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Learning What You Already Know

How Product Development Organizations Can Make Better Use
of Lessons Learned from Previous and Ongoing Projects

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Master of Science Thesis in Management and Economics of Innovation

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Abstract

Industrial companies find themselves in an ever increasing competitive environment, for which globalization is one reason. Knowledge becomes one of the company's main assets as the increased competition puts high demands on being efficient in the development of new products and minimizing costs. However, it is far from easy for companies to effectively create, capture, distribute and adopt knowledge in the organization.

This thesis is based on a case study of a project management office involved in product development for an industrial company. The aim of the thesis is to investigate how the project management office could become more effective in its product development organization. Currently the organization is documenting its lessons learned from projects in white books but the project management office feels that they are not working in a satisfying way. The purpose of this thesis has been established together with the supervisor at the case company and was set to: *“Developing a requirement specification for an IT-based tool to be used for facilitating the documentation and re-use of knowledge that can be acquired from previous and ongoing projects and to find what kind of information and data that would be necessary to include in such a tool.”* We divided the purpose into three research questions to make it more manageable:

1. What are the reasons for that the white book process is not generating the learnings that it could if fully utilized?
2. What is missing in the current documentation and what information and data would be valuable when initiating a new project?
3. If a new IT-based tool would be recommended, what are the prerequisites for such a tool to be of value for the project management office?

50 interviews function as a base for the thesis as the purpose of the thesis required the authors to have a thorough understanding of the department at the case company in order to make good recommendations. Seven of these interviews, constitute a brief inspirational outlook on a few other companies, as we believed that others probably have encountered similar issues before. These interviews are served as inspiration for the recommendation to the case company. A theoretical framework is used to analyze the results from the interviews as well as to provide the authors with ideas for solutions for the case company. The framework gives an introduction to why organizations must learn, followed by a description of product development and knowledge management explaining the context. The subsequent sections then explain more on how to actually work with knowledge in organizations.

We conclude that if a new lessons learned tool is to be used in an organization it needs to be supported by and included in the work processes. The thesis ends with a recommendation for how a new lessons learned tool could be constituted for the case company but also how it could be incorporated into the work processes of the project managers, as well as how knowledge from projects can be fed back into the organization.

Keywords: Project management, lessons learned, white books, knowledge transfer, knowledge management, lean product development.

Definitions

Database – “A database is an application that manages data and allows fast storage and retrieval of that data.” (About.com, 2012)

Knowledge – “Knowing something with the familiarity gained through experience, education, observation, or investigation, it is understanding a process, practice or technique or how to use a tool.” (Project Management Institute Inc., 2004, p. 363)

Knowledge Management – The matter of creating, discovering, adapting, adopting, transferring and applying knowledge in an organization. (Collison & Parcell, 2004)

Lessons Learned – “The learning gained from the process of performing the project.” (Project Management Institute Inc., 2004, p. 363)

Project Knowledge Management – The overlap of project and knowledge management. (Johansson, 2011)

White book – A document similar to a post-project review that is to capture the learnings from a project and is meant to be used as input when new projects are initiated. (Alfredson & Söderberg, 2009)

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We would like to express our appreciation to all the people who have given their valuable input to the result of the thesis.

First of all, *Andreas Hellström*, our supervisor from the Division of Quality Sciences at Chalmers University of Technology, who has been very supportive during the entire project and added useful insights from an academic as well as a practical perspective.

Secondly, our supervisor from the case company who transformed the project into a thesis and appointed us the assignment, gave us full support during our time at the case company and were at all times available and willing to discuss whatever question crossed our minds regardless of whether it concerned the project or not.

Thirdly, we would like to thank all colleagues from the case company taking time to contribute with their knowledge and ideas through participating in any of all the interviews that were performed at the case company.

Lastly, participating employees of the external companies taking part in the study, who provided us with a broader view on various alternatives for working with knowledge sharing issues in different industries, deserve to be mentioned.

Göteborg, November 2012

Fredrik Berntsson
Joel Regnander Bergh

*“You learn more quickly under the guidance of experienced teachers.
You waste a lot of time going down blind alleys if you have no one to lead you.”*

– W. Somerset Maugham –

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1. Introduction

During the last decades, knowledge has been acknowledged as perhaps the most important asset of an industrial company. As products and, to some extent, services are easily and commonly copied in the global society of today; producing firms must compete with competence as their competitive advantage. (Nonaka & Toyama, 2003)

Increasing competition due to firms' internationalization creates a complex business environment for producing companies to operate in. Together with the ever-changing demographics of customers and developing technologies this generates demand on companies to at all times improve their business offer, develop new and improve existing products. (Clark & Wheelwright, 1993)

Increased competition of this kind along with unsatisfactory performance can be characterized as two of the key drivers of change. For a firm to survive and perform in a business of increased global competition, the organization must identify and utilize its competitive advantage towards its competitors. The challenge for an industrial organization is to enhance its capability to develop and deliver higher quality products in shorter time using less resources than the competitors. As the significance of utilizing knowledge as source of competitive advantage increases, it is more and more obvious that so is the importance of improving the organization's capability of learning from their own mistakes and successes both internally in the project team and between different projects. (Lindkvist, 2001)

To increase the use of knowledge within the firm, collaboration and information exchange between projects is essential. What is learnt in one project might instantly come to use in another. (Lindkvist, 2001)

Lindkvist (2001) discussed two main incentives of intra-organizational knowledge sharing. Primarily, sharing of knowledge in terms of direct re-use of it in other projects helps preventing non-value-adding work to be performed in those projects i.e. duplication of work and/or facing the same problems over and over again. The other reason for sharing knowledge is that the transfer situation itself might be knowledge creating. As the intra-organizational communication takes place, their respective knowledge might be combined into generating new knowledge. If a favorable knowledge sharing system is not in place in project management organizations this might be an impediment for both exploitation of and development of knowledge. (Lindkvist, 2001)

March (1991) described advantages of knowledge creation and distribution in another way. Through the use of different models he concludes that knowledge stabilizes performance. He argues that knowledge does not per se increase the performance, but it can surely be said to reduce the variability in performance when combined with standardization ideas. (March, 1991)

It seems apparent that knowledge is an important ingredient in product development, whether it is a true source of competitive advantage as Nonaka and Toyama (2003) stated, or if the main aim is to reduce the variance in performance as March (1991) put it. Regardless, it can be a key insight for product development organizations to realize the importance of managing knowledge. The department at the case company seems to have realized this.

1.1 Presenting the Case Company and the Issue

The case company is a large global industrial corporation with tens of thousands employees. The thesis project is located in the field of product development within the corporation. Within Product Development, there are further divisions into, in our case, the *Verification* department and even further into *Project Management Office (PMO)*.

As such the verification department is responsible for defining measurable customer requirements in early product development project phases, as well as working together with product development to break down customer functionality at both system and module levels. They manage validation plans to reach requested functionality level and brand's satisfaction, as well as validating customer functionality achievement on the complete product before market launch. Furthermore, they manage verification plans in partnership with development teams, and provide optimized tools such as calculations, proving grounds, and field tests. Altogether, the verification department is performing verification and validation tests on different functionality ranging from durability and reliability to materials and environmental impacts.

The Project Management Office is managing all project deliveries performed by their section of the product development in order to deliver projects with Quality-Delivery-Cost-Functionality demands fulfillment. The PMO has the responsibility to define and refine all incoming orders to their part of the product development, and are also managing several important functions like co-ordination of test objects, portfolio management and overall project budget. To act as a Steering Committee representative is also a natural part of the PMO responsibility. The Project Management Office is a global organization spread out over six different sites of which two are in Europe and constitute the main focus of this study. Other locations include two Asian sites, one site in South America and one in North America. The main site of this study, located in Sweden, has 20 – 50 employees at their PMO whereas the secondary site adds 10 – 30 people to the group of main stakeholders of the coming recommendations.

The PMO can be characterized as a pure project organization in the sense that they only perform work of project nature. One could maybe question what this actually means and implies for the shape of the organization. U.S-based Project Management Institute (2004, p. 5) defined a project as “*a temporary endeavor undertaken to create a unique product, service or result*”. The temporary nature of projects implies that projects are finite and thus will be terminated as objectives are reached, or ascertained not to be fulfilled due to constraints or a shift in requirements. At the same time project teams are dissolved, adding another dimension to project-based work. The main characteristic difference of projects and operations is that a project concludes as the objectives are achieved, whereas operations adopt new set of objectives to continue the process. (Project Management Institute Inc., 2004)

The nature of project-based organizations of this kind, makes it somewhat difficult to create a learning organization. As projects are finite and cross-functional project teams stretching over several different departments are dissolved, it gets particularly difficult for the line organization to capture and adopt what can be learnt from these activities. What further complicates this for the case company is that they are experiencing a rather high employee turnover. At the PMO, most of the employees are externally hired consultants. As these people leave the organization after a certain period of time, they bring their acquired knowledge with them. Hence, for the PMO to learn and get better at what they are doing, they must in some way adopt the learnings

in the organization and not just let it remain in the heads of vanishing employees. If the employee turnover had been negligibly small, the knowledge sharing issue would not be as essential. However, since it is rather the opposite it is understandable that knowledge transfer issues are of great significance for the department.

As the work at the PMO is divided among the different project teams the technical results and the learnings obtained during the project mainly stays within the project teams as the project is proceeding. After projects are completed, the teams are supposed to document their learnings into the so called *white books*; a document where technical data and information along with lessons learned from successes and failures during the project are to be included. Hence, white books are aimed at capturing experiences gained from previous projects. These white books are then to be stored in an accessible way for other project teams to learn from them as new projects are initiated.

At the PMO, like in many industrial firms, they feel that these white books are not completely fulfilling their purpose. White books are, due to the mandatory task to deliver it, written and finished at the end of the projects and are then to be stored in a web-based portal, or on a project-specific server where people concerned may reach it when needed.

The Group Managers of the PMO are experiencing that the current situation with learnings and knowledge sharing through the creation and distribution of white books are not functioning as well as it could be.

All this generates a white book system with clear limitations in the capturing and sharing of knowledge throughout the organization. The Group Managers have therefore for some time been discussing a restructuring of the work on knowledge documentation and white books at the PMO. What has been requested is a new situation where continuous documentation of learnings and figures are significantly facilitated and that the capturing and re-use of knowledge is to a greater extent assured. The department wants to leave the feeling that they are facing the same problems over and over again behind and instead, in the long run, experience time savings and cost reductions in their part of the product development due to a greater collaboration between the previous and currently running projects. This leads us into the aim and purpose of this thesis and later on also the formulated research questions chosen for this topic.

2. Purpose

The aim of the project at the PMO is to investigate how the organization could become more effective in its organization of the product development, i.e. using less time while at the same time lowering costs, through learning from previous and ongoing projects and prevent duplication of non-value-adding work. The department is experiencing that their current way of documenting lessons learned is not working in a satisfying way and it is therefore of main concern to investigate if a new tool could improve their way of working. The objective of the thesis has therefore developed into being to create a requirement specification for an IT-based tool to be used for facilitating the documentation and re-use of knowledge that can be acquired from previous and ongoing projects and to find what kind of information and data that would be necessary to include in such a tool. An additional objective has been to review the current way of working with lessons learned and also investigate how the department can become a more learning organization.

The main purpose is thereby settled to developing a requirement specification for an IT-based tool that in an easy way can receive, store and return information, data and lessons learned and thereby function as a supporting tool for project managers in different phases of the projects in a better way than today's solution. To get an idea of how to come up with a descent analysis and a reasonable conclusion on this matter, the purpose has been reformulated into three separate research questions, altogether summarizing and aim to answer to the purpose of the project.

2.1 Research Questions:

The first research question aims to help analyzing the current situation at the PMO, clarifying the issue and why the lessons learned process is perceived not to be working that well. The last two research questions are focused at trying to come up with a good base for giving recommendations on a new lessons learned process, or at least a new set of means to support it. They are therefore aimed at trying to find out what is missing in the current situation and what would be useful to include in a new system.

1. What are the reasons for that the white book process is not generating the learnings that it could if fully utilized?
2. What is missing in the current documentation and what information and data would be valuable when initiating a new project?
3. If a new IT-based tool would be recommended, what are the prerequisites for such a tool to be of value for the project management office?

2.2 Scope and Delimitations

The requirement specification has been designed and created for the PMO continentally, meaning for the European sites. Hence, focus has been on retrieving the opinions and thoughts on knowledge sharing within the company from employees at various levels from those two organizations. A global implementation was to be supported however, which is why a global

reference team was created where at least one from each site participated and represented their respective sites. A continental focus supporting global implementation meant that, due to the magnitude and different characteristics of the entire PMO organization, the solution was designed for, and will be fully implemented at the European sites initially and, if successful, later on expand to also embrace the other four sites.

The company is a large organization, employing tens of thousands of people globally. Only in the main site investigated, several thousand people are concerned. Considering this, one might realize that significant organization-wide changes of knowledge sharing strategy and procedures must come from a central top-down initiative. Since this was not reasonable, the scope of the project was decided, in collaboration with process owner of the white books and supervisors from the company, to be limited to solve the issue with regards to the requirements of the PMO at the verification department and fulfill their needs until such a central strategy has been developed.

What is important is to distinguish between establishing a requirement specification and actually creating the IT-tool. The job requestor initially limited the project to handle the compilation of a specification of what a prospective tool needs to be capable of performing. Considering the writers' academic and professional background it did not seem suitable to actually build the IT tool either which is why investigating requirements and assuring the technical feasibility of this was adequate.

The limited time frame under which this project was running also affected the result given the mentioned delimitations etcetera. An IT tool was specified mainly based on the learnings from the European sites. Considering the chosen research design and methods used within this time frame, it was not feasible to meet all interviewees face-to-face even though this would have been favorable in this situation of semi-structured interviews. For the main site input, it was rather easy to set up face-to-face meetings since most interviewees were situated in the same location. For the other sites on the other hand, interviews were partly held over conference phones, which might have limited the quality of the result.

Finally, regarding the actual writing of this thesis, it has been somewhat limited by the case company secrecy policies. As they do not want to be publicly associated with the thesis, in terms of that it would enable competitors to search for theses that have been performed within the case company, their name and complete description of the company along with the names of the companies in the inspirational outlook have been censored. This might be perceived as limiting the comprehensibility of some sections.

3. Theoretical Framework

The purpose of the theoretical framework is to provide relevant and necessary information for the topic of this thesis. This information is then used to analyze the results from the interviews but also serves as inspiration for our conclusions and recommendations. The logic of the theoretical framework is to begin with a broad introduction on reasons to why organizations must learn in the first place. This is followed by characteristics of both product development and project management. After that, the framework deals with different concepts of knowledge and learning in organizations, starting with an introduction of knowledge and knowledge management. Furthermore, it is described how companies creates, captures and re-uses knowledge together with examples of existing tools that are used today. The later sub-chapters concern barriers to creating and using knowledge and how to overcome them, leading to the concept of organizational learning. Finally there is a short section with critique to the knowledge management concept.

3.1 Why Must Organizations Learn?

As presented in the introduction of this thesis, the increasing competition among companies forces firms to learn in order to stay competitive. Bartezzaghi et al (1997) highlight this in the following quotes:

“In an age of discontinuity, one of the few sources of sustainable competitive advantage remains in the ability of companies to innovate their products effectively.” (Bartezzaghi, Corso, & Verganti, 1997, p. 116)

“... mastering the overall process of knowledge creation, dissemination and application is the basis for creating and continuously improving a capability in product development.” (Bartezzaghi, Corso, & Verganti, 1997, p. 116)

Fifteen years have passed since this article was written and many things have changed since then. However, with the rapid development of technology these quotes are more valid than ever. Indeed, Nonaka and Toyama (2003) agrees with this as they write that *“Today, knowledge and the capability to create and utilize knowledge are considered to be the most important source of a firm's sustainable competitive advantage.”* (Nonaka & Toyama, 2003, p. 1) One of the reasons to why this is the case is because it is easier to replicate an existing solution than creating new ones. Therefore, competitors will often be able to create similar products in terms of quality and price as time goes on. The re-use of knowledge can prove to be a sustainable competitive advantage since knowledge assets increase with use, unlike material assets (Davenport & Prusak, 2000).

Lindkvist (2001) discussed two main incentives of intra-organizational knowledge sharing. Primarily, sharing of knowledge in terms of direct re-use of the knowledge in other projects helps preventing non-value-adding work to be performed in those projects i.e. duplication of work and/or facing the same problems over and over again. The other reason for sharing knowledge is that the transfer situation itself might be knowledge creating. As the intra-organizational communication takes place, their respective knowledge might be combined into

generating new knowledge. If a favorable knowledge sharing system is not in place in project management organizations this might be an impediment for both exploitation of and development of knowledge. (Lindkvist, 2001)

Learning and re-using knowledge can also be important from a risk management perspective. As the name implies, the risk management concept concerns the managing of the risks and uncertainties of a project. (Project Management Institute Inc., 2004). The idea is naturally to counter or mitigate these in order to have an as reliable and predictable process as possible. According to Knight (1921) risk is a measurable uncertainty and as Davenport and Prusak (2000, p. 25) states “*Knowledge is the most sought-after remedy to uncertainty*”. By using knowledge from previous project, uncertainties can instead become risks, which from a risk management perspective would be easier to manage.

So, if knowledge creation, capture and re-use are as important as discussed above, why are not more companies better at it? The fact is that it can be trickier and more time-consuming than one might think (O'Dell & Jackson Grayson, 1998). One reason for this is the nature of the product development business.

3.2 What Characterizes Product Development?

Lindkvist (2001) described product development as being of a non-repetitive character, being focused on one specific assignment during a limited time period, requiring a high level of knowledge and also being of a high level of complexity. All of these aspects can affect the knowledge transfer process in different ways and in order to understand more we will look into more on the characteristics of the product development process.

A widespread way of structuring the development of new products is with a stage-gate system, originally developed by Robert Cooper. The idea of the system is that the product development process can be divided into a number of different stages and gates. The stages represent where the actual work is done and can for example be: preliminary assessment, detailed investigation, development, testing & validation, and full production & market launch, as seen in *Figure 1* below. The gates represent checkpoints where a number of criteria need to be fulfilled before the next stage can be started, ensuring the quality of the project. As Lindkvist (2001) stated, new product development contains a number of different uncertainties and one idea of the stage-gate system is to control these. (Cooper, 1990; Cooper, 2008)

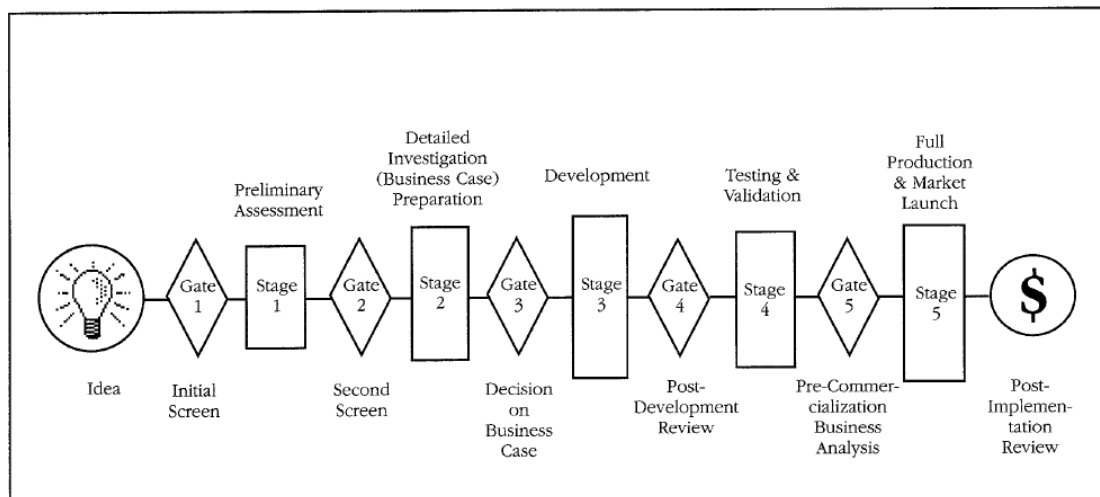


Figure 1: The Stage-Gate System (Cooper, 1990)

While the stage-gate model is useful for structuring the development process in product development it does not deal with knowledge that is created during the process. Lean product development comes from the concept of lean but is specified for the development of products and identifies knowledge as a deliverable in the process. Ward (2007) writes that the lean development, i.e. both product and process development, is based on one fundamental idea: “*Lean development’s goal is learning fast how to make good products*” (p. 2). Notable is the words *learning fast* which highlights the focus on the learning process. More specifically in lean product development one distinguishes between two different value streams that occur simultaneously, product and knowledge value stream, see Figure 2. Kennedy et al. (2008) explain that during the product value stream, knowledge is created and “*it’s the re-use [of knowledge] that increases productivity.*” (p. 159) This is illustrated by the arrow that is moved up and to the right in Figure 2. The horizontal arrows represent the temporary organization, i.e. the projects, and when knowledge, information and data are created in this organization they are to be fed back into the permanent organization, i.e. the knowledge value stream. When that is done the knowledge value stream is moved forward, represented by a shift upwards and to the right in the picture. Hence, when the next project start, the project value stream can start on a “higher knowledge level” (Kennedy, Harmon, & Minnock, 2008; Swan & Furuhjelm, 2010).

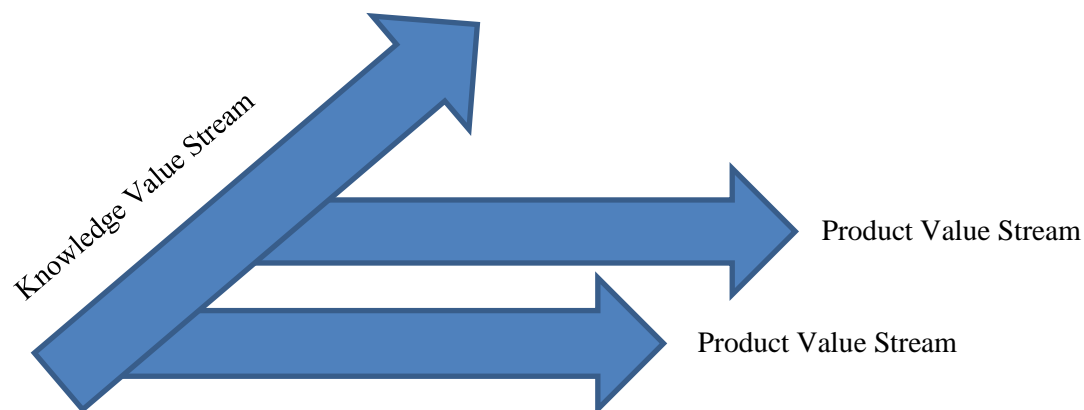


Figure 2: Knowledge and product value stream (Kennedy, Harmon, & Minnock, 2008, p. 160; Swan & Furuhjelm, 2010)

The development of new products and services is carried out as different projects within companies. The characteristics of which are similar to the ones of product development described by Lindkvist above, namely that they are unique and temporary (Project Management Institute Inc., 2004). Being temporary means that projects have a defined start and end date, this is one of three big constraints for projects. The other two being scope and cost, which together are called “the triple constraints”. Simplified, project management can be said to be the work of meeting the project requirements while following the constraints given. However, the actual work performed is more comprehensive. The Project Management Institute (2004) writes that managing a project comprises the identification of requirements, establishment of objectives and taking the different stakeholders’ opinions into consideration, in addition to following the constraints. Björkegren (1999) wrote that this can be called a traditional point of view on projects. This is signified by an internal focus on the project, meaning that the project manager focuses on the individual project and project task. This might make it harder to see connections between projects making them seen as separate entities rather than seeing them contributing to a whole. However, Björkegren (1999) identifies a second view on projects, namely from a *knowledge management* perspective, that can serve as a compliment to the first view. The idea is to recognize that projects can create synergies by combining what they learn in each project, sharing the knowledge between them. More on how this subject will be covered in the following section. (Björkegren, 1999)

3.3 What Does Knowledge Actually Mean and How is it Managed?

Before describing the different parts of knowledge management we first need to understand what knowledge is in the first place. The Project Management Institute (2004) defines it as:

“Knowing something with the familiarity gained through experience, education, observation, or investigation, it is understanding a process, practice, or technique, or how to use a tool.” (p. 363)

Additionally, Davenport and Prusak (2000) write:

“Knowledge is a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information.” (p. 5)

As these quotes indicate, the definition of knowledge is neither straightforward nor simple. For example, Lindkvist (2001) lists five additional definitions of what knowledge is and two more are presented by Kalling & Styhre (2003). However, the quotes give us a starting point from which we can begin understand the concept. Bierly-III, Kessler & Christensen (2000) have created a framework that can further help us with this. In the framework the authors explain how knowledge is related to data, information and wisdom in what is also referred to as the wisdom hierarchy (Rowley, 2007), see *Figure 3*. Data is considered as the most basic level in the framework and is defined as *raw facts*. An example is numbers, which do not tell us anything unless they are presented in a context, for example the number 22. Information is slightly more complex and is defined as *meaningful or useful data*. An example could be that

the temperature outside is 22 degrees Celsius. Knowledge is considered to be on an even higher level and is defined as *clear understanding of information*. For example, the temperature outside is 22 degrees Celsius and it is sufficiently warm to wear shorts. Finally wisdom is defined as *using knowledge to establish and achieve goals*. For example, it is sufficiently warm to wear shorts but since I am going to the office it might not be suitable to wear shorts despite the temperature. (Bierly-III, Kessler, & Christensen, 2000)

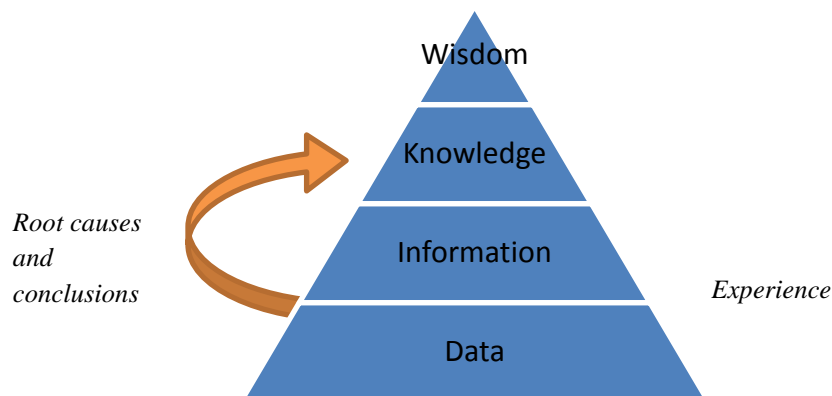


Figure 3: The wisdom hierarchy inspired by Rowley (2007)

Normally the wisdom hierarchy is presented as only the pyramid in the figure above, however we have expanded it slightly. The reason to this is to underline the fact that knowledge *can* be created from data, information and experience, but they are not knowledge themselves. Instead the arrow is meant to visualize that they can become knowledge if root causes are identified and conclusions are drawn from them.

In addition to the definitions above, knowledge can be divided into different categories. One example of this is dividing it into tacit and explicit knowledge, which we will explain later on. Another way is to separate between product and process knowledge, where the first category concerns technical knowledge about the product itself and the second concerns the manufacturing process and the engineering methodology (Catic, 2011). Björkegren (1999) adds project-related knowledge as a third category, which concerns technical and project organizing knowledge for the project itself. Having these categories makes it possible to identify what type of knowledge that is created in, for example, a project, making it easier to distribute the knowledge correctly.

Knowledge management is the matter of creating, discovering, adapting, adopting, transferring and applying knowledge in the organization (Collison & Parcell, 2004). This can be made in several different ways, ranging from capturing all knowledge in documentation, such as databases or reports, to keeping the knowledge solely in the heads of the employees and relying on the connections between them. The optimal solution is somewhere in between the two extremes, depending on the need and situation. Collison and Parcell (2004, p. 16) do not prefer a solution where companies



Figure 4 Interrelation of People-Process-Technology (Collison & Parcell, 2004)

document everything and refer to a quote from Alan Ward: *“It’s not about creating an encyclopedia that captures everything that anybody ever knew. Rather, it’s about keeping track of those who know the recipe, and nurturing the culture and the technology that will get them talking”*. On the same topic, Nonaka and Takeuchi (1996) write that only a small part all the knowledge can be documented with words and numbers. As an explanation, Collison and Parcell (2004) say that knowledge management is when the three areas people, process and technology intersect, illustrated in *Figure 4*, which also Davenport and Prusak (2000) agrees with. The authors mean that the people are crucial since it is they who have the knowledge. However, they need to be supported by both processes and technology. The first in order to facilitate sharing and validation and the second to support the sharing of knowledge. (Collison & Parcell, 2004)

While knowledge management generally concerns activities for the permanent organization it is also of importance to make sure that the activities are performed for temporary organizations as well. This could for example be on project level, where the nature of projects may cause a lack in knowledge management activities (Johansson, 2011). Two reasons to this are that projects generally have a short term focus and that they are temporary organizations. An example is that the benefits of documenting knowledge in an ongoing project mainly affect future projects. It is therefore easy for project managers not to prioritize this and instead spend the time and resources on the current project (Busby, 1999). As a way to overcome this, Johansson (2011) writes about *project knowledge management*, which comprises both the permanent and the temporary organization. The author explains the concept as being the overlap of project and knowledge management. Combined these two concepts comprise the following five different categories of knowledge:

- Knowledge about current projects
- Intra-project knowledge,
- Knowledge from upstream projects
- Knowledge between projects in parallel
- Knowledge between temporary and permanent organization.

Making it a more extensive approach in some aspects as it is more dynamic. Two main objectives for project knowledge management that are mentioned are avoiding duplication of work and learning by repetition. (Johansson, 2011)

3.4 How do Companies Create, Adopt, Distribute and Review and Revise Knowledge?

In addition to understanding what knowledge is, we need to know more about how the knowledge is created and re-used. Bhatt (2000) describes a knowledge development cycle consisting of four different phases of knowledge; see *Figure 5*, explaining the different phases of knowledge in companies. The author writes that creating knowledge in the organization is based on that individuals create knowledge. Senge (2001, p. 125) explains it further with the following quote: *“Companies learn as individual people learn. The development of the single individual is no warranty for the development of the company, but it is a necessary prerequisite.”* In the knowledge development cycle, Bhatt (2000) makes the distinction between individual knowledge and organizational knowledge. For the first, it can be sufficient to only

include the first two steps, knowledge creation and adoption, in order to have a knowledge development cycle. However, in order to create organizational knowledge from individual knowledge, the last two steps of the model need to be included as well. The author states that these steps are essential for moving from individual to organizational knowledge. (Bhatt, 2000)

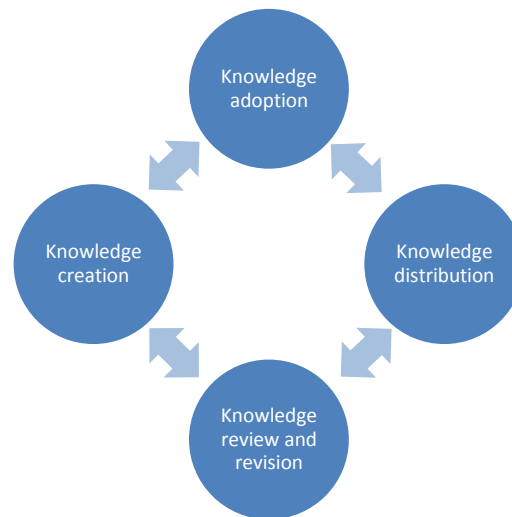


Figure 5: Knowledge development cycle (Bhatt, 2000)

The first phase in the model, **knowledge creation**, serves to highlight the fact that knowledge needs to be created in the first place

in order to have a knowledge development cycle. Notable is that the arrows between the phases go both ways. Thus, as the created knowledge is being both adopted and reviewed, the relationship also goes the other way, indicating that knowledge is adopted and also is reviewed and revised in order to create knowledge. The author states that creating knowledge is about learning from uncertainty, instability, randomness and chaos and saving the learnings as they are encountered. The phase of **knowledge adoption** is the matter of incorporating the knowledge or information that has been created. If a better way of working is identified it should be standardized into specific practices and processes. These first two phases can be adequate for individuals to learn but in order to for the organizational to learn the knowledge needs to be **distributed** from the individual to the rest of the ones concerned. Knowledge is distributed differently depending on if it is tacit or explicit knowledge, which will be further dealt with in the next section, however, the idea is that it needs to exist a functional process for accessing, retrieving and sharing knowledge in the organization. If an organization succeeds in its work with the phases mentioned, there is still a risk that the current knowledge becomes obsolete. As a last phase in the model **knowledge** needs to be **reviewed and revised** to have a functional knowledge development cycle. Besides the fact that knowledge can become out-of-date there is also a risk that it is forgotten or ignored if it is not used. (Bhatt, 2000)

Related to Bhatt's (2000) ideas on individual and organizational learning, Chris Argyris (1991) writes that there are two different levels for how people learn. These are referred to as single and double loop learning. The first type of learning is compared to basic problem solving. In short it can be that an error occurs, the error is fixed and if the error occurs again then it can be fixed the same way again. But the author means that this is only a very basic type of learning. Instead double loop learning focuses on the root cause to why an error occurred, making sure that the situation does not occur again. One can draw parallels between Argyris (1991) and Bhatt (2000) as Bhatt's idea of individual learning is similar to that of Argyris' single loop learning, where no deeper knowledge is being created. Instead if a root cause of an error is identified, i.e. double loop learning, the organization can use the knowledge as well, i.e. organizational learning.

3.5 Can all Knowledge be Transferred?

Knowledge and the term knowledge management have been defined and the strategic ways of creating, capturing, distributing and reusing it have been discussed. But what modes of knowledge transfer exist that enables distribution and re-usage?

Kalling and Styhre (2003, p. 57) defines *Knowledge sharing* as “*the idea that knowledge, no matter how intangible or fuzzy, is capable of being disseminated, transferred, diffused, shared and distributed within and between organizations, communities of practices and departments*”. Knowledge sharing intra-organizational as well as inter-organizational is complex though, and therefore difficult to manage. (Kalling & Styhre, 2003)

To manage knowledge transfer, one often makes the separation between *tacit* and *explicit* knowledge (Nonaka & Takeuchi, 1996). According to Nonaka and Takeuchi (1996) a common perception in the western part of the world is that an organization is a machine, whose only task is to process information. This information is, as a consequence, seen as being systematic and formal, i.e. explicit. The opposite, tacit or *implicit* knowledge i.e. being very difficult to visualize and express, is more common in Japan. (Nonaka & Takeuchi, 1996) (Johansson, 2011).

The core of the distinction between explicit and tacit knowledge is the possibility to express it in words. Explicit knowledge is easily formulated and can be communicated in written form as textbooks, guidelines, SOPs and rules etc. Tacit knowledge, in contrary, is said to be the knowledge that resides in the head of individuals and that is difficult to retrieve and communicate. (Johansson, 2011) (Nonaka & Takeuchi, 1996)

The ability to communicate explicit knowledge can also be expressed as being possible to *codify*. Hanisch et al (2009) defined codification as *the transfer of knowledge by documents*. This implies that knowledge that is documented in written form is codified, and hence solely explicit knowledge is applicable for this knowledge transfer mode (Hanisch, Lindner, Mueller, & Wald, 2009). Koskinen (2004) points out that information technology is key in today's use of codification as a knowledge sharing strategy and Alfredson and Söderberg (2009) presented in their case study that codification using IT tools such as white books and databases is the most used knowledge transfer modes in Swedish Industry (Koskinen, 2004) (Alfredson & Söderberg, 2009).

When dealing with tacit knowledge, codification is rather incomplete. Codification strategy has the advantages of being able to handle a large amount of information and data efficiently and can bridge the time and place gaps between projects. However, it has clear disadvantages regarding tacit knowledge since codified material is very limited in providing the receiver with explanatory comments and interpretations of the material. Hence, another strategy is needed for fulfilling the requirements of tacit knowledge transfer, namely *personalization*. (Johansson, 2011)

Hanisch et al. (2009) has a definition also of personalization, that is *the transfer of knowledge by personal interaction* (Hanisch, Lindner, Mueller, & Wald, 2009). This is a knowledge transfer strategy designed for the sharing of tacit knowledge. Remembering that tacit knowledge resides in the head of individuals, one can say that personalization aim to foster the direct exchange of

knowledge between individuals. Hence, the core is to create interaction between stakeholders of the project issues that might appear and of those that have already appeared and been handled in other projects (Johansson, 2011). Wenger et al (2002) present *communities of practice* as the creation of a group of people and roles that share the same concerns regarding project issues and exchanges their respective knowledge on a regular basis (Wenger, McDermott, & Snyder, 2002). The personalization strategy allows for the receiver to assure complete understanding of the issues communicated and has significantly lower risk of misinterpretations. On the other hand, in the case where organizations have a high employee turnover significant amount of knowledge risk disappearing with employees leaving the organization. (Johansson, 2011)

In recent years, there has been a general shift in industry from focusing on codification strategies to more personalization strategies. As the importance of knowledge is increasing and the technologies and work practices become more advanced, the difficulty of documenting and communicating lessons learned increase accordingly. However, one can also argue that as competition increases there is less room for mistakes and unnecessary costs and thus a greater need for documenting and updating best practices. Hence, organizations are to a greater extent in need of the combination of codification and personalization as their knowledge sharing modes. (Johansson, 2011) (Chen & Ghaedian, 2012)

Goffin et al (2010) suggest that personalization can be supported by codification. When setting up communities of practice, having documented personal thoughts and lessons learned before the actual meetings have proven very useful (Goffin, Koners, Baxter, & Hoven, 2010). Also for actually enabling the creation of communities of practice codification might come handy. Keeping the project organization well documented and accessible significantly facilitates connecting the people in need of retrieving the knowledge generated in previous projects to the creators of the knowledge. In the same way, personalization can support the codification strategy in the capturing and re-usage stages. Personalization and codification are thus not two completely separate strategies for organizations to choose between as knowledge is to be shared intra-organizationally but rather two modes of knowledge transfer that works best in combination. (Johansson, 2011) (Chen & Ghaedian, 2012)

Coming back to the difference between explicit and tacit knowledge; Nonaka and Takeuchi (1996) describe them as being “*mutually complementary entities*” meaning that they interact with each other and can be interchanged from being tacit to becoming explicit and vice versa. They further elaborate on a framework for performing this knowledge conversion where they categorize knowledge conversion modes from tacit to explicit and back again but also from tacit knowledge of one entity to tacit knowledge of another and similarly for explicit knowledge. *Figure 6* show the modes of knowledge conversion where the transformation from tacit to tacit is named *socialization*, tacit to explicit is called *externalization*, explicit to explicit is represented by *combination* and the conversion from explicit to tacit is called *internalization*. (Nonaka & Takeuchi, 1996)

The process of transforming knowledge from tacit knowledge residing in an individual to tacit of other individuals is referred to as **socialization**. This type of knowledge conversion is said to be possible without the use of language for communicating the knowledge due to that it concerns only this implicit type of knowledge that cannot be expressed. Nonaka and Takeuchi (1996) use apprenticeship to exemplify this conversion where the apprentice learns through observing, practicing and training. (Nonaka & Takeuchi, 1996)

Converting tacit to explicit knowledge, **externalization**, handles the issue of forming tacit knowledge into concept or models. The idea is to try to express and conceptualize an image into words even though a full picture will not be provided. However, the authors state that these limitations highlight the importance of complementing such a conversion with reflections and interactions. (Nonaka & Takeuchi, 1996)

Combination is the conversion from explicit knowledge, in some way documented or concretized by different individuals and teams into documents or computerized communication networks, into a reconfigured set of sorted, categorized and combined knowledge documentations that can be used by the organization. This process of combining knowledge of different sources can create new knowledge and can e.g. be illustrated by the functionality of databases. (Nonaka & Takeuchi, 1996)

Individual usage and adoption of such documented knowledge requires a conversion from explicit knowledge into tacit knowledge of the individual, named **internalization**. This is the process that finally assures that the captured knowledge has actually come to use. Important is that the documentation is precise and does not allow for a too wide set of interpretations. Preferably it is presented as instructions or manuals that enables the receiver to easily adopt the knowledge through usage of the documentation. What is further emphasized when it comes to internalization is that the documentation itself does not really teach the receiver anything. The learning process is rather initiated as the documentation is used for actually performing the task and this learning by doing is what creates the tacit knowledge of the individual. (Nonaka & Takeuchi, 1996)

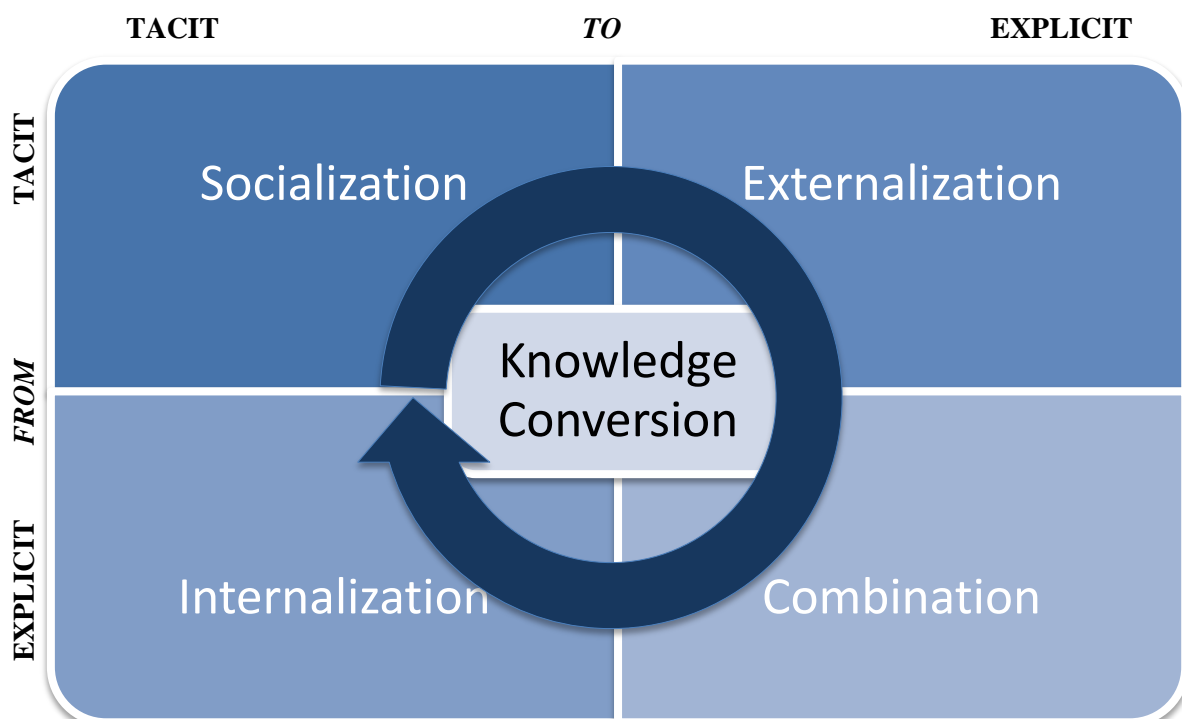


Figure 6 Nonaka and Takeuchi's (1996) model for knowledge conversion

3.6 What Means of Knowledge Transfer are Commonly Used Today?

Naturally, organizations from all kinds of industries have existing processes and modes of knowledge sharing. Terminologies such as *lessons learned*, *post-project reviews*, *white books* and *knowledge databases* are frequently appearing when researching knowledge transfer operations. (Rinman & Wilson, 2010) (Alfredson & Söderberg, 2009) (Busby, 1999)

Post-project reviews (PPR's) refer, as the name reveals, to summarizing learnings and evaluating the results of the projects only after the project has finished. Busby (1999) states that use of these PPR's enjoys the advantages of disseminating the knowledge and current best practices and improve the individual knowledge of employees and generate predictions on how new solutions will perform as compared to the current best practices. The main drawback of PPR's is the not too seldom outcome that the documented reviews end up in some archive (web-based or not) and are never utilized (Busby, 1999). Busby (1999) mentions the reasons for the PPR's not being used are

- 1) The time-consuming parameter of it. Especially in project organizations where PM's want to keep the costs associated to their projects low as the beneficiaries are not even taking part in the particular project organization but rather part of a future one.
- 2) The false belief that experience equals knowledge.
- 3) The perception that these evaluating activities can lead to blame or criticism of fellow project team members, and people prioritize maintaining social relationships.
- 4) Engaging in new projects is perceived as more worthwhile than looking into old ones. (Busby, 1999)

A lessons learned tool very often treated and experiencing similar issues as PPR's is white books. Alfredson and Söderberg (2009) identified that white books appear as lessons learned tools in several different industries even though sometimes under a different name (project report, experience book, lessons learned) but with the same meaning (Alfredson & Söderberg, 2009). The white books are often, as similar to PPR's written at the end of the projects and are to be re-used as new projects start. The documented knowledge usually concern project management issues for the project manager to bring to the next project and it is not meant to include learnings on the actual product (i.e. no technical product performance knowledge). Alfredson & Söderberg identified in their case studies that the main issue of white books is generally in industry perceived to be the fact that they are written only after project closure. Several years might at that point have passed since the project team experienced their main learnings of the project and to remember all the issues in detail to enable fair documentation of it is difficult. (Alfredson & Söderberg, 2009)

Kotnour (1999) pinpointed two main incentives for conducting white book documentation from a project manager perspective. The first one being to learn how to improve the existing product development work practices, while the perhaps neither obvious nor beneficial incentive is to satisfy the demand of managers to deliver a white book. In many cases, project managers may perceive the management demand to be the main driving incentive, which does not promote the quality of the documentation. (Kotnour, 1999)

Another option used as a substitute or a complement to white books and PPRs in industry is databases. Alfredson & Söderberg (2009) state that databases are commonly used for more technical issues on product and component level throughout the industries researched. The authors, however, sound a note of caution for the use of a database without a well-developed search function since learnings risk getting lost and become inaccessible. Some of the disadvantages of white books are also recurring in the case of databases e.g. the tendency that information is uploaded to the database due to the demand of managers, not with the intention that it would be valuable for coming projects. (Alfredson & Söderberg, 2009)

3.7 What Could Reflection Mean for Knowledge?

Whether to have reflection sessions or not within organizations has been said to create the conflict of productivity needs versus the quality of working life. The meaning of that statement is that reflection sessions lead to insights of how to improve productivity that often means worse conditions for the employees actually experiencing the insights. However, this view has its origin in producing organizations and mainly concerns the learning of individuals. Boud et al (2006) suggest that through moving away from the focus on individual learning and focus on the learning of the organization as a whole the productivity objectives and the improved work situation of the employees can be achieved simultaneously. As responsibilities of improvement efforts have been decentralized to a greater extent in modern organizations, employees have become aware of that they can in fact improve both productivity and work situations by performing them as a collaborative activity rather than seeing only potentials in their own work. (Boud, Cressey, & Docherty, 2006)

The process of reflection comes into play as one tries to deduct where learning that generates change comes from. Boud et al (2006) state that experience is a key for improvement by transforming it into a learning. In this process reflection over one's experiences is essential. As the authors express it: "*Reflection is a key human mechanism in understanding our experience and drawing lessons from it*". (Boud, Cressey, & Docherty, 2006, s. 4)

Productive reflection is a term constructed by Boud et al that highlights "*the creation of contextualized workplace learning that allows and releases the capacity of the workforce, via de-centralized and flexible project groups, the use of multi-functional networks and multiple stakeholder perspectives*" (Boud, Cressey, & Docherty, 2006, s. 16). Embedded in this Boud et al (2006) quote is the importance of cross-functional team-based reflection on their respective experiences and perceptions of their combined efforts in a project. The individuality is transformed into the shape of collective reflection. Furthermore Dilworth (1996) said that learning arises from reflecting upon one's actions and use the outcome to shape coming actions within the organization, i.e. updating the mode of operation. Combining these constituents of productive reflection leads to the conclusion that it is a very versatile concept. It includes that reflection should be a group activity performed by a diverse set of people, that the result must lead to an action affecting work practice and that it aims to create an environment of mutual learning where employees are encouraged to learn from also the activities of others. Altogether, productive reflection is said to generate a wider competence base and capacity among the employees. (Boud, Cressey, & Docherty, 2006)

Reflecting in a group and creating a learning environment sounds very promising. However, introducing and implementing it can be very difficult. High workloads tend to distract employees and make them prioritize among work tasks allowing them to on their own decide when to reflect and when not to. There are some recommendations on how to implement productive reflection and how to use it. Gibbs' reflective cycle, *Figure 7*, presents a framework for what to reflect upon that could be useful for single experiences as well as complete projects. Using these questions of discussion character is a good way for opening up for creative discussions and sharing and adopting knowledge based on each other's experiences. (Gibbs, 1988)

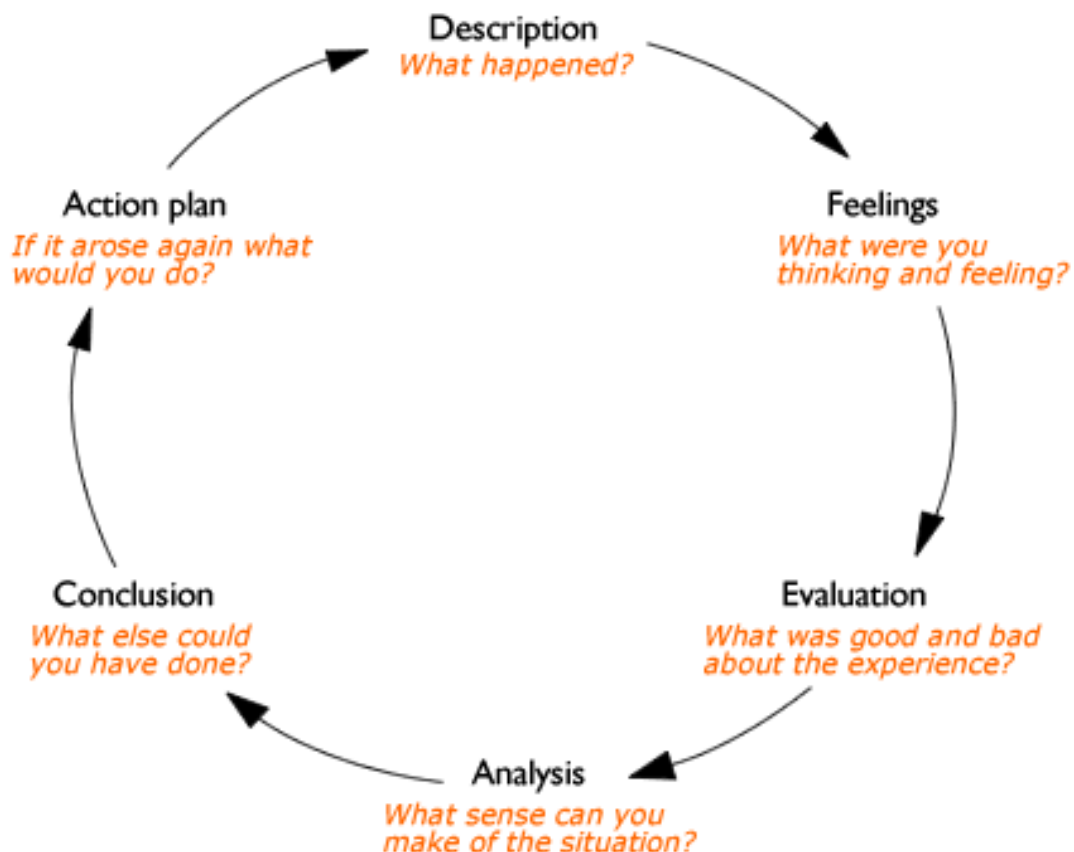


Figure 7 Gibbs' Reflective Cycle (Oxford Brookes University, 2011)

3.8 What Barriers are There for Knowledge Transfer?

Barriers of knowledge sharing within product development organizations have been identified in previous theses in product development organizations. In order not to re-invent the wheel we want to capture the knowledge created by previous theses and try to use these barriers, verify if they are valid also at PMO and work on recommendations on how to overcome these barriers in order to facilitate an efficient use of a new lessons learned tool.

Alfredson & Söderberg (2008) analyzed barriers for knowledge sharing in product development organizations through a case study of eight companies in different industries. They characterize these barriers as formal and informal barriers and state that all their identified barriers must be dealt with in order to get any leverage on knowledge initiatives. The formal barriers regards

issues related to the corporate structure and existing work methods applied to the organizations while the informal barriers refer to cultural and attitude matters. (Alfredson & Söderberg, 2009)

Perhaps the main issue of project organizations within product development is the very widespread tendency to focus on short-term project deliveries rather than alignment with the company's overall objectives and important parameters might therefore be viciously rationalized. The same short-term focus brings on another apparent barrier according to Alfredson & Söderberg (2008), the problem-solving issue. As the project is running to an end, and at many times have been experiencing delays the organizations tend to rush through problems occurring. This is not implying that they do not solve the issue or that it is solved carelessly or sloppy. Rather that the focus is not on analyzing where the problem came from and how to prevent it from happening again but only to solve the current product issue through kind of a quick-fix similar to what is often called a "firefighting" mentality. This is also related to Argyris (1991) idea of single loop learning. (Lindkvist, 2001) (Alfredson & Söderberg, 2009)

Unexploited transferability refer to that companies in most cases have not truly investigated the opportunities for learning from each other within different parts of the organization. Commonly, especially in product development, employees believe their task/product to be so unique that no one else can either contribute or use the knowledge generated (Björkegren, 1999). However, not very seldom, it turns out that there are a lot more similarities and lessons to be learned than one would expect as the possibilities for knowledge sharing are scrutinized (Alfredson & Söderberg, 2009). Szulanski (1994) goes further and call this issue *ignorance* and highlight it as the most important barrier of knowledge sharing (Szulanski, 1994).

Lindkvist (2001) further state that even though there are existing modes of transferring knowledge between the parts of the organizations they are at many times underutilized due to similar uniqueness belief as previously described (Lindkvist, 2001). O'Dell and Grayson (1998) argue that it often has to do with the inadequate absorptive capacity of the recipient due to limited resources or practical details in place in order to implement it (O'Dell & Jackson Grayson, 1998). There could also be the absence of a bond or a relationship between the recipient and the knowledge source and hence, the potential learning never ends up at the radar of the intended or proper recipient (O'Dell & Jackson Grayson, 1998).

This can also be connected to the fact that project managers often run several projects at a time or that new projects are initiated before completion of the previous one. In such cases motivation for evaluating and documenting experiences of previous projects are not seen as important as getting going with the new ones. A reduced motivation could also be due to another barrier, that being the lack of visible incentives for the project managers. If one does not see the gains of sharing experiences or lessons, why would one spend time and effort on doing so? (Lindkvist, 2001) (Alfredson & Söderberg, 2009) (Collison & Parcell, 2004)

In organizations with high employee turnover knowledge transfer becomes significantly more important. If no transfer modes are in place, a lot of knowledge will be lost as employees leave the organization. In project organizations, where the nature of the work implies that the current work has a defined end date, employee turnover is consequently in general high. Thus, in project organizations the knowledge sharing is of even greater importance and at the same time more difficult. (Lindkvist, 2001) (Alfredson & Söderberg, 2009)

The formation of the knowledge or learning documentation can create a barrier in itself. If it is not composed in a user-friendly way and written continuously in a standardized format it will be difficult to handle and run the risk of being greatly underutilized (Alfredson & Söderberg, 2009).

Björkegren (1999) highlights the time parameter in knowledge sharing and re-usage. The coming project that may have great use of the learnings generated in the current project might not be the one following directly after in time. There are time gaps, sometimes of many years, between projects of similar character. This time gap must be bridged, since in project organizations one cannot rely on that the same staff is present and furthermore remembers the crucial learnings from the previous projects. The organization needs thus some way of bridging this gap, often through the use of some kind of supportive documentation to use for briefing the new project teams. (Björkegren, 1999)

3.9 How Can These Barriers be Mitigated?

The barriers identified must in some way be mitigated in order to achieve the creation of a learning environment within the organization. Overcoming the barriers is the key to successful knowledge sharing. In project organizations in most cases the knowledge face discrepancies in time, place and possessor between the creation and usage of it. The creator of the knowledge in an earlier project is likely not to be the same person as the user of the knowledge in a project later on. Just as uncertain is whether the new project starts right after the previous one or if many years pass in between. Lastly, in large organizations the physical location of where the knowledge was created is perhaps not the same as the location of usage. (Rosenbloom, 1995)

Several of the barriers presented can be deducted to the fact that product development project organizations have the nature of an all the time changing organization. Project teams are changing, responsibilities and characteristics of current work is changing very frequently. Björkegren (1999) states that this implies difficulties of generating organizational knowledge and know-how from the work within project groups. In contrast, the knowledge generated will mainly be adopted by the individuals who were part of the project team. If the knowledge is to be captured, these individuals must function as *knowledge bearers*, carrying the learning on to the next project group. This requires either interaction between this individual and the new project team or even that the individual takes part in the new team. (Björkegren, 1999) (Nonaka & Takeuchi, 1995)

A project organization's tendency to focus on achieving the short-term objectives of the projects rather than putting time and effort of reaching the organizational aims is mainly due to the natural structure of the organization. Project teams about to be resolved as the project is closed have little or no immediate incentive to consider the organizational goals of the company or the department, as this is usually not rewarded in any way. Alfredson and Söderberg (2009) suggest that a project organization experiencing this short-term orientation should move away from the project focus into a *program focus*. This comprises emphasizing continuous development of the end product's KPI's and reducing the project-specific concentration on balancing cost, quality and product development time against each other. The benefits of the organization or product as a whole is somewhat neglected to ensure fulfillment of the project objectives. Issues appearing close to the end date of a development project might compromise with quality and cost in a way

that is not beneficial for the entire organizations only to be able to keep up with the designated start-of-production date. One could say that project focus can generate sub-optimizing activities and prioritizations that do not favor or encourage knowledge sharing initiatives. As knowledge transfer between projects seems to be a complex process it is feasible to question the use of project structure for product development organizations, at least from a knowledge sharing perspective. (Chen & Ghaedian, 2012) (Alfredson & Söderberg, 2009)

Björkegren (1999) highlights the opportunity of avoiding or at least reducing the complexity of the knowledge transfer issue through suggesting that individuals involved in the previous project should go on to have an active role also in the new project. Hence knowledge in possession of the employees is automatically transferred (Björkegren, 1999). This is a method not very different from what Alfredson and Söderberg (2009) describe as moving from a project to a program focus. Since, similarly the point is that knowledge is not to be acquired in temporary teams that then are completely dissolved but remain in the relatively consistent team.

Moving from a project focus to a program focus or making individuals move on to similar projects may seem like a very beneficial solution. However, this is not always that simple. Imagine for example that there are several years between two projects of very similar characteristics. What are the odds that the same people participating in the previous project are still available and remember anything of value, considering the topic being a project-oriented product development organization with high staff turnover? (Alfredson & Söderberg, 2009) (Björkegren, 1999)

Some knowledge transfer and sharing is, hence, useful and necessary for the organization not to lose parts of its most valuable asset, its knowledge. As described previously in this chapter knowledge transfer is about creating a system of both personalized and codified knowledge transfer modes (Chen & Ghaedian, 2012). Creating knowledge in codified format still demands interaction with a more personalized work practice to be fully distributed and re-used. Hence, learnings must be connected to anyone responsible of capturing the knowledge generated and bringing it forward through the organization. Alfredson and Söderberg (2009) name these persons responsible for capturing knowledge within certain categories *knowledge owners*, who have the task of assuring the long-term development of knowledge within these categories (Alfredson & Söderberg, 2009). Chen and Ghaedian (2012) develop this further and try to identify these knowledge owners within the line organization and thus, capture the knowledge generated in the project matrix-organizations and distribute it through the line organization. Through this, the idea is that the line organization later on can feed the captured knowledge into new projects. The cross-functional nature of the project teams enables a transfer from the projects to the right knowledge owner within the right functions in the line organization (Chen & Ghaedian, 2012). This is a way of creating the bond between the recipient and source of knowledge as requested by O'Dell and Jackson Grayson (1998).

Creating incentives for project managers to perform the documentation is a tricky one. However, fundamental for getting something done is to actually follow up that it is done and evaluate it. As has been accredited to the American management philosopher, Peter Drucker: "*What gets measured gets done*". Hence, assuring that the knowledge documentation activity is followed up by management is the main key to incentive creation. On the other hand, Alfredson and Söderberg (2009) among others conclude that creating a feeling of responsibility to perform a task is most often superior to making it an obligation. Only making it a mandatory task risk forming a mind-set related to the knowledge management activities that they are just time-

consuming activities that must be completed. However, they do suggest that making learning an individual goal for employees could be a solution for creating this motivation and incentives to share and adopt learnings. This would also enable the management to follow up if the employees are fulfilling this. (Alfredson & Söderberg, 2009)

3.10 Could These Knowledge Management Ideas be Questioned?

After the first two sections, the theoretical framework has been dealing with knowledge, knowledge management and different ways of working with and looking at knowledge. We are however, aware that there are different opinions on these topics and as a final part of the theoretical framework we present a few of these. We start by returning to the ideas of Nonaka and Takeuchi (1996) and more precisely to that knowledge is created via socialization, externalization, combination and internalization. Stephen Gourlay (2006), who has much experience in the area of knowledge management and organizational learning, has summarized critique that has been given on Nonaka and Takeuchi's (1996) ideas in an article. In short, the main critique concerns that Nonaka and Takeuchi simplify the definition of knowledge to only being "*justified belief*." Gourlay (2006) means that the definition of knowledge is more complex than that and as a consequence the conclusions that are made suffer the risk of being too simplistic. The author concludes by writing that the model or theory therefore actually might be more about managerial decision-making than on how knowledge is created as managers have much influence on what are justified beliefs.

Even if Gourlay (2006) is skeptic of Nonaka and Takeuchi's ideas there are still many that agrees with them. Malhotra (2005, p. 9) is one of them as he writes that "*real knowledge is created and applied in the processes of socialization, externalization, combination and internalization.*" On the other hand, Malhotra (2005) criticizes knowledge management or more specifically, knowledge management *technologies* as he writes that there is too much focus on the technology rather than the actual knowledge. He writes that databases, intranets and establishing corporate libraries etcetera can all be good but more importantly one need to ask oneself "*what knowledge to manage and to what end*" (Malhotra, 2005, p. 7). Too much focus on what technology to support knowledge management has led to a confusion regarding what actually is knowledge management and what is more information management or data management. In the conclusion of his article, Malhotra (2005) therefore writes that more emphasis should be put on asking "why" and to what purpose one should work with knowledge management before asking "how" and with what technologies.

4. Methodology

This chapter describes how we have proceeded to collect the data and information used in the thesis. The design of the study is described followed by the research methods that have been used as well as what type of data that is used. We also describe how we practically have collected the data and finally what potential sources of error that we see. In order to discuss the trustworthiness of our study, we have used Lincoln and Guba's criteria of trustworthiness of a research study, as presented by Cohen and Crabtree (2006).

4.1 What Design has the Research been Based on?

The aim of the thesis has been to investigate how a project management office at the case company could become more effective in its organization of the product development, i.e. using less time while at the same time lowering costs, through learning from previous and ongoing projects and prevent duplication of non-value-adding work. As the thesis' main concern has been one department at one company, the research design was performed as a case study. The reason to why we have chosen to perform a case study can be deducted from Cepeda and Martin (2005) who writes about eleven points that characterizes a case study. Several of these points correspond to the type of research that we wanted to perform and a few examples are: *"the phenomenon is examined in a natural setting"*, *"the focus is on contemporary events"*, *"one or a few entities (person, group or organization) are examined"* (Cepeda & Martin, 2005, p. 854).

The reliability and validity are always of interest for reports and theses such as this one. The idea is, in short, to make sure that the results are correct by confirming that one is both measuring and gathering information in the right way but also that it is the right information that is measured and gathered. In other words, one can say that the reliability and validity is a measure of a report's trustworthiness, which is what the authors Lincoln and Guba have stated. They mean that the trustworthiness consists of the four areas: credibility, transferability, dependability and conformability. The credibility concern the degree of "truth" in the findings, the transferability concerns how well the results in one report can be transferred and applied to another, the dependability concerns if one gets the same results if experiments or measures are repeated and finally the conformability concerns if the findings of a study is affected by the interviewers' or interviewees' interests. We have taken these aspects into account in order to increase the trustworthiness of our study and we will return to these concepts in the subsequent sections of the method to show just how we have done it. (Cohen & Crabtree, 2006)

4.2 What Research Methods has been Used to Collect the Data during the Study?

During the course of the thesis we have used several different ways to collect our data. Our main source of data has been interviews as we have performed 50 interviews with 46 different people. We consider this to be primary data as we have talked to people with direct knowledge of the issues at hand. To clarify, primary data is collected directly from first-hand experience while secondary data has been collected by someone else (Business Dictionary, 2012). Besides from the interviews, we have been looking into previous master's theses both on similar

subjects and also on the same case company. In addition, we have read and reviewed many different articles and books in order to help us analyze the results from our interviews, and to provide us with a theoretical foundation to start the analysis from. We consider this information to be secondary data, as we have not seen the results first hand.

Our way of working with our data can be likened with a hermeneutic spiral where one goes back and forth between understanding and interpretation (Eriksson & Wiedersheim-Paul, 1997). As an example, we did not know very much about the current way of working with lessons learned at the case company and we therefore started interviewing and reading literature on the topic to gain a basic understanding. After gaining the new understanding we needed to realize what it meant in order to proceed to the next step, i.e. we needed to interpret it. We could then perform more interviews on, for example, what information the project managers would prefer to have for a new lessons learned tool, i.e. new understanding. The next step would then be to interpret this information so that we could gain more understanding and so on and so forth.

Before we move on, let us shortly review the research methods based on Lincoln and Guba's criteria of trustworthiness. We have worked hard to increase the credibility of our findings by triangulation. We have triangulated both by using different methods, such as interviews, articles and books on the same subject, but also by using different sources. This is one of the reasons to why we have a relatively high amount of different interviewees.

The interviews have been semi-structured as we wanted the interviewees to talk freely based on a number of questions that we had prepared beforehand. We describe more on how the interviews have been performed in section 4.3 below. In order for the reader to get an idea of what roles we have been interviewing, we have summarized our interviews into a table, see *Table 1* below. The table shows the roles of the people we have interviewed, how many people of each role we have interviewed and also the location where the interviewee was based.

Table 1: Overview of interviews

Overview of interviews		
Case Company – Roles	Number of People interviewed	Location
Global Group Manager	1	All Locations
Database Expert	2	Main Site Investigated
Functionality Responsible	1	Main Site Investigated
Global Manager, Functionality Responsible	1	Main Site Investigated
Group Manager	1	Main Site Investigated
Internal Consultant and Former Master's Thesis Supervisor	1	Main Site Investigated
Knowledge Management Specialist	1	Main Site Investigated
Manager, Functionality Responsibles	1	Main Site Investigated
Process Manager of the project management office	1	Main Site Investigated
Process Owner, the White Book Process	1	Main Site Investigated

Project Assurance Manager	1	Main Site Investigated
Project Controller, Finance	1	Main Site Investigated
Project Development Project Manager	1	Main Site Investigated
Project Manager	4	Main Site Investigated
Quality Manager	1	Main Site Investigated
Senior Project Manager	4	Main Site Investigated
Group Manager	4	Other Sites
Group Manager	1	Secondary Site Investigated
Project Assurance Manager	2	Secondary Site Investigated
Project Manager	3	Secondary Site Investigated
Chief Project Manager	2	Secondary Site Investigated
Other than the Case Company		
Other Companies	8	
Former Thesis Worker	2	
Supervisor, Chalmers University	1	

4.2.1 Why have We Interviewed These People?

As mentioned in the introduction of the thesis the case company has several different sites around the world. Our main focus has been on the site located in Sweden, i.e. “the main site investigated” and with a secondary focus on another site in Europe, called “the secondary site investigated.” The reason for this was that the case company wanted to primarily look at a solution that would work for these locations. However, the case company also requested that the solution should be able to be implemented on other sites as well if the solution turned out to be satisfying. For this reason, we have also interviewed group managers on others sites of the company. Returning to the discussion of the trustworthiness of our results, we have aimed to increase our credibility by interviewing people on many different levels in the company. The reason for this is that there are many different stakeholders in for example the white book process and we are interested in looking at the process from many angles in order to be sure to see as many aspects as possible.

Snowball sampling is one method that we have used very extensively to get ahold of the right persons to talk to. Basically, the idea is that at the end of each interview we, as interviewers, ask the interviewee if he or she thinks that there is anyone else that we should talk to about this subject. The interviewees almost always had a suggestion of someone for us to contact. We then proceeded to contact the new person and book a meeting with him or her. We were thus able to get a hold of many people that we otherwise probably would not have found. A potential downside of this is that the interviewee we were asking might not know who the best person to talk to is, or that the interviewee might only recommend persons that he or she knows or likes. Both of these aspects could mean that we did not get a hold of exactly the right person. However, by getting a name we would be better off than before since we then had nothing.

As we believed that other companies probably also have worked with the issue of how to use lessons learned from previous projects, we decided to make an inspirational outlook on a few

other companies. Questions we asked ourselves were for example: could other companies have encountered the same issues and solved them? How have they done so? What obstacles have they encountered? These companies have been chosen based on what interviewees and others have recommended but also based on what we believed would be relevant companies to compare the case company with. The interviewees have been project managers or group managers of groups of project managers of similar sizes to that of the case company, which makes the results more comparable. From a trustworthiness perspective, the credibility of the results is very low as we only interviewed one or two persons at each company. We are aware of this fact and even if we believe that the answers from the interviewees were given truthfully, the interviewees might not know the correct answer in the first place. However, the purpose of the inspirational outlook was, as the name implies, to give inspiration to our conclusions and we believe that even if the credibility is low the interviews serve a good purpose. But once again, these answers should be considered more as good indicators rather than absolute truths. We interviewed seven different companies other than the case company and one might question why we did not interview more or less companies. The reason for this is mainly due to practical reasons, as we simply did not have time to interview many more companies, but also since it was these companies that had the time and were willing to participate.

4.3 How have We Collected the Data?

As the authors were stationed in Sweden the interviews of the main site have been performed via face-to-face meeting to the largest extent possible. The reason for this was both due to convenience during the interview as it is much easier to explain something by using body language and drawing images on whiteboards etcetera, and also due to the reason that we believed that the quality and credibility of the interviews would be better with a face-to-face interview compared to a phone interview. Interviews with people stationed outside of Sweden have been performed via conference phone. The interviews have in general been 30 – 60 minutes long and this has been sufficient in almost all cases. In the cases when we have had additional questions after the interview was finished, we have been able to send the interviewees our questions via e-mail and thereby getting them answered. In almost all of the interviews both of the authors of this thesis have been present. We have alternated the roles during the interviews, meaning that both of us have posed questions and both of us have documented what the interviewees have said. The reason for this is that we believe that we might look at things differently and thereby think of different follow up questions to ask as well as documenting differently. Directly after each interview we compiled and wrote down the information from the interview together. By doing it directly afterwards, the information was fresh in our minds and together with the notes taken during the interview we were able to remember most of the content of the interviews. One might question why we did not record the interviews in order to make sure that we do not miss anything, however, we actively chose not to. The reasons for this is are several; first, we believe that by asking the interviewees if we could record their interview they might become slightly more restrictive in their answering and we wanted their honest opinions. Second, we believe that we are able to catch the absolute majority of the information given as we both take notes during the interviews and then compile the interview directly afterwards. Also if we were to miss any information we made sure to ask the interviewees if we could get back to them with follow up questions if needed, and they all agreed to this. Third, if we were to use the recordings made we would need to listen through each interview once more, meaning that the total time it would take to perform one interview would be very long. For

example, for a one-hour interview the listening of the interview would also take one hour and then the actual writing might also take one hour, which means that very much time is spent for each interview. Bryman and Bell (2011) agrees that recording and then transcribing interviews can be very time-consuming and that the recording might be off-putting for the interviewees. For this reasons we choose to rely on our skills in taking notes and our memories for documenting the interviews.

We wanted our theoretical framework to provide the readers with a good starting point to understand the context of the thesis as well as to help us in the analysis of the case company. This is why the chapter starts by introducing why organizations must learn, followed by a description of product development and knowledge management in general. The subsequent sections then explain more on how to actually work with knowledge in organizations. In order to create this framework we have reviewed many different articles and books of many different areas. The collection of these has been made with the support of the Chalmers library, the library of Gothenburg University, our supervisors at the case company and at Chalmers. In addition, previous master's thesis workers have provided some input but we have also searched for much information ourselves. Our method was to first to set the headlines that we wanted to include in the framework and then collect many different sources that we believed would be of use. When we felt that we had a good amount of sources we performed a clustering exercise to organize the sources under the different headlines. We started by writing down each headline on a white board and then we went through each of our articles and books to see where each could fit in. Much of the literature had information on more than one headline as we were able to get an overview of all our literature it was much easier to see how they could be connected to each other. When we were to write each section in the framework we could just go back to the list we had made for each headline to see which authors that would fit. Naturally, it happened that we encountered an article or book that we found interesting after we made the classification of the literature. In those cases we simply tried to fit the information where it would suit best and it was not very problematic. With this exercise we were able to identify several sources of information for each headline which increases the credibility as the information was triangulated.

4.4 What Potential Sources of Error Might Affect our Results?

The interviews have been performed in both English and Swedish depending on the origin of the interviewee. Since many of the interviewees and both of the authors of this thesis have Swedish as mother tongue this language has been preferred when possible. However, for the interviews made in Swedish we have translated the results of these into English since this thesis is written in English. This gives rise to a potential source of error if the answers are translated incorrectly. However, we believe that we have managed to be accurate in our translations. In addition, we believe that it would be better for the interviewees to talk freely in the language in which they are most comfortable with and with us translating the answers, rather than having them giving their answers in a language they might be more uncomfortable with.

4.5 What Can be Said about the Trustworthiness of the Study?

Throughout the method we have tried to discuss our study from a trustworthiness perspective based on the ideas of Lincoln and Guba. In this section we summarize the different aspects to provide the reader with a more collective view of the trustworthiness, as it might be slightly difficult to grasp otherwise.

From a credibility view we believe that it is quite high since we have had a rather high amount of interviews together with the fact that we have triangulated the interviewees to get as many views on the topic as possible. We have also tried to triangulate the sources as we have used interviews, articles, books and previous master's theses for the same reason. The fact that we have been able to discuss our results with our tutors, both at the case company and at Chalmers University, could also be said to have a positive effect on the credibility of the thesis. However, even if we have discussed with our tutors we have tried not to see their opinions as absolute truths as that then would affect the credibility in turn. The credibility of the inspirational outlook should be considered as very low as we have only interviewed one or two persons at the companies but as we have mentioned, it was mainly meant as a source of inspiration.

From a transferability perspective, our main focus has been on one single company, i.e. the case company. Apart from the case company we also made the inspirational outlook on seven other companies, which provided us with several new ideas and which we believe increases the transferability of the study. In addition, we believe that much of our findings can be applicable for other companies as well since the issue of how to manage knowledge is of relevance for almost all companies.

Regarding the dependability of the study, the best way to ensure this would be to record the interviews performed since then other could take part of our data. As discussed above, we decided not to do so which means that others cannot replicate the study exactly.

Finally, the conformability concerns if the interests of the interviewers or interviewees have affected the results. This issue can be difficult to address but we have tried to minimize our own influence during the interviews by trying to ask open questions so that the interviewees could talk freely. Triangulation of interviewees has been made to minimize that individual interviewees influence the results with their own opinions.

5. The Process of Re-Using Knowledge, Data and Information at the Case Company

This chapter describes the current situation of the case company and summarizes the issues that they are experiencing regarding lessons learned. Thus, the chapter will provide a good basis for analyzing why these issues are appearing and how to deal with them. First of all, the product development process of the case company and their process of documenting lessons learned will be presented. The second part summarizes technical issues of the white book and the third part aims to describe the organizational issues associated with the process. The content of this chapter is mainly based on the semi-structured interviews performed at the case company and to some extent also on process documentation available at the public company website.

5.1 The Current Process and its Shortcomings

The following section regards the ways of working with lessons learned and other types of knowledge sharing mechanisms present at the product development organization. The way the procedure of documenting and distributing project learnings have been incorporated into the, by the entire corporation, adopted white book process.

A white book is meant to be seen as a live document to be updated throughout the project lifetime. Positive and negative experiences as perceived by the different parts involved in a project are documented along with certain results from the project in the shape of tables and figures. In the end of a project the white book documentation is summarized into a *project white book* containing the relevant information needed to capture and distribute to other projects with similar scope or that encounters the same type of issues. As described earlier, at the PMO, they feel that the white book process with its end product being the project white book cannot offer the support that new project managers or project managers who enter new areas need as they are initiating new projects. To find out the reasons for why it does not currently offer these possibilities, interviews were made with people at all appropriate levels involved in the white book process.

The product development organization base their work on a stage-gate model. The process is divided into six different phases, ranging from the initiation stage to the final stage, see *Figure 8*. The stages reflect different parts in the development process where each stage has its specific goals. For instance, the first stage serves to develop a concept of the product that is sufficiently good to allow the development to continue. When projects approach a gate (marked as the dotted lines in the illustration), it faces a set of deliverables. The project manager has to respond and present the status to each of these in a project steering committee. Only as the project has received confirmation from the committee that all deliverables have been approved, the project team is allowed to move on to the next phase. The constant time-pressure that projects are under sometimes obstruct an effective use of this model. As some deliverables are seen as less critical than others, the steering committee tend to compromise slightly on e.g. white book documentation requirements along the road to make sure the gate does not stop the project until the next steering committee meeting. Hence, the priority level of documentation of results and learnings is somewhat lower than most other requirements. All projects are based on the stage-gate model but how projects work with it may vary depending on the size and scope of the

project. Projects that only concern a very small part of the end product does not always go through all of the stages and very large projects may have additional smaller gates between the main ones as there might be up to one year between them otherwise. In addition the deliverables that are to be met at each gate also vary depending on the size and scope of the project.

Case Company Stage-Gate Model

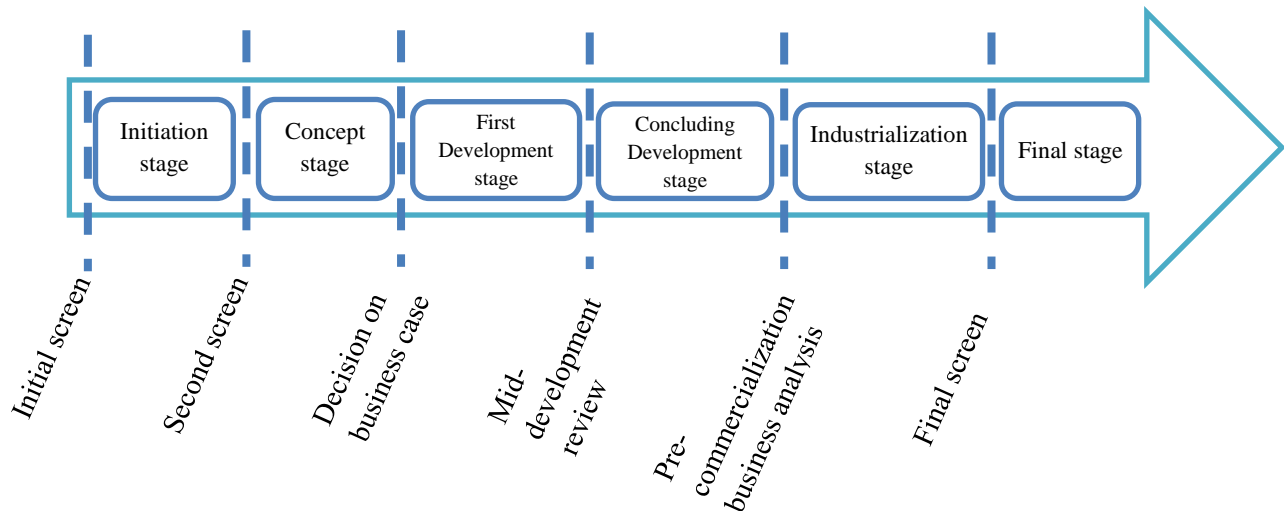


Figure 8: Case Company Stage-Gate Model

5.1.1 The White Book Process, How it is Meant to be Carried out.

The project white book is published for internal use within the product development organization and is written by project managers on the highest level of the product development organization, namely Chief Project Managers (CPM). These are to gather information on how the project has been proceeding from all involved parts of the organization. The CPM leads the Project Management Team (PMT) where representatives from marketing, finance, manufacturing etcetera are present along with the Product Development Project Manager (PDPM) and the Project Assurance Manager (PAM). As the organization follows the company's stage-gate model, the project white book is listed as a deliverable at the final gate of every project. The project can therefore not be closed without the hand-in of a complete white book at the end of the project. The CPM or the PAM is responsible for continuously updating and gathering information for the white book as the project is proceeding. The Project Assurance Plan states that there should be a white book update at each gate in the stage-gate model. However, it is only at the final gate that the white book is published and hence made available for people outside the project.

Looking at the white book from a verification perspective, their input reaches the CPM via the Engineering Management Group (EMG). As illustrated in *Figure 9* below, the PDPM leads the second level of the project structure; the EMG. On this level representatives from all the different commodities discuss and deliver their view on the successes and failures of the project. As a clarification, a commodity is responsible for a part of the whole product. On this level, the discussions are mainly on the level of project management issues that are common for all the

different commodities and hence do not go into deep on specific learnings for e.g. verification testing procedures etcetera. The focus is rather on general opinions on what has been working well and not so well regarding the coordination between different departments and how the different commodities collaborate rather than on technical issues.

Further down the product development chain the verification project manager is responsible for gathering the white book input from the actual areas of testing through the functionality responsables and the rest of the verification line organization. In this lower project level the issues are of more technical nature and discussions are directed at handling specific difficulties and progresses in the area of complete product testing. The idea is to generate lessons learned that can be supportive for future projects as input to their planning and estimation procedures.

Information exchange between the mentioned levels is to be performed in both a codified way and through personally interacting with the other representatives, PDPM and CPM. The importance of personal interaction is stressed and it is often stated, at the case company as in other large organizations, that no matter how good your documentation is you can never codify everything that constitute a project team's knowledge. At each organizational level there should be white book sessions for collecting the input for the project white book where issues and good experiences are discussed and evaluated and brought up to the next level. As the CPM is the one actually writing the final project white book, documentation on the lower levels take on other forms. The PAM gathers learnings from the engineering management group in a so called *white book log* or *lessons learned log*, two very similar Excel-based templates where the issue/learning is summarized into stating the issue, its impact and recommendations for the future etc. From the PMO level, the output is a *Verification white book template* built on the same structure as the project white book but with the content more focused on verification specific technical information.

The white book sessions along with the documentation in white book logs, lessons learned logs and verification white books provide the CPM with the information necessary from the product development side to include in the project white book. His or her task is then to compile this information with the input received from other parts of the company, and summarize this into the project white book. The risk at this stage, since the white book delivery is the responsibility of the CPM solely, is that the interpretations and prioritizations of the CPM has to great influence on the final content, which is supposed to be avoided. After completion, the document is published in a web-based portal on a location dedicated to white books. Access and secrecy is often an issue, however, all white books should be open to anyone that can access the specific part of the web-based portal. What creates the access issue is the fact that an unnecessarily high restriction level is set as default as the white book is uploaded, and hence failure to change the level leads to very limited accessibility.

The white books are to be extracted and re-used as new projects are initiated. The verification PM is obliged to search for projects with similarities as it is stated in the Project Assurance Plan. Finding relevant projects are not at all times easy, but yet needs to be done. The lessons learned identified from this review of the previous white books are supposed to be lifted at the project start-up meeting and thus shared to the rest of the project team.

White Book Process Structure

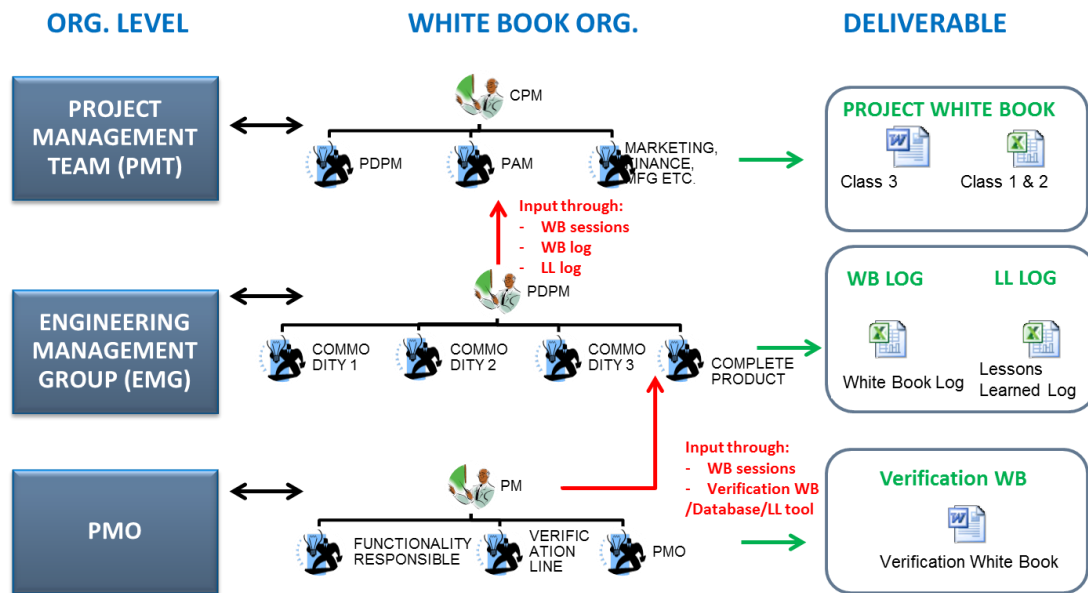


Figure 9: The white book process structure

The white book process varies in different ways from project to project depending on unpredictable reasons that are difficult to control on beforehand as well as on given differences in the handling of lessons learned that depend on project size (classification of projects) and duration. The more unpredictable factors are such as the personality of the documenting verification PMs and CPMs. Some of the interviewed verification PMs are performing extensive white book sessions with related documentation while some of them hardly do any documentation at all. The same relation goes for the frequency of their documentation; some do it regularly and often while some only do it in the end of the project. As for the given factors affecting the differences from project to project, these are due to size differences. Projects are given classification 1-3, 1 being the smallest project types and 3 being the most extensive ones. Smaller projects do not require as extensive documentation and thus, projects of class 1 and 2 have gotten a separate deliverable as can be seen both in Figure 9 above and Figure 10 below. Regarding documentation frequency, it is mainly a recommendation to update the documentation when passing each gate while the only actually requirement is to deliver a complete white book as the projects have reached the final gate.

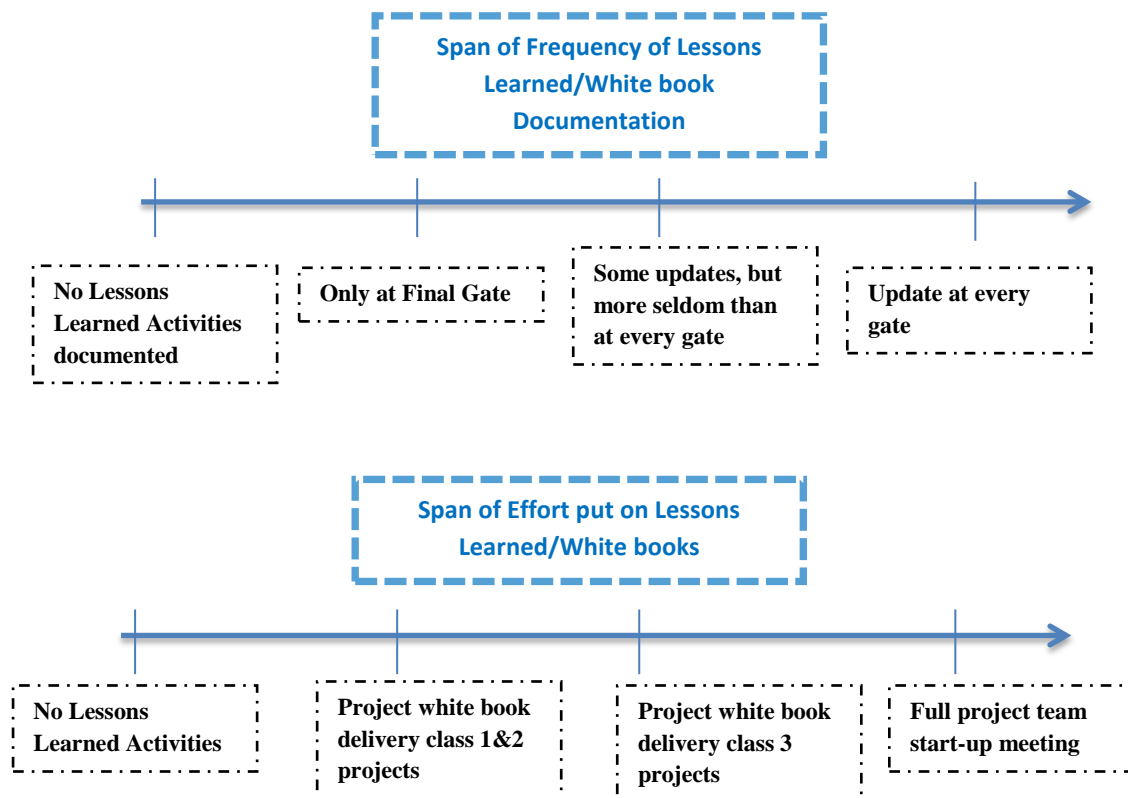


Figure 10: Span of frequency and effort for white book documentation

5.1.2 Deviations from the White Book Process in the Different Sites

Whatever solutions and/or recommendations this report may generate, learnings are to be useful more than just in the main site where we are currently situated. The design is to be made with regards to main and secondary site requirements and hence be functioning as a continental tool for handling of lessons learned. The wish is thereafter that the tool will be applicable also to the global sites even though this lies further away in the future. To enable this continental design input and assuring global applicability, representatives from all sites have been interviewed and with origin in the intended way of working with the white book process the deviations and main issues of the sites are to be presented below.

The interviews with PMs, CPMs, PAMs, Group Managers and Site Managers showed both similarities and differences in how the different sites work with the white book documentation. An interesting finding is the deviations within the sites on how PMs actually perform their white book input collection and the inconsistency in what happens to the final project white book.

There is no officially formalized process for working with white books due to difficulties in creating a coherent operating procedure for the entire corporation to follow. However, the process owner says that there is an *intended* way of working which was just described above. Deviations from the presented intended way of working are present at all sites. The European sites differ the least whereas the Asian sites show greater deviations, likely to be mainly due to their deviating characteristics and procedures.

5.1.2.1 Main Site, Sweden

At the main site, the procedure follows the intended one relatively well. The main divergence is that it is very seldom documented continuously during the project life-time. In most cases the

white book system is more of a post-project review document where projects, no matter how long the total time used for the project, summarizes everything into the project white book at the final gate only. Furthermore, on the CPM level, the storage of the project white books bring along some inconsistencies. Most of the interviewed CPMs did not even know about the designated location for white books in the web-based portal. Hence, many finished white books never end up in the portal but remain on different PM's internal servers and, in the best case, on a Team Area (Team Area platform to be explained later on) for the project. The storage phenomena are intermittent throughout the process. Neither the interviewed PDPMs, nor the verification PMs were aware of this common storage space for the project white books.

The verification PM interviews shows further inconsistency in how to document the learnings from a verification PMO perspective. Some PMs are frequently using lessons learned logs and the verification white book template flawlessly in accordance with the intentions of the white book process. Others, on the other hand, have never even seen the verification white book template and completely skip documentation of this nature. These PMs really stressed the importance of personal interaction and investing in meeting times with those other relevant projects rather than trying to codify knowledge.

5.1.2.2 Secondary Site, Southern Europe

The main difference between the secondary site and the intended white book process is that it has not come as far in implementing it as in the main site. The deviations in between projects within the site are rather significant and the level of standardization in the white book procedure is hence low. This can partly be deducted to that the PAM-function is relatively new here. Since it in many cases lie on the PAM to drive the white book process forward during the project lifetime, the tendency to not document continuously but only at the final gate of a project is even greater here.

They are not really using the template for the project white book but have created their own PowerPoint-based template. Regarding the verification white book template, no one of the interviewees in the secondary site had seen one of those before. Further inconsistencies between the secondary site and the intended white book process lie in the storage. Just as in the main site, they are not aware of the common storage area for white books in the web-based portal. During the project lifetime the white book logs used for the continuous documentation of learnings are stored on the Team Area. After project completion the white book logs are summarized into the PowerPoint template and stored on "random" location in the web-based portal. Some of the interviewed PMs are following the intended procedures with continuous and frequent documentation and summarize these at final gate. Some others, on the other hand, have never seen even a single white book. What is most puzzling about the situation in the secondary site is the complete awareness of that the learnings are not coming to use, and that the issue has been ignored until now. This is best exemplified by the similar answers received from a PM and a CPM in the secondary site when asked the question: *"What happens with the white book and the learnings as the documentation is finalized?"* and the answer came out as *"We present to the steering group that there are documented learnings without presenting the actual learnings. Then the learnings are placed somewhere in the web-based portal and that is it."* and *"The learnings are put in the web-based portal, and then...they are dead"*.

"The learnings are put in the web-based portal, and then...they are dead." – PM, Secondary site

5.1.2.3 Global Reference Site, South America (Site SA)

In the South American site they feel, as in the other sites, that the white books are not working that well. It is seen as a straight post-project activity, even though they know they should be documenting continuously. As in the secondary site, they are not really using any white book templates. They state they are doing some documentation in the end of every project, but that they have no formalized way of doing so.

The group manager believes the reason for the poor documentation is the lack of incentive for the CPMs to perform the documentation. It is very often the same CPMs that will perform also the next project within the same area, and they therefore do not feel the need of documentation, they are of the opinion that they know the lessons to be learned.

The South American site experiences that they lack historical information from previous projects. Budget estimations and time plans are very rough estimates as of today and they do not match very well with reality. The belief is that if the white books would be improved or complemented by another tool the estimations could be improved severely.

"The budget estimation is a problem. We are just guessing or use the exact same budget as for the previous project without evaluation" – Group Manager Site SA

5.1.2.4 Global Reference Site, South Asia (Site A)

In the South Asian site there is no white book documentation exclusively for the verification department. However, they are participating in white book documentation on project level where updates are made continuously during the project. The market of Site A differs in many ways from the European market. To exemplify, only low-end products are produced and distributed on the local market. Only one product has been completely developed at site A and in this project they have held continuous white book sessions on project level. The focus on low-end products brings along a search for cost reductions. They screen among the available functionality and choose to focus mainly on the very few most significant ones for them. The lower cost objectives make it difficult to invest in timely documentation.

5.1.2.5 Global Reference Site, North America (Site NA)

The North American site's white book process is not that far from the intended one. The CPM is the requestor of the white book just as it is supposed to be. The difference lies in that some CPMs request from the PMs that they even write their own part of the white book. This seems similar to using the verification white book, however the verification white book is an initiative from the PMO of the main site and is not really a request from CPMs. In site NA the PMs then, in some cases, delegate the task to write the white book further to the engineers. In other cases, the PM writes it himself and does not involve the engineers at all. None of these solutions seem to be functioning well.

In site NA they have identified two issues with the white books that they believe is the reason to why they are not used, the storage and the mindset. They have similar inconsistencies in where to store the white books as in the other sites. However, here white books are spread all over different team areas and the web-based portal. This brings along several visualization and access issues.

"I have never seen a single document that has been filled in continuously. White books are seen as tick-off items" – Group Manager Site NA

Regarding the mindset they experience that white book are seen as a tick-off item, which must be performed at the end of the project. The idea of using it as a live concept is not working. The group manager stated he had never seen a single document that had been updated continuously during the project lifetime.

5.1.2.6 Global Reference Site, East Asia (Site EA)

At Site EA, they do follow the white book procedures on CPM/PAM level. On the lower verification PMO levels they do not document anything. They have never used any white book templates. The CPM compiles learnings in PowerPoints. These are then to be updated only to the project-specific Team Areas where only the project team can access them. Other will have to go to the CPM and request access.

At site EA, they mention that their focus is on technical issues, not project management learnings. It is, as in the other sites, mandatory to look at old projects as new are initiated. However, site EA experience that white books are not as useful as they could be since they are not giving any recommendations.

5.1.3 Summarizing the Common Issues of the White Book Process

The six different sites do not seem to differ significantly in their way of working with lessons learned. Even though they might in general be positioned at different places on the effort and frequency spans of the documentation, on the great whole it does not look too different. The Asian sites differ the most and it seems as this is due to the nature of their low-end-products, which does not allow for as much time being spent on documentation processes. However, the generalities of the white book process are similar enough to believe that designing the solution based on continental needs could support also the global requirements.

The idea of the white book is that it is supposed to work as a supportive tool as new projects are initiated within the organization or as projects face an issue that might have been dealt with before by previous projects. PMs can then easily reach the white books from previous projects in just a few 'clicks'. For this to work out properly, the white books must be accessible. Step one would be, knowing where to look for the previous projects in the electronic filing system.

During the interviews with the people actually about to perform these reviews of older projects, it came to the interviewers' attention that so was not the case. The opinion of both group leaders, PMs, PAMs, CPMs, in the main and secondary site is that it is more time consuming trying to locate and go through white books from previous projects than reinventing the wheel again, so to speak. Another aggravating factor is that it is not enough knowing where to look for a specific white book, but one has to first of all know there is an existing previous or ongoing project that has dealt/is currently dealing with the same situation. Once you have found out there is a project and located it in the system, you have to make sure to have the accessibility to retrieve the file. This can be summarized as a **localization/accessibility issue**.

The fact that the white books are not used in the same way in between and within sites goes further than the storage and format of publishing as described in the previous section. What to include is also a question of obvious interest. White books should be providing the PM with the **right information, at the right time, in the right quality**. Only information that is of use to

coming projects should be documented in the white books. In today's situation, PMs feel that the white books are too extensive and yet do not include everything that would be of use.

The difficulty of understanding the need for documentation among the PMs, CPMs is a tricky one. As most of them know what happens with the white books after completion, the incentives become extremely low. The **motivation and incentives** of producing the white book with this knowledge leads to low quality of the white books and in one way towards a negative spiral in getting worse and worse white books.

The issues of the white book process that have been summarized up to this point could be broken down into smaller issues actually creating e.g. the low motivation and incentives of producing qualitative white books or the fact that the wrong information is available. For the purpose of presenting these smaller issues in a structured way we have divided them into technical and organizational shortcomings of the white book process.

5.2 Technical Shortcomings of the White Book Process

The above sections showed that the white book process is not functioning as well as it could be and that there is much room for improvements. One issue for the project managers is that the white book is not very fitted to their scope of work since the project white book encompasses all parts of the project. This makes it hard for the white book to provide specific input to the project managers. One way to try to solve this has been to create a more detailed white book intended for verification PMO usage only. Some of the information in this white book is then used in the project white book, which means that the work of collecting information does not need to be done twice. However, even this more specific white book is of limited use since it has many of the same issues as the project white book, such as inconsistency in storage and inconsistency in how often and how well they are written. Even if this white book is more specific there is still information that project managers would find useful that is not included. This is partly due to practical reasons since it is not possible to include everything. An opportunity could be to create an IT-based lessons learned tool that would be able to include more information and would hopefully be of more use to the project managers. The next step for us to take was therefore to investigate what more information that would be useful and why.

5.2.1 What Functionality, Information and Data that PMs are Currently Lacking would be Valuable for their Work?

One of the first features that were desired for a lessons learned tool was the ability to quick and easy search amongst projects. For the current situation there is much useful information but it cannot be found or accessed which means that it is not used. Therefore the search function is central in a new tool. Almost all of the interviewees mentioned that this is important and there were many suggestions on search criteria. First of all one should be able to search on project number and project name. However, since these are very specific it would be difficult to find a project if you do not know what to search for. Some of the newer project managers said that as a new employee it takes time to know what project the specific project numbers concern. The

people who have worked a long time in the organization often know what a project is only by the project number. To find specific projects it would therefore be useful to be able to search on project number and project name, but that alone would not be enough.

If a project manager is unsure of what projects that have been made before there is need for additional search criteria. One example that has been brought up in the interviews is to classify the projects based on the type of project, such as what part of the product that is in focus. Such a classification would make it possible to find projects of the same type if a project manager would like to gather information from several different projects. It was also suggested to specify the classification even further and also use sub-categories. This would make it easier to find similar projects. In addition, the projects can also be sorted according to size. It can, at times, be more relevant to compare projects of similar sizes than of the same category if scopes are much different. Date issued was also of interest to the project managers since the most recent projects are likely to be the most similar to the new ones in certain aspects.

As this topic was brought up in each interview we were given many different suggestions of search criteria but the ones mentioned above were the most frequent ones. Subsequently, the interviewees were asked what output they wanted to have from a lessons learned tool and why it would be useful.

Almost all of the interviewees agreed that there is much information from previous and ongoing projects that would be useful in their work that is not available to them at the moment. Mainly it concerns information that can help PMs in their cost estimations and planning of tests and activities but also information on size and scope that provides an overview of the earlier projects was highlighted as valuable.

Starting with the cost estimations, an important activity of the project managers is to estimate the budget of the project, i.e. how much time and cost they expect to put in. Almost all of the interviewed PMs stated that it would be of use to see how the cost was distributed between different commodities in earlier projects. Let us take a project for developing a specific part of the end product as an example. In general, the cost distribution between different commodities for developing the part is often similar for different versions of the part. For example, verification might account for 30% of the costs, the responsible for the design of the part might account for 25% etcetera. The figures for the cost distribution could easily be displayed via for example a pie-chart. Besides the distribution between the different commodities, many PMs stated that it also would be of use to have information on the distribution within the commodity of the PM, concerning the verification activities. By comparing with earlier similar projects the PMs can see if their estimations seem valid. If the figures are much different the project manager might have forgotten an activity or simply miscalculated giving him or her an early indication to review the estimation. This could therefore be used to avoid errors and spot potential issues that otherwise would have appeared later on and also as decision basis to motivate decisions.

Budget development over the course of earlier projects is also information that can help PMs in their cost estimations. By looking at the predicted budget and the actual budget of previous similar projects, the PMs could use such information to help them answer question like: Have predicted budgets of earlier projects turned out to be accurate? If not, where have other projects' budgets gone wrong? Why have they done so? The PMs highlighted that such information

would be very useful for their risk management, to spot potential issues in their estimations and avoiding them.

The second area that PMs highlighted as important is helping in the planning of tests and activities. A major part of the verification work of the PMs concerns the planning of different types of tests of the products and parts developed by the case company, which is summarized into a test plan. These tests concern for example the reliability and the lifetime of the products and the PMs face questions like: How many tests will we need to do to assure the quality of the product? How long do the tests have to be? What tests do we need to do? Looking at the test plans from earlier projects can help PMs answer these questions as they show how many and what tests that were made for the respective projects. In addition, the planning is one of the activities that are the most uncertain for the PMs since it is hard to predict all events of a project. Delays are especially difficult to foresee. As a consequence, all of the PMs wanted information from previous test plans to be able to see what and when activities were planned for a project and what and when they were actually performed. Such information could be displayed in an excel-sheet for example, showing different tests and activities on each row and weeks spent in the columns. If there was a delay in the plan the cause of this could be looked into to identify if there is a risk to include in the new project.

Similar to the reasoning above, previous and ongoing projects can help in the estimation of how many products that needs to be tested. If the PM concludes that a reliability test needs to be made he or she still needs to know how many products that needs to be tested in order to make sure that the result is valid. To be sure, the PMs could always test 10% more products than what is expected as necessary, however, there is much interest in and pressure on the PMs to not perform more tests than necessary due to costs. Certain tests can be very expensive and due to the competitive environment of the case company's industry, the case company constantly strives to lower its costs. As a consequence the PMs' decisions are challenged from time to time regarding if certain activities and test in the project really are necessary. But sometimes removing an activity could ultimately lead to increased costs and time if it turns out that the activity needs to be performed anyway and tests could then be forced to be repeated. It could also work the other way around that some tests or activities could be canceled if they did not turn out to be useful. Project managers could thus use data from previous and ongoing projects to motivate their decisions on how many tests that need to be made and how many products that needs to be tested.

Providing a project overview was the third area that PMs stated as important when looking at earlier projects. This could for example be information on the size and scope, top and bottom experiences and employees involved in the project. Starting with the size and scope of the project, such information would enable the PMs to get an idea of if an earlier project is comparable with a current one. If the a new part is estimated to have a scope that concern all products of a certain type it might not be of interest to compare it with an earlier project that only concern a few percent of a product type. A simple example is if an earlier project only concerned products that were painted orange, it might not be comparable to a new project that concerns products with all colors. Similar to the scope, the size of a project can help to compare different project. Questions one could ask is: How much time did the PM spend on the project? How many parts were affected by the project? How many new parts were created from the project? But besides using an earlier project to compare with the estimations of a current project, the information from the earlier project can also be used to help in the planning of the current project. For example, if a previous project had a similar goal as a new project it would

give an indication on the size and scope of that project. Thus, providing the size and scope of an earlier project can be of aid both to compare and also to help with the planning of a new project.

Hard facts in terms of data and information can be valuable as discussed above, however, several of the interviewees mentioned the use of more “soft” facts as well. Currently in the white books there is a section where people can document their top and bottom experiences in the project. The good experiences can be useful to identify since by looking at what is working well, it could be increased and used even more. By identifying what works less well, pitfalls and mistakes might be avoided. By having this as an output in the lessons learned tool the people involved would be able to document more thoughts, opinions and recommendations for future projects. This can be difficult to convey in more hard facts.

Even if both data and information can be very valuable it is difficult to replace the importance of direct communication. Almost all of the interviewees highlighted the fact that the best information comes from talking to people with the right experience. Some project managers said that when starting a new project the best thing is to invite the members of the most relevant previous project to share their thoughts and experiences in a meeting or a workshop. A downside with this is that it requires time from many people and might therefore be hard to set up. Hence, for smaller projects it might not be worth the effort to have a large meeting. Another issue might be that as time goes on the involved employees might forget what they did in the project and valuable information could be lost. Some might also have ended their employment since the project finished and cannot be contacted and the information is lost that way. However, the idea of having a contact person for each project was considered a very good idea. In that case, if you need to know more about a project it is easy to find the right person to talk to. There were also suggestions that a brief organization chart could be included in the description of the project in a lessons learned tool to give additional information on who was involved in the project.

5.2.2 If a new Tool Would be Needed, How Could it fit into the Existing Systems at the Case Company?

The most convenient alternative for a lessons learned tool would probably be to use a system that already exists at the company. This would mean that people might already be familiar with the interface, which could make it easier for people to adopt it. It could also mean that the expertise already exists in the company, leading to cost savings. With this background we started by looking internally within the company for existing systems that could be used as a lessons learned tool.

At the company today, there exist several different computer based tools and the PMO uses a number of these in their day-to-day work. An example is a web-based portal for long-term storage which is a low cost alternative but that has limited functionality. The main issues with this tool are the limited search functionality – which makes it very hard to find anything at all – and the managing of user access – which is very limited due to confidentiality reasons. Another tool is the Team Area, where members can share documents, news etcetera. This tool is considered to be user-friendlier than the web-based portal. However, some of the interviewees thought that a Team Area would not be the best alternative for a lessons learned tool. The Team Area has a better search function than the web-based portal but it is still limited. Furthermore, the Team Area does not offer the ability to compile different inputs to reports, which was

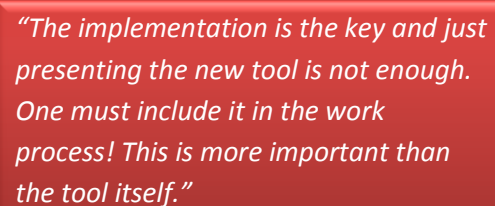
discussed as a possible feature for a lessons learned database. In addition to this, basic servers are used with the basic purpose of storing files and folders.

Interviews were also held with employees at the company working with IT such as the development and maintenance of databases. There exist several databases and systems at the company today and even if they are not adapted specifically for a lessons learned tool one interviewee said that it would be relatively easy to create a prototype database, based on an existing one. One major difficulty in designing a new tool is to have a well-made specification.

The issue of compatibility between a new tool and the existing databases was discussed in several of the interviews. Since there currently are many different databases at the company there is a question of whether the new tool should be “smart”, i.e. that it would be able to retrieve data from other systems. This would probably be the best for the users as it would be more comfortable for them. However, it would also mean that the complexity of the tool increases and many interviewees highlighted that simplicity always is important when introducing new tools. On the other hand, if the tool is unable to extract data from other databases it means that the users will need to insert all the data themselves. This will in turn make the tool more complex in another way.

5.3 Organizational Shortcomings of the White Book Process

Moving on from the technical shortcomings of the white book process, section 5.1.3 also identified that there are organizational shortcomings with the process. By identifying what works less well with the white book work process, that information could be used for designing a new lessons learned tool. Indeed many people highlighted the importance of integrating the tool into the work process rather than only focusing on the functionality of the tool. The interviewees implied that the current work process of the white books is not working satisfactory. As mentioned in 5.1.1 and 5.1.2 there is a difference in how much the employees work with the lessons learned process and white books. The differences concerned how often one worked with the white book and the amount of effort that was put down in the documentation, ranging from little to very much. The fact that the frequency and effort of the documentation are different from project to project is one shortcoming with the current process. Interviewees stated that there is no standardized way for how to work with the white books. Even if there are headlines that are to be filled in in the white book, it is the one writing the white book who decides what is documented and the level of detail of the documented information. As a consequence, the quality of the content can be very different depending on the author.



“The implementation is the key and just presenting the new tool is not enough. One must include it in the work process! This is more important than the tool itself.”

Digging deeper into the issue of why the quality of the white books vary, the interviewees mentioned some additional underlying organizational reasons. One reason being that documenting the lessons learned is not given a priority in the projects. Updating the white book, when passing each of the gates in the stage-gate model of the case company, is strongly

recommended. However, many projects are approved by the project steering committee to pass the gate even if the white book is not updated as it is not followed-up by the committee. Documenting in the white book is therefore often only made at the end instead of continuously during the project. For long projects it might be very difficult to remember facts from early in the project, leading to that the input to the white book is poor.

Connected to the fact that white book documentation is not given priority is that there need to be a budget allocated for that specific activity. More specifically, the budget needs to be assigned specifically for the white book so that the time is not used on other activities. As many projects are under a lot of time pressure it might be tempting to use the time that is meant for the white book documentation to something that is more acute. Another aspect is that smaller projects might only have very little time assigned for documenting lessons learned since otherwise it would constitute a too large part of the budget.

When discussing the current way of working with lessons learned, i.e. the white books, many interviewees said that often the same issues are returning in the new projects as well. When they were asked why they believed this to be the case a common answer was that often the lessons learned from a project were not seen to. Therefore the interviewees pointed out that when something that can be improved is identified, a recommendation of what to do should be made. This should then lead to an action that needs to be performed by someone. As it is now, project teams sometimes identify things that have gone well and things that have gone less well when they are reviewing their projects. These aspects could be summarized into recommendations that can lead to new work processes or guidelines, based on what the project team perceives that the company should capture and do more of and what they should prevent to be repeated. However, there is no one in charge of the process of the actual change. Therefore, the same issues may appear in the new projects. Many people therefore do not see the use in working with lessons learned as they do not lead to anything.

In the previous section accessibility was identified as a technical issue as the employees were having difficulties in getting access to the white books. However, before needing the access, the employees first need to locate the white books, which is why accessibility also is an organizational issue. Earlier we saw that there is no standardized way in working with the white books, this is also reflected in the storage of them. Currently, white books are stored on many different places and when the interviewees were asked where they would look for previous white books many did not know where to look.

In the theoretical framework we reviewed a number of master's theses that have been written on a similar subject. Some of them had been written at the case company as well and we interviewed the tutor at the case company of one of the theses. He believed that it is important to connect a new tool to existing processes at the company in order to implement it successfully.

"Connecting to existing processes, e.g. the stage-gate model, creates understanding and motivation among the employees."

A knowledge management specialist at the case company highlighted the importance of identifying where the knowledge would be created if a new tool was to be introduced. He said that the first alternative is that the project documenting the learnings builds the knowledge. Thus, through review of data and information from the producing project, knowledge is created.

An advantage with this is that as reviews are held, the project team will learn during the project which could improve the end result. The negative aspect is that it takes time. The knowledge management specialist said that this could be seen as a “push” alternative, where the knowledge is being pushed through the organization. According to basic lean theory, a push methodology can be a cause of waste and that a “pull” methodology is more time efficient. The second alternative in which knowledge can be created is more of a pull character. This means that the producing project supplies data and information and the knowledge is created by the recipient. The second alternative can be seen as more effective, however, one downside is that data and information may be seen out of its context which possibly makes it more difficult to reach correct conclusions and knowledge. Similarly, it requires more knowledge and experience by the recipient to be able to create the knowledge from the data and information from the previous projects. Another downside is the lost benefits for the project team of the producing project, if they work less with building knowledge during the project.

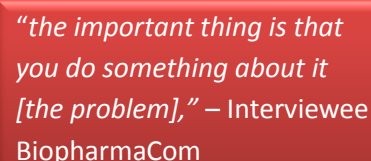
6. Inspirational Outlook on a few Different Companies

The following chapter is an inspirational outlook on seven other organizations that have been dealing with similar knowledge management issues as the case company. All the interviewed organizations are localized in Sweden and were chosen with the aim of finding organizations that could have inspirational solutions or had similar characteristics as the investigated PMO at the case company. The idea is to see what inspirational opportunities there are, both regarding the technical solution but also how they handle the issue of incorporating lessons learned into the work processes. The companies are described shortly and it is then presented how they are working with lessons learned. A reflection on this section is that some aspects of the information from the interviews may sound very good in theory but might be difficult in practice. Since we have only performed one interview at each company we have not been able to triangulate the answers. Even if we believe that the answers were given truthfully it might be wise to consider the answers as good indicators rather than absolute truths. Due to the secrecy policy of the case company, the company names have been modified to prevent a too obvious connection to the case company. For the convenience of the readers the names of the companies aim to reflect the business they are in. The companies interviewed are:

- BiopharmaCom
- AutoCom
- PharmaConsultCom
- ProdCom
- ITCom
- IPMCom
- Telecom

6.1 BiopharmaCom¹

BiopharmaCom is a biopharmaceutical company that develops, tests, manufactures and sells medicines. The company has more than 57 000 employees around the world of which around 7 000 are working in Sweden. Similar to the industry of the case company, the development of new medicines are made in project form but with the difference that these projects normally stretches for a much longer period of time, around 10-12 years. One of the reasons to this is that the industry is greatly controlled by governmental laws and regulations due to the nature of the products. A very large number of tests need to be performed both on animals and humans in order to ensure that it is safe to use. It is of interest to see how such a company handles lessons learned throughout the projects in particular due to the length of the projects. If there is no knowledge transfer during the project, no other project can benefit from the knowledge until after it is finished. As mentioned earlier, this was often the case for the PMO we investigated at the case company, where the documentation only was available after the project was finished. Two group managers at a project management office were interviewed to get information on how BiopharmaCom works with capturing and re-using lessons learned.



“the important thing is that you do something about it [the problem],” – Interviewee BiopharmaCom

¹ Interview BiopharmaCom, two Group Managers at a PMO, 2012-08-20

The fact that the pharmaceutical industry is a highly regulated business was highlighted from the beginning and was stressed throughout the interview. These regulations put high demands on the employees since they are required to document everything they do in order to be able to trace decisions, results etcetera, from the beginning to the end of the projects. **The interviewees agreed that they have a lot of product documentation that are useful but lessons learned are one thing that is hardly documented at all.** They say that they have a department that is working to improve this area by developing templates, guidelines and a common, searchable storage space for lessons learned. This area would then contain specific project knowledge since all product knowledge is already being stored. Today, the lessons learned are mainly in the minds of the employees which are supposed to be forwarded to the person in charge of the process or knowledge in the specific business area. It is then his or her responsibility to make it into for example a new work process and to share it with the group if the information is useful. When something that is not working is recognized, they make sure to identify who can fix the problem and meet this person. The interviewees highlighted the importance of actually capturing the learnings and creating an action to improve the current processes.

"We produce knowledge. The end product surely is a pill or similar, but what we, as product development unit adds is knowledge."—
Interviewee BiopharmaCom

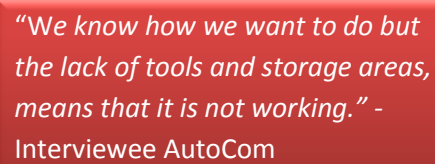
At BiopharmaCom they seem to be aware of the importance of knowledge, as sharing and being receptive of knowledge are individual goals for the employees. The interviewees further stated that their contribution to the project actually is knowledge. The management follows up that sharing of knowledge is made, which is an important fact according to the interviewees. In addition, **BiopharmaCom focuses on creating meeting places for different project teams to share experiences.** As an example, they have meetings where project managers share what they have learned during a project with other project managers. At times someone else will face a similar situation and these two can then discuss further after the meeting. This networking and creation of relations between project managers, facilitates the sharing of lessons learned. Since **sharing and being receptive of knowledge are individual goals for the employees**, the interviewees say that these meetings work well and that people in general are keen to share their knowledge. In addition, they stress the importance of relations and personal contact to spread knowledge.

Due to the long scope and duration of the projects at BiopharmaCom, the operations in the company are divided, for example into animal trials and clinical trials. Since they are divided the project team changes during the project life time, requiring hand over between the different operations. This is also demanding from a knowledge management perspective since it the new project team needs the information from the old. As written, the product knowledge is well documented but more project specific information such as lessons learned is not. Therefore, the transition between operations can be a source of error as valuable knowledge may be lost. The interviewees said that the most optimal solution is that someone follows the same project from start to finish, acting as a knowledge bearer. However, due to practical reasons this is not easy to accomplish, for example due to the length of the project, geographical location of the different operations etcetera. A similar issue might arise when an external company is used in a project. Knowledge and know-how needs to be transferred to them as well. To handle this, BiopharmaCom has people who are responsible for the relations with external companies. Meetings are being held and the relation is developed over time and again the interviewees mention the importance of a personal relation.

6.2 AutoCom¹

AutoCom is a global automotive company. The interviewee at AutoCom is a group manager at a project management office similar to that being investigated at the case company but with the difference that this PMO are working with IT-related projects rather than specific product development projects. A notable reflection from the interviewee is that he has been working 25 years as a project manager and during that time period, no project has ever gone exactly as planned. This is the reason to why it is important to be able to review earlier projects and learn from them.

In the PMO, working with lessons learned is a closing activity in every project. A project is not finished if lessons learned are not documented. There seems to be similar issues to that of the PMO at the case company, where lessons are not being documented continuously throughout the project



"We know how we want to do but the lack of tools and storage areas, means that it is not working." - Interviewee AutoCom

and the storage is an issue. The interviewee expressed that the lack of IT-tools to support the processes has been their major issue. As it is now, the management of the PMO stores the lesson learned without categorization. They do so to make sure that everyone has documented the learnings from a project, then it is stored at a SharePoint which the PMO-management has access to. It is illustrated by the quote *"the knowledge is in the head."* In practice, the lessons learned are identified in workshops with the project team. There is **focus on identifying the lessons together since one does not get all aspects otherwise**. One thing that the interviewee highlighted was that it is important to have approach to not look for scapegoats but instead together identify what has gone wrong. Two common misunderstandings are that people do not think that they have time to document lessons learned and that they do not see the use of documenting it. The documentation of lessons learned is often done at the end of the project but it is recommended to do it continuously during the project. It is important since the project can change entirely from one phase to another. Having lessons learned meetings during the project, through reflection over what has been done and its result, also makes the project team learn for the continuation of the project.

Even if the PMO lack some aspects for having a fully functional learning organization, they seem to have several ideas on the subject. An interesting reflection was that it is one thing to collect lessons learned but they need to be used as well. The idea is that lessons that have been identified should be connected to the relevant part in the line organization. For example, if a problem with the infrastructure is identified, the people working with the infrastructure need to be contacted so that they can see to it. The interviewee said that they have a model consisting of the five steps: identify, document, evaluate, store, retrieve, where the evaluate phase includes definitions of recommendations that could be valuable for future projects.

¹ Interview AutoCom, Group Manager for a Project Management Office, 2012-08-22

An example was given of a project where they worked very well with lessons learned. The project stretched for a long period of time, about four years, and they managed to have continuous meetings during the project. **Much was documented and several lessons learned were identified, however, there was a problem after the project as none of the lessons were seen to.** The identified issues were given to the steering committee for IT but no action was taken from it and no new guidelines or ways of working were developed. The interviewee concluded that someone needs to be in charge of a change if it is to be successful, preferably with support from management.

"You need to appoint someone to be responsible. If something is to be changed it needs to come from the top, the executive sponsor needs to enforce the decision. The money is in charge." - Interviewee AutoCom

6.3 PharmaConsultCom¹

A pharmaceutical consultancy firm was interviewed during the thesis. The company is keeping busy with more than 100 different active projects at a time and has 30-50 employees. Since the company is operating in the pharmaceutical business, extensive documentation is essential and all procedures and results must be documented in detail. What was interesting to find out was whether they had as extensive documentation of lessons learned. Furthermore the size of the firm in terms of active projects and number of employees as well as its project management characteristics make it a very interesting organization to look into due to its similarities with the case company department of interest.

PharmaConsultCom is, despite its main attention being within pharmacy, a very IT-focused company. In fact perhaps their perceived main competitive advantage is their IT-based journal system developed by the founders of the company. The company is rather young and the IT-structure and the processes of the company could be said to have been developed simultaneously. As a result, PharmaConsultCom has a very well integrated IT-structure that enables other processes to run smoothly. So also for their lessons learned process.

The company is currently using three different tools/work areas in their work. One server for all projects, one internal web portal and another web portal for communicating with their clients.

- On the **project server** they document everything about the projects. The folder structure is the same for all projects to make it searchable between the projects. This documentation is made continuously throughout the project. Furthermore, there is a time plan for each project in which there is a list of relevant guidelines and Standard Operating Procedures that needs to be reviewed for the project.
- On the **internal web portal** all projects are listed and the employees can see the current status of the project, when it was last updated and who made the update. In another tab one can see another list of the projects' milestones and timeframe. By clicking on the project you can see general information on who is responsible for different areas, estimated time and who is supposed to do what.

¹ Interview PharmaConsultCom, Clinical Research Associate, 2012-08-29

- The **external web portal** is designed for interacting with doctors, nurses and customers etcetera directly and project by project. There is a Q/A document for questions that arise during the project. Everyone can post a question and anyone can answer it. This is used as a base for lessons learned and is used continuously and is reviewed once a week by the project manager.

In general the systems used by the company are very visual and user-friendly. They more or less assure that the project managers have done what they are supposed to and nothing can be missed. In that sense the three different systems are very well integrated and complement each other in an impressive way. Furthermore, everyone in the company has the same access internally. However, not everyone is allowed to perform changes/updates to the documents. Changes can be made, but can be traced due to knowledge of who updated it and when.

6.4 ProdCom – a Part of the Case Company Corporation¹

ProdCom is responsible for production and development of one of the main parts of the case company corporation's products. The interviewee is a Chief Project Manager (CPM) at ProdCom and is hence responsible for the white book delivery in the projects he is running.

Generally, the white book process has been rather inadequate also at ProdCom. How they use the white books are very much up to the respective CPM. As the interviewee initiated his current project he tried a somewhat different and more active approach to white book usage. Time has been spent on finding relevant white books, and those are evaluated and if perceived useful split into a categorization of the content depending on functional area rather than what projects it belongs to. **This functional information was sent to the different project managers, who had to use the information to generate function-specific input to the risk management analysis for the overall project.** Furthermore, the personal interaction between new and previous project teams was emphasized and CPMs from two different projects were invited to share their experiences.

One of the projects identified as particularly interesting, a project in the U.S. was selected for further collaboration. The CPM introduced an initiative where everyone taking part in the new project had to contact the person with corresponding responsibilities in the U.S.-based project to exchange lesson learned. After completion, all project members had to present what they had learnt from previous project in front of rest of the group. This system generated new input for the risk analysis and as this was completed, responsibility for different risks was distributed among the project team members. Notable is that no effort is put on documenting and sharing these risk management learnings for coming projects if not asked for.

¹ Interview ProdCom, Chief Project Manager, 2012-09-03

6.5 ITCOM – a Part of the Case Company Corporation

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ITCOM is a wholly-owned subsidiary of the case corporation offering IT solutions, telematics and consulting services to a range of different industries. With over 5,000 employees spread over 35 locations around the world, ITCOM is in itself a truly global organization.

The interviewee is currently enrolled at the project support department and has been involved in all kinds of project management at ITCOM. A couple of years ago ITCOM had a similar idea as the verification PMO, to create a database aimed to improve their work with lessons learned mainly to be handled by the project management organization. At ITCOM they are following a variant of the stage-gate model of the case company, however with a greater focus on business-related project types. In accordance with this process, white books are to be written and delivered at final gate as kind of a post-project item. However, there is neither a documented way of using white books in the initial stages of a project, nor any requirements of continuous documentation throughout the project. The issues of the white books were seen as the fact that they were treated as post-project tick-off items, the quality of the white books and the lack of a structured gathering place with a well-designed search function. In addition, no specific ITCOM documentation were being stored, input was only given to the overall project white book where ITCOM only corresponds to a minority part.

ITCOM decided to develop a project database and the result was a **“quick-and-dirty”-solution** to be further refined from experiences of usage. A Team Area-based tool was created where all projects are gathered and sorted after given parameters. As one enters the Team Area database, all projects are automatically listed and sorted after date updated. One can re-order the projects by clicking one of the other parameters categories being e.g. site, project name, project manager, end customer etc. Here, there are still only reports of the finished projects that are updated. During the projects, a project catalogue, where all projects are listed along with smaller notifications such as status updates and planned activity dates, complements the database. This domino-based complement is updated at least at each gate but in general as often as once a month.

They have managed to gather all projects in the same place and making them searchable along with assuring that they are actually written for all projects. **What they still feel is missing is the actual usage of the information generated.** As mentioned, the solution was introduced with the aim of being continuously refined and improved. Some years later they note that this has not been done, and the solution is still the “quick-and-dirty”-solution as when first introduced. **The deficiencies are thought to have been the result of poor monitoring during implementation and follow-up of the database features.** Hence, ITCOM sense that they have come a few steps down the road to becoming a functional knowledge sharing project organization but still has a long way to go.

“Deficiencies often lie in the implementation. Presenting a new work practice in a PPT is not enough” – Interviewee ITCOM

¹ Interview ITCOM, Project Manager 2012-07-09

6.6 IPMCom – a Part of the Case Company Corporation¹

The IPMCom is a newly started institute for project management within the case corporation that aims to connect the different project management offices across the global organizations to share learnings and project management best practices. The institute was up and running from the 1st of January 2012 and is still in the phase of fully connecting the different PMO's to the institute.

IPMCom are currently developing a “Lessons Learned/Knowledge Management tool”, a knowledge database, intended to facilitate instant electronic global sharing of documented learnings and best practices between the PMO's. In addition, a career tool for project managers with assessments methods for the group managers to use and evaluate the work of the project managers is included as functionality in the knowledge database. The group within the product development organization responsible for *Organizational Development (OD)*, had been working with a tool of similar character from which IPMCom took its inspiration and started to develop their tool with their own interface. A pilot project of the knowledge database will be run in November 2012 and the database will hopefully be launched in the beginning of next year.

The focus of the IPMCom solution will be on what in the theoretical framework has been defined as project management knowledge that is general and can be distributed through the entire case corporation.

6.7 TeleCom²

TeleCom is a Swedish world-leading provider of telecommunications equipment and services to mobile and fixed network operators and is active in more than 180 countries. The interviewee is a former group manager of a project management office within product development at one of the TeleCom sites. The organization is of roughly the same size as the PMO at the case company main site and the organizational set-up is relatively similar.

A few years ago this TeleCom PMO experienced comparable issues as the ones identified at the targeted case company PMO. They came to the decision to perform a major re-structuring of the project management office organization, **moving away from the distinct project focus to more of a program focus**. The idea was to eliminate the discontinuity of working in temporary project teams and create consistent work teams that remains as projects come and go. At this stage, to further enhance the team consistency, they decided to terminate the strategy of mixing permanently employed with external consultants and chose to focus on having only permanent employees. As a natural result, **the employee turnover was significantly lowered and keeping the knowledge within the organization was facilitated**.

¹ Interview IPMCom, Director of IPMCom, 2012-09-05

² Interview TeleCom, former Group Manager of a Project Management Office, 2012-09-03

The program focus means that the teams are no longer taking on complete projects of the same character as before but are breaking down the product development assignments in to smaller fragments that are separately decided on whether to accept to the program month by month. The perception is that the program focus and the decision to focus on consistent teams of permanent employees have given them a more agile organization that learns and adapts more quickly than before.

In order to capture best practice updates generated in the program the TeleCom **PMO has created a project manager's forum**, a meeting that is run every third week where ideas and recommendations are lifted and discussed. Project managers are obliged to present their potential learnings in this forum and the intension is that it leads to new standard operating procedures or best practices. This is according to the group manager a very successful way of enabling for the project managers to address their findings and connect it to the right responsible person directly. Generally, this solution has been rather successfully implemented at the TeleCom PMO. However, they still experience difficulties in feeding the line organization with the acquired knowledge and, as with most new processes, they had some lead-time in fully adopting the new program focus and getting everyone on the same boat.

6.8 What Interesting Ideas have been Identified from the Different Companies?

The inspirational outlook has provided us with some useful thoughts and ideas on how companies can change their way of working with lessons learned into the better through moving in different directions. Some organizations see technical issues as their key to a successful knowledge management system while some companies seem to focus almost exclusively on organizational questions. In the end it seems however that one way or another all the interviewed companies seem to have or have had issues on both of these levels and have been experiencing difficulties in developing both of them at the same time. Table 2 below summarizes the key learnings that we want to highlight from this brief outlook into other organizations. Technical and organizational aspects have been separated even though they in many cases interfere and form issues in combination with each other.

Key Learnings from Inspirational Outlook		
Interviewed Companies	Technical Aspects	Organizational Aspects
BiopharmaCom	<ul style="list-style-type: none"> - No actual lessons learned documentation - Extensive documentation of product information 	<ul style="list-style-type: none"> - Creating meeting places for PMs to share experiences - Learning as an individual goal that is followed-up - Importance of creating an action as a result from learnings
AutoCom	<ul style="list-style-type: none"> - Know how they want to document lessons learned, lacks tools and storage areas 	<ul style="list-style-type: none"> - Post-project workshops to enable collective reflection - Success in identifying lessons learned but failure in incorporating them into the organization -> Need to connect learnings

		to higher-level decision-makers
PharmaConsultCom	<ul style="list-style-type: none"> - Well-functioning IT-structure with clearly stated what belongs where and how they are integrated - IT-structure and processes of the company developed simultaneously and suit each other - IT-solution facilitates for PMs to follow the processes. 	<ul style="list-style-type: none"> - Continuous documentation and sharing of learnings and issues, e.g. through mutual Q/A-document
ProdCom	<ul style="list-style-type: none"> - The same issues as the case company 	<ul style="list-style-type: none"> - Distribute relevant learnings to people of different functions, right information to the right people - Enables good use of competencies for interpreting documentation
ITCom	<ul style="list-style-type: none"> - Quick-and-dirty-solution enabling common storage area and search function. - Poor implementation and development of any useful tool functionality 	<ul style="list-style-type: none"> - Not really re-using the documented learnings. No process for doing so.
IPMCom	<ul style="list-style-type: none"> - Well-developed search function based on a set of given parameters - No actual data-handling functionality, only sharing of documents and excel-files 	<ul style="list-style-type: none"> - Enables knowledge sharing between PMOs in the line organization
TeleCom	<ul style="list-style-type: none"> - As a consequence of their organizational knowledge sharing strategy, hardly no lessons learned documentation 	<ul style="list-style-type: none"> - Program focus as opposed to project focus - Consistency in project teams, keeping the knowledge within the organization - Forum for project managers with aim of sharing learnings/experiences

Table 2 Key learnings from inspirational outlook

7. Analysis

In the following chapter the current situation of the case company is reviewed and analyzed with the input from the theoretical framework, the inspirational outlook and our own reasoning about it. The analysis is divided into three parts, where the first section handles issues of the current lessons learned process and reasons to why these issues appear. The second and third sections present the issues after being categorized as either technology-related or organizational. To wrap up the analysis chapter a summary of how the technical and organizational issues are interconnected and combined to answer to the main objective of the thesis and the case company. Of main concern to the case company has been the technical solution, however, due to secrecy and practicalities of this report all the technical details will not be revealed and focus is on the integration of the technical and organizational solutions.

7.1 What are the Issues with the Current Lessons Learned Process and What are the Reasons behind These Issues?

In order to identify what aspects that are missing from the current lessons learned process we will start off our analysis with the knowledge development cycle that was introduced in the theoretical framework. The categories of the model are:

- Knowledge Creation
- Knowledge Adoption
- Knowledge Distribution
- Knowledge Review and Revision

By pinpointing what issues that exist in the different steps it is easier to find solutions that address the different steps specifically. As could be seen in the theoretical framework, the phases in the knowledge development cycle overlap each other in certain aspects, which are also the reason to why several of the issues concern more than one phase.

We want to highlight that the lessons learned process at the case company will be analyzed based on the white book process of the company. More specifically, we will be looking at the process concerning the *project white book*. As seen from the interviews there is also the verification specific white book, however, since the use of this is very limited we will analyze the process for the project white book.

7.1.1 Where and How is the Knowledge Created?

Starting with the **knowledge creation**, it can be reasoned that knowledge is created in all projects to some extent. BiopharmaCom even stated that knowledge constitutes the competitive advantage for product development organizations. However, in his model Bhatt (2000) does not define what knowledge is. With the light of the wisdom hierarchy one can question if it is indeed knowledge that is created or if it is data and information. Naturally, it can be all three and while it might not seem be of great importance, the interviews showed that it is a significant part to consider when analyzing the knowledge sharing process in an organization. A knowledge

management specialist at the case company highlighted the matter of where the knowledge is created. Either it can be created by the producing or by the receiving project. Some differences are that in the first alternative, the project team of the producing project can benefit itself from the knowledge that they create from the information and data. The downside is that it can be time consuming to do so for all information and data since some parts may be irrelevant, i.e. sort of a push alternative. In the other case, the receiving project creates the knowledge from the producing project. It can be seen as more of a pull methodology but one that requires more experience and expertise from the receivers. **In the design of a new tool one would need to consider where the knowledge will be created and which alternative that would be the best for the case company.**

A number of issues can be identified in the current knowledge creation phase. The organization has a work process for lessons learned, i.e. the white books process, but this has not been working in a satisfying way. First, the information is not written in a standardized way. It is fairly specified what to include in it but how to include it is not specified. This means that there can be relevant information documented but if it is made differently, from project to project, it would be difficult to compare them. For example, if one section of the white book concerns product description, one project might write a very detailed and technical description, while another might just write about it generally. During the data collection it appeared as the project managers interviewed were well aligned when it comes to what output would be useful to receive from white books or other types of learnings documentation and yet what is actually provided differs severely. Alfredson & Söderberg (2009) referred to this as a standardization issue, which is strongly related to time the consumption limitation of the project managers. Lack of standardization of the documentation increases the time needed to locate the relevant information, given that the information exist in the first place. Project managers then have to spend time trying to find information that might not even be there since a non-standardized process enables the person in charge of the documentation to exclude or include certain information. March (1991) stated that standardization reduces variance in performance. Applying this statement on the white book procedure of the case company further implies that the quality of the white books tend to vary greatly, which is also the impression from the interviews with white book stakeholders. An additional thought is that since the information that is put into the white book is not standardized, maybe the way of working with the information is made differently as well. This might not be an issue, but it could be of interest to see if the general way of working at the PMO could be more homogenized. That would arguably make it easier for the project managers to work on other projects, for example if he or she is handed another project or if another project manager needs support. **A review of how to document the information in a standardized way is therefore needed.**

Returning to how knowledge is created, the interviews identified that the documentation of lessons learned is made differently depending on the people involved. However, one issue that seems to be frequent is that most of the documentation of the lessons learned is made at the end of the projects. Naturally, it is difficult to remember things that happened one year earlier and for some projects the time can be even longer, leading to that the quality of the information is low. **Lessons learned from projects need to be documented and reviewed more frequently.**

There also seem to be an issue of what information that is stored in the white books. By wanting to store too much information, the documentation requires more effort and time by the project managers and it is more difficult to sort out what is relevant. It is of value to review the stakeholders of the white books, who is meant to be reading them? What information does

he/she want? What background information is required to be presented? This issue seems to be somewhat hard to answer regarding the white books, but we have attempted to map the stakeholders for the project white book in *Figure 11*. The stakeholder mapping is based on the white books as they are shaped and used today. Given their poor usage, at least on the verification level, the stakeholders' relation influence/interest on the white books can be said to look something like in *Figure 11*, where only the CPM/PAMs have any real interest of significance. Important to remember is that if the white books would have been working the way they were intended, the interests are likely to have been higher.

7.1.2 For whom is the Knowledge Created in the White Book Process?

The mapping has been inspired by Expert Program Management (2010) and shows the relation between different stakeholders based on their interest and influence in the project white book. Four categories are created in order to more easily separate them and a list of the stakeholders is presented in the table below, see *Table 3*.

Stakeholder Overview	
Stakeholders	Clarification
CPM/PAM	Chief Project Manager/Project Assurance Manager, in charge of the white book
PM Current Project	The project manager in charge of the verification side of the current project
Other Commodities	Employees working on commodities other than the one of the project manager, e.g. different sections of the complete product
Other Departments	Employees working on departments other than product development, e.g. marketing and finance
PMO MGMT	The management team for the project management office at the verification department
Functionality Responsible	Person in charge of a specific functionality in the final product, e.g. durability and reliability
Other Verification PMs	Project managers of the verification department not participating in the project

Table 3: Stakeholder overview

The CPMs/PAMs are the main stakeholders of the project white books. They are the ones with the responsibility for the final publishing. As a consequence, they have both much interest and influence of what is to be included in the white books.

The Project Manager for the current project has significant influence since the PM is participating in the making of the white book. On the other hand, he or she has quite low interest since the PM already knows the content of the white book. Some aspects of the white book could be useful for the

Stakeholders – Project White Books

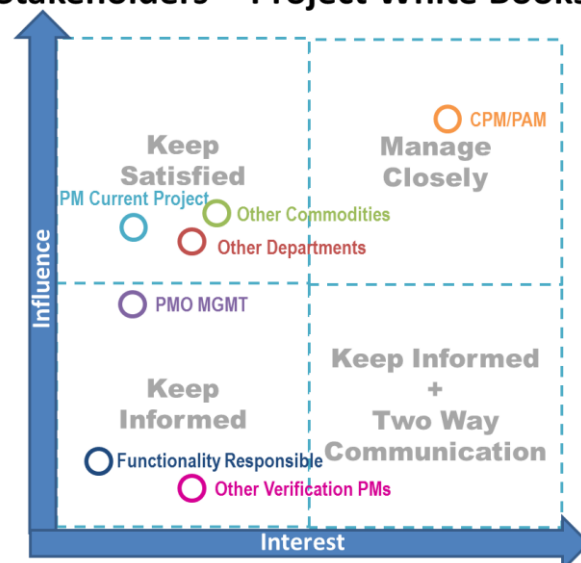


Figure 11 Stakeholders of the project white book. PM, (Inspired by Expert Program Management (2010))

for example if information could be re-used in a later project. In addition, they could be of use if lessons that are identified in the project could be used later in the same project. As of now, the white books are generally written at the end of projects which means that the information cannot be re-used during the ongoing project. Together with the fact that there is a limited amount of specific information, the interest for the PM is lowered.

Other commodities and other departments have similar influence as the PM for the current project as they also are involved in the making of the white book. The amount of interest they have in the white books would actually be quite high but due to the fact that the white books are so difficult to retrieve and get access to, the actual interest is quite low. Like the PM of the project, responsible from other commodities and departments take part in writing the white book but there are also others not taking part, which has interest in the white book. Hence, the interest is similar to that of other verification PMs and the influence is similar to that of the PM of the project.

The management team of the PMO has low interest in the white books since they never cross their table and there are little incentives for them to check on previous projects. They may have a fair amount of influence based on their involvement in the project. As an example they are part of the decision for if a project can be closed or not at the final gate in the development process. Since white book documentation is a part of the delivery for the final gate the management team should follow up if proper documentation has been made.

The functionality responsables have some influence as they take part in documenting their lessons learned with the PM. Their information is communicated to the PM who then forwards it to the CPM or PAM. The CPM or PAM then decides what information that is to be included in the white book. Often there is not much purely technical information in the white book since it might only be relevant for a small number of people. Therefore the information the functionality responsible provides risks being rationalized on the way, which is why they both have little influence and little interest in the white books.

The other verification PMs have very little influence since they do not participate in the project and the documentation of the white books. The white books would actually be of interest, however, since there is too little information that is relevant and the fact that there they are very difficult to access and locate the total interest in the white books are low.

A concluding remark of the stakeholders of the project white book is that the ones with the most interest is the CPM/PAM. Difficulties of retrieving and locating the white books are key issues that lowers the interest for other stakeholders. In addition, PM specific information is not included which also makes them to be of less interest for the PMs.

7.1.3 How is the Knowledge Being Captured in the Organization?

Moving on to the phase of **knowledge adoption**, the first conclusion is that many of the issues identified in the process are overlapping the phases. An example is that if there is poor information written in the white books there will be little incentives to adopt it. However, we have categorized some issues concerning the adoption of knowledge. The first is straightforward; if the knowledge cannot be found then it cannot be adopted. From the interviews we could see that there is a big issue of storing and retrieving white books in the

PMO. In the intended process the white books are to be stored in a web-based portal for long term storage. However, as of now the white books are stored in several different locations and there are still issues even if the white books are stored in the web-based portal. For example, they are not stored at the same place in the portal making them hard to find especially since the search function is very limited. When white books are found there is still an issue of getting access to them. Many of them are restricted for the employees even if they should be available. **A solution where all information is stored in one place, with a well-designed search function and with no access issues is therefore needed.**

A similar issue of adoption is that if people do not know that the information or knowledge exist it is very hard to adopt it. Indeed, Szulanski (1994) highlighted this as the most important barrier for knowledge sharing. Improving the awareness of the employees of the existing projects is one way to cope with the issue. However, the question is how this awareness is created. It is not feasible for the employees to keep track of all projects by head. For instance, new employees would need to spend very much time on this which can be difficult to motivate. Instead, a new tool with a good search function could be of more use. If the information and knowledge could be consolidated into such a tool the employees would not need to know that about all previous projects but could instead use filters to sort out relevant projects. **Once again the importance of a good search function is highlighted.**

7.1.4 How is the Knowledge Distributed in the Organization?

The issues identified for knowledge adoption also concern the phase of **knowledge distribution**, namely being able to access, share and re-use knowledge in the firm or in short; to transfer knowledge. Remembering the theoretical framework, Nonaka and Takeuchi (1995) distinguished between tacit and explicit knowledge. In short, explicit knowledge can be codified by documentation etcetera and can then be successfully transferred to others. The transfer of tacit knowledge however, can be supported by codification but that alone it is not enough. Imagine, for example, learning how to whistle or ride a bike by reading instructions only. The case company tried to codify their knowledge into the white books but with limited success. The white books would sometimes be very long, making it difficult to find the relevant information. One reason for this could be that they tried to capture both explicit and tacit knowledge. In order to try to capture the tacit knowledge very much documentation is needed and it is still very difficult to codify tacit knowledge so that it makes sense. Some of the interviewees said that the best way to learn from previous projects is to invite the project teams of those projects into a meeting. By doing so, both tacit and explicit knowledge can be transferred to the new project team. **However, as it works now, there is need for a new codification strategy.**

7.1.5 How is the Knowledge Re-Used in the Organization?

The final step in Bhatt's (2000) model is the **knowledge review and revision** phase in which lessons learned should to be reviewed and revised since they otherwise can be forgotten. A clear parallel can be drawn to the case company where several people stated that the learnings are put in the web-based portal for storage and then they are "dead". It clearly shows a lack of the process in the fourth phase. If lessons, which are identified in the projects, are not being taken care of there is little incentive for the people in the projects to continue to identify lessons learned. This is also indicated in the interview findings as many interviewees stated that it is

often the same issues that are brought up in for example the top and bottom experiences. **There is a need to see to that the lessons that are learned in projects are taken care of.**

Reviewing existing knowledge is important as knowledge can become out-of-date. An example is guidelines which fill a good purpose if they are relevant but can be of no use, or even counterproductive, if they do not contain the correct information. The employees would then need to draw their own conclusions from the guidelines, which would mean a much less standardized process. Additionally, experienced employees might have no difficulty with out-of-date knowledge as they know what has changed. Instead, it would be much more difficult for new employees. **There is a fair amount of employee turnover at the case company and correct guidelines would probably be of help** to integrate the new employees as smoothly as possible. This is an additional aspect of the review and revision of knowledge that could be improved for the case company.

7.1.6 Why is the White Book Process not Supporting the Creation of a Learning Organization?

After having reviewed the knowledge transfer at the case company from the view of the knowledge development cycle, several different shortcomings could be identified. Table 4 summarizes the take-aways from the white book process that need to be seen to if the knowledge sharing is to be improved.

Main Take-Aways From the Analysis of the Project White Books
In the design of a new tool one would need to <i>consider where the knowledge will be created and which alternative that would be the best for the case company</i>
A review of how to <i>document the information in a standardized way</i> is therefore needed
Lessons learned from projects need to be <i>documented and reviewed more frequently</i>
A solution where <i>all information is stored in one place</i> , with a well-designed search function and with no access issues is therefore needed
However, as it works now, there is need for a <i>new codification strategy</i>
There is a need to see to that the <i>lessons that are learned in projects are taken care of</i>
There is a fair amount of employee turnover at the case company and <i>correct guidelines</i> would probably be of help

Table 4: Main take-aways from the analysis of the project white books

The issues formulated in the table are rather wide and will be broken down and further specified later on in this analysis. What is important for the process as a whole is that these issues in turn create a negative loop for working with lessons learned. The fact that the white books are poor leads to that people do not use them, which leads to that people do not put effort in writing the white books, which leads to that the white books are still poor, and so on. A reason for this is, as mentioned, that the current white books are difficult to find and retrieve. In addition, since lessons often are not documented continuously during the project and since the content is not always relevant, lowers the incentives further for people to use them. As a consequence, people do not see the use of documenting the lessons learned as they know that the white books most likely will not be used. The documentation becomes an issue to deal with and then leave it. A parallel can be drawn to Argyris' (1991) theory of single and double loop learning. Only seeing

the white books as a tick-off item could then be compared with the single loop learning, where the organization does not really learn. Instead it becomes more of solving problems. Alfredson & Söderberg (2009) reached the same conclusion when they identified barriers for knowledge transfer. This type of short-term focus hinders the work towards a learning organization as there is little focus on identifying and fixing the root causes of the problem and rather “only” solving the immediate problem at hand (firefighting).

We have made a version of a 5-why analysis to try to summarize and illustrate the issues of the white book process in order to see the root causes behind the process. The result is shown in Figure 12 below.

5-Why analysis over the issues in the white book process

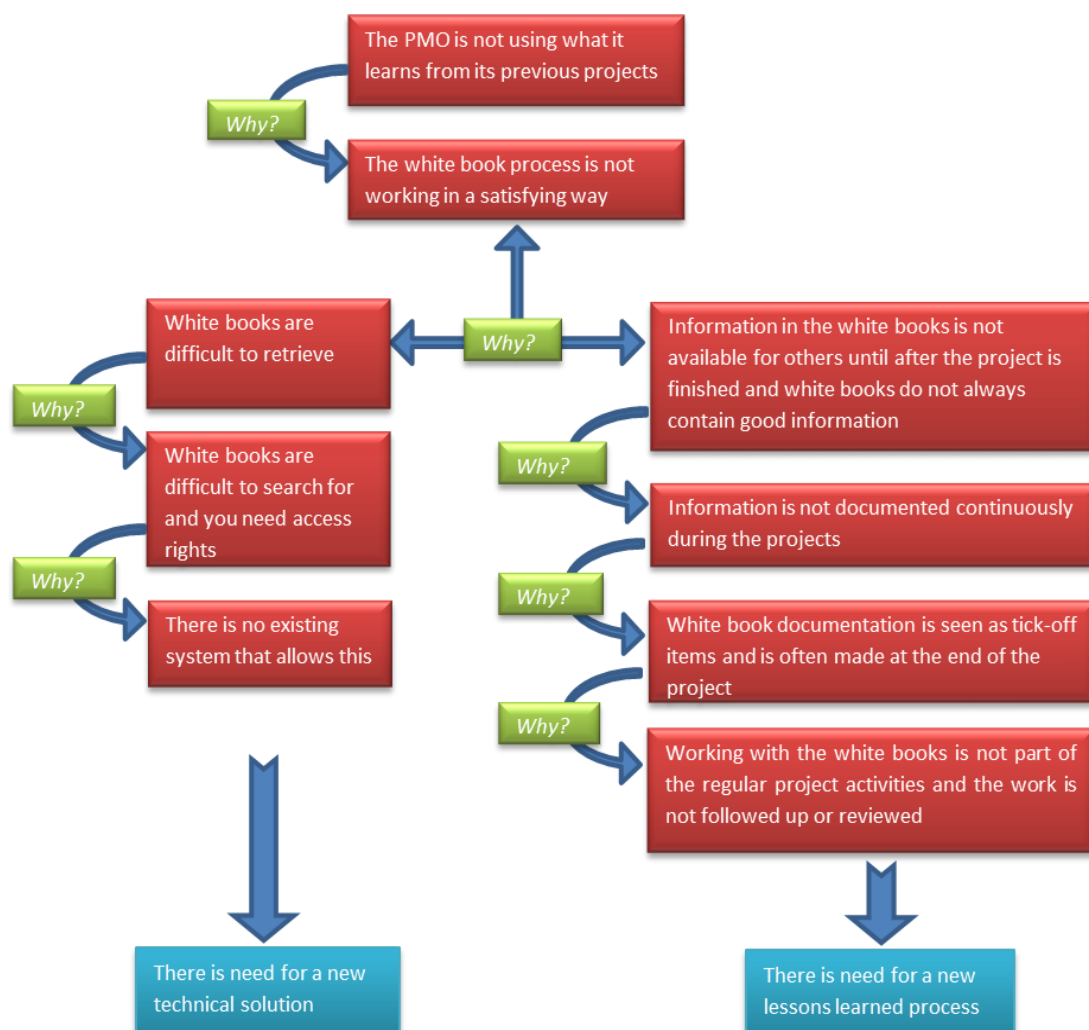


Figure 12: 5-why analysis over the white book process

From the modified 5-why analysis we have been able to identify two root causes leading to the issues with the way of working with lessons learned at the investigated PMO at the case company. First, the current system for codifying knowledge does not support PMO needs and a new tool would be useful. Second, there is a lack of processes both to include the current system in the work of the organization and to handle the personal knowledge sharing and transfer. Similar to our findings, Collison and Parcell (2004) identified people, process and technology as three key components in knowledge management. In line with their reasoning, the people are, naturally, central in any knowledge management process but, as we also have seen, they need to

be supported by both processes and technology in order for knowledge management to work. The white book process is an example of that as the people have been involved but not the right technical solutions or processes to support them.

A related idea is used by Dean and Bowen (1994) when they analyze an approach to management. Even if the approach they analyze does not concern knowledge management we believe that their idea is both interesting and relevant for this thesis. They mean that an approach to management is characterized by its *principles*, *practices* and *techniques*. We see similarities between the ideas of Dean & Bowen and Collison & Parcell as we believe that techniques and technology are related as well as processes and practices. Based on our own findings and with the support in the ideas of Dean & Bowen and Collison & Parcell, the following two chapters will therefore first analyze how a new tool could be designed and then how it could be included in the work processes. However, as Dean and Bowen highlighted, having underlying principles is also an important aspect. We will hence conclude the analysis with how a new tool and new work processes should be connected to principles of the case company and what principles that could be.

7.2 Specifying the Technical Solution

This section will discuss the features of the technical solution needed to respond to the issues presented above. Starting off with a discussion of what type of documentation tool would be beneficial, continuing with how this tool can be constituted and what kind of knowledge and data to include in order to fulfill the needs of the case company's verification PMO.

7.2.1 What Type of Technical Solution Would Be Favorable for Answering to Verification PMO Needs?

A need for a new technological solution for knowledge sharing and storage has been identified throughout the first part of the analysis. The case company is lacking standardized ways of documenting, distributing and retrieving the potential learnings generated in the development projects. First of all, having these various placements for guidelines, instructions and lessons learned etcetera complicates the process of retrieving the information for the project managers. To reduce the barrier of time consumption for the project managers, a designated location gathering all useful tools and work practices along with the lessons learned would be very beneficial. Not knowing where to look and the limited search possibilities make the barrier too difficult to cut through given the limited time frame that the PMs stand before. As emphasized by several interviewees, even though you put all your effort into finding the relevant documents you run a great risk of coming up empty-handed. Hence, PMs in many cases ask themselves: Why should I even bother?

Assuring that all useful documentation is indeed available at one spot at least partly mitigates this risk. PMs would no longer have to blindfolded look into the IT-structure of the company hoping to grab the right needle in the haystack, if anything at all. Project-specific servers, intranets, Team Areas and especially the web-based portal simply do not allow a structural search with given output saying if the documentation is there or not. It is one thing to have several types of IT-systems active in the organization, which is almost inevitable. It is another

thing not to not having designated locations for different type of documentation among these systems. Compare this case company situation to the case of PharmaConsultCom. This small consultancy firm is also using several different IT-systems but make it function flawlessly. The main difference in this aspect is that they do have designated spots for various kinds of documentation. There is no question of where to go to look for lessons learned from a specific project since there is and can only be in one place. The systems simply do not allow one to put it somewhere else. Hence, at PharmaConsultCom one could say that they have an IT-structure that enables the project managers to keep different types of documentation in one spot and thus facilitate the search ability. This is definitely worth to keep in mind when designing the lessons learned tool and process.

The interviews implied that the documentation of lessons learned is not performed in a consistent way. The white book procedure varies depending on project size, who is responsible of the final white book documentation (i.e. who the CPM is) and who is the verification project manager. What is included in terms of data and information, how the input to the final project white book is collected and in what way the outcome is presented varies despite existing templates. This indicates that the existing white book documentation can be questioned with regards to their content.

The fact that the verification specific learnings only constitute a small part of the final project white book induces the sense of irrelevance for the PMs. As previously concluded, white books therefore contain a lot of information that is not value-adding input for the verification PM's work and some that risk getting weeded out somewhere in the process of merging the white book input of different departments. Hence, comprehensive white books that are not only difficult to find and access but varies in terms of content and way of presenting the output could therefore be questioned whether they are well-adjusted for handling the lessons learned of the verification department.

Alfredson & Söderberg (2009) presented the different existing ways of performing the codified part of the knowledge sharing commonly used in industry as being the use of white books or other similar post-project reports alternatively using some kind of database. White books seem, based on the analysis up to this point, to not be very suitable for knowledge sharing with regards to verification PMO needs, which is also why this research project was initiated in the first place. However, replacing the white book process is not an option at this point though, due a centrally taken decision to use it and since the scope of this project is limited to PMO needs. Thus, a prospective technical *complementary* tool answering to those needs appears to be the beneficial alternative. Such a tool could be in the shape of a database, which is commonly used as a complement to end reports for lessons learned sharing. The database can handle large amount of information in a structured way and could give great opportunities for standardizing the way of submitting learnings. However, one must not forget that as Alfredson & Söderberg (2009) imply a database is not per se a solution to the knowledge sharing issues and thus just switching from a white book reporting system to a database solution will not be enough.

7.2.2 How Can the Technical Solution Be Constituted in Terms of Functionality?

A short reminder of the purpose of this thesis being:

“..to create a requirement specification for an IT-based tool to be used for facilitating the documentation and re-use of knowledge that can be acquired from previous and ongoing projects and to find what kind of information and data that would be necessary to include in such a tool”.

The ambition to fulfill this purpose along with the research performed lead us into discussing how a database can be constituted, to be aligned with verification requirements for lessons learned. As mentioned, only making the transition from using the traditional white book system to implementing a database solution is not likely to solve the issue if not certain aspects are thoroughly worked through. The take-aways of the white book process summarized in *Table 4* of section 7.1.6 include several aspects related to the functionality of the database. The need for a common storage area, a search function and changed access restrictions along with the demand for a new codification strategy can all be affected by the functionality development of the database. In the IPMCom example from the inspirational outlook one could deduct that they had experienced issues of this kind when developing their tool. They had created a common storage area for project management learnings and given this area a very thought-through search function. Also the new codification strategy, i.e. sharing learnings between different PMOs of the case company corporation was considered in their development of a lessons learned process. However, the issue with the IPMCom-solution from a verification perspective was that the access restrictions had been completely removed. As mentioned the verification department had an accessibility issue in terms of that it was very unlikely that PMs had access to the white books available in the web-based portal. However, completely removing the access restrictions would not be the solution since the verification specific information cannot be shared all over the case corporation.

7.2.2.1 Common Storage and Search Function

A database's capability of accepting a large amount of data and information is not at all times beneficial. The data collection showed that the current white book procedure generates large reports stored in various data storage system active in the organization as project servers, online project-specific Team Areas or the company's web-based portal. The risk of created and captured knowledge being lost in any of the systems is impendent. Given that the all the systems are lacking a well-functioning search capability further induces this risk. A prerequisite for mitigating this issue in a feasible way is to, first of all, gather all the lessons learned documentation in one common place. If a database only concerning lesson learned of the PMO is to be developed for this purpose, the content compared to existing systems will be dramatically reduced and thereby facilitating extraction of the wanted project information. However, the verification department still runs a great deal of projects and for a database solution replacing the verification white book part to be successful hence an accurate search function must be included. The importance of the search function can also be linked to what Björkegren (1999) described as time gaps between creation and usage of knowledge. This time gap combined with a rather high employee turnover leads to the probability that the PMs that are about to look for previous project of relevance were not around as these projects were closed. Thus, the PMs are not likely to even be aware of their existence and would not know what projects to search for in the existing storage interfaces. Without a well-developed search function the only feasible way of receiving this awareness from a time consumption perspective is to ask co-workers with longer on-site experience. Interviews with newer PMs showed that their willingness to do so is rather low since they do not want to disturb the experienced PMs with more questions than they are already doing and the chances of it leading to actually being

able to find the relevant project reports are still very low. In order to decrease the need of turning to experienced PMs already at this stage, a search function implementation in to a database could let the PMs identify relevant projects on their own and find the right people to talk to through that.

Implementing a database solution can facilitate a standardization of how the PMs work with lessons learned. The database can be shaped so that it only allows for the PM to add the learnings in a specific way and thus in some sense eliminate the variance in the handling of lessons learned issues among the PMs. At least concerning Bhatt's (2000) adoption and distribution phases. Standardized adoption of knowledge in terms of documenting it into the database allows assurance of what is to be included in the database, having the right information. Distribution is facilitated through the fact that this in turn enables searching on given parameters that will be possible to base the sorting of projects in the database on. Hence, the search function combined with a standardized way of submitting data and knowledge is more or less a prerequisite for knowledge distribution.

The key of the search function is that it needs to be simple and user-friendly. A modified version of the search function designed for the case company is presented below in *Figure 13*. The idea is that from a given set of parameters one could screen among the entire list of projects and receive a shortlist of matching projects. The important characteristics of the projects were identified through the interviews with the different project managers that highlighted what parameters that would decide upon relevance for projects to compare results. The easiest example is that very small projects of short duration may not benefit from comparing budgeting or planning issues with a very large long-term project. Similarly, projects focused on a certain part of the product, which is developed at e.g. one of the Asian sites where they focus on improving a certain functionality of the end product might not be interested in comparing technical testing issues with projects of completely different concerns. Hence, the search function will enable the opportunity to get very specific types of projects in a list as shown in the figure. In this example, the project names and numbers have been replaced with course names and codes from Chalmers Student Portal due to secrecy, but the principle is the same.

Search project

Submit new Project

My Projects

Project Number

Project Name

Commodity

Module

Class

Type of Project

Project Manager

Site

Feature

Search

Fill the form with wanted selections. To find a specific item you can enter part of the code or name. The search fields are not case sensitive.

Projects

1 - 20 of 119

[Next 20 »]

Click on the header to change sortorder

Project No	Project Name	Updated	Project Progress	Project Start Date	Project End Date (expected)	Project Manager
TEK300	Advanced ICM theory	20XX-XX-XX		20XX-XX-XX	20XX-XX-XX	Name
TEK295	Applied intellectual capital management	20XX-XX-XX		20XX-XX-XX	20XX-XX-XX	Name
TEKX04	Bachelor's thesis in Technology management and economics	20XX-XX-XX		20XX-XX-XX	20XX-XX-XX	Name
TEK210	Brand management	20XX-XX-XX		20XX-XX-XX	20XX-XX-XX	Name
LBT818	Business development	20XX-XX-XX		20XX-XX-XX	20XX-XX-XX	Name
TEK260	Business marketing and purchasing	20XX-XX-XX		20XX-XX-XX	20XX-XX-XX	Name
TEK050	Business planning for high-growth startups: Venture Cup	20XX-XX-XX		20XX-XX-XX	20XX-XX-XX	Name
TEK430	Change Management & Improvement Processes	20XX-XX-XX		20XX-XX-XX	20XX-XX-XX	Name
TEK140	Construction contract relationships	20XX-XX-XX		20XX-XX-XX	20XX-XX-XX	Name
TEK010	Creating new business	20XX-XX-XX		20XX-XX-XX	20XX-XX-XX	Name
TEK116	Customer Relationships	20XX-XX-XX		20XX-XX-XX	20XX-XX-XX	Name
IBS092	Decision support systems in industrial management	20XX-XX-XX		20XX-XX-XX	20XX-XX-XX	Name
TEKX01	Degree project in Technology management and economics	20XX-XX-XX		20XX-XX-XX	20XX-XX-XX	Name

Figure 13: Modified version of the search function

7.2.2.2 Efficiently Enabling both Codification and Personalization of Knowledge

So far we have come to the insight that to improve the current situation a new database would need the ability to gather lessons learned and project data in one common place. A standardized input and a search function based on relevant parameters must be in place to enable the capability to generate relevant projects. To further ensure relevance of the projects generated by the use of the search function a *project overview* would be a proper output from the database at that stage. As of now, if a list of white books can be located in the web-based portal, there is an issue of knowing what the projects of the white books actually are about as well as what information is included. Often the names of the white books might only be “white book”, which means that you have no idea of what the project is about. In the best case the white book is named the project number, however, that requires the user to know what project the project number concern. Hence, people looking for information need to open each of the documents to know if they are relevant. Since there are issues of having access to the white books to open the document one needs to request access for each document one wants to open, which complicates matters even further. Users would therefore benefit if a new tool would be able to provide an informative overview of the projects as they are generated by the search function. This project overview should provide the searching PM with general information of the project to be used for fast determination of whether the project might be useful to look into and who to contact to learn more if needed or seen as beneficial. Examples of parameters for a project overview are: project description, project scope, responsible project manager, type of project, site concerned and start- and end-date of the project etcetera. Contact persons are also of great significance in this stage. The interviewed PMs highlighted the importance of sharing the knowledge through personal interaction and in the studied literature Goffin et al (2010) as well as Johansson (2011) highlighted that personalization can be supported by codification. BiopharmaCom further stressed the importance of this as they tried to create meeting places for PMs to enable sharing experiences directly between employees. Applying this to the technical database solution induces the use of an organizational chart with a clear dividing of different responsibilities to be included in the project overview. Thus, project managers are through the database provided with means to support the personalization part of the knowledge sharing.

Enabling codification of knowledge is the main incentive of creating a lessons learned database. However, to do this one must clearly specify what information and data to include in the database to avoid ending up in the same situation as the white books, i.e. having so much information that what one is actually looking for is difficult to retrieve or have been rationalized. What learnings are then to be documented in the database? In order to answer that question, one must re-connect to the stakeholder analysis to find out who has a saying in this matter.

7.2.3 How Can the Technical Solution be Constituted in Terms of what Information to Provide as Output?

To untangle what is necessary for the database to generate one must deduct who is to use it, and whom the output will target. In the analysis of the white books a stakeholder analysis was made. The same actors naturally have interest also in the database solution. There are, however, reasons to question whether these stakeholders have the same kind of interest and influence also in the new solution due to its somewhat different scope.

7.2.3.1 For Whom should the Output be designed for?

The project white books aim to compile and document learnings from all the different parts of the project into one uniform end report. Many parts of the organization therefore want to have their saying and share their input. In order to keep the document concrete and manageable the CPM therefore must rationalize and keep the documentation on a level that is useful not only to the different departments separately. The database on the other hand, aims to summarize learnings specifically for verification PMO and do not have as wide spread of learning categories that characterize the white books. The different stakeholders involved are summarized in *Table 5* below.

Table 5: Stakeholder overview

Stakeholder Overview	
Stakeholders	Clarification
CPM/PAM	Chief Project Manager/Project Assurance Manager, in charge of the white book
PM Current Project	The project manager in charge of the verification side of the current project
Other Commodities	Employees working on commodities other than the one of the project manager, e.g. different sections of the complete product
Other Departments	Employees working on departments other than product development, e.g. marketing and finance
PMO MGMT	The management team for the project management office at the verification department
Functionality Responsible	Person in charge of a specific functionality in the final product, e.g. durability and reliability
Other Verification PMs	Project managers of the verification department not participating in the project

The CPM/PAM's interest in the database output will be lowered as compared to the white books due to their significantly lowered involvement in the documentation process and the type of information being documented in the database. The technical information regarding implications of different test procedures is not of main concern to the CPM/PAMs and thus, there will be many learnings documented that the CPM/PAMs have very little interest in and in the same way very limited possibility to influence. However, what must not be forgotten is that the CPM/PAMs interest in the white book input will not be dissolved. White book usage and their interest as mapped in the white book stakeholder analysis remains and must still be supported. In the new situation, this support is assured through a combination of a codification

Stakeholders – Lessons Learned Tool



Figure 14: Stakeholder overview - lessons learned tool

and their interest as mapped in the white book stakeholder analysis remains and must still be supported. In the new situation, this support is assured through a combination of a codification

and a personalization strategy where the PMs lean on database documentation to remember learnings that can be personally delivered to CPM/PAMs. In short, the database must provide enough documentation to, in combination with the personalization strategy, keeping the CPM/PAMs satisfied.

Additional actors that will have their interest or influence significantly lowered regarding the database documentation as compared to the project white books are the other commodities and the other departments of the organization. None of them give any direct input to the database documentation apart from their contribution to the project budget, and the outputs might be too technical for the other departments and too verification specific for the commodities. However, for estimating the other commodities' parts of the budgeting at early stages in the project the output generated from the database can act supportively and some interest will therefore remain. Moreover, learnings generated from the reflection sessions on verification level may generate valuable insights of relevance also to the other commodities. The objective will be to create a pathway for this knowledge to enable sharing between the commodities and direction of this knowledge to the concerned key persons, which will be further elaborated on in the next chapter.

The most significant and most important change will be experienced by the project managers and the management team of the verification department. As the scope of the documentation is exploited to this shift in focus, the applicability of the learnings will severely increase from a verification perspective. For the PMs, the continuous updating of the project documentation will furthermore generate opportunities for regularly intermittent reflection that allows for enhancement of the remaining project phases of the current project and not only for future projects. They can directly analyze causes of the deviations from their planning and act proactively with regards to following phases. Their influence is naturally greatly enhanced since they will be in charge of the documentation and affect exactly what learnings to be documented in the database. Along with this comes the fact that the responsibility of capturing and distributing verification learnings will lie completely on the PMs. During the interviews it was found that the motivation of dealing with lessons learned was fairly low among the PMs. This was motivated with arguments regarding time consumption but could also be deducted to their low lack of incentives and the treatment of white books as tick-off items. Increasing the usefulness through this scope shift and distribute the lessons learned responsibility to the PMs might help mitigating the knowledge sharing barrier of low motivation and lack of incentives as previously identified by Collison & Parcell (2004) and Lindkvist (2001).

From a management perspective, their possibility to assure an effective use of the documentation tool will be significantly higher than in the case of the white books. They will have full insight in what is documented and the opportunity to follow-up on PMs handling of learnings through the quick overview of the project documentation provided by the database. By looking at the progress bar, as shown in *Figure 13* above, the management team can see how much documentation that has been made for a project. If the management team knows that the project is currently in the fourth stage but has only documented for one or two stages in the company stage-gate process, the management can follow up on this and make sure that the documentation is up to date. This can be seen as one way of enabling the use of learning as an individual goal as a suggested solution to getting management involvement and incentives for PMs to document as suggested by Alfredson & Söderberg (2009) and as emphasized at the interview with BiopharmaCom. Hence, both their interest and influence in the new tool will be higher. The fact that this project started off as a management initiative further induces this.

The functionality responsables' interest in the information documented in the database is significantly higher than their interest in the white books due to the more relevant technical information and that less of the technical data is rationalized. The continuous updates of the database are also valuable for the functionality responsables during the projects, since the functionality responsables strongly influence the verification planning.

Finally, the interest of other verification PMs, not taking part in the project is a lot higher due to that the database will significantly increase the user-friendliness and assures that the PMs will actually be able to withdraw lessons learned from the database. The information available will be specified for their usage and their competencies since the PMs are to address most learnings in that way. The influence on the other hand remains low since they are still not taking part in the project or the documentation. But perhaps the most important interest catalyzer is the opportunity to receive learnings from ongoing projects and not just finished projects that might have passed the gate of interest years ago.

To sum up, the tool must be designed and implemented in order to mainly correspond to verification needs and interests and be more of a supportive data storage unit when it comes to the white book process. Verification PMs constitute both the creators and the main receivers of the knowledge and hence constitute the main stakeholders of the new database solution along with the verification management and the functionality responsables.

The scope of the verification PMO documentation is, hence, shifted from focusing on *fulfilling white book interests and only supporting the PMO's own needs* to mainly **fulfilling the PMO's own needs and supporting the white book process**. Shown in *Figure 15* below is an attempt to illustrate this shift. To keep in mind is that the illustration only shows knowledge resources that can be codified and not the aspect of personalization. Starting from the left, the blue circle shows documentable verification specific information that is generated from a project. When the project is finished the verification specific information is boiled down to a smaller amount, illustrated by the smaller orange circle. This information then becomes part of the project white book together with the information from other commodities. Thus, in the current state only the learnings that fit in to the project white book documentation will be documented and the rest will remain undocumented. As new projects are initiated they therefore only have these white-book-adapted learnings to rely on and the verification specific learnings generated from the previous project are not available in codified format. This is illustrated by the right side of the picture, where a new project tries to use the orange input to learn from a previous project. Hence white book documentation must serve the need of learning lessons for verification operations that are planned in the new project, which has proven to be insufficient.

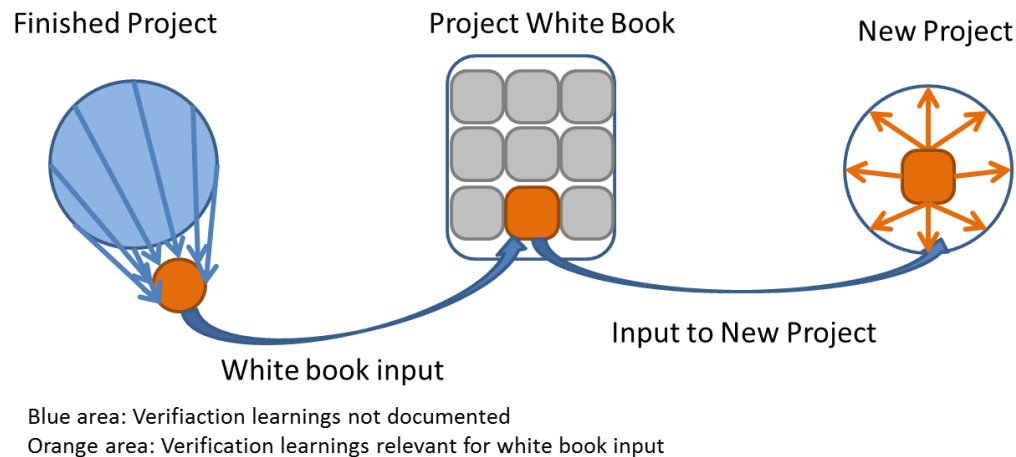


Figure 15: Transfer of in the current white book process

In the database solution the focus is shifted to documenting more of the verification specific documentation while still supporting the white book process. In *Figure 16* below we have tried to illustrate the new focus. On the left side of the picture we have an *ongoing* project (notice the difference from a *finished* project in the previous picture). With the database solution more verification specific information can be documented, continuously, and be stored in the lessons learned database. The codification in the database is aimed to document the verification learnings and use this as supportive material for the PM to bring to white book sessions with CPM and other stakeholders where this is transformed through a personalization strategy to input to the project white book. This is illustrated by the stick figure that uses information from the database to create the orange circle, which is the verification specific information inserted into the project white book. In addition, a new project can also use the database and use more information and data from older projects than before since more information and data are available, illustrated by the blue circle in the right side of the picture (notice that it is larger than the orange area in *Figure 15*). Hence the white book documentation with learnings on a complete project level will be separated from the specific learnings that are documented in the database, and in the end both of them will be available to use for new projects that are initiated.

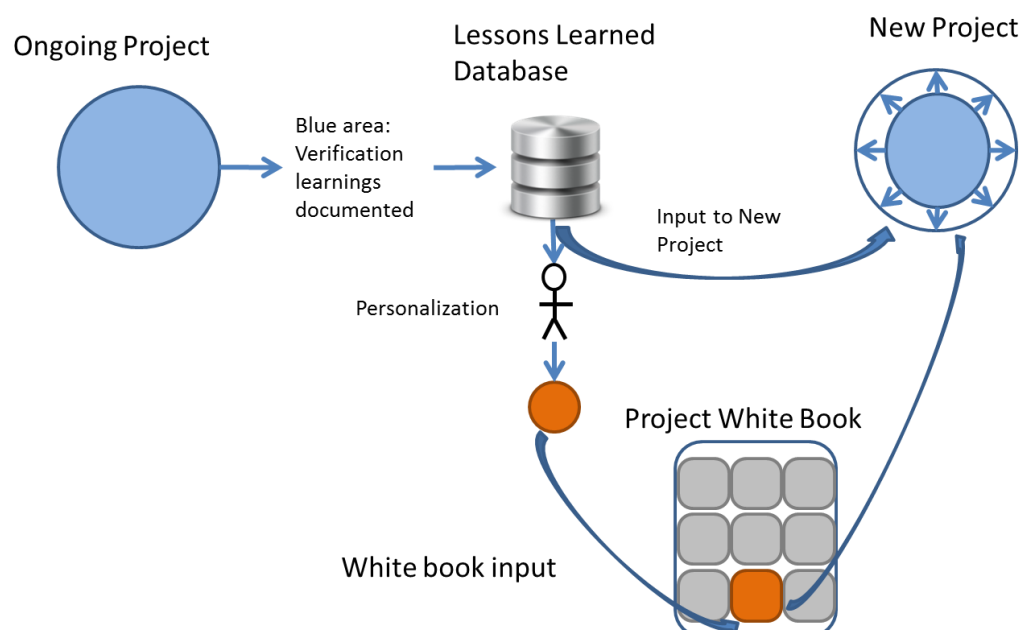


Figure 16: Transfer of information for a new lessons learned tool

7.2.3.2 What Output would these Stakeholders be Interested in and how should it be Presented?

From the stakeholder analysis of a lessons learned database we were able to identify that the stakeholders with the most interest would be the PM of the current project and other verification PMs. Hence, the database should provide output according to the preferences of these project managers. From the interviews we saw that the PMs main interest from previous projects concern information that can help in their cost estimations and planning of tests and activities, but also information on size and scope that provides an overview of the project.

Regarding the cost estimations the output could be presented in the shape of pie charts, showing the cost distribution both between different commodities and within the verification department. In addition, the budget development of previous projects could be presented graphically to provide the project manager with information on how the costs might change over time.

Information from previous projects is also useful when planning the tests needed for a new project. All projects have test plans specifying what and when tests are to be performed as well as the duration of the tests. Such information is very valuable for project managers as it can help them to estimate their own test plans. In practice, such information can be presented in an excel spreadsheet with the rows containing the tests to be performed and the columns showing the time schedule in weeks.

The third main output that PMs wanted from a lessons learned database is a project overview. As an example a short description of the project and its scope would be of use. In order to support the personalization aspect of lessons learned an organization chart over people involved would also be of much use as it would allow PMs to identify who to talk further with if needed.

This section has provided us with information on how to set up a database from a technical aspect but it still leaves the question of how this will be made practically. Even the best tool in the world would be useless if it is used the wrong way. That is why it is equally important to look at the process and how the tool will be incorporated into the organization and that is what the next section will deal with.

7.3 Improving the Lessons Learned Process and Organizational Requirements for Implementing a New Tool

Early in the work with this thesis, a knowledge management specialist at the case company underlined the importance of making sure that a new tool is integrated into the work processes. Rather than starting with specifying the technical solution he suggested that we look into how such a tool would fit into the daily work processes. Otherwise the solution will not be sustainable in the long run which is also what we have been able to identify in the previous section. Remembering the theoretical framework, authors criticizing the knowledge management ideas used so far highlighted that these ideas and methods often relied too much on technology. Malhotra (2005) stated that real knowledge is created in the way described by Nonaka and Takeuchi's (1996) Knowledge Conversion Model and not through establishing corporate libraries through the use of databases and intranets. This further emphasizes the need

for a knowledge management process that clearly defines how the organization is to capture and make use of the generated learnings. Several aspects of the white book process would be useful for PMs and employees, however, it does not really work in practice as it has failed to be fully integrated into the work processes. Several issues with the existing work process were identified in chapter 7.1 and were summarized in a table in section 7.1.6. Below we have listed the ones that concern the actual work process and they will be handled in this section.

Issues identified in section 7.1:

Lessons learned from projects need to be *documented and reviewed more frequently*

In the design of a new tool one would need to *consider where the knowledge will be created and which alternative that would be the best for the case company*

There is a need to see to that the *lessons that are learned in projects are taken care of*

Table 6 Organizational take-aways from the analysis of the project white books

The inspirational outlook on ITCOM gave us another aspect to consider when trying to implement a new tool. It said that the company integrated a solution that was “quick-and-dirty” with the essential features but with some apparent flaws. The idea was to improve the system continuously but after a few years the system had the same flaws as when it was introduced. The reasons for this were due to poor implementation and lack of follow-up. For the case company, this means that even if the initial solution is to be kept simple it needs to support upgrades. One should be able to update the outputs from a new system as the importance of these might change as testing procedures are modified. For a successful implementation, a database needs to be flexible and developed together with the work processes. If not, search parameters and outputs might become irrelevant; leading to that the tool becomes less and less useful as time goes on. Ultimately leading to that the employees see no use in the tool and stop using it.

PharmaConsultCom is a good example of an organization that dealt with the IT issue successfully, in more than just the aspect that was described earlier in the chapter. They managed to avoid the issue identified at ITCOM, i.e. having an IT-system and a process not developing in the same pace. At PharmaConsultCom their entire business was developed simultaneously with their IT-structure. Being a very young company using IT-competencies and IT-products as order winners in a pharmaceutical consultancy business let them develop their business processes as well as their lessons learned process along with their IT-systems. This seems to have been their key to success from several aspects. What separates them from the other interviewed organizations is that they have an IT-structure that is flexible and adapted after their processes, but the processes are also regulated by the IT-structure. The relation between the process and IT is that they are to be flexible and adaptable to each other and mutually developed. Not separately developed where companies then hope to create one to match the other, as the case seems to have been in all the other investigated companies. We believe that this might be a success factor also to the case company. Integrating the process and the tool into each other and assuring this continuous simultaneous development should give them good prerequisites for a successful implementation.

Before moving on to more practical aspects of how to incorporate a new tool into the organization let us take a step back and look at the issue from a wider perspective. We start by recollecting the ideas of Dean and Bowen (1994) and more specifically their thoughts that a management approach is governed by its *principles, practices and techniques*. Starting on the

highest level, let us be reminded that the overall principle is to improve the product development process by better using knowledge management ideas. The practice, i.e. how is it made, is by using lesson learned from previous and ongoing projects. We have already looked into the technique part, as we discussed that a new technical solution is needed, i.e. a new lessons learned tool. In the previous section we discussed how a new tool could be constituted and the next step is to look at how the technique can be connected to the practices or processes.

We can use ideas from lean product development, presented in the theoretical framework, to analyze the differences between the current process and a new process that we suggest. In lean product development one makes a distinction between the knowledge value stream and product value stream. The idea is that the product value stream feeds back new knowledge and practice into the organization as the project proceeds. The organization learns and when the next project starts the project team can hopefully save time by not repeating mistakes and getting a head start. An issue with the current process is that the white books are only available for others after a project is finished. As some projects stretch over several years it means that new knowledge cannot be accessed until the project is finished. A similar project could therefore already have started without the ability to use the knowledge from the previous project. In addition, the knowledge or information risks getting out of date if it is not brought back to the organization in time. To keep in mind is that the goal is to improve the product development process in general which is why the knowledge needs to be brought back into the organization from the projects. We have tried to illustrate how the PMO department could work by modifying the image of knowledge and product value stream from the lean product development methodology to suit the case company, see *Figure 17*. The arrow pointing up and to the right shows how the knowledge value stream is meant to be moving forward as new knowledge is feed back into the organization from the projects. The horizontal lines represent the product value stream, in our case; different product development projects. This picture differs from the original one as we have replaced the previous horizontal arrows with the stage-gate model of the case company. As we have stated, there have been a lack of feedback during the projects and we want to illustrate how knowledge can continuously be brought back into the organization. In the picture we have shown this by arrows going back and forth between the product value stream, i.e. a project, and the knowledge value stream, i.e. the organization. This is where a new lessons learned database comes in. A database would create an area for projects to store data, information and knowledge coming from projects, which would also be accessible for new projects. The ideas can be related to the ones of Dean and Bowen (1994) as the technique, i.e. the new tool, is incorporated into the work practice, i.e. the company stage-gate, which then supports the overall principle, i.e. to improve the product development process by better use of knowledge management ideas.

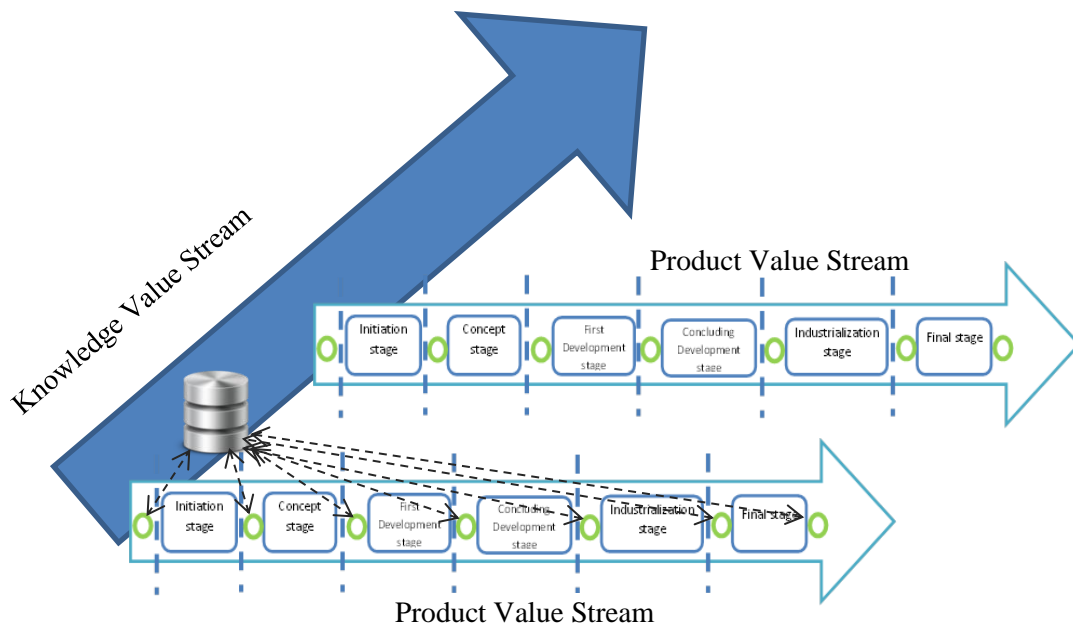


Figure 17: Knowledge and Product Value Streams at the Case Company

Moving on, we need to further specify how a new solution will be better at returning and incorporating new knowledge into the organization. At the same time the solution needs to become a part of the work processes for the PMs. How these two issues are handled is described in the following sections.

7.3.1 How Can the Tool be Incorporated into Project Managers' Regular Activities?

From the interviews at the case company we have been able to identify that the white books are seen as a tick-off item for many PMs. We have discussed reasons for this earlier in the analysis and one conclusion was that PMs do not set aside time for this in their budget. Due to the high demand of delivering the project on time, the activity of documenting for the white book gets delayed to until after the project finishes. As written in the theoretical framework, project managers need to manage the three different constraints: time, scope and cost, in their work. Therefore, if no time is set aside for working with the documentation for the white book it is not performed. When implementing a new tool these constraints need to be taken into account meaning that time and budget need to be allocated for the activity of working with lessons learned.

An issue identified with the white book process was that the information is only available after the project is finished. A new tool would therefore need to allow other verification PMs to get information on projects that are currently ongoing. In turn, it means that the responsible PM for the project needs to regularly update the new tool with information and knowledge from the project. It is for this reason that time needs to be allocated for this activity as the project proceeds. The following image gives a suggestion of how the tool can be integrate into the different phases of a project, see *Figure 18*.

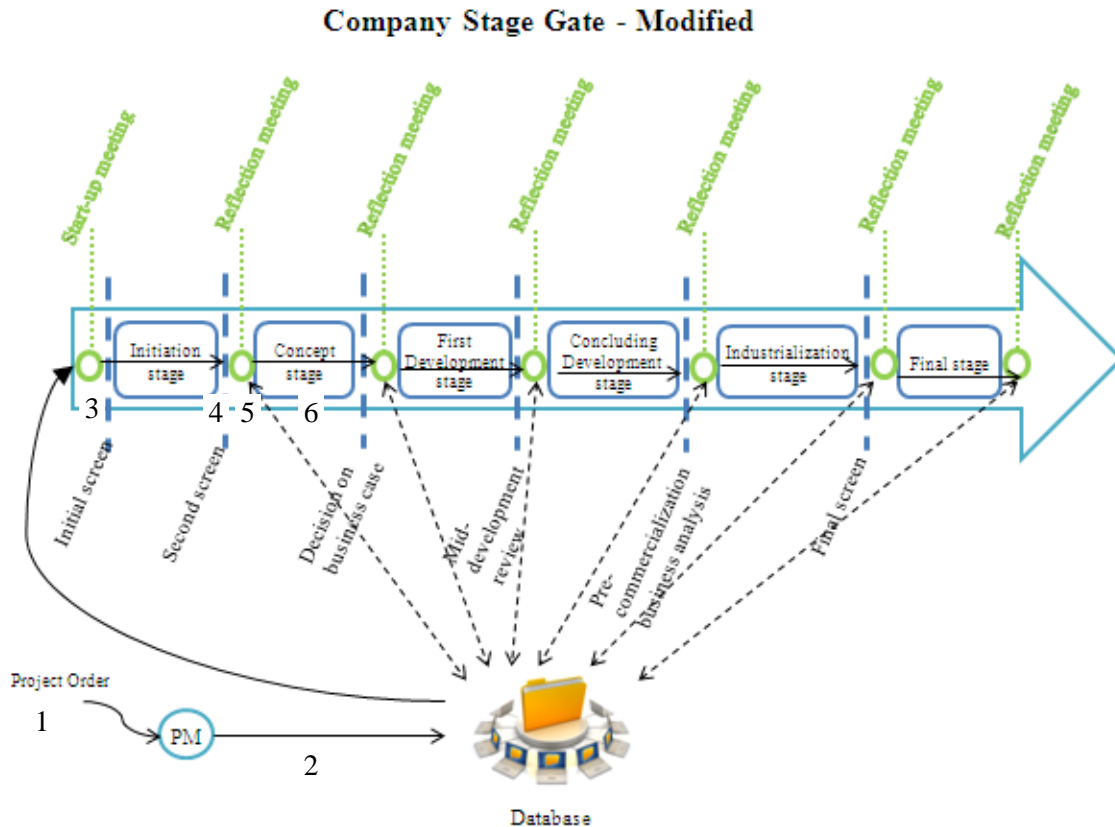


Figure 18: Company stage-gate modified

The image is based on the stage-gate model for the company the different steps are specified in the list below:

1. The process starts in the bottom left corner as an order for a new project is received by the PMO which appoints a responsible PM.
2. The PM starts by going to the database to perform two tasks:
 - a. First, create a new project in the database, filling in the information that is available at the time such as scope of the project, people involved etcetera.
 - b. Second, look for previous projects that could provide useful information for both the PM or others in the project team
3. The next step is a start-up meeting for the project with the project team. As the PM already has information from previous projects he or she can distribute this information to the project team to facilitate the planning phase.
4. With the support of the information the project's first stage is carried out until the second gate is reached. If the project has reached its deliverables it passes the gate.
5. Soon after the gate the project team is gathered in a reflection meeting. The aim is to collectively review the work during the previous stage and to compile certain key information and then update the database with the new information. More specific information on how the reflection meetings are performed is given in the next section. In addition to adding information to the database the PM can also get information from earlier projects preparing for the next gate.
6. The same idea applies for the following stages where collective reflection meetings enables the project team to learn during the project while information is being both inserted and extracted from the lessons learned database.

7.3.2 What Does this Mean for Project Managers in Practice?

The incorporation of the database tool into the work practices of the project managers suggests that input to the database is to be generated continuously, with gates as clearly specified checkpoints. What is further important is to specify how this is to be done. In one way the structure of the database itself tells how to document and what kind of information that should be documented. What it does not tell is how this information, data and reflections are to be gathered. Of course, the PMs day-to-day work is perhaps the main source of information, data and figures as they put the testing plans and the verification budget together in the end. However, the idea is not that the PM should be sitting alone at his computer documenting learnings solely based on his own perceptions and experiences from the project. In contrary, and as in the intended way of working with white books, learnings to be captured should be created from a joint effort in reflecting upon why the results look like they do, what could have been done differently and not least what went particularly well and should be kept. This is also to be connected to the stage-gate-based development process of the organization. As learnings are to be fed into the database as the project passes a gate, reflection meetings with all project participants on verification level should therefore be held with the same frequency. Boud et al (2006) expresses his definition of productive reflection, highlighting the importance of reflection being the combined effort of the entire workforce, below:

“The creation of contextualized workplace learning that allows and releases the capacity of the workforce, via de-centralized and flexible project groups, the use of multi-functional networks and multiple stakeholder perspectives”

In the case company, these de-centralized, flexible project groups that Boud et al (2006) mentions, are present. Through implementing intermittent reflection setups the organization can use the competence of the combined verification work force to interpret their results and their deviations from plans and estimations and in collaboration create the learnings to be documented in the database and thereby distributed to other parts of the organization. By doing this, the joint competence of the verification personnel, each representing functions that will be future stakeholders of the documentation is applied already in the knowledge creation and adoption phases.

If possible, to some extent, to document the reasoning from these reflection meetings about the obtained results up to the point of documentation would partially allow the learnings to be categorized as *knowledge* created by the project team. Relating back to the wisdom hierarchy from Rowley (2007), the reflection meetings serve the purpose of using data and information, and by applying the competencies and experiences of the participants analyzing the causes of the retrieved result. Thus, some of the transformation from pure information and data can be done by the documenting project team and reflection is a key process of achieving this. As Boud et al (2006) further expressed it:

“Reflection is a key human mechanism in understanding our experience and drawing lessons from it.”

An important effect of reflecting upon past experiences and results continuously during the project lifetime is furthermore that the learnings can be applied already in the coming phases of the current project. Testing procedures and plans can be updated and budget estimations may be more precise through pro-actively judging what issues might arise and their effects. Through

this, project managers and the rest of the project team can also gain benefits from reflecting and documenting learnings, and not only future projects get to use the benefits of the created learnings. As stated in the theoretical framework by Alfredson & Söderberg (2009) and Lindkvist (2001) lack of incentives for the documenter is a strong barrier for knowledge sharing. Creating this possibility for the project teams to benefit also within the project can significantly contribute to mitigating this barrier. Currently, in the case company this benefit cannot be realized, given the fact that the white books have been more or less treated as a post-project activity to be done as the project reaches the final gate, with or without reflection sessions being held in association with this. Re-defining the continuity of the reflection sessions and instant re-usage of the learnings allows for creating the incentive needed for the PMs to realize the benefits of documentation.

However, transforming all the information and data into knowledge already at this stage is very time consuming and might neither be feasible nor necessary for all types of output for all projects. First of all, not all knowledge is viable to document even with the combination of figures, analyses and comments on causes etcetera, such as Nonaka and Takeuchi's definition of tacit knowledge. Secondly, not all the information and data must necessarily be transformed into knowledge. The transformation might be a rather time-consuming process and trying to do this for all learnings might be a waste of time and could be categorized as a type of 'push'-methodology. A preferable situation would be that it is the requestor of the project knowledge from the new project that 'pulls' this knowledge out of the previous project organization so that time is spent only on analyzing the learnings of interest. However, the earlier described time gaps between related projects may somewhat impede complete implementation of such a strategy. During the interviews a knowledge management specialist highlighted the significance in defining *who* the creator of the knowledge is, i.e. who is performing the interpretations and analyses of the information and data to enable applying it as knowledge. The reasoning above implies that the creators of the documentation stand for some of the knowledge creation, while some information and data will be left for interpretation by the new project team. In the latter case, it is up to the new project team to rely on their combined competencies and experiences to process the given data and information and transform it into usable knowledge for their own planning and estimation procedures. Different roles within the new project teams possess knowledge within different areas, and to be able to utilize this, the project manager will have a key role. As he or she will be the only one directly communicating with the database it will be his or her task to connect the learnings to the right people with the right competence to fully enable this part of the knowledge creation. In this way, the process of transforming the codified (explicit) knowledge provided by previous teams, into individual knowledge of the project team members, by Nonaka and Takeuchi described as internalization, can be performed efficiently with regards to the organizational prerequisites that are present. A beneficial spillover effect of that the PMs are the only ones in direct contact with the database is that the accessibility and secrecy issues can be dissolved. All project managers can have the same access rights and thus, the restriction need is eliminated.

When having this combined strategy for knowledge creation, where creating project team is responsible for some of the knowledge creation and the receiving team has their own part of it, naturally there will be gaps appearing. This is where the combination of a codification and a personalization strategy for knowledge transferring steps in to the work practice. In the case of ProdCom, they managed to efficiently make use of these competencies within the project organization and distribute the responsibility of adopting learnings from previous projects accordingly. The encouragement from the project management to establish contact with

employees with the same roles from previous projects was perceived as particularly valuable. Through this strategy the chief project manager felt that a combinatory model of codification and personalization strategies were the beneficial choice efficient distribution and re-usage of the lessons learned. In this way, a ‘pull’ approach was emphasized and knowledge was not created only for the sake of it. The right information and learnings were retrieved, and also at the right time. One could say that this case in particular, bridged the gaps of time and competencies between the two projects efficiently. Remaining was the place gaps, but the personal one-on-one connection between the project groups facilitated also this factor.

This ProdCom example of how to connect the different project teams would be applicable also for the investigated PMO organization. It can be categorized as a way of creating communities of practice as Wenger et al (2002) described. Establishing communities of practice is essential for the personalization part of the knowledge sharing, and hence also fundamental for the transformation of data and information into knowledge. ProdCom created virtual communities of practices through enabling an establishment of connection between the different roles.

Another one of the investigated cases where communities of practices had been successfully implemented was BiopharmaCom. The nature of this business demands for extensive documentation due to its regulations, and yet this is not enough. They have lifted the issue of creating communities of practice for a long time, and managed to create a forum for initiation of this. Learnings from the projects are brought up in project management meetings of the department and hence, an awareness of project issues in other projects is generated. The aim here was to connect people and facilitate for personalized knowledge transfer, which is not very different from the aim of the organizational chart of the project overview as discussed in the previous section. Through combining the two, good prerequisites for connecting projects of relevance to each other to share experiences are created. It is feasible to say that the creation of communities of practice is a mean for personalized knowledge capturing and sharing to be supported by the developed codification strategy. For the case company, we see a possibility to create such a meeting place between project managers as they have semi-weekly coordination meetings. These could be further utilized for sharing experiences in between project managers of the case company department.

7.3.3 How Can the Organization Use the Lessons Learned?

The previous sections describe how a new tool could be integrated in the work of a PM. However, they do not describe how the lessons that are identified are being incorporated into the organization, which was highlighted as important in the lean product development methodology. In addition to how lessons learned can be included in the stage-gate model for the specific PMs, *Figure 19* shows how the lessons that are identified can be returned into the organization.

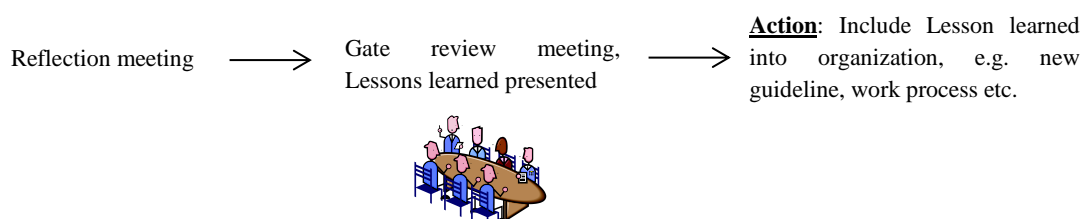


Figure 19 Incorporating the lessons learned into the organization

The idea with the reflection meetings is to make the project team identify lessons learned from the project. These lessons can directly benefit the project team as they learn for the next stage but also important is that they can be fed back into the organization. The idea is that lessons are presented at the review for each gate, lifting issues or better ways of working identified in the work process. Only lifting the issues are not enough, however, the issues need to lead to an action where for example a lesson is turned into a new guideline/work process or a process is changed. This would help enable the learnings to be spread on an organizational level rather than just on an individual level. In order to verify that the lessons are being taken care of the work needs to be followed up. Therefore a person should be appointed as responsible for each specific lesson that is of use. As these meetings are held regularly, each week, there could be a follow-up item to report back to the meeting in three weeks for example. Recalling the ideas of Argyris (1991) the case company could then move from a single-loop to a double-loop learning. Instead of making a short-term solution within the project, the organization can deal with the root cause, moving the knowledge value stream forward.

A challenge that can be identified with this way of working is that the projects can differ much in size and scope. For a large project it might take up to a year between gate reviews and reflection meetings should then be held more often. On the other side of the scale, some projects can be very short and have a limited budget, why it might not be economically feasible to have that many reflection meetings. How often reflection meetings should be held would therefore need to depend on the type of project.

AutoCom highlighted the difficulty of taking a lesson from the project team in to the organization. In their case they had performed a project with a good result and good documentation of lessons learned. These were presented for a steering committee but no action was taken after that. The result was that the project team learnt much from the project but not the organization. The fact is highlighted in the quote: *“You need to appoint someone to be responsible for turning the learning into something useful”*. To successfully capture a learning it seems that three key points can be identified as necessary;

- First, that there is a person in charge of the action.
- Second, that it is the right person in charge of the action. The person in charge of the action needs to have the mandate to perform a change otherwise the lesson learned will have no effect.
- Third, that there is a follow up for the actions that are to be taken.

To reconnect with the ideas mentioned in the end of 7.1, we have identified a technique in the new tool, a practice in the new work process but as Dean and Bowen (1994) said; underlying principles are the foundation for a learning organization. Which for the case company means; to improve their product development process by better using the lessons learned from previous and ongoing projects and thereby avoid repeating mistakes and unnecessary duplication of work.

8. Conclusion

At the beginning of the thesis we could see that knowledge has been identified as one of the most important assets of industrial companies. Yet, developing and keeping the knowledge within the organization has proved to be a challenge for many companies, a fact that we also have been able to conclude after looking at the case company and the other companies in the inspirational outlook. The project management office at the case company has experienced such difficulties as they felt that they were not able to use lessons learned from previous and ongoing projects. Looking back on chapter 2, the aim of the thesis was:

”To investigate how the organization could become more effective in its organization of the product development, i.e. using less time while at the same time lowering costs, through learning from previous and ongoing projects and prevent duplication of non-value-adding work.”

We broke down the aim into three research questions in order to make it more manageable. These were:

1. What are the reasons for that the white book process is not generating the learnings that it could if fully utilized?
2. What is missing in the current documentation and what information and data would be valuable when initiating a new project?
3. If a new IT-based tool would be recommended, what are the prerequisites for such a tool to be of value for the project management office?

We have reasoned around each of the questions and we will summarize our findings and analysis based on the different research questions. Starting off with the first research question, we have been able to identify a number of issues with the current white book process that lead to the fact that the white book process is not generating the learnings that it could. In short, we found that:

- White books are not written continuously or sufficiently frequent
- The quality of the contents of the white books varies much
- White books are not stored in a common place
- White books are difficult to retrieve due to issues with access
- There are no incentives to make good white books

What is important for the process as a whole is that these issues in turn create a negative loop for working with lessons learned. The fact that the white books are poor leads to that people don't use them, which leads to that people do not put effort in writing the white books, which leads to that the white books are still poor, and so on. Looking at the white book process as a whole, one could say that the interests of the verification users are not ideally reflected neither in the content of the documentation nor in the intended use.

Moving on to the second research question, the above aspects are evidently missing in the current way of documenting. In addition, we conclude that from the perspective of the PMO, the current process is focusing on *fulfilling the white book interests and only supporting the needs of the PMO*. Instead we mean that a new solution *should fulfill the needs of the PMO while at the same time support the white book process*. As a consequence, the interest of the PMO has been mapped in order to specify what information and data that would be valuable for them.

The information from earlier projects that would be of use for the project managers can be summarized into the three areas: cost estimations of verification activities, the planning of tests and activities – in terms of which to perform, when to perform them and their duration and costs – and providing a project overview.

Regarding the third research question we can conclude that if a new IT-based tool is to be recommended, it needs to be supported by and integrated into the work processes. For the case company, it means that the work with a new tool is integrated into the regular project activities, i.e. the stage-gate model of the case company. However, that alone is not enough. We have seen that the process and the technology should be developed simultaneously as time goes on in order to create a solution that is sustainable. Otherwise, they will eventually grow apart and no longer fit each other. Indeed, from the inspirational outlook we saw that the company that was the most successful had been able to do just that; developing the technology at the same time as the process. On a higher level, knowledge that is created in the projects needs to be fed back into the organization in order for it to be available for others. By using the ideas from lean product development we saw how the product value stream could work to move the knowledge value stream forward. The same idea is applicable for the case company as the projects need to have an exchange with the permanent organization.

To conclude this section, we have seen that being able to successfully create, adopt, distribute and review & revise knowledge is far from easy. Companies may succeed in some aspects but often not in all stages. One way for companies to improve is to make sure that they have well thought-through ideas for connecting their principles to their practices with the support of technology. As it is likely that knowledge will remain one of the main assets for industrial companies, this topic will continue to be important. Spending time and effort on improving the management and transfer of knowledge should therefore be seen as an investment with potentially high returns.

9. Discussion

Knowledge management issues are far from new in product development organizations. Project-oriented organizations of this kind have rather been experiencing these issues for a long time, consciously or not. As the industries are internationalized, competition strengthened and thus low-cost alternatives are arising, companies seem to more and more acknowledge the importance of knowledge sharing within the organization.

Looking back at the companies interviewed during this thesis, they have all been experiencing knowledge sharing issues at some stage. They have all been at the current stage of the case company, i.e. facing a turning point where they have taken a step back and said that they need to do something about their knowledge sharing strategy. What has been interesting to see is that no matter how far they have come since then, they still seem to have major issues in common with each other and the case company. The main reason for this can surely be deducted to that the project-orientation and product development nature of several of the companies have greater impact on the organizations in this matter than what type of business they are in and what product they are developing. Another reason is that almost none of the interviewed companies have actually managed to eliminate that many of the issues that they experienced but are rather still dragging these issues around. They all seem to have been rather aware of knowledge management methods and ideas but have had difficulties in adopting and implementing them into the organization.

What we believe to be the cause of these organizations not being able to fully create a knowledge sharing strategy that works on most levels, is failure in integrating the lessons learned processes and the IT-tool to handle the data and information. Some of the organizations have managed to create rather useful documentation tools but have not been able to utilize it in the right way, and actually use the documentation to learn from it. In contrary, others have been developing impressive practices for capturing lessons learned and connecting project managers to each other for knowledge sharing processes but have not yet managed to assure that such learnings are documented. Such organizations thus still risk losing that knowledge if staff turnover is not minimized or at least kept low.

On the other hand, employee turnover is indeed possible to lower. As in the TeleCom case, they actively assured to keep a higher amount of permanent employees and removed the inconsistent project teams through moving towards a program focus and replacing consultants with permanents. By doing that the knowledge remains in the company as long as nothing changes in that strategy and as long as the employees want to stay. Such a decision, to move away from a project focus to a program focus could in the long run perhaps be beneficial also for the case company. Important to keep in mind though, is that such a decision is of significantly higher strategic importance and could only come from a higher management initiative and is thus not very reasonable to recommend in the shorter term.

The interviewed organizations have tended to, if not fail then at least not entirely succeeding, in either the organizational or the technical aspects of their knowledge sharing strategy. We think it is fair to say that most of them seem to have failed in the integration between those two important ingredients of fruitful knowledge management. As analyzed, principles (what one wants to achieve), practices (how one is to achieve it) and techniques (with the help of what means) need to be very well integrated to ensure success from a general management approach.

Applying this into a knowledge management perspective one must assure that the lessons learned are actually adopted by the organization and contribute to improving the product development process, hence assuring that the principles are met. In order to achieve that, it must be clearly specified how this is to be done through a well-built knowledge sharing process that is simultaneously developed with the tools needed to provide supportive documentation of learnings. We saw an example of PharmaConsultCom who succeeded in this manner. However, one must remember that they had very beneficial prerequisites in terms of the size and the IT-character of the company along with the habit of performing extensive documentation due to the pharmaceutical requirements. In their case, the entire business process and IT-structure was developed simultaneously as the business grew and changed. In large corporations as the case company this might not be completely feasible. However, when limited to a small fractional part of the corporation, one could create a knowledge sharing process and an IT-tool simultaneously and assure mutual adaptations to enable fulfillment of the principles.

One could certainly discuss whether it is optimal for the corporation as a whole or if it is sub-optimization to create an additional IT-system for the organization, as there are already a sense that there are too many. If time and scope had been significantly larger, it might have been beneficial to create a new large system for the entire corporation from an IT-point-of-view. On the other hand, identifying and fulfilling the documentation requirements of all parts of the corporation would be extremely difficult. The risk of ending up in a situation not very unlike the one of the white books, i.e. that the documenting departments tend to aim at fulfilling the white book needs while only supporting their own, would be severe. Hence, in corporations of this size, it is likely to be beneficial to assure fulfillment of department-specific learning than to try to centralize the lessons learned process to get a documentation structure that is synchronized over the entire corporation.

Some issues have been discussed in different sections of the thesis regarding the difference between individual and organizational learning. The realization that, a situation where the individuals of the organization learn and possess the knowledge is neither necessarily beneficial nor at all times disadvantageous has been a key finding. Traditional Knowledge management literature highlighted the importance of feeding the organization with the learnings generated by the individuals and the project teams, mainly through the use of various documentation systems. Looking at the Knowledge Development Cycle as described by Bhatt (2000) we would claim that the knowledge management concept seem to be generally focused at the adoption and distribution phases but not that much in the creation or the review & revision phases. Organizational knowledge literature and ideas seem to be mainly focused on the creation and distribution of knowledge and the conversion from tacit knowledge of some individuals to knowledge of others. Combining the two in some way separated views on knowledge sharing and how it is to be done gives what we feel is a rather holistic view of how knowledge can be created, adopted and distributed. What is not as emphasized is the actual usage of the knowledge. A lot of opinions on how to create prerequisites for reusing the generated knowledge is discussed, however, what is not really touched upon within the scope of this thesis or in the studied literature is how to define usage of knowledge and how to show what is re-used and not. We believe that this would need to be further elaborated on. One part of it is of course to assure that the first steps have actually generated something useful, but straightforward recommendations on how one is to re-use it would be valuable in many cases. And last but not least, being able to *show* what knowledge that has been re-used would be treasured from many aspects. This could credit the documenting team or individual as well as be used for motivating further investments in knowledge management initiatives through demonstrating the return.

10. Recommendations for the Case Company

As conclusions answering the research questions have been drawn and a brief discussion on the generality of the conclusions has been held the final chapter of the thesis will now present the specific recommendations that have been given the case company. A complete technical specification has been delivered to the case company saying exactly what functionality the database should have in terms of data handling and transformation. Due to the very technical nature of the complete specification and secrecy issues, this specification will not be presented here. Instead recommendations on the capabilities of the database, process and their interrelation will be in focus.

In general, the following take-aways in *Table 7* must be considered when designing and implementing a new technical solution to support the knowledge sharing process.

Technical Take-aways to Consider

A review of how to *document the information in a standardized way* is therefore needed

A solution where *all information is stored in one place*, with a well-designed search function and with no access issues is therefore needed

However, as it works now, there is need for a *new codification strategy*

Table 7: Technical take-aways from the analysis of the project white books

A database, based on the requirement specification delivered to the case company, should be constructed to deal with these issues in the following manner:

- The database is to be constructed for verification PMO documentation and usage of lessons learned from projects only, initially. Hence, a common storage area without any accessibility restrictions can be created.
- A user-friendly search-function based on a set of given parameters such as project size, commodity focus and the type of projects is to be included as the starting functionality of the database and hence enable fast search ability for projects of relevance.
- A standardized way of submitting the input to the database will significantly reduce variance in data quality and handling as well as the time for finding the information and key data that is actually useful and generate value for the PMs. This will be enabled in the database through the use of dropdown lists, figures and number fields and less free form text fields will be included.
- The key of the new codification strategy is that information and data will be documented with the aim of fulfilling PMO needs and supporting documentation of the needs of the remaining white book stakeholders. This is done through, from a verification perspective, ending the actual writing of white books and leaving that completely to the CPMs. However the new codification strategy, documenting almost only verification specific learnings are, in combination with personalization giving input to the project white book process directly to the CPM/PAM.

The following take-aways in *Table 8* must be considered when designing and implementing a new knowledge sharing process.

Organizational Take-aways to Consider
In the design of a new tool one would need to <i>consider where the knowledge will be created and which alternative that would be the best for the case company</i>
Lessons learned from projects need to be <i>documented and reviewed more frequently</i>
There is a need to see to that the <i>lessons that are learned in projects are taken care of</i>
There is a fair amount of employee turnover at the case company and <i>correct guidelines</i> would probably be of help
Table 8: Organizational take-aways of the analysis of the project white books

- Considering where the knowledge is created comprises knowing where to create what type of knowledge and how this is documented. The idea is that the PMs then could be able to rely on the competencies of the receiver to interpret the learnings in a proper way. Hence, we recommend that both creator and receiver use their knowledge to try to create interpretable knowledge mainly for the most prominent results of the output.
- The documentation and review frequency is supposed to be mainly adjusted by the developed knowledge sharing process based on the case company stage-gate model. As indicated in *Figure 17* (Company Stage-Gate – Modified) these documentation and review sessions should be performed after each gate in the new process. However, this might also have to be adjusted for very small and large projects
- Lessons learned need to be connected to someone responsible of performing improving actions that might lead to updates to or completely new processes and/or guidelines etc. This is to be done through connecting reflection sessions of the project teams to the gate review meetings where lessons learned are to be presented, discussed and appointed to someone responsible of making the changes of the work processes.

The technical and organizational issues of the currently utilized white book process can partly be seen to as separate issues to be mitigated through the introduction of a new IT-based tool and a new work process for lessons learned. However what has been identified as a pitfall for organizations interviewed in this research is that they commonly handle and develop these two key features in isolation of each other or try to create one based on the other or try to adapt one of them on basis of the other's properties. What seems to have been a success factor both from the inspirational outlook and theoretical reasoning is to develop the IT-tool and the work process for knowledge sharing simultaneously, mutually adapting the two after the needs of the other and not just one-sided adaptations. This integration is illustrated through the modified knowledge and product value stream in *Figure 20* and is based on the interrelation of principles, practices and techniques.

- Important for a successful implementation of a new knowledge sharing process is to assure to know what is to be achieved, i.e. having your principles clearly defined. For the case company the main principle is to improve the product development process of

the verification PMO through better using the lessons that can be learned from previous and other ongoing projects.

- This principle is to be supported by the practice or knowledge sharing process that is answering how to achieve the principle and the technique or database that answers in what way the supportive documentation is to be fed into the organization to support the knowledge value stream.

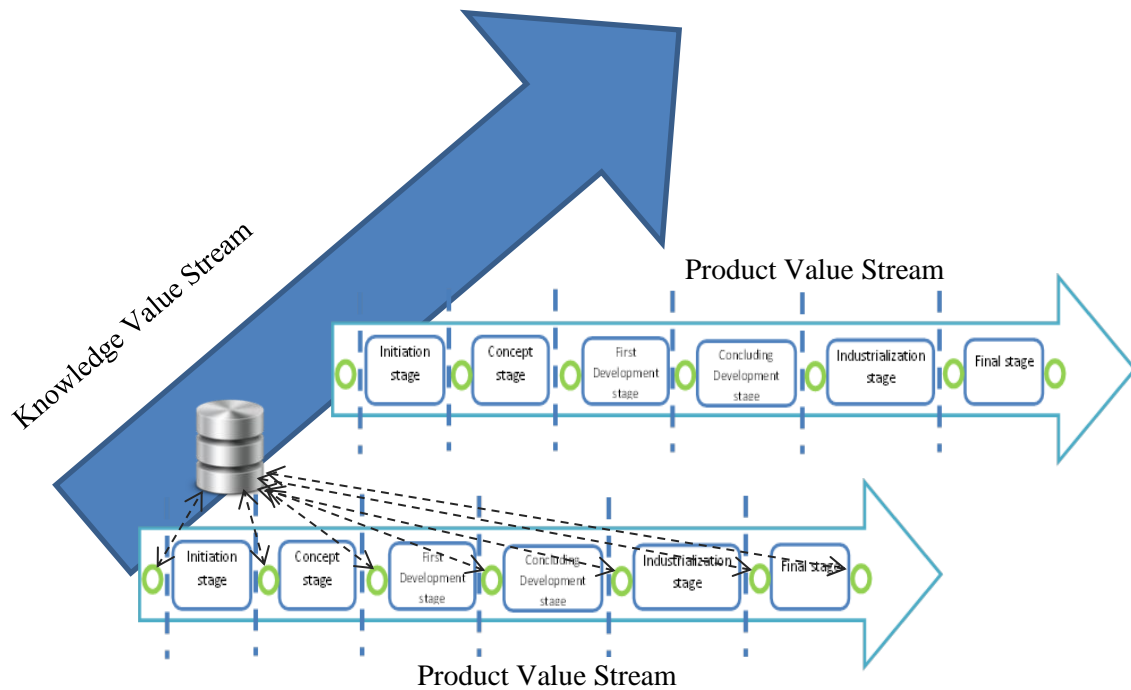


Figure 20: Knowledge and product value streams at the case company

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