al., 2018, p. 2286)

Morgan and Liker (2006) have studied Toyota's product development system and what makes it successful. They write "*The ability to learn and continuously improve may be a lean product development system's most powerful competitive weapon. Within this framework, it is the tacit, "know how" knowledge that is most potent, the most difficult knowledge to foster and manage. There are no short cuts or IT solutions.*" (Morgan & Liker, 2006, chapter 11). Toyota work consistently with their tacit knowledge management. At Toyota, it is important that the relationship between individuals sharing tacit knowledge is deep, so that people can share their insights. Sharing of tacit knowledge at Toyota mostly occurs face to face and one to one.

Tacit knowledge is used also in purchasing, according to Giunupero et al. (1999). They concluded that tacit knowledge, or common sense, was used in decision making by purchasing managers. Furthermore, they state that their findings indicate that purchasing managers uses approximately tacit knowledge half of the time and formal data the other half.

There are also indications that tacit knowledge is needed in negotiation, which is a fundamental part of working as a purchaser, when for example discussing with suppliers. When Nadler et al. (2003) conducted a study on which learning methods that are the most beneficial in training negotiators their findings showed that the method that gave the highest outcome on the achievement was the one where the ones who had participated in the method were not able to formulate what they had learned. They conclude that *"They were apparently learning something useful that they could not really articulate"* (Nadler, et al., 2003, p. 538). That they could not articulate the learnings indicate that it could be tacit knowledge, in relation to the definition by Nonaka (2001) presented earlier.

Tools for Tacit and Explicit Knowledge Sharing
There are several methods and tools supporting knowledge management. Carillo et al. (2012) divide them into tools focusing on tacit knowledge and tools focusing on explicit knowledge. Tools focusing on explicit knowledge are project review files, intranets, expertise database, lessons learned documents, best practice sheets, wikis, audit documents, defects avoidance systems and feedback systems. Tool focusing on tacit knowledge are post project reviews, project meetings, consulting individuals, communities of practice, technical forums, brainstorming sessions and conferences or trainings.

Knowledge Creation and Conversion between Tacit and Explicit Knowledge
Nonaka (1991) state that new knowledge always begins with an individual having an insight or likewise. Making that personal knowledge available to others is a vital activity for a knowledge-creating company. To make the knowledge available to others it needs to be transformed between tacit and explicit knowledge. In total, there are four kinds of conversions that can be done between the two knowledge types.

The first conversion type described by Nonaka (1994) is socialization, transfer from tacit knowledge to tacit knowledge between two individuals. This can be done without words, for example when an apprentice learns by observing and practicing. To gain tacit knowledge, experience is an important factor. The second one is from explicit knowledge to explicit knowledge, called combination. It is a social process that combines explicit knowledge from two individuals. It can take place for example in a meeting or over telephone. During this transformation information may be reconfigured or recategorized. The two last conversions are both involving explicit and tacit knowledge. Internalization, to make explicit knowledge tacit, bears according to Nonaka (1994) some notion of what traditionally is called learning. In the externalization process – going from tacit to explicit – Nonaka (1994) argue that metaphors play an important role: "*Metaphor is not merely the first step in transforming tacit knowledge into explicit knowledge; it constitutes an important method of creating a network of concepts which can help to generate knowledge about the future by using existing knowledge*" (p. 21).

3.1.2 Knowledge Push and Pull
Knowledge push and pull are two other terms that are used within the knowledge management field. The terms knowledge push and pull are discussed by Holtshouse (1998), who uses the term "flow" to explain them. Flow is "*what facilitates the connections between seekers of specific knowledge and the providers of needed knowledge*" (Holtshouse, 1998, p. 278). The flow can be seen in different ways depending if having

the perspective of a knowledge provider or a knowledge seeker. A provider might see it as a selective pull process, while a knowledge seeker might perceive it as a selective push process. For a provider it can be hard to know who needs the knowledge. He/she might be forced to guess in advance what knowledge might be asked for and organize it accordingly. For a seeker, the question is known, but maybe not where to find the answer. Holtshouse (1998) recommend a balance between the pull and push process. Furthermore, he writes that systems and environments that enable a flow of knowledge can deal with the issue of information overload, since it can provide people with an awareness of what is needed and access to it.

Edwards et al. (2005) identified a tension "*between ''pushing'' information and knowledge out to people and leaving them to ''pull'' it when needed*" (p.123) when studying knowledge management systems. Their findings show that pulling systems are preferable.

3.1.3 Roles in Knowledge Management

Another concept used within knowledge management is different roles and their tasks in the knowledge management process. Markus (2001) present three major roles related to knowledge management, the knowledge producer, the knowledge intermediary and the knowledge consumer. The knowledge producer records explicit knowledge or makes tacit knowledge explicit. The knowledge intermediary arranges the knowledge so that it more easily can be reused, by for example summarizing it, packaging it and disseminating or facilitating it. The knowledge consumer retrieves the knowledge and uses it in some context. These three roles can be "played" by the same or by different individuals and groups, or some combination. Hereafter in this report the roles referred to will be knowledge consumer as described by Marcus (2001) and knowledge provider. Knowledge provider will include two roles, both knowledge intermediary and producer. That is because this thesis topic is reuse, and hence it is not in focus if the source of knowledge is the producer or the intermediary.

3.2 Individual Learning Theories

All organizations consist of individuals. Kim (1993) states that it is the individuals in an organization that ultimately makes the organization learn. As mentioned in the scope, knowledge is, in this Master's Thesis, seen as a subjective contextual construction, meaning that knowledge cannot be transferred but must be redeveloped by each individual (Paulin & Suneson, 2012). With this background, it is of interest to consider how an individual learn to develop methods for knowledge reuse. The following sections will therefore describe individual learning theories.

3.2.1 Learning Anxiety and Survival Anxiety

Coutu (2002) introduce two concepts, both closely related to learning: "learning anxiety" and "survival anxiety". Learning anxiety occur because of the fear of learning something new, one can "*fear that it will become too difficult, that we will look stupid in the attempt*" (Coutu, 2002, p. 104). The other anxiety, survival anxiety is when one realizes that one must learn and change to achieve something. It is only when survival anxiety is greater than learning anxiety that learning will take place. Hence, learning can be achieved by either increase the survival anxiety by, as an example, usage of threats or monetary rewards, or by decreasing the survival anxiety which can be done by striving towards a safe environment for employees. In Coutu's (2002) opinion the later, decreasing learning anxiety, is the preferable option. The employee should not feel forced to learn, instead the employees should understand why they need to learn certain things, he concludes: *"There will always be learning anxiety, but if the employee accept the need to learn, then the process can be greatly facilitated by good training, coaching, group support, feedback, positive incentives, and so on"* (Coutu, 2002, p. 105).

3.2.2 Active Learning

Bonwell and Eison (1991) defined active learning as *"anything that "involves students in doing things and thinking about things they are doing""* (p. 19). Furthermore, several reports state that active learning is needed (Bonwell & Eison, 1991). One example is Michael (2006) who authored the article *"Where's the evidence that active learning works?"*. He concludes *"There IS evidence that active learning, student-centered approaches to teaching physiology work, and they work better than more passive approaches"* (Michael, 2006, p. 165).

3.2.3 Multitasking

Another concept that can be connected to individual learning is multitasking. Multitasking occur when a person deals with more than one task at the same time (Oxford, n.d.). Ellis et al. (2010) write that multitasking is done by continuous context switching. Furthermore, they write that existing research has shown *"that multitasking reduces the brain's ability to effectively retrieve information"* (Ellis, et al., 2010, p. 1). This statement is strengthened by Junco (2012), who claims that multitasking leads to lower performance. Hence, multitasking can affect an individual's ability to learn.

The consequences of multitasking have been investigated within education by several researchers. Many studies have shown that multitasking has a negative effect on the grade and hence the students' performance. Some examples are Ellis et al. (2010) and Kraushaar & Novak (2010). In addition, Adler and Benbunan-Fich (2012) conclude that multitasking has a potential negative effect when it comes to performance, however their studies have shown that *"some multitasking actually improves productivity, but too much multitasking has a negative effect"* (p 167). Another aspect that is stated by Adler and Benbunan-Fich (2012) is that multitasking can give an impression of being more productive.

In a study performed by Buser and Peter (2011) they designed and conducted an experiment comparing three groups, one that was forced to multitask, one forced to work in sequential order and one group that could organize their work as they wanted. After the experiment they concluded that:

> *"Subjects who could choose the amount and timing of their switches freely did only marginally better than those forced to switch at unanticipated points in time. Performance under the self-chosen work schedule is actually significantly lower than under the exogenously imposed sequential work schedule. This suggests that subjects fail to choose their own schedule optimally. This finding of inability to organize one's own work optimally is not unprecedented"* (Buser & Peter, 2011, p. 12).

Hence, based on their result one can argue that multitasking is lowering the performance independent if it is self-chosen or forced, compared to sequentially performing tasks.

3.3 Motivation

To enable knowledge reuse in an organization, one can argue that employees must be motivated to both transfer and reuse knowledge. Therefore, motivational theories are of interest to study.

Ryan and Deci (2000) explains motivation as *"To be motivated means to be moved to do something"* (p. 54). They further explain that motivation can vary in both amount and type, and distinguish between two main types of motivation, namely intrinsic and extrinsic motivation. The difference between the two is that intrinsic motivation appears when a person is *"doing something because it is inherently interesting or enjoyable"* (Ryan & Deci, 2000, p. 55), while extrinsic motivation appears when a person does something to gain from its outcome.

One can argue that there are similarities between survival anxiety and extrinsic motivation. As an example, one way to increase the survival anxiety was by using rewards (Coutu, 2002), which can be considered extrinsic motivation since then the employee is motivated by gaining that reward.

3.3.1 Job Characteristics Model

Hackman and Oldham (1976) present a model called "The Job Characteristics Model", which they describe as a model that *"specifies the conditions under which individuals will become internally motivated to perform effectively on their jobs"* (p. 250). The model consists of three psychological states: *Experiences Meaningfulness of the Work*, *Experienced Responsibility for Outcome of the Work* and lastly, *Knowledge of the Actual Results of the Work Activities*. They argue that to ensure internal work motivation all these psychological states need to be present to a high degree. Within this thesis, internal and intrinsic motivation are used as synonyms.

To achieve the first state, experiences meaningfulness of the work, Hackman and Oldham (1976) identify three job dimensions which need to be high. These are skill variety, task identity and task significance. Firstly, skill variety is the variation of skills required when doing the work. Secondly, task identity is *"The degree to which the job requires completion of a "whole" and identifiable piece of work; that is, doing a job from beginning to end with a visible outcome"* (Hackman & Oldham, 1976, p. 257). Thirdly, task significance is the degree to which the task affects other peoples' lives or work.

To achieve the second state, experienced responsibility for the outcome of the work, autonomy is by Hackman and Oldham (1976) presented as a core job dimension. They define autonomy as *"The degree to which the job provides substantial freedom, independence, and discretion to the individual in scheduling the work and in determining the procedures to be used in carrying it out."* (Hackman & Oldham, 1976, p. 258).

To achieve the third and last psychological state, knowledge of the actual result of the work activities, Hackman and Oldham (1976) mean that feedback is a crucial job dimension. They define feedback as *"The degree to which carrying out the work activities required by the job results in the individual obtaining direct and clear information about the effectiveness of his or her performance."* (Hackman & Oldham, 1976, p. 258). The importance of positive feedback in relation to intrinsic motivation has also been examined by Harackiewicz (1979), who argues that positive feedback increases intrinsic motivation.

In sum, the Job Characteristics Model by Hackman and Oldham (1976) shows five core job dimensions for enabling internal motivation. The five dimensions are skill variety, task identity, task significance, autonomy and feedback.

3.4 Methods and Practices for Reusing Knowledge

In this section three methods and tools that promote knowledge reuse are described. These are project debriefings, storytelling and knowledge cafés.

3.4.1 Project Debriefings

Knowledge management in project-based environments face many challenges, this since each project is unique, which creates a discontinuity in for example personnel, materials and information between projects (Bresnen, et al., 2003). However, as Schindler and Eppler (2003) write, systematic project learning enables an organization to develop competencies that create a competitive advantage. Schindler and Eppler (2003)

therefore stress the importance of carrying out for example project debriefings to enable cross-project learning.

Project reviews, or postmortems, are an important part of the "learning organization", according to Williams (2007). Trees (2018) describe a study of six organizations which investigated how organizations manage the knowledge that comes out of large, complex projects. Most of the organizations asked project teams to identify lessons learned at key points throughout the project. Lessons learned are a widely accepted method for recording improvements to project and work activities (Michell & McKenzie, 2017). Companies commonly transfer experiences between projects by using lessons learned (Schacht and Maedche, 2016). The organizations in the study described by Trees (2018) differed in how the processes were designed, but in general the lessons learned sessions included discussions around what went well, what went wrong and what should be done differently in the future. The lessons learned where for example used to update project-related advice and standards. However, Trees (2018) warn that many organizations put lessons-learned repositories in place and then fail to distribute and reuse the knowledge collected there. Some additional issues with commonly used processes to handle knowledge in projects, such as lessons learned, are mentioned by Michelle and McKenzie (2017). For example, they write that lessons learned databases are often overloaded with information, but rarely used because of lack of succinct and common data structure and missing contextual information and definition of value to the learner. Williams (2007) further mention lack of employee time and lack of management support as barriers for undertaking lessons learned. He also mentions that formal processes assist, but the culture and structure of the organizations are key factors that facilitate the process.

Success Factors in Project Debriefings

Schindler and Eppler (2003) identify key success factors for effective project debriefing methods. One factor is that it is beneficial to regularly capture the most important project experiences directly after milestones with the entire project team, in contrast to only doing it in the end of the project. This is because the events are more recent and consequently learnings can be recalled more easily. In addition, it is easier to gather whole project team during the project compared to when the project is done. Another key success factor is to use an external, neutral moderator during the debriefing workshop. It is also recommended to strive to gain a commitment and action related to the gathered insights, that is, possible forms of implementation and who should be responsible for them.

Ways to make reflection events succeed are also identified by Morgan and Liker (2006). They stress the importance of holding the reflection as soon as possible after the event. One should also focus on things that can be controlled by the group. Furthermore, criticism must be allowed, but no personal attacks. Participants need to feel that they can express their opinions without fear of repercussion. The reflection events need to be regular so that people see the activity as part of their everyday job. Lastly, one must update standards and processes, "*Just talking about it doesn't fix it. The end result of each event must be some concrete, observable improvement or people will view these events as worthless and stop participating*". (Morgan & Liker, 2006, chapter 11).

Methodology for Reuse of Knowledge Between projects

Schacht and Maedche (2016), researchers within the knowledge management field, have developed their own methodology to increase knowledge reuse. The research that lies behind the methodology was based

on a case study of a large financial service provider; however, their findings can be argued to be applicable in other contexts as well.

The basis of their methodology is a double-cycled lessons learned process. One cycle consists of lessons learned sessions that focuses on recapitulation, that is, coping with events that have happened in the project. The project team goes through key events in the project and try to make the lessons learned created in the project useful for projects in the future, by for example putting them into standards.

The other cycle consists of lessons learned sessions where the team focuses on preparation, that is, finding old knowledge that can be useful in the current project. As a first step in a preparation session, the team identifies knowledge sources that may be relevant for the project. After the knowledge is identified, it is assessed and rated. Further Schacht and Maedche write:

> *"From all selected project insights, the team together estimates the probability of the event described in this finding*
> *and tries to rate its impact on the project. Here, for example, methods used in risk management can be applied."*
> (Schacht & Maedche, 2016, p. 34)

Throughout the project, lessons learned sessions of both types should be conducted several times. When starting the project, the team should begin with a preparation session, and when closing the project, a lessons learned session focusing only on recapitulation should be done.

In addition, to improve the lessons learned sessions, Schacht and Maedche (2016) introduce two roles that should be present. One role is the lessons learned expert, who organize and moderate the session. The other role is a topic expert who is experienced within the area, becomes a consultant for the project and who also should prepare lessons learned for the project.

Project Postmortem Stories and Reports
Desouza et al. (2006) separate between two common outputs from project postmortems, such as lessons learned sessions focusing on recapitulation. These are postmortem reports and postmortem stories. Postmortem reports are template-based presentations of lessons learned, with a pre-defined structure. Often, they include analysis of issues and thing that went well. The pre-defined structure of a postmortem report makes it less resource demanding to fill in, and the structure makes it possible to more easily run automated searches through them. Postmortem stories are semi-structured and can be more difficult to write since there is no template. They can also be harder to comprehend. On the other hand, a story can capture the project context better, and a story is also more likely to be remembered than a standardized report. Desouza et al. (2006) state that for a familiar project, a report is sufficient. If the project is unique, significant and peculiarities have occurred it can be valuable to capture the knowledge from the project in a story.

3.4.2   Storytelling
To share stories can also be done orally. Storytelling is one of the oldest ways of transferring knowledge (Katusáková, 2015). Several researchers have stated that storytelling work as a transfer mechanism (e.g. Swap et al., 2001; Sole & Gray Wilson, 2002). Swap et al. (2001) defines an organizational story as *"a detailed narrative of past management actions, employee interactions, or other intra- or extra-organizational events that are communicated informally within the organization"* (Swap, et al., 2001, p. 103).

Stories enables externalizing tacit knowledge (Perret, et al., 2004). Swap et al. (2001) highlight that storytelling can act as a mechanism for leveraging an organization's knowledge in general and tacit

knowledge in particular. Sole and Gray Wilson (2002) state that *"Research suggests that sharing experiences through narrative builds trust, cultivate norms, transfer tacit knowledge, facilitates unlearning, and generates emotional connections"* (p. 1), however, they also argue that the success of storytelling depends on the chosen situation and on clear goals with the knowledge transfer. In their article, they write that storytelling is not always the most appropriate method, but storytelling's flexibility and its handiness are two of its benefits. They list kickstarting a new idea, socializing with new members, mending relationships and sharing wisdom as contexts where stories can be useful. They stress the importance of always having a clear motive and being sure on why a story should be told. They continue to argue that one should strive toward *"using more than one medium"* (p. 10).

There are more studies that show that storytelling has a positive effect on knowledge sharing. For example, Katusáková (2015) performed a study in which she compared knowledge sharing via storytelling and a slide presentation, when she later tested this she reached the conclusion that *"the results of knowledge transfer were significantly better in favour of story"* (p. 1) Another example is provided by Gouvêa et al. (2017). Gouvêa et al. (2017) conducted a study in an educational setting where their result "*showed that narratives can be excellent vehicles for communication and dissemination of knowledge and when supported by a computer system can generate positive results.*" (p. 369).

3.4.3   Knowledge Café

Another method for reusing knowledge is the knowledge café, a concept presented by David Gurteen (n.d. a) who has studied conversational leadership and has worked within the field of knowledge management for over twenty years. This section describes the underlying idea and benefits of a knowledge café and lastly how a knowledge café can be run. The knowledge café is a method that was found via the general online search, see section *2.3.2 General Online Search*. This section is based on information from the knowledge café website and recorded interviews with and presentations by David Gurteen.

The Idea of a Knowledge Café

At the knowledge café website (Gurteen, n.d. b) it is argued that within the complexity we live in today, it is not possible for one single individual to know everything. Hence, individuals need to collaborate to solve issues and challenges. It is further written that *"One of the best ways to make sense of an issue or challenge and ultimately make better decisions and to innovate is to bring a diversity of people together in open conversation, in dialogue. The Knowledge Café is the ideal tool to achieve this."* (Gurteen, n.d. b). In an interview on YouTube posted by Flimt (2009), David Gurteen describes a knowledge café as *"... a simple process for bringing people together to have a conversation around a topic of mutual interest ... the café is not about debate, the café is about dialogue, the café is about having open learning conversations where people are looking to learn from each other rather than try to win an argument."* . The knowledge café is as a setting where people can have open and creative conversations (Gurteen, n.d. c).

In the interview on YouTube posted by Flimt (2009) Gurteen describe that it is not rare that people rush to decisions, without understanding the topic. He further explains that the main idea of a knowledge café is not to make decisions or to make sure that everything that is said is written down and captured, instead he argues that the outcome of a knowledge café is what people have captured in their heads when leaving the café. The knowledge gained during a knowledge café is often about understanding different perspectives, and in the prolongation understand actions that other people make, due to that their perspective is different.

How to Run a Knowledge Café?

In a recorded presentation by David Gurteen on YouTube, see Gurteen (2006), it is explained that the leader of a knowledge café should summarize the topic and present one or two questions to the group. Gurteen (n.d. c) explains that the leader should not talk too long, maximum 10-20 minutes In the interview on YouTube uploaded by Flimt (2009) Gurteen further says that the leader should in addition in the introduction encourage people who know that they talk much to listen a bit more than usual, while the quiet ones should strive for talking more.

In the same interview, Gurteen explains that the bigger group of participants are after the introduction divided into smaller groups, in which the question(s) are discussed. During the knowledge café the small groups are changed a couple of times. If a person is taking over and dominating one conversation, the leader can speed up things and let the participants change groups, that because then the behavior might change.

When presenting the idea of the knowledge café Gurteen (2006) also explains that within the small groups there should not be a leader appointed. He argues that a leader would probably feel responsibility to report back, and hence taking much notes, and while doing so missing the opportunity of truly engage in the conversation. This is not an arrangement where the groups need to report back at all.

3.5 Knowledge Management Systems

There exists plenty of literature regarding technological solutions that support knowledge management (Schacht & Maedche, 2016). IT-systems supporting knowledge management are often called knowledge management systems. Kulkarni et al. (2006) explains knowledge management systems as:

> "*any system that automates the input, storage, transfer, and retrieval of knowledge. These may include contextual taxonomy for knowledge (meta knowledge), systems for capturing various types of knowledge from useful lessons learned, systems for classifying knowledge documents, systems for locating the relevant experts, technology to facilitate sharing of expertise (groupware, videoconferencing, and so on), repositories for structured as well as unstructured information, and so on*" (p. 315).

That is, the term knowledge management system includes many types of software with various functions. According to Riege (2005) there is a discussion within the field of knowledge management on whether knowledge management should be people-driven or technology-driven. In the discussion some authors argue that knowledge sharing should be adapted to social dynamics at the workplace, not focus on technology. However, as Riege (2005) write, IT-systems are an important support function that can make knowledge management more effective.

3.5.1   Personalization and Codification

Hansen et al. (1999) studied management practices in several industries, initially management consultancy firms, to see what approaches there were to create successful knowledge management. In short, they found two ways of dealing with knowledge. They named the first one codification, where "*knowledge is codified using a "people-to-documents" approach: it is extracted from the person who developed it, made independent of that person, and reused for various purposes*" (p. 108). The second one, called personalization, focuses on "*dialogue between individuals, not knowledge objects in a database*" (p. 108). Hansen et al. (1999) argue that a company needs both these strategies to some extent, but should focus on one, having approximately an 80-20 split. There are several questions a manager needs to ask before choosing main strategy, among others regarding if the employees rely mostly on explicit or tacit knowledge. If the answer is tacit, the recommended main strategy is personalization and vice versa.

Ventkitachalam and Willmott (2017) does also emphasize the importance of finding a balance between personalization and codification. They write that both strategies can be supported by knowledge management systems, but different types. For example, codification can be supported in document management systems and enterprise information portals, while personalization can be supported by an email, online forums and organizational yellow pages.

Desouza et al. (2006), who researched the use of knowledge management systems within the software industry, also stress the social aspect of knowledge management. They suggest that knowledge management systems should encourage person-to-person communication and not only direct people to directories, since it is hard to capture expertise in databases.

3.5.2 Factors Affecting Usage of Knowledge Management Systems

It has been studied what can make people use an IT-system supporting knowledge management more frequently (e.g. by Schacht and Mädche, 2013; Watson & Hewett, 2006). Watson and Hewett (2006) specifically studied what makes individuals use knowledge from a knowledge repository, not only contribute to it. They found three motivating factors. The first one was that the systems should be easy to use, and employees needs to be trained in how to use the system. Secondly, if the individual trusted the knowledge, it also made them use the repository more frequently. The last factor that made individuals reuse knowledge from the repository was if they found the knowledge valuable. Schacht and Mädche (2013) investigated a similar area, more specifically what design principles one should use when developing a knowledge management system that would increase individuals' intention to reuse existing project-related knowledge. The first design principle is about ensuring access to both experts and expertise. That is, a knowledge management system should include both possibilities to look for documented knowledge and ways to find experts that can share their internalized knowledge. The second design principle is that a knowledge management system should provide contextual and packaged information in structured documents. This could be done by having a mix of pre-structured documents that eases documentation and free-text fields to provide more contextual information. The third design principle is about maintenance, which can be enabled based on feedback regarding usefulness of the project insights. Schacht and Mädche (2013) write that useful feedback is a form of incentive, and it is important to provide incentives to increase willingness to share and reuse knowledge.

3.5.3 Different Types of Knowledge Management Systems

As mentioned earlier, there are several different types of knowledge management systems. Majchrzak et al. (2013) chose to differentiate between traditional knowledge management systems (documents repositories, e.g. Microsoft SharePoint), conversational knowledge management systems (e.g. blogging and discussion forums) and Wikis, explained as a *"…technology [that] allows multiple people to work on the same document without overwriting each other's changes, and with the advantage of keeping track of each other's contributions"* (p. A3). Majchrzak et al. (2013) have mainly studied company wikis, but in their Appendix A they summarize some features of the different types of management systems and their challenges.

Majchrzak et al. (2013) explain that traditional management systems rely on only a few experts. This leads to a bottleneck, where the few experts may not have time to share their knowledge to all who need it. Further, centralized maintenance of the knowledge may lead to limited and delayed updates. This does in turn lead to decay of the knowledge in the knowledge management system. On the other hand, the information in the knowledge repository is almost always correct. This is not always be the case in

conversational knowledge management systems, but that type of system has other benefits. For example, conversational knowledge management system does not have a bottleneck issue, since the knowledge is produced by large numbers of small contributors. However, an issue with conversational systems is that the knowledge usually is organized based on time. Often, this creates redundancy, and makes the systems less user friendly, which Majchrzak et al. (2013) explains as "*thread readers may find themselves in a position where the search for an answer requires the reading of an entire thread with conflicting information, repetition of the same answers and comments, comments that add little value, and comments that possibly divert from the original topic*" (p. A3). Majchzrak et al. (2013) further argue that corporate wikis address some issues with knowledge management systems that the other systems do not. Knowledge in a wiki is organized by topic. New knowledge can be easily integrated, which will make knowledge reuse easier. In addition, wikis enable deletion of old knowledge that has been outdated.

An example of a conversational knowledge management system is company social media. Neeley and Leonardi (2018) studied two larger companies during the implementation and first period of usage of company internal social media sites. One company used the site Yammer, and the other the site Jive. They write that theory on social media use for knowledge sharing suggest that when employees use social media sites and see colleagues' interactions, it can increase trust which in turn makes it easier to connect. Further, they write "*Once they establish these connections, employees can learn what those employees know and they will know how to approach them in ways that increases their likelihood of receiving knowledge from them*" (p. 926). However, Neeley and Leonardi's (2018) empirical findings show that company social media sites do not always work that well. They identified three phases during the implementation and usage of the social media sites in the companies that they studied, where the two first phases were positive for knowledge sharing, but the last phase showed a decline in the usage of the sites. The first phase was characterized by curiosity, employees were interested in the site, and wanted to know and shared both work-related and nonwork-related information. The second phase was characterized by three mechanisms. Mechanism number one, called social lubrication, was about people learning about their coworkers and creating trust. The second mechanism, knowledge sharing, included employees actively seeking help from specific individuals. The third mechanism was encapsulation at the firm level, meaning that those who found relevant knowledge used it in their own work, and further in some occasions included it in company-wide routines.

In the last phase employees decreased their usage of the sites, despite the positive effects that occurred in the second phase. That was because of a fear that the nonwork-related activities would make them look like they were focusing too much on socializing rather than working. Consequently, there was also less interesting nonwork-related content on the sites which made them less attractive to use. However, Neeley and Leonardi (2018) propose that a more positive outcome from a social media site should be possible, to prolong the positive effects that occurred in phase two. To achieve that outcome, leaders must make sure that the employees understand that they are safe from professional risk, and that it is acceptable also to engage in nonwork-related content on the social media sites.

3.5.4 Challenges with Knowledge Management Systems

As mentioned earlier, much of literature that touches the subject of knowledge management systems has been produced. According to Schacht and Maedche (2016), one must be aware of that some of the literature might be outdated, especially in the context of information technology where significant innovation has taken place in recent years. For example, researchers have noted that just putting knowledge in databases and make it accessible is not a working solution since it is only used sporadically. Further, they write that

even if the knowledge management system belongs to more traditional systems or are more modern (such as wikis), most of them does not fulfill what is needed for efficient knowledge management. Schacht and Maedche (2016) in addition suggest that "*many KM systems designed by researchers and practitioners neglect results gathered in behavioral science*" (p. 28). However, Schacht and Maedche (2016), who present their own methodology for knowledge reuse between projects (shortly described in *3.4.1 Project Debriefings*), state that modern knowledge management system technologies play an important role in their methodology. They write that "*nearly all phases of the knowledge centric project management can be supported by modern communication and collaboration technologies*" (p.42).

Another issue with current practices related to knowledge management systems is described by Stan Garfield in an interview on YouTube made by the channel Major Projects Knowledge Hub (2018). In the interview, Stan Garfield is presented as a knowledge management author, speaker and community leader. Stan Garfield states that companies he worked with often have the systems they need in place, instead the issue for some companies is that they have too many systems active at once, that the systems do not interrelate and that employees use different systems. He recommends that such companies should narrow down the number of systems.

3.6   Knowledge Barriers

Several researchers have studied the area of knowledge barriers (e.g. Paulin & Winroth, 2013; Riege, 2005; Goh, 2002). Different factors have also been categorized in various ways. Paulin and Winroth (2013) categorize the factors into facilitators, inhibitors and obstacles. Facilitators are factors with positive influence on knowledge dispersion, inhibitors factors with negative influence on knowledge dispersion and obstacles factors that obstruct knowledge sharing until certain levels or conditions are fulfilled. In this report, all inhibitors and obstacles will be referred to as barriers, since both of which are hindering knowledge sharing and hence reuse. When analyzing barriers, one shall remember that they are often intertwined, and combinations of them exist in most organizations (Riege, 2005).

The following sections present different barriers and facilitators and how they are clustered and classified within this report. In the following chapters the clusters will be referred to as barriers.

3.6.1   Trust

Trust is a recurring concept when reading about knowledge barriers (e.g. Paulin & Winroth, 2013; Riege, 2005). Trust can be divided into two parts; whether the knowledge recipient trust the accuracy of the received knowledge and whether the sender trust people enough to share the knowledge with them (Riege, 2005). Hong et al. (2011) point out the importance of trust when they refer to Barson et al. (2000), who write that a person will most likely not use knowledge that they do not trust. If studying tacit knowledge trust is also a crucial barrier, according to Cumberland & Githens (2012), something that is also mentioned by Okoroafor (2014).

3.6.2   Fear of Job Security and Competitiveness

Another cluster of barriers that have been identified relates to fear and competitiveness. Riege (2005) describe a barrier related to people's fear that sharing their knowledge may jeopardize their job. He writes that sharing knowledge might mean that the employee loses power or status within the company. Closely related to this barrier is another barrier described by Riege (2005) which is that a person is not be willing to share knowledge, or intellectual property, if they fear that they will not receive well-deserved recognition. Hong et al. (2014) also emphasizes the same aspect, when they refer to Barson et al. (2000) and internal

resistance. They state that by sharing knowledge the person possessing it can experience it as a disclosure. Other barriers presented by Riege (2005) relates to competitiveness between different business areas, subsidiaries and functional areas, both externally and internally.

3.6.3 Time Availability and Prioritization

The third cluster of barriers identified is time availability and prioritization. A facilitator mentioned by Paulin and Winroth (2013) is available time. Even if appropriate structures and processes are put in place, employees need an opportunity to use them, and the organization need to free time for employees to engage in knowledge sharing activities (Goh, 2002). Riege (2005) write that *"general lack of time to share knowledge, and time to identify colleagues in need of specific knowledge"* (p. 23), is a barrier. He also states that time restrictions may lead to people hoarding their knowledge instead of sharing it.

3.6.4 The Value of Knowledge Reuse is Not Realized

The fourth cluster of barriers that was identified is when the value of knowledge sharing and reuse is not realized. Riege (2005) formulate a barrier as: *"low awareness and realisation of the value and benefit possessed knowledge to others"* (p. 23). Another critical failure factor is if the knowledge management image is erroneously perceived (Akhavan & Pezeshkan, 2014), which is closely linked to understanding the value of it. Akhavan and Pezeshkan (2014) further mention that a critical failure factor is if the results of knowledge management work is not related to the routine tasks. Lastly, one barrier that is relating to the realization of value is presented by Riege (2005) and a barrier he describes as *"lack of leadership and managerial direction in terms of clearly communicating the benefits and values of knowledge sharing practices"* (p. 26).

3.6.5 IT-Systems

The fifth area of barriers is connected to risks that comes with IT-systems. Riege (2005) write that technology can act as a facilitator for knowledge sharing processes, since it creates access to large amounts of data, and makes long distance collaboration possible. Paulin and Winroth (2013) also classify IT-systems as a facilitator. However, Riege (2005) list some issues with an IT-system that can hinder knowledge sharing, and hence knowledge reuse. Lack of support for the system, lack of compatibility between processes and IT-systems and a mismatch between individuals' needs and the IT system are some examples. He states that to succeed with knowledge sharing, one main factor is to have modern technology that provide a sharing platform accessible to those who may need it.

A third part that is relevant when discussing barriers that are related to IT systems is described by both Riege (2005) and Paulin and Winroth (2013). They discuss barriers that concern usability and risks if employees are not confident in using the IT-systems. Paulin and Winroth (2013) refers to Attewell (1992) whom concludes that one potential obstacle could be "technical know-how", explained as that employees need to know how to use new technology to be able to adopt it. This is also emphasized by Riege (2005) when he presents three barriers that all relates to that employees needs to be familiar with IT systems to be likely to use them.

3.6.6 Individual Differences

Another group of barriers that has been identified is individual differences. One part of this cluster is differences in age and gender, which is emphasized as something that can inhibit, and hence become a barrier, by both Riege (2005) and Paulin and Winroth (2013). Riege (2005) also states that barriers can occur if individuals have different experiences or education levels.

3.6.7 Geographical and Cultural Distance

Both Riege (2005) and Paulin and Winroth (2013) mention geographical distance as a factor affecting knowledge sharing. Paulin and Winroth (2013) categorize it as an inhibitor, meaning that it has a negative influence on knowledge sharing but does not obstruct it. Riege (2005) argues that the distance makes basic communication harder, however, there are tools, such as IT-systems with groupware applications, that can make communication easier despite the distance. However, Riege (2005) state that the creation of trust-based relationships will be more challenging when employees are not able to meet face to face frequently, and as written above, trust is an important factor for knowledge sharing and reuse.

Another factor of distance is cultural differences and language barriers. Riege (2005) write that these factors cannot be ignored by companies that rely on sharing practices between international subsidiaries. That language can be a barrier is also stated by several authors, for example it is mentioned by Hong et al. (2011) who refers to Bures (2003). Paulin and Winroth (2013) list both linguistic distance and cultural distance as inhibitors.

3.6.8 Organizational Culture

Knowledge sharing is also influenced by the organizational culture. Riege (2005) conclude that one barrier is if *"existing corporate culture does not provide sufficient support for sharing practices"* (p. 26). McDermont and O'Dell (2001) studied how cultural barriers affect knowledge sharing. They state that culture is often seen as the key inhibitor of effective knowledge sharing. In an organization with a knowledge sharing culture, employees share because they find it natural, not because they are forced to. There is an assumption that sharing is the right thing to do. McDermont and O'Dell (2001) further describe how they have found many examples of well-designed knowledge management tools and processes that did not work because people felt that they were already sharing enough, or management didn't clearly support the knowledge management initiative. They also emphasize the importance of building the knowledge management system so that is fits the culture, since it is hard to succeed when working against an organizational culture.

Riege (2005) emphasize the importance of culture in relation to knowledge management, he writes *"Knowledge sharing practices often seem to fail because companies attempt to adjust their culture to fit their KM [Knowledge Management], instead of implementing them so that they fit their culture"* (p. 28). In addition, Akhavan and Pezeshkan (2014) emphasize the importance of culture when concluding "*Lack of KM-oriented culture in organization*" (p. 34) as a critical failure factor when considering knowledge sharing. The importance of culture as a barrier is also pointed out in relation to tacit knowledge by Cumberland and Githens (2012), who's findings furthermore where strengthened when Okoroafor (2013) evaluated them.

3.6.9 The Organization and Its Processes

The next cluster that has been identified is related to the organization and its processes. Within this cluster different dimensions can be found.

The first dimension is concerning the hierarchy and bureaucracy at an organization. By referring to Disterer (2001) Hong et al. (2011) conclude that bureaucracy can be a barrier. Furthermore, Riege (2005) states that strong hierarchical organization structure can negatively affect the knowledge process and become a barrier. He also explains that one barrier can occur if communication flows are delimited to certain directions, such as top-down. Related to how the organization is constructed, one can mention that Riege (2005) also

highlights that the business units are sometimes too big and, as a consequence, contact facilitating sharing can be hindered.

Another dimension, related to the organization's construction, is the physical layout of the organization. Riege (2005) formulates one barrier as: *"physical work environment and layout of work areas restrict effective sharing practices"* (p. 26). He also mentions another barrier connected to the physical layout, which is if there is a lack of spaces where knowledge can be shared and generated.

As the third dimension, both Riege (2005) and Paulin and Winroth (2013) emphasize the proper processes and basic infrastructure is needed. Paulin and Winroth (2013) write that the issue of infrastructure can be seen as an obstacle, by referring to Gold et al. (2001).

Lastly, Riege (2005) mentions one barrier that can occur if the strategy of knowledge management and included sharing incentives are unclear or not existing within the overall goals and strategy of the company. The knowledge management strategy needs to be aligned with the company goals to have a better chance of success.

3.6.10 Communication
Another group of barriers that have been found concerns communication. According to Riege (2005) one barrier on the individual level is about verbal and written communication. He also argues that different interpersonal skills can become a barrier. However, Paulin and Winroth (2013) write that confusion can arise when talking about communication and transfer channels as barriers. They instead state that it can be both a facilitator or an inhibitor.

When studying barriers related specifically to tacit knowledge (within franchising) communication can also be argued to be a common barrier according to Cumberland and Githens (2012). However, that is questioned by Okoroafor (2013) who argues that: "*Communication cannot be defined as a barrier to the sharing of tacit knowledge within franchise organizations because it is the common thread that binds all tacit knowledge-sharing activities, being only an impartial mode of transmission between the giver and receiver of tacit knowledge.*" (Okoroafor, 2014, p. 100).

3.6.11 Motivation and Incentives of Knowledge Sharing and Reuse
The last group of barriers that has been identified is motivation and incentives for knowledge sharing and reuse. According to Disterer (2001) a barrier can occur if the benefits received when transferring knowledge are not considered high enough (Hong, et al., 2011). Riege (2005) does also emphasizes how motivation and incentives can become a barrier when he states that *"Lack of transparent rewards and recognition systems that would motivate people to share more of their knowledge"* (p. 26). An "inefficient reward system" was also concluded a critical failure factor for knowledge management by Akhavan & Pezeshkan (2014).

3.6.12 Summary of Identified Theoretical Barriers

In Figure 7 the clusters of barriers identified are presented:
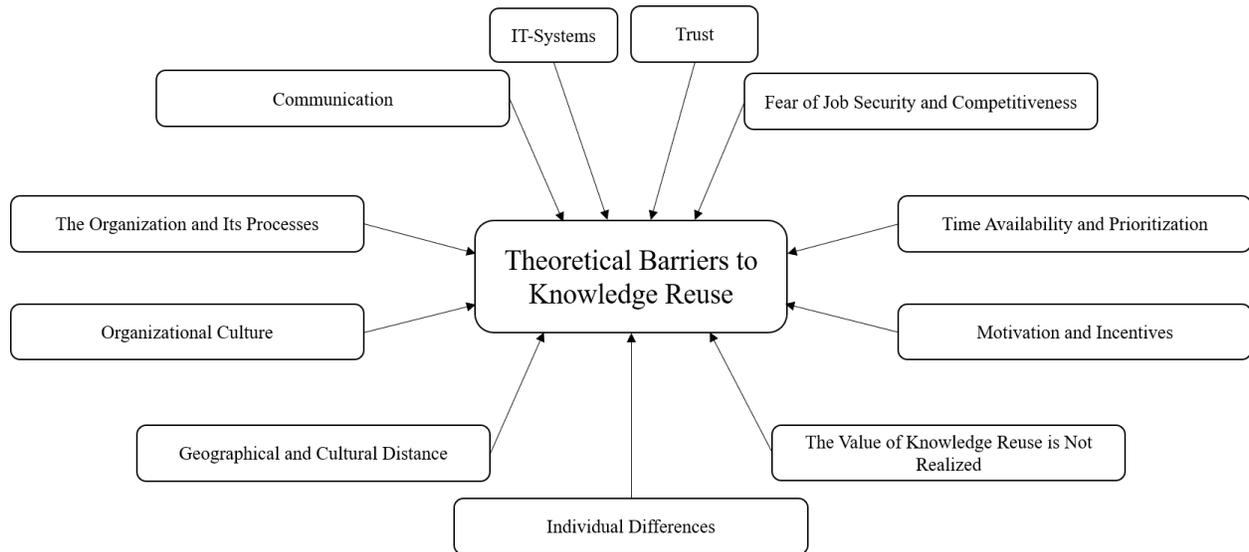
Figure 7 The clusters of barriers that have been identified from the theory.

4 Result of the Empirical Study

In this chapter the result from the case is presented. Firstly, the product development process that Company X uses is described, followed by a presentation of the purchasing sub-process. The next section focuses on type of knowledge needed (tacit or explicit) when working in purchasing, since it can affect what methods are suitable for knowledge reuse. After that follows the result describing three methods used at Company X that includes tasks which are designed to make employees reuse knowledge. Thereafter follows sections describing meetings at the purchasing department at Company X, how purchasing uses knowledge management systems, how purchasing uses knowledge from other departments and lastly the company culture.

4.1 Company X's Product Development Process

Company X's standard describes the studied product development process as a structured process including a cross-functional team, designed to be able to deliver the right products in the right time at the right quality consistently. The process is a stage gate process and it is divided into five phases, as can be seen in Figure 8 below. However, the phases are sometimes overlapping. Before closing a phase, the project team needs to pass a tollgate, which is decided at a tollgate-meeting. At the tollgate meeting, among others, the Department Manager at purchasing is represented for decision making.
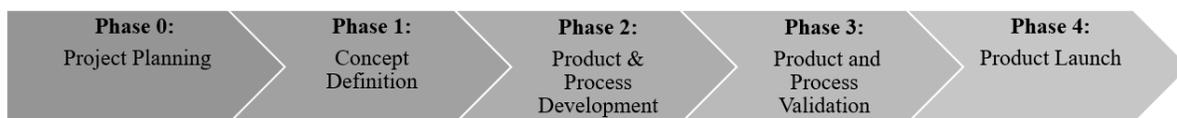

Figure 8 The studied product development process as described in Company X's standard

Phase 0 is the start of the project. It involves planning activities and ends with tollgate 0 where a development start approval is given.

Phase 1 focuses on concept definition. Risk evaluations for e.g. the product, business case and manufacturing process are performed. It ends with tollgate 1 where the concept is approved.

Phase 2 is the product and process development phase, which ends with tollgate 2 where the production definition is approved, meaning that the design is set.

Phase 3 is about product and process validation. Tools and equipment are ordered and installed. In tollgate 3 parts are approved for market use.

Phase 4 includes the start of production and product launch. In the last tollgate the project is closed and handed over to operations.

4.1.1 Functions Involved in Product Development Projects

A minimum requirement is that a product development team at Company X consists of representatives from engineering, manufacturing, logistics, purchasing (Project Buyer), quality (Supplier Quality) and sales. Each representative has different activities that he/she is responsible for, and local procedures or sub-processes that should ensure that the requirements at each tollgate is met.

Project Buyers

Project Buyers are, as their title implies, purchasers within different projects. They are responsible for identifying and negotiating with suppliers. Their tasks are described further under section 4.1.2. At the local site that has been studied, eight Project Buyers are employed, and seven work in the studied project development process on a daily basis. The group consist of individuals of various ages and genders.

Functions Collaborating Closely with Project Buyers

There are two functions that Project Buyers have a closer collaboration with, compared to other functions. Firstly, they collaborate with Supplier Quality, who are also a part of the product development team. Secondly, they collaborate with Commodity Buyers, who are not represented in the product development team.

Supplier Quality

During the case study, it has been apparent that there is a close collaboration between Project Buyers and Supplier Quality. As the title indicates, Supplier Quality are responsible for the supplier quality performance. They possess knowledge about suppliers and their manufacturing processes that is useful for Project Buyers. In product development projects, after the selection and negotiation performed by Project Buyers, Supplier Quality are responsible for securing quality parameters with the supplier.

Commodity Buyers

Commodity Buyers, among other things, supports Project Buyers in the projects. Hence, they are supporting projects without being a team member. Commodity Buyers are responsible for strategic purchasing. For example, they direct the Project Buyers and decide the split share if multiple sources are available. Commodity Buyers are split into segments or product areas, for example stamping or deep drawn stamping. Hence, they know more about a specific field. Furthermore, Commodity Buyers can also be Lead Buyers, meaning that they have the main responsibility for specific suppliers. Commodity Buyers take part in deciding which suppliers should be approached as possible suppliers for each component in a product development project. They support the Project Buyers in projects by answering questions about for example suppliers, and by doing so provide information can be beneficial in an upcoming negotiation. They also often participate in the final negotiation.

4.1.2 The Sub-Process of Purchasing within Product Development Projects

Within the product development process, Project Buyers are responsible for ten activities. However, they are involved in more activities throughout the process. The activities that purchasing are responsible for are shortly presented together in Table 4. In this section these activities and other tasks performed by the Project Buyer are described.

Phase	Activity
1	Select and Integrate Development Suppliers
1	Quotations for Prototypes and Feasibility Analysis
1	Obtain Quotations and Select Suppliers for all Key Components
1	Design and Process Review for all Key Components
1	Initial ERP Bill of Material Readiness
2	Order Design Validation Parts (if Applicable)
2	Request for Quotations to Remaining Component Supplier
2	Contract Review with Supplier
2	ERP Bill of Material Readiness
3	Serial Orders to Suppliers

Five out of ten activities are in phase 1, concept definition, which ends with tollgate 1. These activities are generally more directed towards prototype development and key components within the project. If the project needs prototypes or needs to develop components together with a supplier, it is what a Project Buyer firstly focuses on. Projects of this kind where a prototype is needed are rare. To find a prototype supplier, a Project Buyer gets some suggestions on suppliers to approach from a group of Commodity Buyers or from the project team. The key components go through a standardized sourcing process. The sourcing process is described further below, where the activities that are performed in phase 2 are presented, since this is when most of the components are sourced.

In phase 1 a Project Buyer furthermore do a carry-over check. That includes checking what components can be used from previous projects, where a supplier already exists, and evaluating when the supplier has capacity to produce for the new project as well. Another task that is performed by the Project Buyer within phase 1 is a risk assessment. It is called Control Level Definition (CLD) and is described further in section *4.3.2 Control Level Definition.*

Four out of ten activities that the Project Buyer owns in the product development process are in phase 2. The activities in phase 2 are "larger" and the main workload for the Project Buyers takes place in phase 2. First, if a prototype was needed in a project, the Project Buyer orders the tool. The following activities in phase 2 are in many cases related to the sourcing of the rest of the components. The Project Buyer gets suggestions on possible suppliers from a group of Commodity Buyers. These suppliers are asked to send a quotation, and in addition what is called a Team Feasibility Commitment (TFC), which is a document that deal with the more technical aspect of the component. Furthermore, the Project Buyer gets a "should cost" estimation from a team at Company X, that is a suggestion on what a reasonable cost for the component should be. In addition, the Project Buyer asks for logistics input about the components.

Thereafter, the Project Buyer begins to negotiate with the involved suppliers. A meeting takes place where the Project Buyer together with Commodity Buyers decide which supplier to suggest for a specific component. The suggested supplier is then presented at another meeting called Sourcing Board Review. The sourcing board either accepts or rejects the suggested supplier. If rejected, the Project Buyer goes into another sourcing loop. If accepted, the process can move forward. The Project Buyer together with other functions, then discuss a Contract Review together with the supplier.

In phase 3, the Project Buyer orders the tool from the supplier. From this step, the contact with the suppliers is mostly handed by Supplier Quality. Examples of tasks performed by Supplier Quality are to get a first component from the tool, make sure that the supplier's process work according to specifications and that they can keep up the production speed as agreed. However, the Project Buyer and Supplier Quality work tightly through the entire project, but the Project Buyer is more active in the early phases and Supplier Quality is more active in the later phases.

4.2 Knowledge Needed in Purchasing

During the processes described above, there are several occasions where knowledge is being reused. In some cases, it is explicit knowledge, for example standardized steps a purchaser should do in a project, written down instructions explaining how to use IT-systems etcetera. However, all knowledge that is needed is not explicit and easy to articulate, and therefore likely tacit. As an example, one guiding document separated "key components" from the rest of the components in a product. When a Project Buyer was asked about how to classify what is a key component the answer was:

> *"It is a bit hard to explain, but that kind of articles that are of big importance and more complex"*
>
> - Project Buyer

The researchers' interpretation was however, that the Project Buyer knew how the components should be classified, but had a hard time articulating it.

Hence, what is defined as a key component is not standardized and depends on a gut-feeling. Another task where the findings suggest that tacit knowledge is needed for a Project Buyer is when negotiating.

4.2.1 Reuse of Knowledge in Negotiations

Negotiations are one of the main tasks in any purchasing function. In total, four out of seven interviewed Project Buyers spoke about negotiation in ways that indicated that tacit knowledge is needed when negotiating. For example, it was mentioned that one uses instinct or uses one's gut feeling.

There were situations where a Project Buyer could not clearly express what had made the negotiation successful. An example is when a Project Buyer explained that he/she had just said "No" in a negotiation, which in that case was a winning strategy. The respondent explained that it is hard to summarize in a lesson learned when it is appropriate to just say no. It is too context dependent. The Project Buyer was following his/her gut feeling telling him/her how to act.

In addition, different Project Buyers uses different techniques and approaches when negotiating.

> *"Negotiations are very hard, one can do it in different ways. Everybody has their way, in which they strongly believe."*
>
> - Project Buyer

The respondent continued by describing two colleagues, using two different strategies. One colleague used a strategy based on analyzing documents and the other colleague used a strategy based on emotions. Another Project Buyer described negotiations as:

"Negotiations are a just a grey area."

- Project Buyer

The respondent continued by explaining that knowledge regarding negotiations with a supplier is heavily dependent on what relation the purchaser has with the supplier. Hence, one cannot simply write it down in a document to enable reuse of knowledge. The Project Buyer further explained that he/she reuses knowledge about suppliers, that is, what is learned about a supplier in one project he/she can use in the next project.

A Project Buyer that have been at purchasing at other companies, and in other roles, described that negation skills are something that he/she has been able to use from previous employments.

"What I have been able to take with me is that I do not have a problem to communicate with suppliers, and to negotiate is also something that I have taken with me."

- Project Buyer

The findings indicate that knowledge about how to negotiate with specific suppliers is difficult to reuse by only writing it down, since it has a tacit dimension. Even though there are difficulties when it comes to reuse of knowledge within negotiations, some ways have been identified.

Project Buyers have been at negotiations courses arranged by external actors. Also, some employees at the purchasing department has arranged negotiation workshops in which Project Buyers can exchange ideas and knowledge.

Another Project Buyer described a method he/she used in negotiating, which included reviewing old projects with similar products and what prices the suppliers had accepted that time. Thereafter, the respondent explained that he/she summarized the data and used it as a negotiation leverage against the supplier. The Project Buyer explained that he/she used arguments as *"if you could do it for this price the last time, how come you need that much more now"*. Such kind of negotiation strategy is easy to explain using words, and possible to write down, meaning that it is explicit. The negotiation strategy was shared by the project buyer with his/her colleagues during a workshop.

4.3 Organizational Methods Promoting Knowledge Reuse

At Company X there exist several methods that promote knowledge reuse. Three of those have been studied in this Master's Thesis and are described in this section. The first one is Company X's lessons learned process. The second one is the CLD-task in the project development projects, which among other includes identifying problems that have occurred with components in the past. The third one is a task or tool used to reuse knowledge by engineering called Product Design Configurator (PDC).

4.3.1 Lessons Learned Process

At Company X the methodology lessons learned is used to share knowledge. The method includes lessons being written down and distributed. Learnings related to purchasing can derive from two origins, namely product development projects or from anyone within the purchasing department in their daily work. The

processes for these lessons will be described in the following sections. Within the company there are additional ways from which learnings can occur, such as problem-solving projects and in production. These additional ways do commonly not include purchasing and are not described further.

Lessons learned within Development Projects

Within every development project a meeting collecting all lessons learned made within the project is mandatory before tollgate 4. In the global standard it is also stated that it is mandatory with a lessons learned session before tollgate 1, but in the local standard it is described as optional. In other phases, the activity of collecting lessons learned is optional. One respondent suggested that the lessons learned process could be improved by making it mandatory to discuss lessons learned before every tollgate.

Before tollgate 4, when lessons learned are mandatory, the project group should have a lessons learned session where learnings made during the project are summarized into a presentation. At tollgate 4 the lessons learned are presented. Next, the Project Manager is supposed to communicate the lessons to concerned Group Manager or Department Manager.

Thereafter, the learning is submitted into a main document of lessons learned (an excel sheet). One can also create a "one-pager" which is a short description of the lesson. The lesson and explanatory one-pager are presented at a so-called Q-first meeting. When filling in the main document (the excel sheet) and the one-pager, one must also describe a proposed action to ensure that the lesson is taken into consideration in the future. The action could be to update a standard, inform about the lesson at a department meeting or updating the PDC (which will be described in section *4.3.3 Product Design Configurator*) or to update another design or process document.

The aim with lessons learned is to update process or design document in such way that the learning will be dealt with the next time a similar situation occurs. However, there is a possibility that all learnings cannot be stored in design and process documents. When a Process Developer got asked about the issue of lessons that cannot be fitted into a standard or likewise, the answer given was:

> *"Many times, one like to strive towards what is perfect, and when one succeeds it is of course good, but it is better to succeed to with a part than nothing at all. The brain is still an amazing knowledge bank."*
>
> - Process Developer

The Process Developer further explained that even if the brain is an amazing knowledge bank, there is a risk that the knowledge disappears if just letting it reside in employees' brains. If the employee retires or end their employment for any other reason, knowledge will be lost. Another respondent described a similar issue, that it can be hard to distribute knowledge that does not fit in a document, and that it easily gets lost.

If a standard is updated, for example due to a lesson learned, every manager that is concerned by the update is responsible for spreading the updated version within the department. At Purchasing when a standard is updated, it is firstly presented at a department meeting, where it is possible for employees to ask questions. Thereafter, every updated standard is registered in a column in and excel sheet. In the excel sheet every employee at the department have a row with their name. When they have taken part of the new updated standard they fill in an "X" in the excel-file. A schematic illustration of the excel-file can be seen in Table 5.

Table 5 How Company X follows up when a new standard is updated.

	Standard A	Standard B	Standard C	Standard D	Standard E	Standard F
Employee 1	X	X		N/A		
Employee 2	X	N/A	X	X	X	X
Employee 3	X	X	X	X	X	N/A

After every employee that is concerned by the standard has ticked in the box that they have taken part of the update, the manager can report back to the Q-first meeting that the standard has been spread at the department. When the proposed action described in the main lessons learned excel sheet or on the one-pager is done, for example changing and spreading a standard, the lesson can be closed. All closed lessons learned are reported as a key performance indicator (KPI).

The idea with the Q-first meeting is to go around the table and ask whether anyone has any new lesson, some update on an existing lesson, or if an existing lesson can be closed. However, the procedure is unclear during the meeting. Usually, one does not go around the table in a structured way. Instead someone brings up a lesson where something has happened or a newly created lesson, and that lesson is discussed.

Perception of the Lessons Learned done in a Project

As explained above, there is a process designed to ensure that learnings gained are stored and reused.

However, five out of the seven interviewed Project Buyers expressed that they could not see the value of lessons learned originated from the product development projects. One Project Buyer explained it as follows:

> *"My general perception is that [the company] is not good at working with lessons learned. It is constantly like 'Oops, how could things go this wrong? We must learn from it, we must take it into the next project, so we think about it'. And then, you start the next project, and then, you do not look at the lessons learned. It is a great flaw according to me."*
>
> - Project Buyer

The same respondent expressed that the flaws in the lessons learned process could be due to the intensive work environment. There is no time to reflect after projects, instead one rushes into the next project.

Three of the interviewed Project Buyers furthermore did not know what happened with the lessons learned created in projects or how to retrieve old Lessons learned. One Project Buyer stated:

> *"Often one usually has a meeting right before the project is closed, in which one writes down things that one think, or that one has learned from the project and one writes down these on little notes, and then one discusses the notes within the project group, if there is anything that other project can gain from knowing. Then, the Project Manager brings them to some lessons learned meeting that I do not know anything about."*
>
> - Project Buyer

Another respondent expressed it as follows:

> *"Where it is stored and so… Not a clue… It ends up in an archive somewhere and you cannot find it again".*

- Project Buyer

Since there is some uncertainty about what happens to the lessons learned, one can assume that it is hard for Project Buyers to see the value of the method. This was evident when a Project Buyer was asked how the project lessons learned are a support in his or her daily work. The Project Buyer stated that the lessons learned does not contribute at all.

In addition, it was proposed by Project Buyers to have more than one lessons learned session during a project.

Lessons Learned when Starting up a New Project

All lessons learned are, as described above, collected in a main excel sheet that everyone can access. However, after this means are taken to ensure that different learnings are stored for reuse in process and design documents. If there are learnings that have not yet been implemented in standards it is the Project Manager's responsibility to *"check if there are relevant LL that are still not implemented and share with project team."*, as described in a local standard. Whether this is done is not sure. When talking to an employee, he/she stated that no one checks new lessons learned in the start of a new project.

To revisit lessons learned in the start of a product development project was suggested as a possible improvement by both the Purchasing Manager and a Project Buyer.

> *"It feels like, for me who is not in any group that is working with lessons learned, I do not receive anything of what has been discussed, except from what I have in my project that I have experienced, but there are several of other projects that I do not hear anything from. So, it could be interesting to have some kind of lessons learned kick-off in the startup."*

- Project Buyer

Lesson Learned at the Purchasing Department

The second type of lessons learned are learnings made at the purchasing department. The learnings can be everything from minor insights that can simplify for colleagues, to learnings that concerns the whole organization. When a learning is made, the one that made the learning is supposed to write it down in an excel-file in which all learnings from the purchasing department are collected.

As mentioned above, all department meetings have time dedicated to lessons learned. During the dedicated time the excel-file with the lessons learned created by employees at the purchasing department is opened and all new lessons are supposed to be discussed. All new lessons are explained by the one that has submitted it. Thereafter, the lessons learned is further discussed by the entire group. The group decide whether the new learning is worth spreading to someone else at the company (other departments or the whole tech center). If someone is missing the department meeting it is their responsibility to check the excel-file and make sure that they have not missed lessons learned.

If the learning is considered of value for another department it is spread to the department in question by the Department Manager of purchasing. If the lesson is considered of interest for the tech center the main

lessons learned excel sheet described above is filled in as well as a one-pager. It is presented at the Q-first meeting, following the same procedure as the learnings that derived from a development project presented in the previous section.

One improvement suggested by a respondent was to have a matrix in an excel-file which everyone needs to fill in when they have taken part of a new lessons learned. The matrix was supposed to work the same way as when standards are spread, as presented earlier (see Table 5).

Perceptions of the Lessons Learned at the Purchasing Department

A Project Buyer stated that it is possible that he/she has gained knowledge when learnings were discussed during department meetings. However, the Project Buyer also stated that he/she has never entered the excel-file with learnings from the purchasing department to read any previous learnings if he/she missed a meeting. He/she also stated that it is most definitely some learnings in that file that he/she does not know about. The Project Buyer continued by concluding that purchasing's local excel-file of lessons learned have become like a *"black hole"*.

Summary of the Lessons Learned Process

In Figure 9 a compilation of how the lessons learned process proceed in a purchasing perspective is presented.
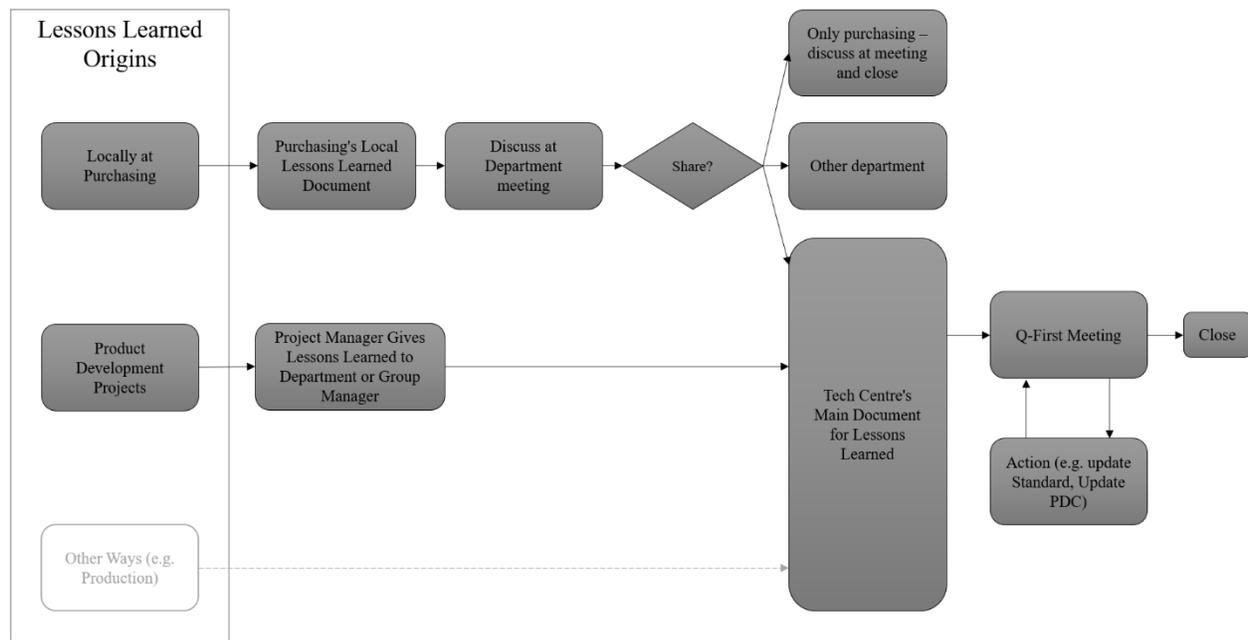

Figure 9 The lessons learned process from a purchasing perspective.

To Search within Existing Lessons learned

When a Project buyer was asked if he/she had used anything from a previous lesson learned, the answer was:

"Honestly, I do not know where to search for it…"

- Project Buyer

Another Project Buyer explained that there exist a lessons learned database, but it is to the Project Buyer's knowledge not used much. The Project Buyer suggested that it could be due to that it is not easily searchable. Furthermore, the Project Buyer presented an improvement suggestion to make lessons learned more searchable. This improvement was also proposed by another Project Buyer. Another possibility raised during an interview was to categorize the lessons learned in purchasing's excel file, to find relevant lessons more easily.

4.3.2   Control Level Definition

Another task that promotes knowledge reuse at Company X is the risk assessment called CLD. As mentioned earlier, CLD is performed by a Project Buyer in a product development project. During the interviews, it became apparent that CLD is a method that makes employees reuse existing knowledge. Six out of seven Project Buyers spoke about using old experiences when filling in the CLD. Guidelines on how to do the CLD have recently been updated, and a new template has been created. This has led to that many of the Project Buyers perceived it as is a new tool, that has only been a mandatory part of a product development project for a short time period. One interviewee explained that he/she did not feel comfortable enough to talk about it since he/she had not used it that much.

The CLD consists of two parts. The first part is about design risks, and the second part about risks related to the supplier. In the first part, the Project Buyer, together with other participants in the project, evaluate risks connected to each component. In short, they discuss how complex the component is, if there have been any past problems with similar components and if significant development is needed. Based on the judgements each component is classified into a risk-level (called CLD-level). This level does in turn define some activities further on in the process. For example, if the component has a high risk-level, someone from the project will have to visit the supplier. One respondent described the CLD-meeting in the first part of the CLD, where the project buyer discusses risks with components together with other project members, as an opportunity to gain knowledge from the other participants in the meeting.

"It is more like fishing from engineering, what experiences they have"

- Project Buyer

Further the respondent explained that the type of knowledge that is discussed in the CLD-meeting often is about what has gone wrong, which the respondent exemplified by things that had generated extra hours, reconstructions, remaking of tools or late customer changes. It is likely that the knowledge that emerge during the CLD-meeting in general is connected to the individuals who participate, hence the risks that are brought up are dependent on the people in the room doing the assessment. For example, one respondent described a situation where the group at the meeting had agreed that a component was high-risk. It was not clear why, it was simply known that there had been troubles with similar components, but there was no formal source that the knowledge about the issue came from.

The second part of the CLD is as mentioned about risks connected to the suppliers. In this step the Project Buyer reflects on, among other things, past problems with a specific supplier. When asked how one can know if there for example has been launch problems with a supplier in the past, one respondent said that it is partially due to intuition.

Another respondent explained that in certain segments there are only few possible suppliers which are well-known to the Project Buyer.

> *"It is something that one has learnt since coming here."*
>
> - Project Buyer

Another respondent explained that he/she usually reflected on his or her experiences with the supplier if he/she had some, looked at Supplier Board and talked to the Lead Buyer who was responsible for the supplier, or asked colleagues. Supplier Board is a webpage where employees can find a page about a certain supplier and see how well they have performed lately.

Regarding asking colleagues to find risks with a supplier the respondent described it as an informal way to gain knowledge. Usually, the respondent did not know who had worked with a certain supplier earlier, but spoke to the Supplier Quality project member, who possibly know someone who worked with the supplier, or might have some own experience with the supplier. As mentioned, the Project Buyer also gained knowledge about a supplier from the responsible Lead Buyer. However, the respondent described an issue with that method:

> *"Often I would say that the big issue is time, I cannot get hold of the Commodity Buyer when I need the information."*
>
> - Project Buyer

4.3.3 Product Design Configurator

Another method used to ensure that old learnings are taken into consideration in a new project is by using a tool called the Process Designed Configurator (PDC). This tool is only used by the Engineers at the company and most of the interviewed Project Buyers did not know what it was. However, in short it is a method for capturing and reusing knowledge, for example from lessons learned.

PDC is a excel-based tool used when designing a new product. In the company's dictionary it is described as *"The flowchart document which drives standardization, highlights risks and shares lessons learned (…) [It] defines where the design is non-standard and automatically generates an action register to mitigate risk A specific PDC template exists for each product type".* Hence, it is a file in which previous problems and actions that should be done to avoid those problems are described. The Engineer needs to get the PDC approved to pass certain tollgates, hence it is ensured that the learnings that are included in the PDC are taken into consideration.

The PDC is designed as a query tree, that guides the user towards the learnings and knowledge that is useful in a specific situation. The user must answer questions about the properties of the product that is going to be developed, how far in the process the project is, etcetera. The design of the PDC enables the Engineer to only be required to through learnings that are relevant for the part of the project that he/she is facing, irrelevant learnings for the specific situation is not presented. A simplified version of the PDC is presented in Figure 10.
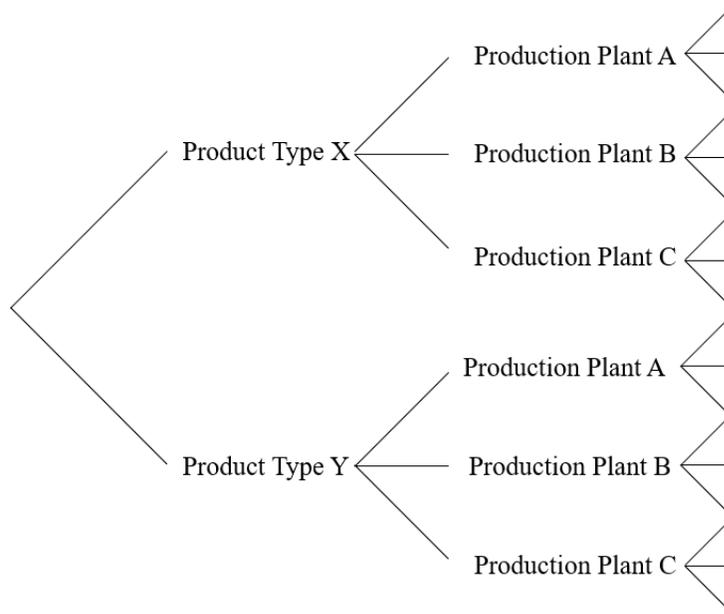
Figure 10 Schematic example of how a query tree like the PDC can be developed.

The PDC includes pictures, making the questions easy to understand. Furthermore, there are links with additional information next to some of the questions for clarification.

When the PDC is filled in, it differs between departments who are present. In one area, both a Project Engineering Leader and an expert are present. The expert is there to clarify if there is anything in the PDC that is unclear and to help the Project Engineering Leader to fill it in properly. There are different experts at different sites and product groups. In another area there is no expert present when the PDC is filled in. It has happened that the PDC has been filled in incorrectly, and thereafter problems occurred that could have been avoided if the PDC was filled in correctly.

If the design is according to standards the PDC becomes approved. If the Engineer for has deviated from the standard, the Engineer will get questions based on what has gone wrong previously (when deviating in similar ways from the standard) to ensure that the same mistake is not repeated. In addition, the Engineer need to write an explanation regarding why the design deviates from the recommendations. When the PDC is fully filled in it is submitted and sent to an approver.

The approver opens the PDC and can find all deviations summarized in a list, and he/she can read about the deviations and the underlying reasons. Based on the underlying reasons, the approver decides whether he/she can approve the PDC or not. If not, the reason to why it cannot be approved is communicated back to the project. The project needs to consider the comments and make appropriate changes to the design to get the PDC approved. As mentioned, an approved PDC is a mandatory task to pass certain tollgates, and the project cannot proceed if they do not get the PDC approved.

The PDC is continuously improved with new learnings made within the company. An update can, for example, derive from lessons learned. One major benefit the PDC was expressed by a respondent, stating that since it is mandatory to get the PDC approved, learnings must be taken into consideration in following projects.

4.4 Internal Meetings and Structures Facilitating Communication

Face to face communication is an old tool for sharing knowledge. When Project Buyers face problems, they often turn to their colleagues and ask for help. The meetings create situations where questions can be asked, and employees can help each other by sharing knowledge. As an example, during every department meeting the participants are asked if there is anything they would like to discuss. In addition, six out of seven interviewed Project Buyers explicitly mentioned that they asked colleagues at the department for help or input. In one interview a Project Buyer described that he/she did not spend time initially in a project searching for old learnings, but if any problem occurred later, he/she asked the project group or the one that is sitting next to him/her. During observations of meetings and coffee breaks it was common that Project Buyers shared stories about what happened to them in past or ongoing projects.

However, to what extent a Project Buyer uses knowledge from colleagues varies. One respondent speculated whether knowledge reuse from a colleague sometimes could be negative. The respondent argued that knowledge from another individual can get distorted, since you cannot fully know the context in which the knowledge was created, and therefore it is important to build your own knowledge base instead.

At Company X there are weekly meetings that facilitates knowledge sharing. During these meetings it was common that the Project Buyers asked each other for help or shared stories. As mentioned, this shows that face to face communication is important. However, a person that for example is not attending a meeting where something is discussed risk missing knowledge.

In the following sections two types of weekly meetings, project purchase tracking meetings and department meetings, will be described. Furthermore, other meetings and structures such as the physical work environment enabling face to face communication and knowledge reuse are presented.

4.4.1 Project Purchase Tracking Meetings

Project purchase tracking meetings occur once a week. The purpose with the meeting is two folded. Firstly, it is a forum in which the department can work proactively on milestones in projects. Secondly, it serves the purpose of being an opportunity for Project Buyers to ask each other question, share knowledge and support each other.

During this meeting the organizer, who is also a Project Buyer, has an excel file in which all projects are listed. During the meeting some projects in the excel file are discussed. For each project boughten up the responsible buyer summarizes what has been done since the last meeting and what the current state in the project is. After summarizing what has happened the Project Buyer has the possibility to raise questions or concerns to the other participants in the meeting. In all three observed meetings this have resulted in discussions where Project Buyers are sharing knowledge and previous experiences. A conversation type that has happened several times when observing this meeting is:

Project Buyer A: *"I have never been in a similar situation before, and I do not have a clue on how to solve it."*

Project Buyer B: *"I have been in a similar situation!"*

Project Buyer A: *"How did you solve it?"*

From this a discussion on how to solve the issue started. It is not uncommon that another Project Buyer has been in a similar situation before. Hence, previous gained experience and knowledge can be reused via this

forum. Another typical comment during meetings was when a Project Buyer described how a specific project is proceeding, another gave input such as: *"I have experienced something like that! Be aware that this can happen…"*.

During the observations it was noted that the participants were glad when they could help each other, and they did not hold back any information or knowledge that could be useful to somebody else. Project Buyers were not scared of asking for help if they needed it. At one meeting a Project Buyer asked for help, but no one at the meeting had the answer. However, they all were eager to help and give guidance on who to contact to find out more about the issue.

Every Project Buyer and the Department Manager at purchasing are invited to the meeting, but everyone does not show up every time. This is mostly due to lack of time and that there are other more urgent things to deal with in the projects. Due to lack of time, it has also happened that a Project Buyer has left the meeting as soon as his or her projects have been discussed. Consequently, this person cannot help the colleagues during the rest of the meeting.

The agenda for the meeting can be perceived as unstructured. It is to the researchers not clear what project is gone through in which order. During one meeting there was an idea of prioritizing projects depending on urgency. This was partially done, but the following meeting this classification was not used. During the observations it was noted that there is almost never enough time scheduled to go through everything without having to rush at the end.

Another thing that have been noted during the observations is that many of the employees have their computers and smartphones up running while the meeting is ongoing. The participants were working with other urgent matters during the meeting and their attention was scattered.

4.4.2 Department Meetings

Department meetings also occur once a week. They are led by Department Manager at purchasing and serves several purposes. Some items are permanently on the agenda for example information from the management at the tech center, lessons learned and an open item, if someone has something that they want to discuss.

The department meetings where useful opportunities for knowledge reuse. In all three observed department meetings discussions arose where knowledge was shared. For example, at one occasion observed, a project buyer used the department meeting for spreading knowledge that he/she had gained from an expert. At an interview a Project Buyer emphasized the value of the communication that the department meetings enable:

> *"To us it is important to just exchange ideas verbally. I believe that it is the alpha and omega to us at least, and it can be about suppliers or systems or anything. So that is why it is good to have our department meeting for example."*

> - Project Buyer

As mentioned above, there is an open item on the agenda. This gives the participants an opportunity to ask questions if they have any or share if they have learnt something. At one occasion the opportunity was taken by a Project Buyer, ending up in discussions regarding how to use a certain document, more specifically when in the process one should get a signed Non-Disclosure Agreement (NDA). During the discussion, a Project Buyer stated: *"You do not say 'Hi' with an NDA"*. At the same department meeting a participant

asked the others *"When do you feel like you have to use a letter of intent?"*, which also created an opportunity for knowledge sharing between the participants.

One part of the agenda, that is of extra interest concerning knowledge reuse, is the one about lessons learned. Here, lessons learned that have been done within the purchasing department are presented. Thereafter, it is decided whom could benefit from knowing about the lessons learned, that is how it should be spread in the organization. It is also an occasion where updated standards are presented to the employees. However, at the department meeting, lack of time is often evident. At the meetings the time for going through the lessons learned document is often not prioritized, it is done in the end of the meeting or skipped to leave room for more urgent activities. When the lessons learned have been brought up, there has not been enough time to discuss all lessons learned.

At one occasion there was some time left for lessons learned, but the participants wished to prioritize other things and therefor the meeting was closed earlier. In one interview a Project Buyer was asked about the lessons learned session at the department meetings, and with a laughter the respondent stated:

> *"It is the item that we never have time for."*
>
> - Project Buyer

During one of the observations, when there was time to bring up lessons learned, discussions began between Project Buyers. The participants presented their different perspectives and where engaged in the conversation, which indicate that they found the knowledge sharing taking place valuable. However, also this time all lessons learned were not gone through before the meeting was over.

As during project purchase tracking meetings, many participants used their computers during the department meetings. This can, as described above, lead to that the Project Buyer's attention is scattered.

4.4.3 Other meetings Between Employees

In general, all employees are available for their colleagues. Even though many of the employees have a high workload the findings show that they always take the time to have a meeting to help a colleague. The researchers' experience are that employees at Company X are easy to get in contact with. Doors are opened and communication channels like Skype and mail are frequently used and most people answer quickly.

Many employees at the office usually take a break together during the morning and then later for lunch. During this time the employees socialize in general, but it is also an opportunity to ask for advice. This is also an opportunity where employees talk about what they are doing. During these breaks the Project Buyers and Supplier Quality are often pausing together, hence there is a wider knowledge base, if asking questions in this setting.

4.4.4 Work Environment Facilitating Communication

Every Project Buyer have their own desk in an open plan office space. All Project Buyers at the site are placed in the same open plan office space. In the same space is both Supplier Quality and the Commodity Buyers situated. Commodity Buyers are however out traveling frequently, and hence they are not at the office much. One Project Buyer emphasized the positive effects of sitting in an open plan office space:

> *"A big benefit, in my opinion at least, is to have such landscape, open office space which we have. Because then one can hear, one hears somebody that is sitting and talking (...) I find it very good and then one can just: 'but you [name] how blablabla?', and like that it becomes a*

direct contact. Instead of actively standing up and walking and knocking on somebody's door. So, I believe that open office spaces help very very very much, I think it is super positive!"

- Project Buyer

Another respondent explained that he in some occasions tried to find colleagues that had worked in similar projects. To find the right person, he/she asked a question at a department meeting or used the open plan office.

"One can probably ask at a department meeting or just ask straight out into the room"

- Project Buyer

4.5 Knowledge Management Systems

There are several IT-systems that works as a support for knowledge reuse at Company X. Systems have different purposes and are used in varied ways by Project Buyers. Some examples of systems are the company intranet with for example links to SharePoint and global standards, 'SWIP' used for local standards, Product Lifecycle Management (PLM), and folder systems located in the cloud. These systems can enable knowledge reuse, among other things.

In the interviews, it became apparent that respondents sometimes find the systems difficult to use and to navigate in. For example, one respondent stated:

"[Company X] has seven billion things in seven billion different places. It is hard sometimes to remember 'ah, where did I find that?' because it is so like, sprawling."

- Project Buyer

In addition, at two out of three observed department meetings, someone projected their screen to for example show the other participants where to find a certain document in the folder system.

4.5.1 Employee Introduction to IT-systems

Two respondents described how their introduction to the IT-systems was when they were newly employed. One respondent remembered that he/she had gotten some documents about some systems from a colleague, but mostly was self-taught. Another respondent described a similar experience.

"You should read to get the knowledge. (…) I can't theoretically read it through, I have to do it. Then I get it."

- *Project Buyer*

In three other interviews it was mentioned that there are several mini courses available and they generally liked the courses. One respondent appreciated that an email is sent out when a course new course is released. That way, one does not have to keep track of updates manually. However, one respondent described that when he/she wanted to check something from the course again, it is time consuming to look through a video. The respondent suggested that more text based quick guides should be created to avoid the issue.

4.5.2 Frequently Used IT-systems and Respondent Improvement Ideas

One system that was used frequently in the daily work is called PLM, a product lifecycle management system. In PLM, among other things, documents such as drawings and contracts are shared. In addition, it

is in PLM that lessons learned gets uploaded. One respondent pointed out that there exists much knowledge in PLM, but whether one can find the knowledge is discussable.

As described earlier, many lessons learned are included in design or process documents. However, one respondent suggested that it would be beneficial to have a better search function to be able to find the one-pagers describing the lessons learned. Another suggestion made by the same respondent was to collect the learnings under different tasks, so that when a Project Buyer was at a certain step in the product development process the Project Buyer easily could go in and read about best practices or lessons learned connected to that activity.

Another system that is used frequently by the Project Buyers is Supplier Board, which was mentioned by four out of seven interviewed Project Buyers. As described earlier, Supplier Board is a webpage where employees can find a certain supplier and see how well they have performed lately. However, as one respondent explained, at Supplier Board one can only see for example that something was not right with the supplier last month, but it is not explained what was wrong. One needed to dig deeper to understand what the issue has been with the supplier and if it is possible to use the supplier anyways. In some interviews it was mentioned that the Project Buyer contacted Commodity Buyers to find out more about the supplier then what was communicated via Supplier Board. One respondent said:

"If everything is green [in Supplier Board], then you can use your energy elsewhere"

- Project Buyer

Further, the respondent explained that if the supplier had some yellow or read months, it could be worth investigating.

4.5.3 Other IT-systems

During the interviews two additional systems, one that exist but rarely was used and one that recently was closed, was brought up. The first one, which still exist, is Yammer, Company X's social media site. Some employees were unaware of its existence, and some did not use it but knew what it was.

The second system that recently was shut down was a wiki-site. The information in the wiki-site was transferred to documents in SharePoint. According to one respondent in an informal conversation, the wiki-site was not closed because employees did not use it. Instead it was decommissioned due to a change of systems. It was further explained that another effect of the wiki-site was that people started to create own pages for example for translation, which led to that the organization risked double information.

4.5.4 Own Procedures and Different Usage

Project Buyers use systems in different ways and to various extent. Some documents that are used have been adjusted by individuals when they use them themselves. As an example, one Project Buyer was asked whether or not he/she uses a specific tool the answer was:

"Yes, though I have some more columns that I add, but basically yes, I follow it"

- Project Buyer

When another Project Buyer was asked about the same tool he/she answered that he/she does not use that tool, only fill it out afterwards.

4.6　Reuse of Knowledge from Other Functions

As have been mentioned both in section *4.1.2 The Sub-Process of Purchasing within Product Development Projects* and *4.3.2 Control Level Definition*, a Project Buyer reuses knowledge from other departments at several steps in the product development process. Within this section, it is described how Project Buyers reuse knowledge from other functions.

4.6.1　Commodity Buyers

One source of knowledge that was mentioned by all Project Buyers in interviews was Commodity Buyers. The Commodity Buyers have, as earlier described, a strategic position and they can help among others the Project Buyers in supplier related questions. The Commodity Buyers are also the Lead Buyer for different suppliers. One respondent described the exchange with Commodity as informal. The value of Commodity's knowledge was stressed by a respondent, who said:

> *" I think Commodity Buyers have a lot of knowledge that can be used in a new project."*
>
> - Project Buyer

Further the respondent explained how a Commodity Buyer had been helpful in a current project.

> *"She has participated in a TFC-meeting, and she asks very good questions (...) She knows the supplier."*
>
> - Project Buyer

The importance of Commodity's knowledge was further underlined by another respondent, who spoke to the Lead Buyer for a supplier when setting the risk level for a component in a project in the second part of the CLD.

> *"... and check with the Lead Buyer, that is an important player, according to me".*
>
> - Project Buyer

When a Commodity Buyer was asked to describe his/her role, the Commodity Buyer among other things stated that one important work task was to help the Project Buyers.

One respondent described the knowledge reuse from Commodity as on a need-to-know-basis. The respondent thought that Commodity had more knowledge about the suppliers, but that all knowledge does not reach the Project Buyer. The respondent clarified that the lack of knowledge sharing most probably was not because of secrecy, but due to a high workload which made it hard for the Commodity Buyer to keep an updated documentation about the suppliers.

During an interview, a Commodity Buyer was asked if he/she thought that he/she possessed knowledge that the Project Buyers could benefit from knowing. The Commodity Buyer explained that the since the Project Buyers purchase several different components from different areas with different responsible Commodity Buyers, it is not possible for the Project Buyer to know everything.

4.6.2　Supplier Quality

The Supplier Quality team was mentioned by six out of seven Project Buyers as a knowledge source. One respondent explained that when deciding what supplier to choose, one of the checks that was made was if it was feasible that the supplier could deliver the required component. By feasible, the respondent further

explained that it was checked if the supplier actually could manufacture the component or if they were only claiming that they could. When asked how this check was done the respondent among other things refer to Supplier Quality.

"*Previous experience from among other SQ. For me, it is important to involve SQ as well*"

- Project Buyer

The same respondent was later in the interview asked how one could know if a certain process at a supplier was well suited for a certain component, and yet again referred to SQ.

"*Partly through SQ (…) they know the most about many processes since they have been visiting the suppliers a lot, so then you can get help from them*".

- Project Buyer

4.6.3 Should Cost Team

Another knowledge source that was brought up in the interviews was the "should cost" estimation team. It was explicitly mentioned by four out of seven Project Buyers, however how the knowledge from the should cost team was retrieved varied between Project Buyers. One respondent described the exchange with the should cost estimation team as formal. Two respondents instead described that they asked about more than just the estimated cost, such as what one could do to make the component cheaper. One of the respondents further mentioned a specific person that the respondent usually spoke to who. The respondent explained that the should cost team could be useful early in the product development process. Already in the first phase of the project, the respondent described that:

"*I also speak to the expertise at the cost analysis team (…) they have a lot of knowledge about which processes, what method, material etcetera that should be chosen*".

- Project Buyer

However, another respondent lifted an issue with that the calculated costs from the should cost team, who sometimes according to the respondent was too simplified.

4.6.4 Other Functions

A respondent who has worked at the company for a long time and at different departments in addition explained how knowledge could be sought from constructors or engineering, if a similar detail had been produced earlier. When asked how it was possible to know if a similar component had been used before, and who to talk to who could know more about it, the respondent referred to experience.

"*Well, I know that myself, since I have some experience. I can easily find out and also know if the information I get is relevant. It is very connected to individuals, one does not check any systems, one goes around and asks about the stuff. Another thing one can do is to check PLM, our part database, and search for similar details to see what is best practice*".

- Project Buyer

When another respondent was asked about how to find expertise in the company, the respondent answered that one asks colleagues. When an expert has been identified, the expert can be contacted via Skype or email. Another respondent also described that it could be useful to find experts or senior employees in some

cases. The respondent said that it usually was well known who was experienced in a certain area, but further stated that perhaps that was something that he/she had learned over time.

Furthermore, experiences from other project team members that can be helpful in the current project can be brought up in an informal way. A respondent described that project team members sometimes say that they would prefer a specific supplier based on something that worked well, or the opposite, in an earlier project.

4.7 Company Culture

Based on both interviews and observations, the culture at the purchasing department is good for knowledge reuse. Four interviewed Project Buyers explicitly described the culture in positive ways, for example it was mentioned that it is accepted to ask questions at the company. A respondent explained that it is normal to ask each other for help.

> *"At Purchasing I think we are good at talking about things that we have learnt (...), no one finds it strange if you want to share something like 'this happened to me, this is what I did'. I think we are very open here (...) you can just ask someone 'have you done this?' and it is not weird at all"*
>
> - Project Buyer

The culture was not only described in a positive way by Project Buyers. During the interview with the Commodity Buyer, the respondent stated:

> *"One can always ask in this company (...) I believe that one can ask almost wherever, whatever"*
>
> - Commodity Buyer

In addition, the Commodity Buyer was asked about the possibility that everyone does not ask questions, since individuals are different. The respondent answered that the culture almost requires that one asks questions, so it should not be an issue.

This is something that has been observed at both project purchase tracking meetings and department meetings, as described earlier. In both type of meetings, it was normal to ask colleagues for help or input. The same goes for asking colleagues for help during a coffee break or at almost any time during the daily work, as previously described. Another observation that was made during a department meeting was that the culture is non-competitive. One example of this was noted at a department meeting, where some KPI's where gone through and one KPI that was good was discussed. The Project Buyer who presented it explained that him/herself had not been involved in the work behind the KPI in question, but still wanted to draw attention to it to appreciate the work done by colleagues. A respondent described the atmosphere at the purchasing department in a positive way.

> *"I think that it's a really good group here (...) everybody is very dedicated, that is also something that I have not experienced before"*
>
> - Project Buyer

The respondent thought that the main reason behind the positive atmosphere was good management.

The culture at the company, not only the purchasing department, was generally described in a positive manner. One respondent explained that he/she had not experienced that someone did not want to share knowledge. Another respondent said that the culture of sharing knowledge was dependent on the individual, but generally good. The respondent further elaborated on the culture at the company at large.

> "*Not only at [the local site] but also other manufacturing sites I have been in touch with. Everyone is very friendly, and you get help, and you get feedback, and you get thanks and appreciation.*"
>
> - Project Buyer

However, another respondent found that the culture varied between different sites. At the local site the respondent found the culture open, but that at other manufacturing sites the respondent sometimes found it harder to gain knowledge. The respondent further said that it was not because other plants did not want to share knowledge but rather because there exist no platforms.

Even though the culture as described in general is open, one respondent mentioned that due to the colleagues being very busy, it sometimes did not fell appropriate to ask for help.

> "*They are very helpful, it is just that sometimes everyone is very busy, and I don't want to disturb so I rather try myself. But if you need help you can really get help.*"
>
> - Project Buyer

5 Analysis

In this chapter an analysis is performed, where the empirical data and theoretical framework are connected. The analysis lays the foundation for the answers to the research questions, which is summarized in chapter 7. Conclusions. The analysis is structured based on the research questions. However, firstly, it is described what type of knowledge is needed in purchasing (tacit or explicit), since it is relevant background to be able to determine what methods for reuse of knowledge are useful, and what barriers are in play. Thereafter, focus is on the first research question, presenting methods and practices that can be used to reuse knowledge in product development projects. After that, barriers for knowledge reuse, which barriers are intertwined and ways to manage barriers are analyzed. The main topics of the analysis are summarized in the figure below.
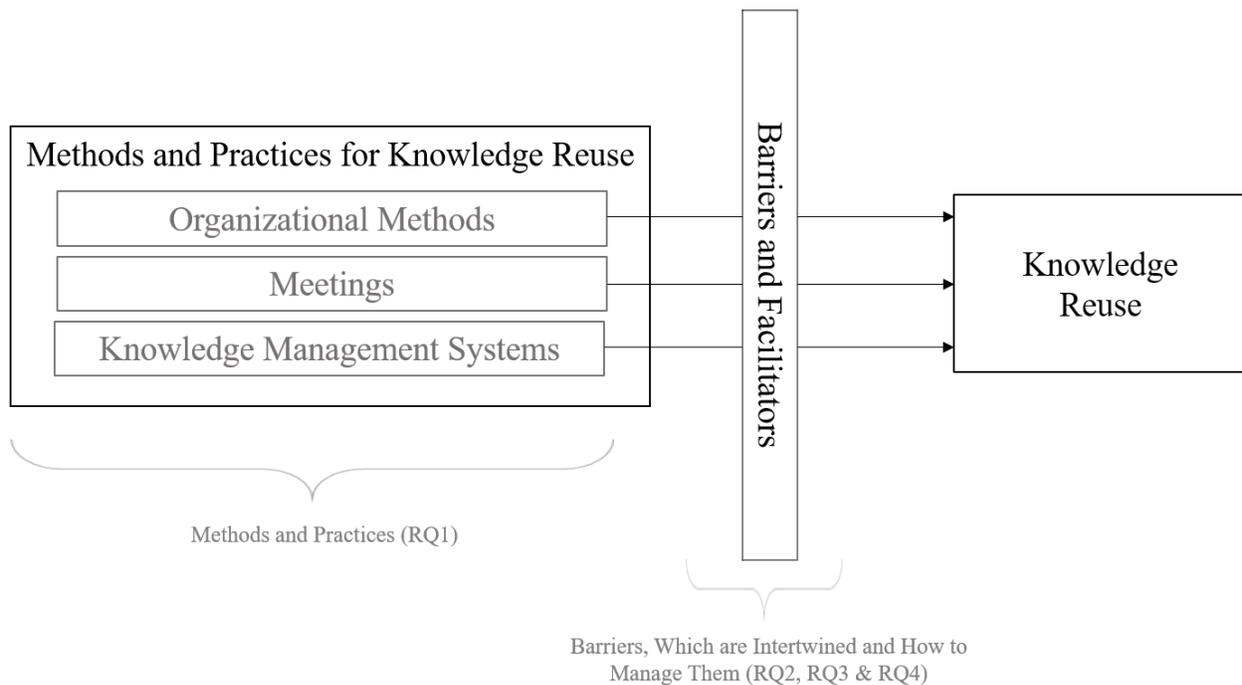

Figure 11 The main topics brought up in the analysis and their connection to the research questions (RQs).

5.1   Knowledge Needed in Purchasing

To know what type of knowledge a purchaser uses is vital to know what methods for knowledge reusing are suitable. That aspect of being a purchaser is therefore analyzed in this section, as a basis for what methods can be recommended to enable reuse of existing knowledge.

As stated in *3. Theoretical Framework*, Giunipero et al. (1999) conclude that about half of the input that purchaser use comes from formal data, and half from tacit knowledge. Findings from this study suggest that a Project Buyer utilize both tacit and explicit knowledge. Examples of when explicit knowledge is used are standards and formalized guidelines. One example of tacit knowledge is when a Project Buyer classifies what components should be key components. A Project Buyer concluded that it is hard to explain what exactly a key component is. The respondent knew how to classify components but could not easily formulate it. It can be related to the definition of tacit knowledge presented by Nonaka (1991) where he cites Polanyi stating that *"We can know more than we can tell"* (p. 165). Other examples that show that a

Project Buyer utilizes tacit knowledge is when filling in past problems in the CLD. One respondent answered that he/she makes decisions based on intuition, also an expression indicating that the Project Buyer knew more than what could be expressed. Another finding that suggests that there is tacit knowledge involved in the work of Project Buyers, is a question asked at a meeting. A Project Buyer asked the rest of the group when they "*feel"* that it is appropriate to do a certain thing.

When Morgan and Liker (2006) investigated how Toyota worked in product development projects, they explained that Toyota put much emphasis on reusing tacit knowledge. Furthermore, Morgan and Liker (2006) states that transfer of tacit knowledge is mostly done using face to face communication. As mentioned in the empirical result, a Project Buyer explained that he/she thought that to Project Buyers it was vital to exchange ideas verbally. This indicates that there is tacit knowledge that is transferred between the Project Buyers. Furthermore, tacit knowledge is needed when Project Buyers negotiate, which is elaborated upon in the next section.

5.1.1 Knowledge in Negotiations

As explained in the paragraph above, a Project Buyer utilize both tacit and explicit knowledge. An essential part of being a purchaser is to negotiate. A study conducted by Nadler et al. (2003) conclude that participants of the study seemed to be learning something within negotiations that they could not clearly formulate. Hence, some knowledge needed in negotiations is tacit, in line with the definition presented by Nonaka (2001).

Both tacit and explicit methods and practices are used by Project Buyers in negotiations. One explicit method was explained by a Project Buyer, who had developed an analytic method that could be used in negotiations, which in short was about comparing similar articles and their prices to the component being developed.

There were also situations where a Project Buyer could not express what had made the negotiation successful. An example was when a Project Buyer explained that he/she had just said "No", which was the key to winning that negotiation, as described in the empirical result. The Project Buyer was following his/her gut feeling, that is, tacit knowledge was used.

In summary, both tacit and explicit dimensions of knowledge are needed as a Project Buyer. The empirical findings correspond with what is presented by Nadler et al. (2003) and Giunipero et al. (1999). Hence, when finding methods that can enable knowledge reuse within purchasing, the methods must enable sharing of both explicit and tacit knowledge.

5.2 Methods and Practices for Reusing Knowledge

There are many methods and practices that an organization can use to increase knowledge reuse in product development projects. Broadly, three groups of methods and tools have emerged during this study. These are organizational methods promoting knowledge reuse, meetings as a method to reuse knowledge and knowledge management systems that can support knowledge reuse. The groups are intertwined, for example, an activity in an organizational method can be supported by a knowledge management system.

5.2.1 Organizational Methods Promoting Knowledge Reuse

A company can create methods which includes tasks that make employees reuse knowledge. In this section, three organizational methods are analyzed. These are lessons learned, query trees and knowledge cafés.

Lessons Learned

Lessons learned is a common way to transfer knowledge between projects, see *3.4.1 Project Debriefings*, the method is also used at Company X.

Making Employees See the Value of Lessons Learned

Lessons learned is a frequently used method and there exists plenty of research on how to conduct it, see section *3.4.1 Project Debriefings*. A success factor that is mentioned in theory (e.g. Schindler & Eppler, 2003; Morgan & Liker, 2006) is to have actions connected to lessons learned. An action can for example be to update standards. If there are no visible improvements or actions after employees created a lesson learned, it will be hard for the employees to see the value of creating lessons learned. For example, if an employee does not know what happens to a lesson learned after submitting it, it is possible that he/she does not see that it contributes to the performance of the organization or helps his/her coworkers. At Company X, standards can be updated based on lessons learned, however this is not known among all employees. Several respondents expressed that they did not see how the lessons learned that they created in projects returned any value to their daily work.

To ensure that employees see the value of lessons learned one solution would be by updating that individual on how the lesson have been used and in what way it will create value to others. Assume that an employee has identified a lack in a procedure, this he/she reports as a lesson learned. After a while he/she receives an email that the lesson learned have led to a changed standard that now will be applied in all future work. In such case, the employee submitting the lessons learned will also in the prolongation see how it has changed the way of working. In relation to internal motivation and the Job Characteristics Model presented by Hackman and Oldham (1976), such feedback loop could be argued to increase the internal motivation in two ways, namely by increasing task significance and feedback.

Firstly, such feedback loop will enable employees to see that the learning is valuable to the organization and/or colleagues. Since employees can see that the learning resulted in an updated standard they will most likely understand that it will affect the organization and other employees, and hence, one could argue that the task significance, presented by Hackman and Oldham (1976), will get higher. According to Hackman and Oldham (1976) task significance is one parameter that increase internal motivation.

Secondly, by designing such feedback loop employees will get feedback on submitted learnings. Feedback is, as mentioned earlier, also presented by Hackman and Oldham (1976) as one core job dimension providing internal motivation. However, Hackman and Oldham (1976) defines feedback as direct information about performance. In this case, it is possible that the feedback loop will take some time, however one can argue that late feedback is better than none.

On the contrary, lack of such feedback loop, as the current situation at Company X, can become a barrier. A barrier for knowledge sharing mentioned by Akhavan and Pezeshkan (2014) is if the result of knowledge management work is not related to routine tasks, as described under section *3.6.4 The Value of Knowledge Reuse is Not Realized.*

However, employees at Company X sometimes saw the value of lessons learned, mostly the ones created locally at the department, which were discussed at the department meeting. In such occasions it is evident that lessons learned helps colleagues, since the creator of the lesson learned explains it directly to colleagues who can use it. This is a way of creating a feedback loop like the one described above. It can increase

internal motivation, by increasing task significance and feedback, see Hackman and Oldham (1976), which is described in the following paragraphs.

Firstly, when Project Buyers can help a colleague with lessons learned and can explain them face to face, it is possible for them to see the value of their knowledge sharing. Project Buyers can directly understand that sharing of knowledge creates value for his/her colleagues. By understanding the value, task significance is increased, and in the prolonging the internal motivation, see Hackman and Oldham (1976).

Secondly, the explanation of lessons learned face to face during meetings create a setting where direct feedback is given. When a Project Buyer share a lesson learned that is useful for colleagues in the room, the colleagues will most probably be grateful and therefore thank and praise the Project Buyer for sharing knowledge. Hence, the Project Buyer will get instant feedback that the sharing is positive, which can be related to both Harackiewicz (1979) and Hackman and Oldham (1976) whom both argue that feedback leads to internal motivation.

Storytelling and Lessons Learned

A lesson learned is based on an event that has happened, therefore there is a story behind it. Desouza et al. (2006) write that a possible outcome from a project postmortem, which lessons learned is a form of, is a project postmortem story. A benefit with a story is according to Desouza et al. (2006) that it is more likely to be remembered. Hence, an improvement suggestion for Company X could be by making it possible to share lessons learned using project postmortem stories. Desouza et al. (2006) is describing stories in written form, however during the observations at Company X it was visible that storytelling was a tool that was used to verbally spread lessons learned at both project purchase tracking meetings and department meetings.

Storytelling is described in theory as a useful tool for knowledge sharing in general (e.g. Katusáková, 2005; Gouvêa et al., 2017), and for tacit knowledge sharing in particular (e.g. Perret et al., 2004). At Company X, time is provided for storytelling when going through projects at project purchase tracking meetings and in connection to the lessons learned item or the "open" item on the agenda on department meetings. Often, the story is told because someone asks for help, meaning that it is likely that the knowledge that the storyteller shares will be used by the individual asking for help (which could be argued to be a form of knowledge pull). As mentioned above, when sharing stories or similar face to face, the knowledge provider gets feedback directly by reactions from the knowledge consumer. This increases internal motivation, see Hackman and Oldham (1976). That face to face knowledge sharing is a knowledge reuse method that is frequently used at Company X can be explained by its way of creating internal motivation by direct feedback and visible task significance.

Furthermore, in some cases when a Project Buyer explained something for a colleague, metaphors were used. This could be a form of externalization, as described by Nonaka (1994). However, stories were only told verbally and not written down. Consequently, only people present in the room could hear the story, which could be a barrier for sharing to people who were not present.

The Challenge with Lessons Learned Repositories

An issue with lessons learned mentioned by Trees (2018) is that many companies save lessons learned in big repositories and fail to reuse the knowledge that is located there. At Company X, the main strategy is to include new knowledge in existing standards or similar, thus, they do at large not struggle with the issue of a big repository. An example of an exception is the local lessons learned file at the purchasing department, which was described as a *"black hole"* that was not read or searched in by the Project Buyers.

Project Buyers discuss lessons learned at department meetings, but in general do not study the local excel file to read the lessons learned again.

To rely on spreading and reusing lessons learned by including them in standards or similar, or by communicating them verbally, is a way to avoid the issue of a big repository that is not used. However, there are issues with that strategy as well. For example, if a standard is updated, Project Buyers are asked to read it through and thereafter confirm that they read it by putting a mark in an excel sheet. That is a way to passively learn. However, when a new standard is introduced at a department meeting the participants have the possibility to discuss it which is more active that just reading through it, see Bonwell and Eison (1991). Active learning is recommended by for example Michael (2006). In addition, lessons learned that does not fit in existing standards are only spread verbally and "saved" in the minds of those who hear it. There is a risk that individuals that have heard the lessons learned forget it or leave the company without spreading it to his/her successor, as also concluded by a respondent.

Sessions to Create and Reuse Lessons Learned

In their methodology, which is designed to enable knowledge reuse in projects, Schacht and Maedche (2016) chose to divide lessons learned sessions into two types. The two types are described in the following paragraphs.

One type is more traditional where the project team goes through key events in the project and try to make the lessons learned created in the project useful for projects in the future, by for example putting them into standards. Schacht and Maedche (2016) recommended that it should be done several times during a project. That the project group should reflect on events as soon as possible after they happened was also mentioned as a success factor by Morgan and Liker (2006) and Schindler and Eppler (2003). Furthermore, it was also requested by a respondent that lessons learned sessions summarizing key events should be done more frequently than just before tollgate 4, which today is optional and recommended, but not mandatory at Company X. Another recommendation made by Schact and Maedche (2016) and Schindler and Eppler (2003) is to have a neutral moderator during the lessons learned session.

The other type of lessons learned session in the methodology by Schacht and Maedche (2016) is about reusing knowledge from previous projects. Participants in the project should identify relevant knowledge sources that can be used in the current project, for example by finding experts that has worked with similar projects before or by finding old lessons learned. Something similar was requested by respondents, for example, one respondent requested a "LL-kickoff" which should be done in the beginning of a project. Knowledge that is reused in such lesson learned session does not have to come from written down lessons learned, it can also be experiences that the participants or an expert have, as mentioned by Schacht and Maedche (2016). Practically, it could be a meeting with participants in the project and experts of the area of the project. Before the meeting a responsible individual can have searched for relevant lessons learned from a repository. During the meeting, the participants discuss the project, relate to similar projects that they have participated in and go through the relevant lessons learned. By doing so, one can identify and avoid risks in the upcoming project by the usage of old experiences and existing knowledge.

In the second type of lessons learned session, Schacht and Maedche (2016) write that methods from risk management can be applied. It can be compared to the CLD-method that is used at Company X. In the CLD, Project Buyers identify different risk factors. For example, they identify problems from the past connected to a component or a supplier, which gives every component a certain risk level. Every risk level is connected to an appropriate action plan. This way, old lessons learned can be used. When trying to

identify past problems, a searchable lessons learned repository can be useful, despite the challenge of big lessons learned repositories described above. The lessons learned could also be structured for example connected to each phase in a project, so that it is easier to find relevant lessons learned, as proposed by a respondent. Another alternative is to save lessons learned in a query tree, inspired by the PDC at Company X, see the sub-section *Query Trees* below.

To search for previously created lessons learned in the beginning of a project can be a way to make the value of lessons learned visible for employees. If using old lessons learned in the beginning of a project, one knows that lessons learned created in the end of a project, will be used by others. It is beneficial to create a feedback loop as previously described, so if someone uses an old lesson learned that an employee was part of creating, that employee for example receive an email where it is stated that someone used the lesson learned. By designing such loop, the employee will get feedback on the submitted learning. Feedback is, as mentioned earlier, described by Hackman and Oldham (1976) as a core job dimension providing internal motivation. Feedback should preferably be direct, however, in this case, it is possible that the feedback loop will take some time. As stated earlier, one can nevertheless argue that late feedback is better than none.

Query Trees
Another method for knowledge reuse identified at Company X was the query tree called PDC. To the researchers' knowledge, no similar solution has been identified in theory. However, to Company X its benefits is prominent. The query tree enables the knowledge consumer to get hold on knowledge that will be useful in a specific situation, without having to search through a huge amount of different unrelated knowledge. Hence, the PDC provides the knowledge consumer with the right knowledge at the right time. However, at Company X the PDC is not used by the purchasing department but introducing a similar method can be beneficial for knowledge reuse.

Knowledge Café
The third method for knowledge sharing, called knowledge café, was identified in the general online search. It is not a method currently used at Company X. However, when a Process Developer at Company X was asked about his/her thoughts about this method he/she expressed that it could be useful. The method is not related to projects, but it could for example be used in the purchasing department to share knowledge that is relevant for all purchasers. As an example, a knowledge café could be arranged with the theme "Negotiations in a Product Development Project". As mentioned in theory, Morgan and Liker (2006) stated that at Toyota tacit knowledge sharing is mostly done face to face. Hence, a knowledge café can be used as a method for sharing tacit knowledge.

5.2.2 Meetings as a Method for Reuse Knowledge

Company X uses different weekly meetings to share knowledge. As explained in the empirical findings, several Project Buyers expressed the advantage with both project purchase tracking meetings and department meetings. Meetings enable sharing of both explicit and tacit knowledge. As an example, new standards can be presented, and hence explicit knowledge is shared. If anyone has any questions about a certain standard these can be discussed face to face during the meeting. Face to face communication is a method that Morgan and Liker (2006) argues enables employees to share tacit knowledge. Furthermore, at several meetings, storytelling was used. According to Perret et al. (2004), storytelling is a way of externalizing tacit knowledge.

Meetings often lead to discussions where Project Buyers are actively involved, which results in sharing of knowledge. When a Project Buyer can help a colleague during a meeting, it is possible for them to see the value of their knowledge sharing. This can create internal motivation, since it can be related to task significance, which according to Hackman and Oldham (1976) is one of the five job core characteristics that create internal motivation.

In addition to task significance, meetings create a setting where direct feedback is given. Suppose that one Project Buyer is asking for knowledge about something that another Project Buyers is knowledgeable about. If the Project Buyer possessing the knowledge share it with the one seeking, that individual will most probably be grateful and therefore thank and praise the Project Buyer for sharing knowledge. Hence, the sharing Project Buyer will get instant feedback that the sharing is positive, which can be related to both Harackiewicz (1979) and Hackman and Oldham (1976) who both argue that feedback leads to internal motivation.

Multitasking at Meetings

Several authors argue that multitasking is negative. For example, the findings of Buser and Peter (2011) indicate that multitasking lowers performance, regardless if someone is forced to multitask or does it voluntarily. Furthermore, Ellis et al. (2010) write that multitasking "*reduces the brain's ability to effectively retrieve information*" (p. 1). Based on observations of weekly meetings, it is apparent that employees at Company X frequently multitask. During both department meetings and project purchase tracking meetings employees have their computers and smartphones in front of them, using them during the meetings. Since multitasking can reduce the brains ability to retrieve information, it can be a barrier for knowledge reuse.

As mentioned previously, lack of time was prominent at Company X. It is possible that employees multitask at meetings because otherwise they believe that they will not manage to finish things in time. Multitasking gives the impression that one is more productive, as Adler and Benbunan-Fich (2012) state. However, as Buser and Peter (2011) write, *"Performance under the self-chosen work schedule is actually significantly lower than under the exogenously imposed sequential work schedule. This suggests that subjects fail to choose their own schedule optimally."* (p. 12). Hence, it is possible that the self-chosen way of working, at Company X that is multitasking during meetings, is not the most productive.

However, multitasking can be seen from another point of view, in which employees can be present at the meetings and contribute with their knowledge when needed, even though their time is limited. In addition, as presented earlier, Adler and Benbunan-Fich (2012) argue that a little multitasking can be beneficial when it comes to productivity. Hence, multitasking could also be a facilitator, which enables the employees to participate in meetings at all and contribute to knowledge reuse.

The behavior can also be connected to the barrier of company culture, as presented by for example Riege (2005). If the culture allows employees to do other things during the meeting it is possible that they miss relevant topics discussed. One can assume that the employees multitask during meetings partly due to the culture allowing it, partly due to lack of time, and partly because what is discussed during the meeting is not relevant to them, which is further discussed in the following section.

Knowledge Push and Pull

At some occasions during meetings, stories or knowledge was shared by a Project Buyer that was not directly relevant for other participants. This could be argued to be a form of knowledge push. Edwards et al. (2005) do, in connection to knowledge management systems, write that pulling systems generally are

preferable. Pulling systems let employees pull knowledge when needed, during a meeting one can draw a parallel to when someone asks for help (and needs knowledge). It is likely that in situations when knowledge is "pushed" to participants in meetings, employees choose to do something that they find more valuable than listening to stories or similar that they do not find relevant, that is, multitask.

In general, meetings create a good opportunity for knowledge reuse, since they function as a platform where colleagues can ask each other for help and come with suggestions when a colleague explains his/her situation, something that can be related to knowledge pull. However, if wanting to improve the knowledge reuse during meetings, especially the project purchase tracking meetings, it could be beneficial to reduce the amount of knowledge push, and consequently decrease the amount of multitasking.

Importance of Unplanned Meetings and Communication
During the empirical studies, the researchers identified unplanned meetings between employees as a method for knowledge reuse. For example, the open plan office and joined coffee breaks enabled Project Buyers to ask each other, and other functions such as Supplier Quality or Commodity, questions several times a day. Several Project Buyers emphasized the importance of being able to ask Supplier Quality and Commodity Buyers when needed.

In general, employees take time to answer when colleagues ask questions. This can, in the same way as meetings in general, be related to internal motivation in the model presented by Hackman and Oldham (1976). By answering a colleague's question, the one answering will get instant feedback and high task significance. Both dimensions will, according to the model presented by Hackman and Oldham (1976), increase the internal motivation. It is possible that employees chose to prioritize to answer questions since their internal motivation is high. That employees provide time to answer colleagues' questions shows the openness of the organizational culture. Furthermore, personal meetings between colleagues enable tacit knowledge sharing. According to Morgan and Liker (2006) face to face communication is one way of sharing of tacit knowledge.

5.2.3   Knowledge Management Systems
Within research about knowledge management systems, one topic of discussion is the importance of finding a balance between systems based on codification and personalization (e.g. Hansen et al., 1999; Ventkitachalam and Willmott, 2017). Schacht and Mädche (2013) state that a knowledge management system should contain both access to expertise and experts. At Company X, there exist, as described earlier, plenty of systems that contribute to knowledge reuse. Some of them focus on codification, such as saving one-pagers from lessons learned, while others encourage dialogue between individuals, such as Skype. A company needs both types, but as Hansen (1999) argue, a company should have strategy on what systems to focus on.

When choosing strategy for what systems to have, the culture of the organization should affect the decision. Riege (2005) write that knowledge management initiatives often fail because they are not adjusted to the organizational culture. At Company X, as described, the culture is open, and people are willing to share knowledge, especially face to face. Employees are extra willing to share when they can see the task significance and/or get feedback, because it increases internal motivation, as described in the model by Hackman and Oldham (1976). Company X can use these traits of the organization in their general strategy for knowledge management systems. The finding that face to face communication is important in the

organizational culture, suggests that emphasis for Company X should be on knowledge management systems based on personalization.

In the following sections, two knowledge management systems that are based on personalization are analyzed in relation to Company X. The first one is systems that can help employees locate relevant experts, hereafter called expert database. The second one is company social media sites. However, as mentioned above, a company needs codification systems as well. Therefore, codification systems are analyzed in the last part of the section.

Expert Database

Currently, there is no system helping employees locating the relevant expert available at Company X. If one needs to find someone who probably has relevant knowledge, one can for example see who is responsible for a standard. However, if not finding the right individual that way, one finds experts by asking around. Hence, if not knowing the right people, this can lead to that someone who searches for knowledge does not find the right person.

In addition, an expert database could be designed to show that the company wants to promote knowledge sharing and reuse. For example, it could be connected to an incentive system, by giving an individual that gets classified as an expert a higher salary. It can increase motivation for the individual who becomes an official expert in two ways: he/she both get the possibility to help people who contact him/her face to face, providing opportunities for visible task significance and feedback, and in addition gets extrinsic motivation by the salary increase. By connecting the expert database to an incentive system the company can in addition avoid a barrier described by Riege (2005) who mentions a barrier related to "*Lack of transparent rewards and recognition systems that would motivate people to share more of their knowledge*" (p. 26).

Company Social Media Site

Another way that Company X can align their knowledge management system strategy with their culture, by focusing on personalization, is by trying to make employees use the social media site Yammer more frequently. As Neeley and Leonardi (2018) describe, a company social media system can be beneficial for knowledge reuse. However, as Neeley and Leonardi (2018) further explain, it is challenging to keep a social media site active. In addition, employees at Company X already perceive that there are too many systems existing. It is not uncommon that companies have too many systems supporting knowledge management active in parallel, and could benefit from narrowing it down, as described by Stan Garfield in an interview on YouTube (Major Projects Knowledge Hub, 2018). To have several systems active can for example lead to that employees use different systems. Reasonably, that employees use different systems is not sustainable in the long run, since it decreases the possibilities for knowledge reuse between employees using different systems. One could argue that Company X should either try to make Yammer a more active tool for the employees or deactivate it since it currently does not appear to be used (at the local site).

Codification Systems

As described above, companies cannot only have systems focusing on personalization, codification is also necessary. Company X has some systems where coded knowledge is shared, for example in folders in the cloud or via the product lifecycle management site. However, some issues with the systems have been apparent in the empirical result that generally align with barriers described in the theoretical framework.

One example is barriers connected to the "know-how" of how to use IT-systems, mentioned by e.g. Paulin and Winroth (2013). Employees at Company X who could recall their introduction described that they were

mostly self-taught in how to use the systems. Employees further use existing systems in different ways, which implies employees are comfortable with using the systems to various degree. One way to manage the barrier of low technological know-how, used by Company X, is with the help of online courses. In addition, the barrier of low technological know-how is managed during meetings, when employees guide each other on how to find knowledge in IT-systems. As described in examples above, the internal motivation to help colleagues face to face is high.

Another way to manage barriers connected to knowledge management systems is mentioned by Watson and Hewett (2006). They state that one factor that makes individuals use knowledge from a repository is that the system should be easy to use. One factor that makes a system easier to use is to have a well-working search function. This was requested by respondents, for example in relation to finding old lessons learned more easily.

A general issue with systems focusing on codification is that knowledge is, as Hansen et al. (1999) write, *"extracted from the person who developed it, made independent of that person, and reused for various purposes"*. When the knowledge is made independent of the creator, the creator does in many cases not get the possibility to get credit in the same way as when sharing the knowledge directly with someone who needs it. This leads to that the knowledge provider does not receive feedback or task significance, which consequently means that the internal motivation to share is lower, as described by Hackman and Oldham (1976). Schacht and Mädche (2013) write about how to create knowledge management system that increases knowledge reuse. They mention that useful feedback is a form of incentive, and it is important to provide incentives to increase sharing and reusing of knowledge.

However, codification is necessary to avoid being dependent on specific individuals and to be able to spread knowledge more easily. It would therefore be beneficial to create a codification system that uses the motivating factor of feedback. One way could be by the usage of a wiki-site, a tool that focuses on explicit knowledge (Carillo et al., 2012). As described in the theoretical framework, Majchrzak et al. (2013) argue that wikis solve several issues that traditional knowledge management systems and conversational management systems (such as social media sites) have. In addition, via a wiki, authors of a certain site can get feedback and thanks from people who are using it or start having discussions with other employees who want to update something the author previously has written. Such communication could be similar enough to face to face knowledge sharing to generate the internal motivation created by feedback and task significance, in line with previous reasoning. However, on a wiki-site, maintenance of knowledge is not centralized, as in traditional knowledge management systems (Majchrzak et al., 2013). This leads to a risk that the knowledge is incorrect.

At Company X a company-wide wiki-site was recently shut down. On one hand, it is positive if following the advice from Stan Garfield, who states that many companies have too many systems active at once (Major Projects Knowledge Hub, 2018). On the other hand, as previously described, the wiki-site was not closed because employees did not use it. It was decommissioned due to a change of systems. It was further explained by an employee that another effect of the wiki-site was that people started to create own pages, for example for translation, which led to that the organization risked double information. This indicates that employees were motivated to use the site to share knowledge. However, a company that chooses to use a wiki-site needs to find a way to deal with the risk of not having control of the knowledge.

5.2.4 Summary of Methods and Practices

In this section, three main groups of methods and practices have been analyzed. All enable reuse of knowledge in various way.

The first group was organizational methods that promote knowledge reuse. The main process analyzed was lessons learned, which is a common method to transfer knowledge between projects (Michell & McKenzie, 2017) used also at Company X. In short, one goes through key events in a project and tries to make sure that learnings made in a project are used in following projects. One of its benefits is that each lesson is based on a real event, therefore it can be supported by storytelling. However, at Company X, some employees could not see the value of the lessons learned process. They had a feeling of that when they had created a lesson, it disappeared. This was however not the case for some learnings that they could share directly face to face with their colleagues. In such cases, it was evident that the lessons would be useful and when sharing they got direct positive feedback from their colleagues. Two other methods analyzed as part of the first group were query trees and knowledge cafés.

The second group analyzed was meetings. Meetings provide opportunities for sharing and reusing of knowledge. Meetings further provide possibilities for employees to ask for help, which is a form of knowledge pull. Knowledge providers are in most occasion open and available to share knowledge both in planned and unplanned meetings. It is because they are internally motivated to share, due to the direct feedback and task significance that occur when one can help a colleague face to face, see Hackman and Oldham (1976).

The last group in this section was knowledge management systems. A discussion topic connected to knowledge management systems is whether they should be based on personalization or codification. In short, the knowledge management strategy and whether an organization chose to have a majority of systems based on personalization or codification, should be based on the organizational culture. At Company X, knowledge sharing is to a great extent done face to face. Therefore, a personalization strategy is recommended for Company X. However, at another organization where the culture is to search for knowledge in systems, rather than ask colleagues at first, codification is recommended.

Overall, a read thread discovered in this section was the importance of that the knowledge sharer has a high internal motivation to share. At Company X, knowledge reuse works best when the knowledge provider and knowledge consumer discuss face to face. That can be because the knowledge provider gets direct feedback and that the task significance is high, which creates internal motivation, according to the model by Hackman and Oldham (1976).

5.3 Barriers Hindering Reuse of Knowledge

There exist many barriers that hinder knowledge reuse. In this section the identified barriers are firstly analyzed, thereafter it is described which are intertwined and lastly, suggestions on how to manage barriers are presented.

5.3.1 Identified Barriers

In this section the identified barriers from both theory and the empirical case are analyzed. In the figure below, the barriers from the theoretical framework are summarized.
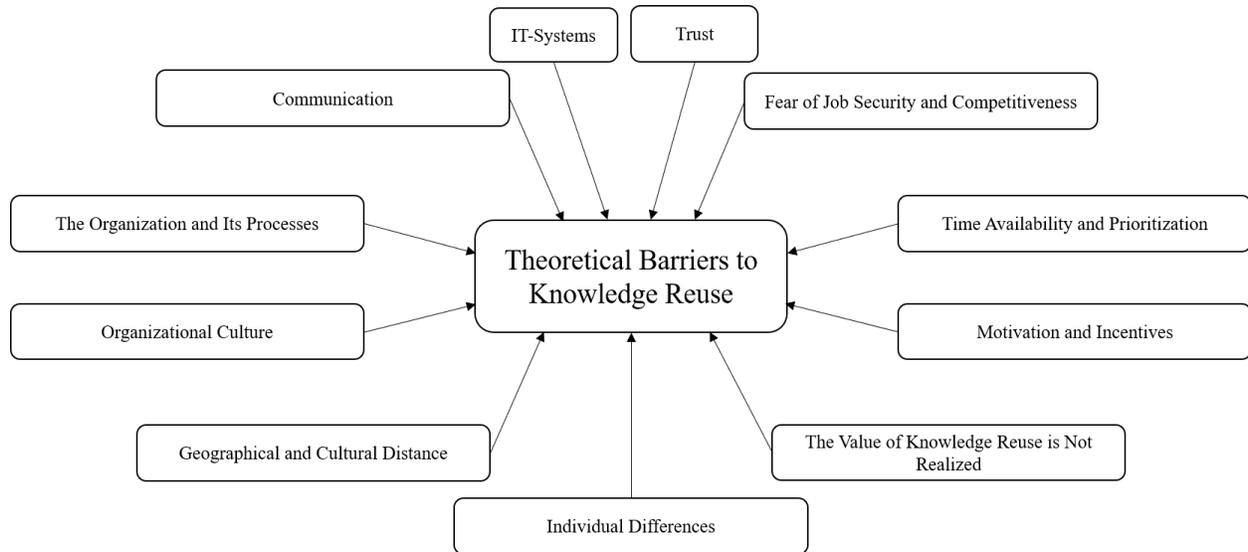

Figure 12 Barriers identified in the theoretical framework.

Trust

As mentioned in the theoretical framework, the barrier trust can be divided into two dimensions; one about whether or not the recipient of the knowledge trust the knowledge, and another about whether or not the knowledge sender trust colleagues enough to share knowledge with them (Riege, 2005). The empirical findings show that this is not a barrier affecting knowledge sharing and reuse at Company X. Instead employees trust what their colleagues say and gladly both share knowledge and ask for help.

Fear of Job Security and Competitiveness

The second cluster of barriers that was identified in the theoretical framework was about fear and competitiveness. In the same way as trust, the barrier is not prominent at the case company. As an example, at one meeting a Project Buyer presented a good KPI, giving credit to his/her colleagues. He/she emphasized that the good result was not his/her merit, but the colleagues. This can be related to one barrier described by Riege (2005), namely, that an individual can hesitate to share knowledge if they are afraid that they will not receive well-deserved recognition.

One explanation to why fear and competitiveness have not been present at Company X can be the due to the trust presented in the previous section. One can argue that an underlying trust among colleagues may result in less fear and competitiveness.

Time Availability and Prioritization

Overall, within the empirical study lack of time was prominent. This aligns with what is described in theory, for example Riege (2005) concludes that lack of time is a barrier. In addition, both Goh (2002) and Paulin and Winroth (2013) emphasizes that available time is something that facilitates knowledge sharing. As an example of lack of time in the case study, one Project Buyer stated that everyone is helpful, but busy. Yet another respondent, when talking about the lessons learned process, stated that the work environment was intense, and that one rushes from one project to the next, without truly reflecting.

However, in the case, employees almost always managed to take time to help a colleague when asked. One could argue that employees manage to make time for face to face knowledge sharing due to the internal motivation it creates. Even though learnings produced in lessons learned sessions can help colleagues just as much as helping them face to face, it does not create as high internal motivation. This is due to that helping a colleague face to face has a clear task significance and provides direct feedback, which creates internal motivation according to the model by Hackman and Oldham (1976). Hence, the barrier of time availability and prioritization is intertwined with the motivational barrier. In addition, one can argue that to manage the barrier of time availability, the solution is to make employees internally motivated to perform the task, not only ensure that there is time dedicated to the task.

The Value of Knowledge Reuse is Not Realized

The fourth barrier identified was about if the value of knowledge transfer and reuse is not realized. At Company X two dimensions of this barrier have been identified, namely value of knowledge reuse at an organizational level and at an individual level.

At the organizational level the value of actions connected to knowledge sharing is realized. The organization have chosen to prioritize to have several methods and practices aiming towards knowledge sharing and reuse, such as lessons learned and project purchase tracking meetings. Since the organization prioritizes to use resources for knowledge management-related procedures it is evident that the organization and its management see the value of knowledge sharing and reuse.

At the individual level, the value is realized is some situations. In relation to the project-related lessons learned the value is, as described earlier, often not realized by employees. This can become a barrier related to the critical failure factor described by Akhavan and Pezeshkan (2014) which is that the outcome of knowledge management work is not related to routine tasks. However, when the value is realized, for example in conversations, employees gladly prioritize to help their colleagues. Something that is aligned with internal motivation arising from high task significance presented by Hackman and Oldham (1976). This way, value can be related to motivation in general, and task significance in particular.

IT-Systems

There are many barriers connected to IT-systems. For example, Riege (2005) mention systems that are hard to use as a barrier and Paulin and Winroth (2013) discuss low technological know-how. These barriers have been analyzed in section *5.2.3 Knowledge Management Systems.*

One of the main takeaways from the analysis in *5.2.3 Knowledge Management Systems* is the importance of taking motivational factors into account when creating the strategy for knowledge management systems. For example, at Company X, face to face meetings are important for knowledge sharing. Therefore, systems focusing on personalization could be more successful than systems focusing on codification.

Individual Differences

In theory, one type of barrier was related to individual differences, see for example Paulin and Winroth (2013). Related to this barrier both Riege (2005) and Paulin and Winroth (2013) mention age and gender as individual differences that can affect knowledge sharing. Even though the studied group at the case company is a group with various aged and different genders, no such individual barriers have been salient during the empirical studies. One possible explanation could be that the group studied is small and know each other well, which could be one underlying reason to how this barrier is managed at Company X.

Geographical and Cultural Differences

Due to the scope of this study, this barrier has not been prominent. This thesis focuses on one local site, and consequently no major geographical or cultural differences existed. However, in some interviews it was mentioned that it was harder with knowledge sharing between sites. This could therefore be an area for future research.

Organizational Culture

Several authors have emphasized that the culture in an organization is affecting knowledge sharing (e.g. Riege, 2005; McDermont & O'Dell, 2001). However, the findings at Company X do not indicate that the culture at the company is a barrier. Instead, the existing culture at Company X is a facilitator for knowledge reuse. As mentioned earlier, employees are not afraid of asking colleagues for help when needed and there are no hesitations to share knowledge with colleagues

Another aspect that suggests that the culture at Company X works as a facilitator for knowledge reuse is its relation to learning anxiety, a concept presented by Coutu (2002). Coutu (2002) argues that learning anxiety occurs when an individual is afraid of learning something new. However, in the case it has been apparent that employees feel safe to ask questions, having low learning anxiety because of the open organizational culture. When the learning anxiety is low individuals are more likely to learn (Coutu, 2002). In addition, this can also be related to trust, since one can argue that trust creates a safe environment.

According to McDermont and O'Dell (2001) culture is often seen as an inhibitor to knowledge sharing. Furthermore, they state that a sharing culture exist when employees find it natural to share, not when they feel forced. This indicates that to create a sharing culture, employees needs to be intrinsically motivated to share. Intrinsic motivation is when a person is *"doing something because it is inherently interesting or enjoyable"* (Ryan & Deci, 2000, p. 55). Hence, intrinsic motivation is needed to create a sharing culture. To create internal motivation two central parts are, as earlier mentioned, task significance and feedback, according to the Job Characteristics Model by Hackman and Oldham (1976).

An example that stresses the importance of intrinsic motivation for knowledge sharing at Company X is lessons learned made in projects. Several respondents stated that they did not know what happened to the lessons learned after creating them, therefore the experienced task significance is low. In addition, the Project Buyers do not receive any feedback when creating a lesson learned. The intrinsic motivation for sharing knowledge in this setting is therefore lower compared to the example above, with face to face knowledge sharing.

The Organization and Its Processes

As mentioned in the theoretical framework, there are several dimensions of this barrier. One related to the physical layout of the organization, something that Riege (2005) argues can affect knowledge sharing. At Company X, the physical layout of the office contributes to knowledge reuse in a positive way. The open

plan office makes it easier for Project Buyers to ask each other questions in the daily work. In addition, if overhearing someone speaking about something that one is interested in, one can join the conversation to gain or share knowledge. As described earlier, findings indicate that face to face knowledge sharing is an important practice at Company X. The physical layout contributes to opportunities were such knowledge sharing can take place.

Another dimension of this barrier that was visible in the case was the importance of processes and basic infrastructure for knowledge sharing, a factor mentioned by Paulin and Winroth (2013). Company X has processes for knowledge reuse in place. It is beneficial that organizations promote knowledge reuse by for example providing time during meetings for knowledge sharing, or include tasks related to knowledge reuse in processes. However, when designing process tasks, the organization must consider what motivates an employee to perform the task. For example, in the case, knowledge sharing takes place at meetings because the internal motivation is higher when sharing knowledge face to face, as earlier mentioned. There is however room for improvements in connection to the lessons learned process at Company X. Currently the creator of the learning does not receive feedback or have a high task significance when contributing with a lesson learned, meaning that the internal motivation is not as high, as Hackman and Oldham (1976) argue.

Communication
In theory, the role of communication as a barrier is debated. Riege (2005) as well as Cumberland and Githens (2012) argue that communication is a barrier. Another point of view is presented by Paulin and Winroth (2013) who states that communication is both a facilitator and an inhibitor. In contrast, Okoroafor (2013) argues that communication cannot be a barrier, since it is the foundation of sharing tacit knowledge. The researchers of this Master's Thesis agree with Okorafor (2013), communication cannot be a barrier, since it in itself is a method for sharing knowledge.

However, even though there exist no consensus on the exact role of communication, the theory emphasizes the importance of communication when sharing knowledge, independent on if it is classified as a barrier, facilitator or a foundation for knowledge sharing.

Motivation and Incentives of Knowledge Sharing and Reuse
In theory, different authors describe that lack of reward systems that rewards knowledge sharing can become a barrier (e.g. Riege, 2005). At Company X, no such reward system exists. However, such reward system can be aligned with external motivation which is described by Ryan and Deci (2000) as when one is motivated due to the outcome of an activity.

Internal motivation has been stressed as an important factor for knowledge sharing in this analysis. As described, to achieve internal motivation, task significance and feedback are two factors needed (Hackman & Oldham, 1976). This barrier is intertwined with many of the previously described barriers and is hence an important factor when trying to manage barriers hindering knowledge reuse. Its effect on other barriers is analyzed further in *5.3.2 Which Barriers are Intertwined* and *6.1.1 How are the Barriers Intertwined?*. However, the importance of internal motivation has mostly been analyzed from the perspective of the knowledge provider. The knowledge consumers internal motivation for searching for knowledge likely is naturally high, due to the need of the knowledge that the consumer is searching for, for example when asking for help.

In this group of barriers, incentives are also included. As mentioned by for example Riege (2005) lack of a transparent reward system that can motivate individuals to share is a barrier. At Company X, there is no

reward system that promotes knowledge sharing, which consequently could be a barrier for knowledge reuse at the company. If wanting to manage this barrier, one could for example connect a reward system to creations of lessons learned to motivate employees to share more knowledge. However, even if an incentive system could be beneficial for the knowledge reuse at Company X, findings indicate that it is more important that the employees are internally motivated to share.

A New Barrier: Multitasking

In addition to the barriers described above, findings suggest that can be identified as a new barrier. The barrier has, to the knowledge of the researchers, not been written about in the context of a barrier to knowledge sharing and reuse before.

As mentioned earlier, this barrier is prominent at Company X. Employees are using their computers and smartphones during meetings, something that scatter their attention. In theory, it is stated that *"multitasking reduces the brain's ability to effectively retrieve information"* (Ellis, et al., 2010, p. 1). However, as discussed in *5.2.2 Meetings as a Method for Knowledge Reuse,* multitasking could be the reason to why the employees can participate in meetings at all, and therefore one can also argue that it is a facilitator. To study whether multitasking during meetings becomes a barrier or a facilitator, or possibly both, could be an area for future research.

5.3.2 Which Barriers are Intertwined

As has been mentioned in the analysis above, some of the barriers identified affect each other. According to Riege (2005), one should, when analyzing barriers, be aware that they are often intertwined. In this section the barriers that have been most prominently intertwined with other barriers are analyzed.

Barriers Intertwined with Trust

Both organizational culture and fear of job security and competitiveness are intertwined with the barrier trust, see Figure 13.
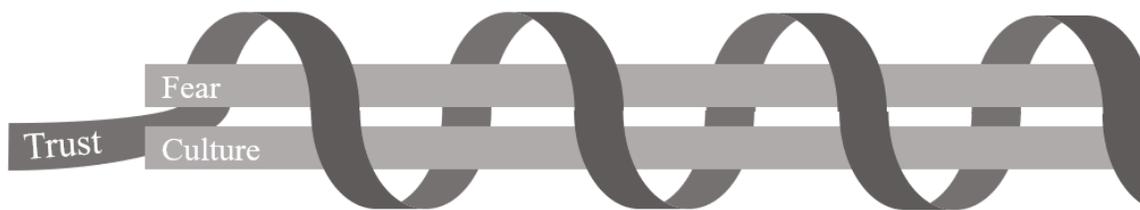
Figure 13 Barriers intertwined with trust.

Trust and organizational culture likely affect each other. In the case company, as described, trust between Project Buyers are high. The knowledge consumer trusts knowledge providers, and knowledge providers trusts colleagues enough to share knowledge. This could be argued to form the basis for the open organizational culture that has been observed at Company X. This leading to for example, a low learning anxiety, see Coutu (2002), where employees are not afraid to ask questions. However, it could also be the other way around, that the organizational culture creates trust among employees.

Trust is also intertwined with fear of job security and competitiveness. Fear of job security and competitiveness is, for example if an employee is afraid to lose his/her job if sharing knowledge or fear that he/she will not receive recognition (Riege, 2005). This was not visible in the case company, were employees as described gladly share knowledge. One can argue that the employees gladly share knowledge because they trust each other, believing that no colleague would use the knowledge without giving the knowledge provider recognition. Nevertheless, as with trust and organizational culture, it could also be the other way around. That is, that there exist the lack of fear of job security and competitiveness leads to trust.

In short, the findings show that the trust is intertwined with organizational culture and fear of job security and competitiveness. However, *how* these barriers are intertwined, could also be of interest to study. It is further discussed in *6.1.1 How are the Barriers Intertwined?*.

Barriers Intertwined with Motivation and Incentives
Motivation and Incentives is intertwined with several other barriers, however, mainly the motivational part of the barrier. The reasoning behind which barriers motivation is intertwined with have its origin within internal motivation and the Job Characteristics Model and its Core Job Dimensions presented by Hackman and Oldham (1976). In Figure 14 below, different barriers intertwined with motivation are shown.

Figure 14 Barriers intertwined with motivation.

Firstly, motivation is intertwined with the barrier stating that the value of knowledge sharing is not realized. These two barriers are intertwined due to task significance. Hackman and Oldham (1976) argue that internal motivation increases with task significance, which they describe as whether it is clear if the task at hand affect other persons. This is closely related to if an employee can see the value of the knowledge sharing activity.

Secondly, motivation is intertwined with the barrier time and prioritization. Low internal motivation affects how an employee prioritizes activities related to knowledge sharing. For example, employees at the case company found time to help colleagues face to face, a knowledge sharing method that inherently creates internal motivation as earlier described, even though they expressed that lack of time generally was an issue. Hence, the barriers motivation is intertwined with time and prioritization.

Thirdly, motivation is intertwined with the barrier of organization and its processes. As described earlier, it is likely that employees do tasks related to knowledge sharing that are included in organizational processes more thoroughly if the task creates internal motivation, by for example ensuring that the task have a visible task significance and provide feedback, as described by Hackman and Oldham (1976).

Fourthly, motivation is intertwined with IT-systems. An issue described earlier, mainly in relation to IT-systems based on codification, is that someone who contributes to such system by for example adding knowledge to a knowledge repository does generally not get feedback or in some occasions cannot see the task significance. This can lead to that the knowledge management system is not used. Hence, motivation and knowledge management systems are intertwined.

Lastly, motivation is intertwined with the organizational culture. According to McDermont and O'Dell (2001), a sharing culture exist when employees share knowledge because they find it natural and not due to being forced. When an employee is internally motivated to share knowledge, one can argue that it means that they find it natural to share, see previous reasoning.

This study has focused on which barriers are intertwined. However, the findings have to some extent also indicated *how* the barrier motivation is intertwined with other barriers, as described above. This is further discussed in *6.1.1 How are the Barriers Intertwined?*.

Barriers with No Prominent Intertwining
In some occasions other barriers than the ones described in the previous section have also been affecting each other. However, the barriers described in the previous section are the ones that most prominently intertwined other barriers in this study.

There are also some barriers that, within this study, is not intertwined with other barriers. That does not mean that they do not affect or become affected by other barriers in general, only it has not been prominent within this research.

5.3.3 Managing Barriers Hindering Knowledge Reuse
Some barriers described in the analysis have more concrete ways of managing them, which have been previously described in the analysis. For example, if a barrier is that an IT-system is hard to use, one could try to increase the usability by adding a search function or redesigning the interface. Another barrier mentioned connected to IT-systems is low technological "know-how", which for example can be managed by educating employees or by promoting that employees who are knowledgeable within the systems helps his/her colleagues.

However, since the barriers are intertwined, actions done to manage one barrier can lead to that one manages several related barriers simultaneously. To manage the barrier of trust and the barrier of motivation and incentives can possibly consequently lead to that other barriers hindering reuse can be dealt with. How this can be done will be further discussed in section *6.1. Managing Intertwined Barriers*.

Considering the newly identified barrier multitasking, more research is needed before fully defining it as a barrier, hence ways of managing it as a barrier will not be further discussed. The barriers of individual differences and the barrier of geographical and cultural distances will also not be further discussed, since they have not been prominent in this research.

Further ways of improving knowledge reuse, and manage barriers, by the usage of methods and tools studied in this thesis are described in section *6.4 Implications for Practitioners*.

5.3.4 Summary Barriers

The above analysis of barriers has been summarized into Figure 15. Communication has been excluded as a barrier, see section *5.3.1 Identified Barriers.* Furthermore, compared to the barriers described in the theoretical framework, multitasking has been added as a barrier.

The barrier of individual differences and the barrier of geographical and cultural distance have not been visible in the empirical findings, due to the scope of the study. However, they were frequently mentioned in theory, and are therefore included in the figure below.
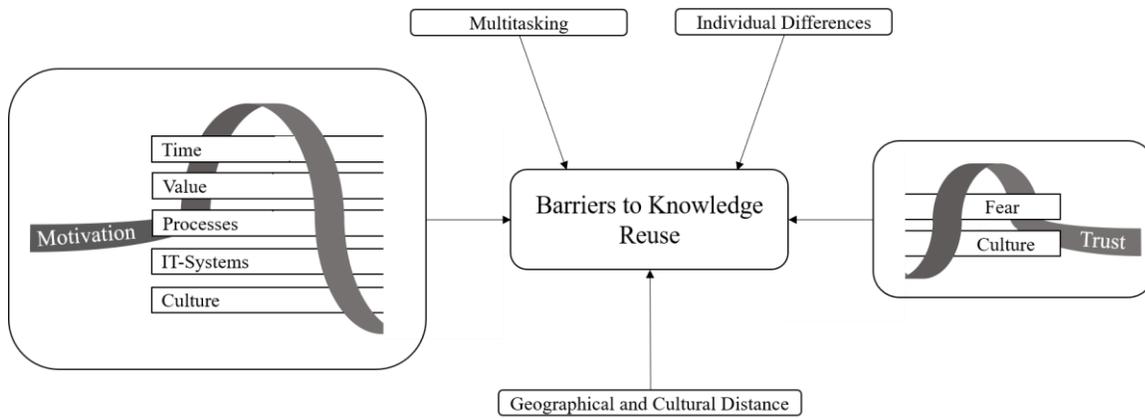

Figure 15 The barriers that have been identified in this study and which are shown to be intertwined.

6   Discussion

The purpose of the thesis is to analyze how product development projects can reuse existing knowledge. This has been done by providing answers to the research questions, in the previous chapter. The answers are summarized in chapter 7. Conclusions. However, since the research questions narrows down the purpose, the perspective is yet again broadened in this chapter.

In this chapter, firstly, it is discussed how barriers are intertwined and how one can manage intertwined barriers. After that, the transferability of the results to other situations is discussed. Thereafter, a sustainability perspective is taken on the topic of the thesis to provide a broader view of the importance of knowledge reuse in product development projects. Lastly, implications for practitioners and suggestions for future research are presented.

6.1   Managing Intertwined Barriers

The third research question focuses on identifying which barriers are intertwined. However, it is possible that identification of *how* barriers are intertwined, can affect how one can manage more barriers at once. For example, if one barrier is the main cause behind another barrier, putting effort into managing the primary barrier might consequently lead to managing also the secondary.

6.1.1   How are the Barriers Intertwined?

As described in the analysis, it has been identified which barriers are shown to be intertwined in this study. The two barriers that were most prominently intertwined with other barriers were motivation and trust.

The barrier motivation and incentives is intertwined with other barriers mainly because of internal motivation. The reasoning was at large based on a model by Hackman and Oldham (1976), in which feedback and task significance are important factors to create internal motivation. The findings imply that internal motivation affect other barriers, rather than the opposite, suggesting that it might be a "primary" barrier. For example, situations where the internal motivation is high, such as when sharing knowledge face to face, the employees prioritizes in and take time to share knowledge. Hence, it is likely that by creating internal motivation for knowledge sharing activities, also other barriers intertwined with motivation can be managed. However, to study *how* internal motivation is intertwined with other barriers, can in the prolonging give further insights on how several barriers can be managed. This could be an area for future research.

The barrier trust is also intertwined with other barriers. The findings do however not indicate how the barrier is intertwined with other barriers. Trust is intertwined with both organizational culture as well as job security and competitiveness. It could be that the organizational culture creates trust. For example, if a new employee starts at a company, and the organizational culture encourages employees to help each other, the new employee starts to trust his/her colleagues because they help him/her. It could also be that a colleague only shares his/her knowledge with the new employee when the new employee has gained trust. It is furthermore possible that low trust can cause low job security and competitiveness, or the other way around. To study the causality and understand how other barriers are intertwined with trust could be an area for future research.

Even if this study has not clarified how barriers are intertwined, the findings indicate that internal motivation and, to some extent, trust are barriers that could influence other barriers. How to create internal motivation and trust, to manage more barriers, is therefore reflected shortly on below.

6.1.2   Creating Internal Motivation and Trust

Internal motivation can be created by using the model presented by Hackman and Oldham (1976), that is strengthening the different core job dimensions. For example, if ensuring that tasks defined in knowledge sharing processes or usage of knowledge management systems have high task significance and provide feedback, motivation and barriers affected by it can be less prominent. One suggestion how this can be done is to create a feedback loop when contributing with a lesson learned.

Within this study, no theory on how to create trust in an organization has been studied. However, at Company X, trust is high between employees. It could perhaps be due to that the group working together is small, meaning that the employees have been able to get to know each other well. To create small working groups with high trust level could therefore be one way of managing barriers hindering knowledge reuse. However, more research is needed both to understand how the barrier of trust is intertwined with other barriers, and how trust can be created, to be able to use trust to manage other barriers.

More concrete explanations of what can be done to manage different barriers are explained in *6.4 Implications for Practitioners.*

6.2   Transferability of Findings

In this section it is discussed if the findings can be used in other contexts. The discussion is divided into sub-sections, where each sub-section is connected to a research question.

6.2.1   Methods and Practices for Knowledge Reuse in the Purchasing Sub-Process

In short, three groups of methods and practices were identified during the analysis, namely organizational processes, meetings and knowledge management systems.

Firstly, organizational methods were identified as a group of methods and practices for knowledge reuse. The three methods investigated within this group were lessons learned, query trees and knowledge cafés. lessons learned have been widely researched (e.g. Schacht & Maedche, 2016). Hence, the findings regarding lessons learned are likely to be transferable. However, both query trees and knowledge cafés are methods that have not been researched to a great extent. One can argue that these methods provide benefits that are hard to achieve with other methods. Nevertheless, the lack of theoretical evidence for these methods is prominent and further research is needed before being able to determine if they are reliable.

Secondly, meetings were identified as a group of methods and practices for knowledge reuse. Meetings are one of the oldest ways of sharing knowledge. Both empirical data and theory suggest that face to face meetings comes with several benefits related to motivation and tacit knowledge. Hence, meetings as a method for knowledge reuse is likely to be applicable in other contexts.

The last group of methods and practices found was about knowledge management systems, an area in which there exists much research, as presented in the theoretical framework. At large, the findings align with existing theory about for example barriers connected to knowledge management systems, which suggest that the findings are applicable in other contexts.

In general, the findings are supported with theory and analyzed using generic arguments independent of the context. Therefore, it is likely that many methods and practices are transferable to other contexts.

6.2.2 Identified Barriers

The identified barriers emerged from different sources. Some were supported by both empirical data and theory. The ones that are prominent in both theory and the empirical case are likely to be applicable in other cases as well.

Two of the barriers identified where identified only via theoretical findings, namely individual differences and cultural and geographical distance, which were not prominent in the empirical case. This is likely due to the scope of the study. However, it is probable that they exist in other contexts.

Multitasking is a barrier identified in this research based on empirical data. It is likely that this barrier exists in other contexts as well. However, there is no support in theory for multitasking as a barrier for knowledge reuse, though there is theory stating that multitasking can limit a person's ability to retrieve information (Ellis, et al., 2010). This area is proposed for future research.

6.2.3 Which Barriers are Intertwined

Several barriers are intertwined. Which barriers are intertwined is not stated in theory but emerged from the analysis. Many of the connections between the barriers were prominent in the case, however, more research is needed to be able to determine if the findings regarding how the barriers are intertwined is transferable to other contexts.

6.2.4 Managing Barriers Hindering Knowledge Reuse

Lastly, ways to manage barriers is in some cases related to how they are intertwined. Hence, ways to manage barriers also needs future research, to be able to determine its transferability to other contexts.

Ways to manage barriers by usage of the studied methods and tools are further discussed in *6.4 Implications for Practitioners*. In that section it is also stated what recommendations likely are useful for organizations in general, and what recommendations mainly are directed towards Company X.

6.3 Sustainability Aspects

From a broader perspective, it is also of interest to discuss how this Master's Thesis contributes to sustainable development. To create sustainable development, three aspects must be taken into consideration: environmental, economical and societal aspects (UK Stakeholders for Sustainable Development, n.d.)

In a large perspective, one can argue that knowledge management is vital for sustainable development. If knowledge is not reused, the same mistakes will be repeated. This can have consequences in all three sustainability dimensions. For example, if a factory creates a more efficient way to use raw material, and that knowledge is reused by another factory in the same organization, it is one step towards a more ecologically sustainable world. It is furthermore more economically sustainable since less resources are wasted. To make that happen, firstly, knowledge creation, for example process or product development need to occur. If the new knowledge should have a larger impact, knowledge reuse is crucial. Knowledge management in addition makes it possible to use human intelligence and creativity in a better way. It is unnecessary that two people invent the wheel. In an ideal state, if all knowledge would be accessible and reusable by all, reasonably, humanity would be able to move forward at a higher speed than it is today. However, that is only positive if forward is towards a more sustainable world.

The result of this thesis has created a better understanding of how knowledge can be reused in product development projects. If products that are being developed are sustainable, and knowledge reuse makes the development of them more efficient, then this thesis has contributed to a sustainable development.

6.3.1   Knowledge Reuse, Purchasing and Sustainable Development

One outcome of this Master's Thesis is methods and practices that enable knowledge reuse for the purchasing function within product development projects. For Project Buyers in general, such methods can ease their workload by reusing existing knowledge, instead of remaking the same mistakes. One can argue that work-related stress could be prevented by a decreased workload and hence increase the societal sustainability. In the prolonging, the risk of a long-term sick leave due to stress related diseases can be decreased. This can also be argued to increase the economical sustainability of the society, since long-term sick leaves is a cost for the society.

By reusing knowledge within the purchasing function all three sustainability aspects can be affected. For example, imagine that a Project Buyer is facing a choice between two potential suppliers, Supplier A and Supplier B. At first glance, Supplier A has a better offer. However, when the Project Buyer mention this to a colleague, that colleague tells the Project Buyer about previous experiences with supplier A. From the colleague's experience Supplier A is insufficient. The colleague explains that when he worked with Supplier A on a similar product the development process got delayed due to late deliveries from Supplier A. In addition, they had a hard time managing the quality of the article. After this conversation, the Project Buyer instead choses Supplier B and the collaboration works well.

This is an example where knowledge reuse is important for sustainability. If the Project Buyer would not have talked to the colleague the choice would have been Supplier A, which possible would have caused delays. Delays would be costly and therefore affect the economy. Perhaps the company would choose to transport articles by flight instead of train due to the delays, which affects the environment negatively. In addition, the situation would likely cause stress for the Project Buyer, which can be related to the societal dimension of sustainability.

6.3.2   Company Specific Sustainability

It is likely that Company X is the organization where the knowledge that has been produced in the making of this Master's Thesis will be used. Company X state on their webpage that they work with sustainability, mainly the societal aspects, due to the nature of Company X's products. Company X furthermore work to reduce their environmental impact, work with their employee's health and safety and commit to acting ethically in their engagement in different communities. Since Company X is an organization that take sustainability seriously, the result of this report may consequently contribute to sustainable development.

6.4   Implications for Practitioners

A main conclusion in this thesis is that several knowledge reuse barriers can be managed by ensuring that an employee is driven by internal motivation when performing tasks connected to knowledge reuse.

Internal motivation can be achieved by the core job dimensions presented by Hackman and Oldham (1976). Two of these core job dimensions have been prominent in this research, namely task significance and feedback. Hence, an organization needs to consider these two dimensions when designing processes for knowledge reuse. As Hackman and Oldham (1976) describe, task significance is achieved by making sure that it is clear for the knowledge provider why knowledge is shared. They further explain that feedback is

achieved by ensuring that the knowledge provider gets direct and clear information about the effectiveness of his/her performance.

Within this thesis, three methods and practices that can be used for knowledge reuse have been studied more thoroughly. In the following sections, these are gone through and it is exemplified how Company X can use the findings to improve their processes for knowledge reuse. It is also emphasized how organizations in general can use the implications.

6.4.1   Organizational Methods

The three methods and practices that are described in this subsection are lessons learned, query trees and knowledge café, focusing on how Company X and companies in general can use the methods.

Lessons Learned

Company X has a lesson learned process in place, which contributes to reuse of knowledge between product development projects. Lessons involving purchasing can come from both projects or be created locally at the department.

The process for spreading learnings that are created locally is working well. It includes discussing the learnings at department meetings, and as have been described in the analysis, to spread learnings face to face is an efficient way of sharing knowledge. This well working method, were employees get the time to discuss learnings face to face at a meeting, is something that can be useful for other organizations as well. However, there is room for improvement regarding how the learnings are saved at Company X, since the current way is not easily searchable, in case someone wants to return to an old learning and read it again. Another issue with today's process is that anyone who misses a department meeting where a learning is discussed, is not obligated to check the document with lessons learned or ask colleagues about the missed learning. To deal with this issue, the researchers suggest that the purchasing department use the same matrix as when spreading standards, where every employee needs to confirm that they have taken part of the learning. This improvement was also suggested by a respondent. Such matrix would minimize the risk of anyone missing a learning.

Regarding lessons created in projects, some possible ways of improving the process have emerged during the study, which are listed below. These points can also be useful for other organizations that use lessons learned to spread knowledge between projects.

- **Perform Lessons Learned sessions more frequently**
  Currently it is only mandatory that a project summarizes key events in a project before tollgate 4. Both respondents and theory suggest that it could be better to do it more frequently, when learnings are still fresh. In addition, as mentioned in the theoretical framework, it is easier to gather the whole project team in the middle of the project rather than in the end, when many team members have started to become involved in other projects.

- **Ensure that employees get feedback after contributing with lessons**
  Employees interviewed expressed that they did not know what happened to lessons learned after they were created in projects. There is a risk that if the employee does not see the value of contributing with lessons learned, it will not be done thoroughly. To avoid this, it is possible to create a feedback loop. This way a project team that has contributed with a lesson can understand that it is used. For example, it could be that when a standard is updated based on a lesson, the team

members that created the lesson could get an email thanking them for their contribution. By doing that, both feedback and task significance will get higher, see Hackman and Oldham (1976).

- **Start of projects by discussing old experiences**
  This was suggested by both theory and respondents. The researchers of this Master's Thesis suggest that it can be done by having a meeting in the beginning of a new project, in which team members can share experiences from previous projects. To such meeting, experts that have worked with similar projects or are knowledgeable within the area can be invited. In addition, one person should be responsible for bringing relevant lessons learned to discuss, see the next point. It could be described as a brainstorming meeting where possible risks with the project are identified by using knowledge from previous projects.

- **Make it easier to find and use old lessons learned**
  At Company X the strategy of saving old learnings is based on including them in standards or design documents. Lessons that do not fit into any document is spread verbally to departments affected. This way, the company avoids creating a big repository of lessons learned which is rarely used, something that other companies struggle with, as described in theory. However, at the company it is still requested that employees write one-pagers when creating a lesson, which are saved, but not easily searchable. One could argue that since these documents are created, it could be of value to upload them to a more easily searchable platform. That way, they could for example be used in sessions described in the previous point. It could also be of interest to save some lessons learned in written down stories and not only standardized one-pagers, since stories explain more of the context and are easier to remember. Such format can make the old lessons learned easier to use.

Query Tree

Query trees is a method that is successfully implemented at a department at Company X. However, the purchasing function could benefit from developing their own query tree. The method can also inspire other organisations, as it can be used as a structured way of spreading explicit knowledge from for example lessons learned.

At company X, if purchasing develop their own query tree, the technical solution needs to be discussed with colleagues at the department using the current method, called PDC. However, the suggestion is to construct a basic structure from which the query tree can continue to grow as more learnings are made. The basic structure needs to be decided by the purchasing department. One example is presented in Figure 16, with a basic structure depending on Product Types and Production Plants. Another example is to base the query tree on different project phases, different components or different suppliers and their processes.
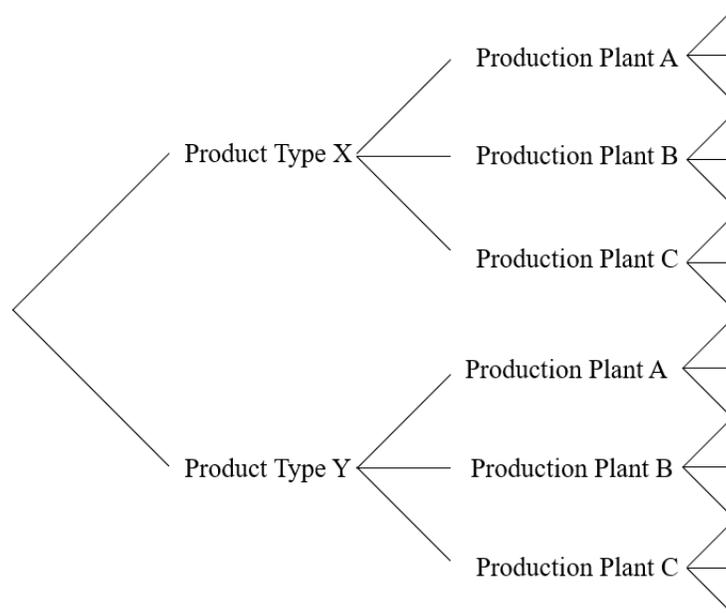
Figure 16 Schematic example of how a query tree can be developed.

Knowledge Café

The last method identified related to organizational processes is the knowledge café. To use knowledge cafés to share knowledge is a method that can be used by organizations in general. At Company X, the purchasing department is recommended to have such discussion forums regularly, not related to any specific development project. The subjects discussed should be general subjects that are relevant for a purchaser. A knowledge café could be based on Gurteen's (n.d. c) tip sheet. Based on that tip sheet, a knowledge café can be conducted as follows.

A facilitator is responsible for the knowledge café. All Project Buyers are invited to participate at a session with a specific theme, such as negotiation. One or two general discussion questions are formulated on beforehand, for example *"How do you conduct the best negotiation?"* and *"What are the most important aspects to consider before a negotiation?"*. The facilitator shortly introduces the participants to the subject and thereafter to the questions. There are no right answers to the questions. Project Buyers are supposed to discuss in smaller groups (with eight Project Buyers supposedly two groups with four in each). After a while they reassemble in the big group and have a discussion with the full group.

6.4.2 Meetings

One important method for knowledge reuse is meetings. Face to face communication creates both task significance and feedback, in line with previous reasoning. Hence, employees' internal motivation is probably higher, comparing to a situation in which they do not get either feedback or task significance when sharing knowledge. To use meetings to reuse knowledge could be beneficial for organizations in general.

At Company X, there exist many opportunities for employees to share knowledge face to face, which is beneficial for knowledge reuse. Opportunities include both formal meetings, such as department meetings, or informal meetings, such as coffee breaks. At large, these knowledge reuse opportunities work well today. Furthermore, the level of trust between employees at the purchasing department is high, for example employees are not afraid to ask each other for help during meetings, which also is beneficial for knowledge reuse.

However, if relying on face to face communication to spread knowledge, both Company X and organizations in general need to be aware of some risks, which are discussed below. Furthermore, some improvement suggestions for Company X have emerged during the study related to meetings, which also are presented in this section.

One risk is that knowledge distribution is limited and dependent on who talks to who. This risk can be partially dealt with by directing in which situation communication with a certain individual is mandatory. Take the above described meeting that could be held in the beginning of a project to discuss old experiences, to which one could invite experts that are experienced in the area of the project. In such case, knowledge sharing is directed by the organization, and the chance that the individual who has the right knowledge shares it at the right time is increased.

Company X, and organizations in general, are further recommended to consider whether employees shall be allowed to work with other things during meetings. As described, at Company X, many observations showed that employees frequently use their computers and multitask during meetings. In line with previous analysis, this could either be a barrier (since the employee is distracted) or a facilitator (since it enables the employee to participate in the meeting at all). However, any organization should make a conscious decision on what culture they strive towards.

Another improvement suggestion that can increase knowledge reuse at the purchasing department at Company X is by designing the project purchase tracking meeting in another way. Currently, it enables knowledge reuse, but it could be redesigned to make the knowledge sharing more efficient. However, since the project purchase tracking meetings has more purposes than knowledge reuse, perhaps it is not of interest for the company to redesign it. However, some adjustments that could be done to the project purchase tracking meeting to facilitate knowledge reuse are described in the following section.

Project Purchase Tracking Meetings – Design for Reuse
The findings show that the meetings work as a forum where it is possible for Project Buyers to lift concerns and ask for help, a form of knowledge pull. However, during meetings Project Buyers also spend time describing what has happened in projects since the last meeting, knowledge that is not always relevant for other participants. At Company X describing past events was also one of the purposes with the meeting, however, if only focusing on knowledge reuse, time spent on describing past events could be decreased. That is, one adjustment is to spend less time on explaining exactly what has happened since the last time, and spend more time asking questions. In addition, the participants can put more emphasis on future actions, since that is mainly where colleagues can contribute with their knowledge and be proactive. On the other hand, when employees describe what has happened in their projects since the last meeting, one can argue that it is a form of knowledge push. In some occasions such knowledge push can lead to that another Project Buyers gains knowledge that he/she did not know existed, hence might not have asked about. One therefore need to find a balance between knowledge push and pull in the meetings, since both can be positive for knowledge reuse. However, currently, observations indicate that there is too much focus on knowledge push.

Another adjustment that the researchers suggest is to ask all participants to spend a few minutes before the meeting thinking through what they want to bring up. By doing so, the meeting can be more efficient, and the participants gets the possibility to prepare what is of importance for them to discuss at every occasion.

However, as mentioned previously, these actions are mainly for improving knowledge reuse, and hence before implementing anything the company should consider other purposes that the meeting has.

6.4.3 Knowledge Management Systems

Riege (2005) have written that a barrier can occur if knowledge management initiatives are not adapted to the organizational culture. When defining a strategy for knowledge management systems, organizations in general should analyze if their culture supports face to face knowledge transfer or if systems where knowledge is codified and extracted from individuals are more suitable.

The identified culture at Company X was dependent on face to face communication between employees, and it is recommended that the knowledge management systems are adapted to this culture. Personalized systems are systems focusing on communication between individuals, rather than extracting and coding knowledge from an individual (Hansen, et al., 1999). To some extent the existing knowledge management systems at Company X are personalized, for example Skype is used frequently for knowledge reuse. However, one improvement that Company X could consider is to create an expert database, to make it easier to find individuals with relevant knowledge. Currently, experts are found by for example seeing who is responsible for a certain standard or asking colleagues. A list of experts, with links to sites where experts can introduce themselves and their areas of expertise could make it easier to find the right person to talk to, as described in section *5.2.3 Knowledge Management Systems.*

Furthermore, this research has shown that employees at Company X sometimes have a hard time navigating in different systems, and to know which system to use when. Therefore, one recommendation, which aligns with what Stan Garfield stated for in the YouTube channel Major Projects Knowledge Hub (2018), is to decrease the number of existing IT-systems. The company could begin by doing an inventory of systems in use and clarifying the purposes of the systems. The number of systems in use and their purposes is something that organizations in general can reflect upon.

For Company X, a knowledge management system that the company is recommended to reflect upon is the social media site Yammer. At the studied site, it is not that frequently used by employees, and one could therefore argue that it should be removed to decrease the number of systems. However, it is a knowledge management system that is focused on personalization, which is aligned with the company culture. According to Neeley and Leonardi (2018) company social media sites such as Yammer can contribute to knowledge reuse. If deciding to work with Yammer it is however recommended that it is reintroduced in a way that makes more employees want to use it, which is needed if the system should be a support in the daily work.

6.5 Future Research

This research has, as mentioned previously, been designed as a case study. Since all empirical data has been extracted from a single case, the transferability can be questioned, as discussed previously in this chapter and in *2.6.2 Transferability*. Studies in the same area but at other organizations could be possible topics for future research, to evaluate the findings' transferability. It could also be of interest to conduct studies on knowledge reuse between product development projects but focusing on other sub-processes than purchasing.

One of the main findings of the study has been that trust and internal motivation are important factors for knowledge reuse. To research how one create trust and internal motivation in the setting of a sub-process in a product development project could also be an area for future research.

Another finding in this thesis is that multitasking could be a barrier for knowledge reuse. As earlier mentioned, it does however need to be further studied and strengthened with more empirical data to be able to determine how multitasking in meetings affect knowledge reuse.

It could in addition be of interest to study knowledge reuse between purchasing and suppliers, a topic that was brought up in some occasions during the empirical study. When purchasing communicates with suppliers, knowledge sharing takes place, and it could be of interest to see for example what barriers are in play in such relations, and how these can be managed.

Furthermore, another area for future research could be to widen the scope compared to this study, and include knowledge transfer between sites, within the same function. It was mentioned both by some respondents and described in theory that geographical distance affect knowledge sharing.

7 Conclusions

This chapter summarizes conclusions from this Master's Thesis. It is structured based on the research questions. Firstly, methods and practices that enable knowledge reuse are presented. Thereafter it is described what barriers exist that hinder knowledge reuse, which barriers are intertwined and how one can manage them. The main parts of the conclusions are presented in the figure below.
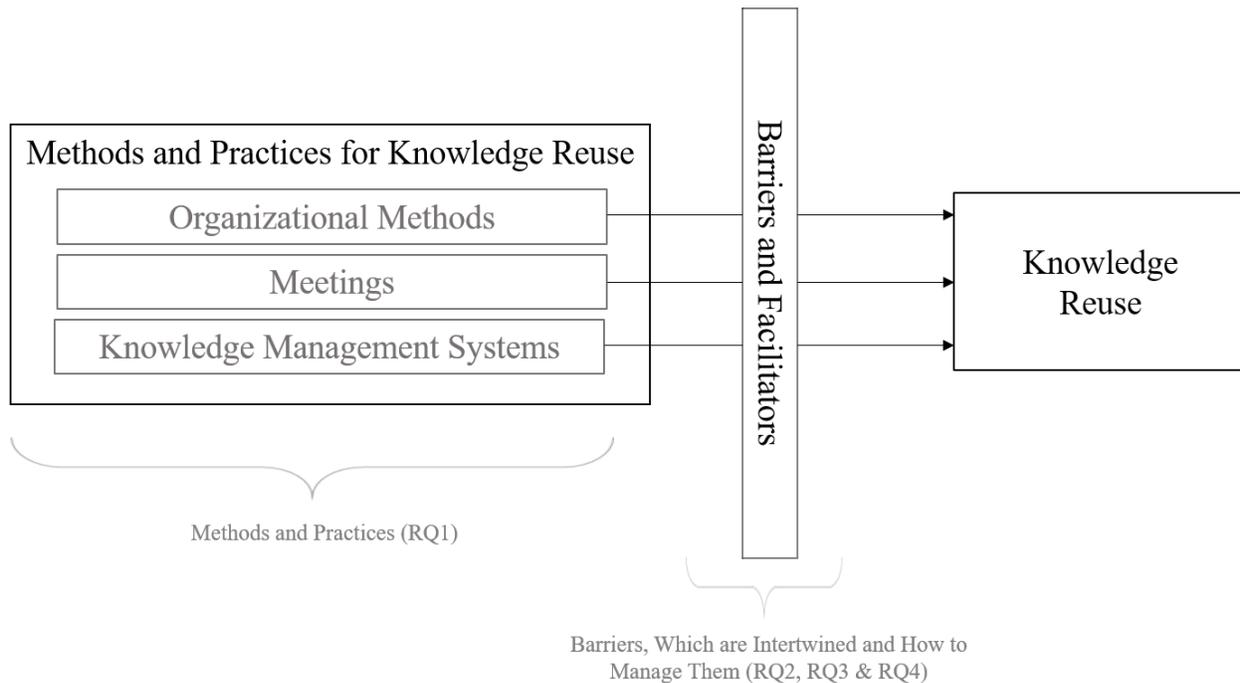

Figure 17 The main topics brought up in the conclusions and their connection to the research questions (RQs).

7.1 Methods and Practices for Reusing Knowledge

The first research question was about identifying suitable methods and practices for knowledge reuse between product development projects within the purchasing sub-process. Three major groups have been found, presented in the Figure 17 above, namely organizational methods, meetings and knowledge management systems.

All the groups contain methods and practices that are suitable to improve knowledge reuse between product development projects in different ways. Some focus on explicit knowledge, which is possible to write down, while others mainly are suitable for tacit knowledge sharing, which one for example can share face to face. Both types are needed within the purchasing function, since a purchaser uses both tacit and explicit knowledge.

The first group is organizational methods that promote knowledge reuse. By standardizing tasks or processes that promotes knowledge reuse, an organization can improve knowledge reuse between product development projects. Three methods where studied in this thesis.

The first method, *Lessons Learned*, is specifically designed to transfer knowledge between projects. In short, project teams discuss learnings made during a project and make them useful for future projects by for example changing standards or writing the lesson in a form, so that future projects can read about it.

One can also start a new project by discussing old lessons learned made by the project participants or experts in the company. In such case, lessons learned enables both tacit and explicit knowledge sharing. The second method, *Query Trees*, only shares explicit knowledge. It is a tool used by the engineering department at the studied case company. In short, one codifies knowledge and helps the knowledge consumer get the right knowledge at the right time. The third method, *Knowledge Cafés*, focuses on tacit knowledge. During a knowledge café a group of employees have an open discussion around a predefined subject, creating possibilities for the participants to share relevant experiences and enable knowledge reuse.

The second group of methods and practices found is meetings. The meetings can both be formal, such as weekly department meetings, or informal, such as conversations during coffee breaks. During meetings, time is provided for colleagues to ask each other for help, which creates a possibility for knowledge reuse.

The third group is knowledge management systems. IT-solutions supporting knowledge management can either be based on personalization, supporting communication between individuals, or codification, extracting and codifying knowledge from individuals. When deciding what system to use for different purposes, one must consider if the main goal is to transfer tacit or explicit knowledge. It is also beneficial to adapt the choice of systems to the culture. For example, if it is common practice at the company to ask colleagues for help, one can support that trait of the organizational culture with systems focusing on personalization.

A main conclusion when studying the groups of suitable methods and practices is that it is important that the knowledge provider receives some sort of feedback when sharing knowledge. It is also beneficial if the knowledge provider gets a possibility to understand that the learning contributes with something valuable, creating task significance. Feedback and task significance are important factors for internal motivation, as described by Hackman and Oldham (1976). Face to face knowledge sharing, which for example take place during meetings, naturally include task significance and feedback. This is because the knowledge provider gets feedback directly from the knowledge consumer, and it is visible that the knowledge consumer will use the knowledge. However, when sharing knowledge in other ways, such as when adding knowledge to a knowledge repository or writing down lessons learned, it is important that the organization gives the knowledge provider some sort of feedback or create task significance in another way, so that the knowledge provider is motivated.

7.2 Identified Barriers Hindering Reuse of Knowledge

The second research question is about identifying barriers that hinder knowledge reuse between product development projects within the purchasing sub-process.

Eleven clusters of barriers that affect knowledge reuse were identified:

- Trust
- Fear of job security and competitiveness
- Time availability and prioritization
- Value of knowledge reuse is not realized
- IT-systems
- Organizational culture
- Organization and its processes
- Motivation and incentives
- Individual differences
- Geographical and cultural distances
- Multitasking

The two barriers, individual differences and geographical and cultural distances, were not prominent in the case. However, that was likely due to the scope of the study. They are still listed here as possible barriers, since they were frequently mentioned in theory.

An additional barrier that could not be found in theory was identified in the case, namely multitasking. It was identified through observations of meetings, during which employees where working on their computers, meaning that their attention was scattered. In theory, it is described that multitasking negatively affects an individual's ability to take in information. Hence, multitasking can be argued to be a barrier for knowledge reuse.

7.3 Barriers that are Intertwined

The third research question is focusing on which barriers are intertwined.

The barrier of trust could be argued to be intertwined with fear of job security and competitiveness. If there exist trust in a work group, it is possible that the group internally share knowledge without being afraid of that colleagues will "steal" knowledge and not give recognition to the knowledge provider. That is, trust might affect fear of job security and competitiveness. The barrier of trust can also be argued to be intertwined with organizational culture. If there generally exist trust within the organization, it can possibly create a more open culture where people share knowledge, and vice versa.

The barrier of motivation and incentives is intertwined with other factors hindering knowledge reuse. Mainly, internal motivation can affect several other barriers. Firstly, it is intertwined with time and prioritization. If an employee is internally motivated to share knowledge, the employee will prioritize knowledge sharing. The barrier of motivation and incentives is also intertwined with realizing the value of knowledge reuse. To create internal motivation, task significance is important, meaning that one can see that the task at hand affects other people. Seeing that a task related to knowledge sharing affects colleagues consequently make the employee see the value of the knowledge sharing. Furthermore, internal motivation is intertwined with the barriers of IT-systems and organizational processes. For example, internal

motivation is needed to increase the likelihood that an employee prioritizes a task in an organizational process, such as adding knowledge to a knowledge repository. Lastly, the barrier of motivation and incentives is intertwined with the culture of the organization. In an organizational culture that supports knowledge sharing, employees share knowledge because they find it natural and not due to being forced. To make an employee find it natural to share knowledge one must create internal motivation for knowledge sharing.

7.4 Managing Barriers Hindering Knowledge Reuse

Barriers can be managed in various ways, some more concrete. For example, when it comes to IT-systems, a barrier can be that the system is not user friendly or that employees have not gotten proper introduction to be able to use the systems. These issues could be managed by for example increasing the usability in a system with a search function or having more courses to develop the technological "know-how" among employees. Other concrete ways to manage barriers are explained in *6.4 Implications for Practitioners.*

Since barriers are intertwined, it is possible that by managing one barrier, other intertwined barriers can be less hindering as well. As described, the barrier of trust is intertwined with the barrier fear of job security and competitiveness and organizational culture. By increasing trust among employees, these barriers might be less prominent. The other barrier that, as described above, is intertwined with several other barriers is motivation and incentives. By creating internal motivation in tasks related to knowledge reuse, many barriers hindering knowledge reuse can be managed. To create internal motivation, two important factors are that the employee understand the significance of the task connected to knowledge reuse and receive feedback.

References

Adler, R. F. & Benbunan-Fich, R., 2012. Juggling on a high wire: Mutlitasking effects on performance. *Journal of Human-Computer Studies,* 70(2), pp. 156-168.

Akhavan, P. & Pezeshkan, A., 2014. Knowledge management critical failure factors: a multi-case study. *VINE: The journal of information and knowledge management systems,* 44(1), pp. 22-41.

Alavi, M. & Leidner, D. E., 2001. Review; Knowledge Management and Knowledge Management Systems: Conceptual Foundations and Research Issues. *MIS Quarterly,* 25(1), pp. 107-136.

Bonwell, C. C. & Eison, J. A., 1991. *Active Learning: Creating Excitement in the Classroom.* Washington DC: ASHE-ERIC higher Education Reports.

Bresnen, M. et al., 2003. Social practices and the management of knowledge in project environments. *International Journal of Project Management,* 21(3), pp. 157-166.

Bryman, A. & Bell, E., 2015. *Business Research Methods.* 4th ed. Oxford: Oxford University Press.

Buser, T. & Peter, N., 2011. Multitasking: Productivity Effects and Gender Differences. *Tinsbergen Institute Discussion Paper,* Issue 11-044/3, pp. 1-13.

Carrillo, P., Ruikar, K. & Fuller, P., 2012. When Will We Learn? Improving lessons learned practice in construction. *International Journal of Project Management,* 31(4), pp. 567-578.

Cheuk, K. P., Baškarada, S. & Koronios, 2017. Contextual factors in knowledge reuse. *VINE Journal of Information and Knowledge Management Systems,* 47(2), pp. 194-210.

Coffey, A. & Atkinson, P., 1996. *Making sense of qualitative data.* Thousand Oaks, California: SAGE Publications, Inc.

Cooper, R. G., 1990. Stage-Gate Systems: A New Tool for Managing New Products. *Business Horizons,* 33(3), pp. 44-54.

Cooper, R. G., 2008. Perspective: The Stage-Gate Idea-to-Launch Process—Update, What's New, and NexGen Systems. *Journal of Product Innovation Management,* 25(3), pp. 213-232.

Coutu, D. L., 2002. The Anxiety of Learning. *Harvard Business Review,* Issue March, pp. 100-106.

Cumberland, D. & Githens, R., 2012. Tacit knowledge barriers in franchising: practical solutions. *Journal of Workplace Learning,* 24(1), pp. 48-58.

Desouza, K. C., Awazu, Y. & Baloh, P., 2006. Managing Knowledge in Global Software Development Efforts: Issues and Practices. *Ieee Software,* 23(5), pp. 30-37.

Dubois, A. & Gadde, L.-E., 2002. Systematic combining; an abductive approach to case research. *Journal of Business Research,* Volume 55, pp. 553-560.

Edwards, J. S., Shaw, D. & Collier, P. M., 2005. Knowledge management in organizations: examining the interaction between technologies, techniques, and people. *Journal of Knowledge Management,* 9(1), pp. 113-125.

Ellis, Y., Daniels, B. & Jauregui, A., 2010. The effect of multitasking on the grade performance of business students. *Research in Higher Education journal,* 8(1), pp. 1-10.

Filmt, S., 2009. *David Gurteen about his Knowledge Café.* [Online]
Available at: https://www.youtube.com/watch?v=7rgT1c_oCFQ
[Accessed 29 04 2019].

Gill, P., Stewart, K., Treasure, E. & Chadwick, B., 2008. Methods of data collection in qualitative research: interviews and focus groups. *British Dental Journal,* 204(6), pp. 291-295.

Giunipero, L., Dawley, D. & Anthony, W. P., 1999. The impact of tacit knowledge on purchasing decisions. *Journal of Supply Chain Management,* 35(1), pp. 42-49.

Goffin, K., Korners, U., Baxter, D. & van der Hoven, C., 2010. Managing Lessons Learned and Tacit Knowledge in New Product Development. *Research Technology Management,* 53(4), pp. 39-51.

Goh, S. C., 2002. Managing effective knowledge transfer: an integrative framework and some practice implications. *Journal of Knowledge Management,* 6(1), pp. 23-30.

Gouvêa, M. T. A., Santoro, F. M. & Cappelli, C., 2017. Digital group storytelling in knowledge management: lessons learned in online tutoring. *Int. J. Web Angineering and Technology,* 12(4), pp. 351-372.

Graneheim, U. H. & Lundman, B., 2004. Qualitative content analysis in nursing research: concepts, procedures and measures to achieve trustworthiness. *Nurse Eduation Today,* 2004(24), pp. 105-112.

Gurteen, D., 2006. *Introduction to the Knowledge Cafe by David Gurteen.* [Online]
Available at: https://www.youtube.com/watch?v=iDvV-Ga5R6I
[Accessed 29 04 2019].

Gurteen, D., n.d. a. *Gurteen Knowledge Café.* [Online]
Available at: http://knowledge.cafe/
[Accessed 29 April 2019].

Gurteen, D., n.d. b. *Knowledge Cafe Concept.* [Online]
Available at: http://knowledge.cafe/knowledge-cafe-concept/
[Accessed 29 04 2019].

Gurteen, D., n.d. c. *Knowledge Café Tipsheet (English).* [Online]
Available at: http://knowledge.cafe/knowledge-cafe-tipsheet-english/
[Accessed 19 03 2019].

Hackman, J. R. & Oldham, G. R., 1976. Motivation through the Design of Work: Test of a Theory. *Organizational Behaviour and Human Performance,* 16(2), pp. 250-279.

Hansen, M. T., Nohria, N. & Tierney, T., 1999. What's Your Strategy for Managing Knowledge?. *Harvard Business Review,* 77(2), pp. 106-116.

Harackiewicz, J. M., 1979. The Effects of Reward Contingency and Performance Feedback on Intrinsic Motivation. *Journal of Personality and Social Psychology,* 37(8), pp. 1352-1363.

Hartmann, A. & Dorée, A., 2015. Learning between projects: More than sending messages in bottles. *International Journal of Project Management,* 33(2), pp. 341-351.

Holtshouse, D., 1998. Knowledge Research Issues. *California Management Review,* 40(3), pp. 277-280.

Hong, D., Suh, E. & Koo, C., 2011. Developing strategies for overcoming barriers to knowledge sharing based on conversational knowledge management: A case study of a financial company. *Expert Systems with Applications,* 38(12), pp. 14417-14427.

James Bryde, D., Unterhitzenberger, C., Renzl, B. & Rost, M., 2018. KM and Project Management . In: J. Syed, P. A. Murray, D. Hislop & Y. Mouzughi, eds. *The Palgrave Handbook of Knowledge Management* . Cham, Switzerland: Springer Nature, pp. 539-562.

Junco, R., 2012. In-class multitasking and academic performance. *Computers in Human Behaviour,* 28(6), pp. 2236-2243.

Kasvi, J. J., Vartiainen, M. & Hailikari, M., 2003. Managing knowledge and knowledge competences in projects and project organizations. *International Journal of Project Management,* 21(8), pp. 571-582.

Katusáková, M., 2015. *Sharing Scientific Knowledge Through Telling Sories and Digital Storytelling.* Kidmore End, Academic Conferences International Limited.

Kraushaar, J. M. & Novak, D. C., 2010. Examining the Affects of Student Multitasking With Laptops During the Lecture. *Journal of Information Systems Education,* 21(2), pp. 241-251.

Kulkarni, U. R., Ravindra, S. & Freeze, R., 2006. A Knowledge Management Success Model: Theoretical Development and Empirical Validation. *Journal of Managment Information Systems,* 23(3), pp. 309-347.

Kvale, S., 1996. *InterViews.* Thousand Oaks, Carlifornia: Sage Publications, Inc..

Lee, H. & Choi, B., 2003. Knowledge Management Enablers, Processes, and Organizational Performance: An Integrative View and Empirical Examination. *Journal of Management Information Systems,* 20(1), pp. 179-228.

Lindkvist, B., 2001. *Kunskapsöverföring mellan produktutvecklingsprojekt.* Doktorsavhandling ed. Stockholm, Handelshögskolan: EFI The Economic Research Institute.

Majchrzak, A., Wagner, C. & Yates, D., 2013. The Impact of Shaping on Knowledge Reuse for Organizational Improvement with Wikis. *MIS Quarterly,* 37(2), pp. 455-A12.

Major Projects Knowledge Hub, 2018. *Stan Garfield shares the secrets of promoting a knowledge management initiative.* [Online]
Available at: https://www.youtube.com/watch?v=Ka9FbZG8-O8
[Accessed 26 April 2019].

Markus, L. M., 2001. Toward a Theory of Knowledge Reuse: Types of Knowledge Reuse Situations and Factors in Reuse Success. *Journal of Management Information Systems,* 18(1), pp. 57-93.

Marshall, M. N., 1996. Sampling for qualitative research. *Family practice,* 13(6), pp. 522-526.

Mays, N. & Pope, C., 1995. Qualitative research: observational methods in health care settings. *BMJ,* Volume 311, pp. 182-184.

McDermott, R. & O'Dell, C., 2001. Overcoming cultural barriers to sharing knowledge. *Journal of Knowledge Management,* 5(1), pp. 76-85.

Michael, J., 2006. Where's the evidence that active learning works?. *The American Physiological Society,* pp. 159-167.

Michell, V. & McKenzie, 2017. Lessons learned: Structuring knowledge codification and abstraction to provide meaningful information for learning. *Journal of Information and Knowledge Management Systems ,* 47(3), pp. 411-428.

Morgan, J. M. & Liker, J. K., 2006. *The Toyota Product Development System: Integrating People, Process, and Technology,* s.l.: Productivity Press.

Nadler, J., Thompson, L. & Van Boven, L., 2003. Learning Negotiation Skills: Four Models of Knowledge Creation and Transfer. *Management Science,* 49(4), pp. 529-540.

Neeley, T. & Leonardi, P., 2018. Enacting knowledge strategy through social media: Passable trust and the paradox of nonwork interactions. *Strategic Management Journal,* 39(3), pp. 922-946.

Nonaka, I., 1991. The Knowledge Creating Company. *Harvard Business Review,* 69(6), pp. 96-104.

Nonaka, I., 1994. A Dynamic Theory of Organizational Knowledge Creation. *Organization Science,* 5(1), pp. 14-37.

Nonaka, I., 2007. The Knowledge Creating Company. *Harvard Business Review,* 85(7), pp. 162-171.

Okoroafor, H., 2014. The barriers to tacit knaoledge sharing in franchise organizations. *Knowledge Management Research & Practice,* Issue 12, pp. 97-102.

O. U. P., n.d.. *Oxford Dictionaries.* [Online]
Available at: https://en.oxforddictionaries.com/definition/multitask
[Accessed 27 03 2019].

Paulin, D. & Suneson, K., 2012. Knowledge Transfer, Knowledge Sharing and Knowledge Barriers - Three Blurry Terms in KM. *Electronic Journal of Knowledge Management,* 10(1), pp. 81-91.

Paulin, D. & Winroth, M., 2013. *Facilitators, Inhibitors and Obstacles - a Redefined Categorization Regarding Barriers for Knowledge Sharing, Transfer and Flow.* Washington DC, ACAD Conferences LTD, pp. 320-328.

Perret, R., Borges, M. R. & Santoro, F. M., 2004. Applying Group Storytelling in Knowledge Management. *International Conference on Collaboration and Technology,* pp. 31-41.

Polanyi, M., 2015. *Personal Knowledge: towards a post-critical philosophy.* Enlarged Edition ed. Chicago: University of Chicago Press.

Riege, A., 2005. Three-dozen knowledge-sharing barriers. *Journal of Knowledge Management,* 9(3), pp. 18-35.

Rowley, J., 2007. The wisdom hierarchy: representations of the DIKW hierarchy. *Journal of Information Science,* 33(2), pp. 163-180.

Ryan, M. R. & Deci, E. L., 2000. Intrinsic and Extrinsic Motivations: Classic Definitions and New Directions. *Contemporary Educational Psycology,* Volume 25, pp. 54-67.

Schacht, S. & Maedche, A., 2016. A Methodology for Systematic Project Knowledge Reuse. In: L. Razmerita, G. Phillips-Wren & L. C. Jain, eds. *Innovators in Knowledge Management .* s.l.:Springer Nature, pp. 19-44.

Schacht, S. & Mädche, A., 2013. How to Prevent Reinventing the Wheel? - Design Principles for Project Knowledge Management Systems. In: J. vom Brocke, R. Hekkala, S. Ram & M. Rossi, eds. *Design Science at the Intersection of Physical and Virtual Design.* Berlin: Springer-Verlag, pp. 1-17.

Schindler, M. & Eppler, M., 2003. Harvesting project knowledge: a review of project learning methods and success factors. *International Journal of Project Management,* 21(3), pp. 219-228.

Shenton, A. K., 2004. Strategies for ensuring trustworthiness in qualitative research projects. *Education for information,* 22(2), pp. 63-75.

Sole, D. & Gray Wilson, D., 2002. Storytelling in Organizations: The power and traps of using stories to share knowledge in organizations. *LILA, Harvard, Graduate School of Education,* pp. 1-12.

Swap, W., Leonard, D., Shields, M. & Abrams, L., 2001. Using Mentoring and Storytelling to Transfer Knowledge in the Workplace. *Journal of Managemetn Information Systems,* 18(1), pp. 95-114.

Sveiby, K. E., 2007. Disabling the context for knowledge work: the role of managers' behaviours",. *Management Decision,* 45(10), pp. 1636-1655.

Tolonen, A., Haapasalo, H., Harkonen, J. & Verrollot, J., 2017. Supply chain capability creation - The creation of the supply chain readiness for a new product during product development process. *International Journal of Production Economics,* Volume 194, pp. 237-245.

Tranfield, D., Denyer, D. & Smart, P., 2003. Towards a Methodology for Devloping Evidence-Informed Management Knowledge by Means of Systematic Review. *British Journal of Management,* Volume 14, pp. 207-222.

Trees, L., 2018. The benefits of identifying and sharing lessons learned across projects. *Knowledge Management World,* 27(1), pp. 25-29.

UK Stakeholders for Sustainable Development, n.d. . *What Is Sustainable Development?.* [Online] Available at: https://www.ukssd.co.uk/sustainable-development
[Accessed 02 04 2019].

Watson, S. & Hewett, K., 2006. A Multi-Theoretical Model of Knowledge Transfer in Organizations: Determinants of Knowledge Reuse. *Journal of Management Studies,* 43(2), pp. 141-173.

Venkitachalam, K. & Willmott, H., 2017. Strategic knowledge management—Insights and pitfalls. *International Journal of Innovation Management,* 37(4), pp. 313-316.

Williams, T., 2007. *Post-Project Reviews to Gain Effective Lessons Learned.* ed. Pennsylvania: Project Management Institute, Inc..

Zammit, J., Gao, J., Evans, R. & Maropoulos, P., 2018. A knowledge capturing and sharing framework for improving the testing processes in global product development using storytelling and video sharing. *Journal of Engineering Manyfacture,* 232(13), pp. 2286-2296.

Zins, C., 2007. Conceptual Approaches for Defining Data, Information and Knowledge. *Journal of the American Society for Information Science and Technology,* 58(4), pp. 479-493.

Appendix

Appendix A – Result Systematic Literature Review

This appendix presents the result of the systematic literature review. Table 1 explains the shortening for each search word.

Table 1 Explanation of shortening for each search word.

Shortening	Search Word
KM	"knowledge management"
PM	"project management"
PD	"product development"
KR	"knowledge reuse"
KB	"knowledge barriers"

Table 2 shows the number of articles that was found using each search combination. The column "Result" is the number of articles found when only using the search combination. The column "Result with Purchasing" are the number of articles found when the search word 'purchasing' was added, and in the same way "Result with Sub-Process" shows number of articles when 'sub-process' was added as a search word. The last column, "Articles Used" shows how many from each search that are used in the final report.

Table 2 The result from the systematic literature review.

Search Combination	Result	Result with Purchasing	Result with Sub-Process	Articles Used
KM	68172	162	42	2
PM	99090	544	46	0
PD	66738	690	54	0
KM&PM	1950	5	2	2
KM&PD	1391	7	6	0
PM&PD	4140	34	7	0
KM&PD&PM	156	0	1	1
KR	952	2	2	3
KM&KR	298	1	1	1
PM&KR	43	0	1	0
PD&KR	73	0	0	0
KM&PM&KR	18	0	1	1
KM&PD&KR	38	0	0	0
PM&PD&KR	5	0	0	0
KM&PD&PM&KR	1	0	0	0
KM&KB	35	0	0	4
PM&KB	4	0	0	0
PD&KB	1	0	0	0
KM&PM&KB	1	0	0	0
KM&PD&KB	0	0	0	0
PM&PD&KB	0	0	0	0
KM&PD&PM&KB	0	0	0	0
KR&KB	0	0	0	0
KM&KR&KB	0	0	0	0
PM&KR&KB	0	0	0	0
PD&KR&KB	0	0	0	0
KM&PM&KR&KB	0	0	0	0
KM&PD&KR&KB	0	0	0	0
PM&PD&KR&KB	0	0	0	0
KM&PD&PM&KR&KB	0	0	0	0
KB	299	0	0	0
Total	**243405**	**1445**	**163**	**14**

Appendix B – Interview Guide Project Buyers

Within this appendix the interview guide used in formal semi-structured interviews with Project Buyers is presented. The interviews were held in Swedish, hence the interview guide is in Swedish.

In part 2 *"Del 2 Gå igenom ett projekt i CTS, för varje fas"* the questions in the box was asked in connection to each phase in a product development project. The CTS is a tool that the Project Buyers use for tracking a product development project. The CTS is based on the different product development phases. The questions below the box were follow-up questions that usually fitted naturally into the interview. When each phase had been gone through the researches ensured that all relevant follow-up questions in the interview guide had been discussed.

Del 1 Intro och bakgrund

Introduktion
- Presentation, vi läser på Chalmers, skriver exjobb
- Syfte med rapport - bättre kunskapsöverföring
- Varför vi vill prata med just dig
- Vi studerar reuse
- Information om intervjun:
  - En av oss frågar, den andra antecknar
  - Intervjuns upplägg - steg för steg i CTS
  - Det du säger blir grund i rapport
  - Dock anonymt - är yrkesroll OK?
  - Du behöver inte svara på alla frågor och kan avbryta när som
  - Är inspelning OK?
  - Vill du fortfarande ställa upp?

Bakgrundsfrågor
- Vilken är din nuvarande roll?
- Hur stor andel ca läggar du i den typen av produktutvecklingsprojekt som vi undersöker?
- Vilken avdelning jobbar du på?
- Vad har du för bakgrund innan du kom till företaget? (utbildning osv)
- Hur länge har du jobbat med inköp? Här och eventuellt på andra företag?
- Hur länge har du jobbat på företaget? Vilka andra avdelningar?

Del 2 Gå igenom ett projekt i CTS, för varje fas

- Kan du kort beskriva vad du gör i de olika stegen?
- I vilka steg tror du att kan det finnas behov av kunskap från tidigare projekt?
- För de stegen:
    o Vilken kunskap behövs i det här steget från tidigare projekt?
    o Hur får du tag i den kunskapen?
    o Finns det något hinder för att få tag i och använda den kunskap som du behöver?
    o Isf, på vilket sätt skulle man kunna arbeta runt hindret?
    o Vad gör det lättare att få tag i och använda existerande kunskap i det här steget?
- I vilka steg behövs det inte kunskap från tidigare projekt?

Följdfrågor:

Barriärer

- Trust – om du hittar kunskap i databas, hur säkerställer du att den är korrekt? (Litar du på den eller dubbelkollar med kollega? Vice versa?)
- Organization and its processes – Vad gör företaget för att arbeta med kunskapshantering? Upplever du att företaget satsar på KM? Ges du tid att göra det?
- Fear of job security and competitiveness – Hur skulle du beskriva kulturen på företaget när det gäller att dela med sig av sin kunskap?
- Time – Hur mycket tid lägger du på att leta/hitta gammal kunskap? Har du tid för den typen av aktiviteter?

Knowledge Management Systems

- Vad fungerar bra, och vad fungerar mindre bra, med IT-systemen?
- Vad skulle få dig att använda IT-systemen mer?
- Hur ser träning/intro till IT-systemen ut?
- (Känner du att du behärskar, förstår och kan använda IT-systemet? (är det lätt att hitta?))

Lessons learned

- Hur jobbar ni i projekten med LL?
- Hur är LL är ett stöd i ditt arbete?
- Hur tar du aktivt reda på vad för lärdomar som gjorts i andra projekt?

Tacit vs Explicit

- Vad baserar du ditt beslut på i den situationen? (Magkänsla vs fakta i specifik situation i genomgången av CTS eller fråga generellt)

Del 3 Avslutande frågor

o Vi har pratat lite om hindren (barriärerna), har du några ytterligare idéer för hur de kan överkommas?

o Har du några andra förbättringsförslag?

Är det något mer du tycker vi borde fråga om? Återkom om du kommer på något eller har några funderingar.

Tack för att du ställt upp!