The purpose of a KMS in projects

A Company Case Study

Master's thesis in Master Programme ACEX30

ELISE JAKUBOVA

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CHALMERS UNIVERSITY OF TECHNOLOGY
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ABSTRACT

Knowledge is something that has high value for today project oriented companies and organisation. To manage knowledge and be able to maintain a sustainable mindset is key success factor for a knowledge-oriented organisation. Questions such as what knowledge management system is and what are the challenges that can occur with implementing such system are ask in this paper. To understand what is required from a knowledge management system and how it works in reality a company case study is conducted. The case study is build on an existing knowledge management system within a specific organisation, to be later compared towards the theory. The method used for the research is qualitative research method with semi structured interviews. The result of the research is outlined in the end of this paper and will give an indication on what challenges can a knowledge management system have.

Key words knowledge, knowledge management, knowledge management systems

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SAMMANFATTNING

Kunskap är något som har högt värde för dagens projektorienterade företag och organisationer. Att hantera kunskap och kunna upprätthålla en hållbar tankegång är en viktig framgångs faktor för ett företag. Frågor så som, vilket kunskaps hanterings system används inom ett företag och vilka utmaningar som kan uppstå vid implementering av ett sådant system stalls i denna rapport. För att förstå vad som krävs av en kunskaps hanterings system och hur det fungerar i verkligheten genomförs ett företags studie. Fallstudiet bygger på en befintlig kunskaps hanterings system inom en specifik organisation, som senare jämförs mot teorin i detta repoport. Metoden som används för forskningen är kvalitativ forskningsmetod med halv strukturerade intervjuer. Resultatet av forskningen beskrivs i slutet av detta dokument och kommer att ge en indikation på vilka utmaningar en kunskaps hanterings system kan ha.

Nyckelord: kunskap, kunskaps system, kunskaps hanterings system

Contents

Preface

In this study, a theoretical research and company case study is conducted. The research has been carried out from January to June 2016. The project is in collaboration with a company that is anonyms in this research and named RED in this paper.

The research and the paper has been conducted by Elise Jakubova as a researcher and Professor Martine Buser as supervisor. All research, material gathering and interviews have been carried out in the company's offices in Sweden, and some research time in the Chalmers University of technology workspace. I would like to thank Martine Buser for her support and supervising.

Finally, it should be noted that this research will not be able to happen without the friendly and supportive staff at the case study company.

Göteborg, March 2018

Elise Jakubova

1 Introduction

"The KMS has been widely implemented in organizations. However, its availability does not guarantee that employees have been willing to spend time and effort using it." (He W. e.g., 2009, pp. 1). This underlines that, an organisation can implement a knowledge management system however, to get the benefits from the system it is critical to have the support and willingness from the user within the organisation.

Various practices that are attempting to manage individual and organisational learning have over time converged into what is now categorised as "knowledge management (KM)". Knowledge management is about getting the right information in right time to right people within a company, organisation, or project. Organisations devote a great amount of resources, both financial and human, to find ways to organise and storage knowledge in a logical way and as well successfully implement it within the organisation, so knowledge is not effectively being lost or have to be recreated at additional cost (Becerra-Fernandez I. e.g., 2008). Knowledge management systems (KMS) are any kind of IT systems that stores and retrieves knowledge, improves collaboration in the project and organization, locates knowledge sources, captures, and uses knowledge or in some other way enhances the KM process (Becerra-Fernandez I. e.g., 2008; Trusson C. e.g., 2014; Singh J., 2013). In the past few years, companies with knowledge workers as employees has increased, and knowledge management has been viewed as an important field of study for organisational learning and has received a lot of attention in academic and professional services (Maier R., 2002). To understand what a knowledge managements system is and how it works, a basic level of understanding the concept knowledge is needed. Knowledge can be interpreted as possession or practice, where knowledge as possession is something people receive from documents, flowcharts, and other similar sources. On the other hand, knowledge as practice is imbedded within people, and can be retrieved by observing and talking to people (Newell S., e.g. 2006).

Furthermore, the company RED, Sweden have developed a project knowledge management system called Design review that is used in larger infrastructure projects. The purpose of the system is to help managers and the project team to maintain and carry on the important knowledge gained from different projects, in an easy and

officiant way. The system is a basic knowledge management tool that consider the whole project lifecycle, from the beginning to the end. It consist of five different stages that are connect to each other and each stage have their own checklists. The checklist are the main tool for storing and retrieving information. These lists are gross lists that are updated after each project so that the next project will have a more detailed and accurate list to work with. Design review is a system that needs continues updates by the organisation and the company, because the projects and organisations ways to work changes and evolves in today's modern society.

Research's today have identified that there are some issues with KMS and highlighted that the main challenge is the implementation of it within an organisation. Some other issues that can occur with a KMS are: lack of performance indicators and measurable benefits, organisational culture, system design, coordination and evaluation, improper organisational structure and so on (Frost A., 2014).

1.1 Background

In 1980s the importance of managing knowledge in organisations started to take off and knowledge workers become more common concept (Pervaiz K. e.g., 2002). However, it was in 1990s that the interests for knowledge management increased significantly and there were already a small number of companies that had implemented the concept within their organisation. A study made by Ernst and Young in 1997 indicated that companies and organisations could leverage the knowledge in their organisations more efficiently if they had more cautious approach to knowledge management (Pervaiz K. e.g., 2002). Managers started to have interest in how to leverage knowledge to be able to enhance business success, which led many companies to develop more structured ways for how to manage knowledge.

Thierauf R. (1999, p. 4) says: *"for all sized organizations, change will be a constant in the next millennium."* Technology is advancing quickly and affecting all aspects of a typical company and organisation. This is increasing the pressures to create a new type of workplace and the need for a new type of systems that captures and shares knowledge, as well that responds to the changing environment, will increase (Thierauf R., 1999). Employee's roles and their relationship to organisations is changing dramatically, as it is more common to be knowledge worker rather than industrial

worker. Maier R. (2002, p.5) says that: "*in the late twentieth and the beginning of the twenty-first century, it is no longer natural resources that creates money but knowledge"*. Knowledge work requires that knowledge is continuously revised, improved and transferred to new knowledge as a resource. Knowledge workers gain bigger role and influence within an organisation because knowledge as seen as a key competitive factor.

1.2 Purpose

The aim of this research is to investigate the purpose of a knowledge management system within a project and see what kind of challenges and obstacle that can occur with implementing such system. What does knowledge and knowledge managements mean and how project-oriented organisations work with this concepts within their projects and organisations? A company case study is conducted to get better understanding on how it works in reality and which challenges and opportunities can occur buy have such system in place.

Furthermore, the purpose is to investigate and see specific how their own developed project knowledge management system, Design review, functions within the organisation and their projects. What do the employees think about the knowledge management and can it be improved? It lies in the company's interest to see where action can be taken to improve the knowledge management within the project as well the organisation.

1.3 Problem Formulation

Managing knowledge within an organisation is a challenge as well a critical success factor for the organisation, because todays organisations mainly consists of knowledge workers and knowledge is the key asset within the company. The questions that are asked in this paper are:

- What is the purpose of knowledge management system within a project oriented organisation and the company case study, RED?
- What kind of challenges and obstacles can occur with implementing the KMS within an organisation?
- How does Design review work and how well is the system implemented within the organisation?
- Is Design Review a KMS for projects and how can it be improved?

1.4 Objectives

The objectives of this study are:

- To investigate the concept knowledge management and knowledge management system
- To see what kind of challenges that can occur with KMS in project oriented organisations
- To assess if the users in the case study are satisfied with the system
- To understand the project knowledge management system Design review

1.5 Limitations

The report considers and addresses already existing theory in the subject knowledge, knowledge management, knowledge management system and project knowledge management. However not all existing knowledge management theory's and research is considered and used in this paper. Selection of the theory is made to the purpose of the report and to be able to conduct a comparison to the company case study and the results from the interviewees.

The case study is conducted at one company and does not consider other companies in the same business. Design review is a project knowledge management system that only applies for infrastructure projects in Sweden, therefore other kinds of projects and divisions within the company are excluded from this research. A dozen interviews are completed with employees working in the division infrastructure; however, it is not all employees. The selection of the interviewed employees was based on the employee's position within the company, technical area, and experience. If other employees were chosen for the interviews, the result of this report may have deferred.

Some knowledge about the company and the system are gained through own experience from the time I worked for the company. There is an already existing relationship with some of the interviewed therefore the answer they gave can defer if interviewing person were someone else.

2 Method

The research started with the idea of knowledge management in projects and how the knowledge within a project can be captured and shared to other projects so the same mistakes don't happen repeatedly. Clear patterns, from my experience working in large infrastructure projects, could be identified. The obstacles that occur where of such simple nature; poor planning, lack of common project goals and lack of communication, not just between project members but also within the organisation, which lead to overruns of time and budget. To have a good understanding in how knowledge management system and knowledge management is working I have chosen to make a case study. The case study is a company with organisational force mainly build of knowledge workers and project-based organisation.

The company that is chosen for this case study, had started to use a system that in some way manages knowledge in projects and attempts to provide a knowledge sharing within the project. The system was their own creation and it had been used in a couple of projects without a real success, but the organisation members had a positive attitude towards the system and believed in it. The company and the specific system was chosen for the case study because of my existing relationship with the company and that they had an existing KM system that was not successfully implemented. In this research due to confidentiality the company name and identity will remain anonymous, and we will use a pseudonym RED. The word is not connected in any way to the company name and it is randomly chosen. The company's logo and sensitive information such as employee's names will have overwritten and not exposed in this research. This is to fallow the ethical roles as well the anonymity of the people that participated. Some of the names for their internal systems and tools has as well been replaced with pseudonym, such as Yellow for the Intranet in this research.

According to Bryman A., (2012) the research design of a case study is about analysing a single case in detail. The research will be conducted in a single company, in Sweden, and even so in a single department at this company. Internal and external communications methods will be overseen; therefore, research case study design is most suitable. Human being's behaviour cannot be described and understood with

science methods, therefore it is necessary that human behaviour is interpreted. (Bryman A., 2008)

The theoretical research in this report is conducted because there is a need to understand what knowledge management is and how those a knowledge management system work. Data and information is collected mainly through scientific articles accessed at Chalmers university of technology library and books with topics knowledge management and project phase. The project knowledge management system Design review is a system developed by the company RED, Sweden, therefore the information about the system is collected through interaction and conversation with the employees, as well as from their own Intranet called Yellow. For the collection of the theoretical information about the company and their knowledge management within the organisation, the internal website, Intranet Yellow and their own company books are used. The readers will not have access to the company and system information, because this is accessible just for employees at RED, Sweden and for keeping the company anonyms. No references for the company are revealed within the text or in the references chapter.

The research was conducted, and the report was written in the company RED, Sweden, office Gothenburg. Five days a week were spent at the office during the research time. Interactions and observations with the employees and organisation were made, during this time. The report therefore consists of interpretations and information given from the daily interactions as well from my time working in the company in the department transportation, group Major Projects. I was working for the company during three years and participated in a project that used the Design review system. To get more understanding of how the employees are using the system and what they are thinking about it, several interviews were conducted.

Qualitative research and interviewing was used since it is bigger interest in interviewee's point of view and that answers are focused in what the interviewees sees as relevant and important. Qualitative research is used to uncover trends in thoughts and opinions. Bryman A., (2012) means that this kind of interviewing tends to be more flexible and the answers are more rich and detailed. The interview type will be unstructured or semi structured interviewing and combination of these two methods

will carried out in this research. The first type, unstructured interviewing is made without asking questions, where the peoples memory and knowledge about the topic is the relevant. In this way it will not lead the answers towards a specific answer. The second one, semi structured interviewing is defined as by Bryman A., (2012) that the researchers has some sample of questions but however the person that is interviewed can answers as they more or less want. All participants in the research have participating voluntarily and the interviews were ethically correctly conducted.

In total 14 interviews were conducted during a period of two months. The interviewed are employees at the company RED, Sweden division Infrastructure. Position, experience, and speciality of the interviewed vary and at least one person from each technical area is interviewed. Furthermore, there is diversity of the interviewees, depending on how long they have worked in the company RED, Sweden, to see and understand if there is difference between employees that have worked in the company for a time and employees that are new within the organisation. Five project managers were chosen for interviewing, because one of the focus area in the research lies in the project knowledge management, and the biggest competence when it comes to managing projects is in project managers position. The interviewed were chose to achieve as high diversity as possible and gain viewpoints from all technical areas.

Often larger infrastructure projects contains project members from different technical areas. However, within an infrastructure project the technical areas varies depending on the schemes scope. For this research the technical areas were chosen by looking in larger infrastructure projects organisational plan and selecting the technical areas that were the most common for a large project.

The interviewed are referred in the paper as interviewee´s and beside the company, division and department name, other names of the employees or organisation departments are not mentioned. The interviewees are categorised in two areas of experience, and two different groups depending on what role they have in a project. The experience type A is employees that have more than 10 years of experience and type B is less than 10 years. The two groups of role in a project are Project Manager and Technical Manager. The category time shows for how long time the interviewed has worked within the company, where 1 is longer than four years and 2 is less than

four years. The categories were chosen and created by me based on my own experience and knowledge gain through the research period and working in the company. The information is outlined in Table 1, Interview description, all interviews are anonymous, and employee's integrity is considered.

Interview description

Interviewee	**Role**	**Technical area**	**Experience**	**Time**
PM 1	Project Manager	Project Manager	A	2
PM 2	Project Manager	Project Manager	A	1
PM 3	Project Manager	Project Manager	B	2
PM 4	Project Manager	Project Manager	B	1
PM 5	Project Manager	Project Manager	A	1
TM 1	Technical Manager	Road	A	1
TM 2	Technical Manager	Road	B	1
TM 3	Technical Manager	Traffic planning	A	1
TM 4	Technical Manager	Railways	A	2
TM 5	Technical Manager	Time planning	A	1
TM 6	Technical Manager	Coordinator	B	1
TM 7	Technical Manager	Geotechnics	A	1
TM 8	Technical Manager	Canalisation and electricity	A	1
In 1	Department Chef	Infrastructure	A	1
Total: 14 Interviewed				

Table 1Interview description

The chose of people for the interviews was made by me, were the goal was to have as high diversity as passable but as well make sure that the interviewed had been in some way exposed to the Design review system. Each interview started with a short description of the participant; about their work experience, education, age and etc., to be able to have an understanding of the participant's knowledge. All interviewed had an engineering background and experience working within large infrastructure projects. The work experience, age and role within the company of the interviews varied. The

information from the interviews are gathered and presented in the result chapter of this paper. The result chapter 5 is outlining what is said during interviews, the interaction with the employees as well as my own experience. My main role within projects were to coordinate within the projects and internal project management. The observations made during my time at the company and my own experience being involved and using the design review system within a project, has as well contributed to this research. The result is divided in seven themes and they are develop based on the theory around knowledge management system and how it is successfully implemented within an organisation or a project. These themes have been identified as the most relevant for this study by me and my interoperations of the theory. Further, in this chapter the result for each theme will be outlined in a matrix. The analyses and discussion, chapter 6, is build up in the same structure as the result with the same subheadings.

The theoretical framework chapter 3 is outlining the research material that is used in this paper. The research from the company case study will be compared to the theoretical framework and conclusions will be made based on that analysis, which is compiled in the Conclusion chapter 7. Chapter 7 is also including recommended improvements that can be made with the system Design review and recommendations to further study.

2.1 Methodology

A qualitative research is conducted and applied in this report. Qualitative research means to understand the human behaviour and ask the question why and how, and not the what, when and where. This type of research conducts and gathers information only on the specific case study and some generalised conclusions can be seen as a statement. Furthermore, quantitative research is a research type that concentrates on the variable and to establish the closeness of the relationship between independent and dependent variables, according to Jensen K. e.g., (2012). With that is meant that data can be transferred into useful statistics. Different type of surveys, interviews and systematic observations are some data collection methods for quantitative research.

For qualitative research the data collection methods can be interviewing, focus – groups and observations. The most common data collecting method in qualitative research is interviewing. There are three kinds of interviewing: structured, semi structured and

unstructured. Structured is where the questions are specified and prepared before the interviewee, unstructured are where no questions are prepared, and the interviewees talk from their own experience. Semi - structured is a combination between structured and unstructured interviewing, some questions are prepared but not in detail. The samples size is small and usually with the task to fulfil a specific quote to the study (Bryman A., 2012).

Qualitative research is to reveal the meaning that informs the action, with which is meant that it is investigates interpretation and meanings. The researcher needs to interpret the result and analysis. This method is used in research that want to uncover trends in thought, it provides insight to the problem and helps to gain understanding to the individual thinking (Jensen K. e.g., 2012).

3 Theoretical Framework

To understand if a knowledge management system is meeting its expectations and functions, an introduction to the theory is necessary. A short description of the key concepts: knowledge, knowledge management system and project life cycle will be carried out in this section. The chapter will outline the theory that is needed to understand and analyse the results from the company case study.

3.1 Definition of key concepts

Knowledge workers are common within the organisations and many project-oriented organisations are built of knowledge workers. The effectiveness of a company, organisation and a project lies in the way they manage and use knowledge. Knowledge management can be executed by an organisation or project, by using a system for sharing, retrieving, organising, implementing, and gathering knowledge. To be able to understand what a knowledge management system is we need to have an understanding of the definitions of knowledge, knowledge management and the project life cycle.

3.1.1 Knowledge

The concept knowledge is defined, according to business dictionary, as "*Human faculty resulting from interpreted information; understanding that germinates from combination of data, information, experience and individual interpretation*" (www.businessdictionary.com, 2016.05.12). Researchers have as well defined the concept as a "*things that are held to be true in a given context and drive us to action if there were no impediments (Andre Boudreau), capacity to act (Karl Sweiby) or justified true that increases an entity's capacity for effective action (Nonaka and Takeuchi)*". (www.businessdictionary.com, 2016.05.12).

Researchers in the concept knowledge have described and understands knowledge in different ways, some predict knowledge as possession, others knowledge as practice. Organisations that acknowledge knowledge as possession place the emphasis on identifying, storing, collecting and distributing information and threat knowledge as something people own or possess. On the other hand, the knowledge as practice view is more adapted by organisations that have stronger social perspective on learning, and see knowledge as something people do, that knowledge is situated in social, organisational practices and relationships (Newell S., e.g. 2006). For those that see knowledge as possession, the knowledge can be divided as explicit and be transferred

from one person or group to one other. Nonaka and Takeuchi's (1996) study explains the interaction between tacit and explicit knowledge. Tacit knowledge is knowledge that is difficult to communicate visibly; it is the stored experiences and skills in people. On the other hand, explicit knowledge is encoded in organisational formal models, rules, documents etc., therefore it is easily communicated visibly (Al-Ghassani A. e.g., 2006). Tacit and Explicit knowledge has two conversion forms each; according to Nonaka and Takeuchi research (1996): tacit to tacit, tacit to explicit, explicit to tacit and explicit to explicit. Tacit can be converted to other tacit knowledge trough socialisation in face-to-face interactions or to explicit knowledge through externalisation by codifying and individual's knowledge. Explicit can be converted to tacit knowledge through internalisation when an individual reads and understand knowledge or to on other type of explicit knowledge through combining more than one form of knowledge to generate new knowledge (Al-Ghassani A. e.g., 2006).

Furthermore, Sutton DC., (2001) outlines that: *"some point out that the possession of knowledge, whether of a 'fact', a 'skill' or 'know how', cannot be recognised other than by inference from certain 'dispositions' to behave in certain ways."* Therefore, if knowledge is embodied in a disposition to behave, rather than any codified representation, the relationship between what is transferred in books and other similar sources needs to be understood (Sutton DC., 2001). However, all products that we receive information from or facts or similar sources have influenced behaviour over the ages, therefore can any codified material, by itself, be knowledge.

The view of knowledge as a possession describes knowledge as a recourse that is controlled by individuals, project teams, organisations or societies. Organisations that adapt this view will tell their new employee to read the different company documentations and processes to understand how the company and the organisation is build up and functions (Olsson N.T., 2015). The critics of knowledge as possession believes that knowledge is situated in social and organisational practices and relationship. Organisations with that view will encourage their employees to seek knowledge within the organisations and company well build social network to gain knowledge. Newell S e.g. (2006) outlines that this perspective of knowledge is more embedded in practice rather than possessed. It can be interpreted to that direct knowledge cannot be transferred between projects where practices do not connect or

communicate and could lead to the fact that where projects involve high innovation and change, knowledge, will be challenged if knowledge is seen as imbedded in organisational practice and relationship.

However, there are different views of the concept knowledge in many of the typologies of knowledge and knowledge management. One example that Newell S., e.g. (2006) point out is McElroy (2000) typology that outlines knowledge as first- and second-generation knowledge management; where first- generation knowledge management focuses on the supply of knowledge, such as imitation and exploitation of knowledge. Second- generation knowledge management is creating and maintaining the sources of creating knowledge. Researchers meant that in reality knowledge management is often a combination of knowledge as possession and knowledge as practice (Olsson N.T., 2015).

3.1.2 Knowledge Management

Knowledge is usually difficult to imitate, transfer and replicate, therefore there is a growing recognition in companies and organisations of the importance of knowledge management. It is common that companies and organisations believes that knowledge resources matter more than conventional ones. This means that knowledge resource must be managed clearly (Wu. J. e.g., 2006; Xia L. e.g., 2013). Furthermore, it has been observed that knowledge transfer is achieved by information flows (Sutton DC., 2001), but information is a flow of messages, whilst knowledge is created by that flow (Nonaka I. e.g., 1998). Rapid development of technology make the knowledge become the key resources of economic growth, social development and enterprise growth in companies or organisations, as well in projects (Heaidari M. e.g., 2011).

Knowledge management refers to a systematic and organisationally specified process where knowledge is gained, organised, and shared through the organisation or a project (Singh J., 2013). Organisations acknowledge that, if knowledge is going to be shared successfully there is a need of processes that facilitate the knowledge sharing between the members of the organisation (Thompson T. e.g., 2011). Xia L. e.g. (2013) outlines that the process of project implementation reflects a process of knowledge achievement, sharing, application and innovation, which is knowledge management of projects. Researchers establish that, knowledge and knowledge sharing is a competitive

advantage for an organisation that emphasise the importance of obtaining, documenting and harnessing the existing knowledge. The advanced IT systems within organisations and projects, has given tools to facilitate and document both tacit and explicit knowledge as well support knowledge sharing (Thompson T. e.g., 2011; Xia L. e.g., 2013; Becerra-Fernandez I. e.g., 2008). However, there is a recognition that companies, organisations and projects must continue to improve their skills in sharing both tacit and explicit knowledge between people to be able to improve their skills. Knowledge sharing depends on continuous interaction and communication within the project and organisation in an efficient way. Lin Y-C. e.g. (2011) explains in its study that, to be able to see what kind of knowledge exist in organisations and projects as well capture it, an understanding for knowledge sharing is necessary. People tend not to share knowledge between each other if the tools that are given are not suitable (Chan S-S. e.g., 2012). The factors organisational cultural, top management cultural and project cultural can as well affect how efficient and successful knowledge sharing is within organisations (Becerra-Fernandez I. e.g., 2008). Some organisations with knowledge workers are built up by temporary project teams to deliver a specific task, therefore the organisational cultural for sharing knowledge can be essential success factor for the organisation as well as determinate the level of knowledge sharing.

3.1.3 Project life cycle / Project Phases

Project oriented organisations today deliver a task by building up a project with a team and same goals, during a specific period of time. A project is defined according to the PMBOK GUIDE (2008) as that a project is temporary and unique formation that has a specific beginning and end within a specific time line. A project has a defined scope and resources, as well a specific set of operations designed to accomplish tasks or goals. The typical project includes a project manager or project management team and a team of members that have specific knowledge expertise that are contributing to deliver, help towards completing / delivering the specific task. There are many formations of a project and project phases. One of the known project life cycles is PMBOK GUIDE (2008) theory where the project manager and project team have a given task to deliver. Every project has beginning, a middle period and an ending. The middle period is where different activities move the project toward completion. A standard project has four major phases:

INITIATION ➡ PLANNING ➡ IMPLEMENTATION ➡ CLOSURE

Often the four phases, Initiation, Planning, Implementation, and Closure are referred to as the project "life cycle" (PMBOK GUIDE, 2008).

INITIATION

In the first phases Initiation the project objectives and goals are identified. The goals and objectives of the project are documented with a recommended solutions. A study is conducted to analyses and investigate the options whether if they meet the project objective. Questions like; Can we do the project? Is it profitable to do the project? Do we have the needed resources that can deliver the specific tasks? are addressed. In the end of the phase, a decision will be taken with which option go further with. This decision is usually taken by the top management within the organisation/ company.

PLANNING

The planning stage is where the chosen option is furthermore developed and planned. This is also referred to as scope management. In this step, the project team identifies and plans all of the work to be conducted, project tasks and resources requirements are identified. When all stages of the planning process are completed, the project manager makes a budget, the delivery method to stakeholders, sets up all the document control tools and documents, produces a risk and change management plan and allocates the necessary resources to deliver the different task to be able to complete the project. At this point the project would have been planned in detail and is ready to be executed.

IMPLEMENTATION

The third phase is Implementation, it is here that the project plan is executed, and the work is performed. The project team is carrying out the tasks that were identified in the planning stage. The project manager or project management team is monitoring the work. If some adjustment to the planning is needed to be made, it is in this phase that this will be implemented. The document control, change and risk systems are put in place to handle the changes that can occur. It is recommended to have status reports to monitor and supervise the project outcome.

CLOSURE

The closing phases is to realis the final deliverables to the customer and make the delivery of the committed task. The last step, before closing down the project within the company or organisation internal systems is to conduct lessons-learned studies. This will help the company to learn from the project and transfer back the knowledge to the organisation. The lesson learned material is stored within the organisations internal system and it is available for project and organisation members to access it.

Knowledge management systems has become more attractive because the need of obtaining exciting knowledge within the organisation to gain more value and be more competitive on the market (Becerra-Fernandez I. e.g., 2008). These specific aspects have an effect in project-oriented organisation, where the knowledge workers are the primary resource and where this knowledge is gain through the whole project life cycle.

3.2 Knowledge Management System

Knowledge management systems are emphasising knowledge as possession where knowledge can be shared, retrieved, and manage. The research suggest that knowledge has become one of the sustainable competitive factors that gives the companies an advantage and helps to achieve success. However, knowledge needs management to become an advantage and this can be accomplished by having a knowledge management system.

Knowledge management systems (KMSs) are describe as systems that targets professional and managerial activities by focusing on creating, gathering, organising and disseminating an organisations knowledge (Singh, J., 2013; Becerra-Fernandez I. e.g., 2008). KMS refers to any kind of IT system that stores and retrieves knowledge, improves knowledge sharing, and enhances the KM process within the organisation or project, by having common platforms for sharing knowledge within the specific project or organisation. KMS can be seen as socio- technical challenges, with this is meant that organisations and projects dynamics and technological advertence continuously shape and reshape each other (Pan S. e.g., 2007). The objectives of such system are the management of knowledge and the sharing of knowledge that contributes to support achievements of organisational goals and deliverables.

The importance of information techniques (IT) has increased within an organisation, and continues to increase. In response to that the knowledge-based practice of IT system management has established itself as fashionable information system management phenomenon (Singh J., 2013)

Organisations and companies are realising the benefits of knowledge management systems, however they acknowledge that the implementation of such system has been facing serious difficulties. This difficulty has attributed either to not being able to anticipate the barriers that can occur when planning knowledge management or using inappropriate methods and tools for implementation (Al-Ghassani A. e.g., 2006). Other research means that the main challenge has been with implementing such system that KMS is often used as an information system (IS) where the main focus is to understand what factors are leading users to accepting and thereby using IT. A successful implementation of a KMS on the other hand requires not only that the user are using the system but as well contributing and further developing it by sharing their knowledge (Becerra-Fernandez I., e.g. 2008).

Some examples of information technologies are Internet, Intranet, search engines and data warehouses. The majority of project build organisation have some kind of Intranet or a technological infrastructure that is develop to store information and knowledge. Usually this information and knowledge is transferred in to flowcharts, process and templates to be accessible and distributed to the members of the organisation. Furthermore, there is a need for an easy used and understandable knowledge management technology, in order to be accepted from the organisation or project participants (Xu, J. e.g., 2005). Some of the common functions of the KMS technologies mentioned in Xu J. e.g. study (2005, p. 383) are:

- Organising and sharing of internal benchmarks/ best practice
- Creating knowledge networks and networks maps
- Constructing corporate knowledge directories

Furthermore, to gain an understanding on how KM and KMS work within projects and project-oriented organisations a more detailed study of KMS within a project has been conducted in this chapter.

3.2.1 The use of KMS within the project

As known knowledge sharing tends to be problematic and there is different reasons for that, one example is sociocultural factors, such as human behaviour, but equally important for the success of knowledge management system (Trusson C. e.g., 2014; Damodaran L. e.g., 2000). The risks and difficulties associated with adopting knowledge management system and the lack of evidence to sufficiently demonstrate organisational benefits have been noted. People need to use the system and continuously update it to be able fully gain benefits. The conclusion of some researchers is that KMS best practice is immature, with organisations lacking commitment to implementation and not understand the organisational benefits (Trusson C. e.g., 2014, He, W. e.g., 2009). Some of the key success factors in knowledge management system and the implementation are: the organisational culture, how the members of the organisation communicate and use of the system, the value of the system within the organisation as well to the client and the functions of the system when it comes to share, transfer and storage knowledge. These factors can be summarised as:

1. Organisational culture
2. Communication and use of the system
3. The value of KMS
4. The functions of KMS

Organisational culture seems to be a critical factor for knowledge management, therefore knowledge sharing culture is an important organisational condition.

3.2.2 Organisational Culture

Creating a knowledge infrastructure and knowledge sharing within an organisation or project does not happen over one night. It requires engagement, planning, time from the company organisation and an organisational culture that is open to changes (Thierauf R., 1999). Organisations today have captured knowledge in a wide variety of organisation process, flowcharts, know-how documents, customer trust, best practise and etc, within the organisations Intranet, project website or other similar internal IT-tool. However, this knowledge could be diffused or stored in a non-user friendly technical infrastructure where the employees do not have access to or cannot find the requested information in an easy way (Iyer L. e.g., 2000).

Organisational culture consists of the values and beliefs of its members. Researchers defines that the characteristics for organisational culture are the norms, beliefs and values that it has (He W. e.g., 2009; Frost A., 2014). Culture persists through social interaction and is communicated through a shared and common language within the organisation. The willingness of sharing knowledge within an organisation or project is in some part affected by the culture of the organisation. Trust, the willingness to accept knowledge from others, the ability and willingness to learn on an individual, group and organisational level is some cultural aspects that needs to be taken to consideration with implementing KMS and successful outcome of the system. Trust within organisation is if the members of the organisation or the project team trust each other when it comes to share knowledge. Such as social relationship between the team and organisation; do the members have a trustful relationship? A trustful relationship is where members believe in the good intend, competence and reliability of other team members. If trust occurs between the organisation members; a knowledge sharing culture and the willingness to accept from others can occur (He W. e.g., 2009; Frost A., 2014).

Furthermore, to consider when it comes to culture within organisation or project are: positive project culture, openness to change, and mistake tolerance. It is difficult to admit mistakes and some organisational culture does not have high mistake tolerance. This factor can be affected by the top management culture and how they act if mistakes happens and what are all the consequences (Singh J., 2013).

The top management culture is reflected on the organisational culture and affects how the people within organisation respond to knowledge sharing. There are several reasons to why sustained management support is necessary. Knowledge management requires a clear vision, guidance and examples set by top management (Singh J., 2013). Highlighting the importance in the organisation of the KMS is a factor that affects the use of the system, if there is lack of support by the top managements and showing the importance and the necessity of the system, the people within the organisation tend to not use it. Top management support can as well be the time allocated to implement the project, such as education, technical support and financial support. (Heaidari. M., e.g., 2011).

The top management in the organisation and company has a role as leadership and support for the project, this means that is important that the top management comes with a positive attitude to the system. Involvement within the project and the system, and leading by example is important for the successful outcome (Weber R., 2007). Furthermore, it is significant that the support is long term (Frost A., 2014), because sometimes the management commitment can wane when problems starts to appear. One way of showing support in KMS is to provide with the necessary resources and education to the user. With resource is meant financial, human, and material resource.

It is beneficial to have commitment from senior management; to handle the cultural changes that are required to get an organisation to accept the idea of sharing and reusing knowledge. One way to build commitment is trough creating enticements to encourage knowledge sharing behaviour. An incitement can be, knowledge and their own expertise is more accessible, the employees will spend less time on helping co-workers, which results in more time for the participant conducting their own work. Other is to demonstrate that it will benefit all participants in the process as well the organisation development (Thierauf R., 1999; Maier R. e.g., 2005).

Furthermore, the organisational culture affects how people are chosen for a specific task or project, which affects the performance and decision making in a project. Project culture is the general attitude to projects within the organisation or company and most projects do not operate in isolation. Because culture is rooted in people it affects their behaviour, therefore it also affects how they react to a new way of working, such as a new KM or KMS for the project or organisation. In engineering companies the project managers often tends to be a specialist within a specific area, and not often having the appropriate management education which can lead to communication difficulties or obstacles (2012; Frost A., 2014; Iyer L. e.g., 2000).

3.2.3 Communication and use of the system

The characteristic for organisations within an engineering companies is that they are often complex and have high diversity within the projects, for example team members with different technical areas and experience. Project teams are build up to deliver a specific task to be conducted for a given time, where a high-level of people movement tends to occur. This results in project participants adapting previous knowledge and

experience, to face the new conditions and tasks within the new project. The new project can have a new way of sharing, storing and retrieving knowledge. Lin Y.-C. e.g. (2011) outlines that if knowledge is shared in an efficient way between the project participants it will help to prevent mistakes that have already come across in previous projects. Therefore, to have common language, where language means that the way of communication is specified, is of importance for knowledge sharing. Project members tend to prefer to communicate with each other in a verbal way, that is more informal, rather than through a system, which is more formal. Knowledge about projects challenges, success and issues tends often to be shared beside the coffee machine, during lunch or other similar informal brakes. This attest knowledge as practice is the preferred, informal form of sharing knowledge rather than knowledge as possession (Iyer L. e.g., 2000; He W. e.g., 2009).

Organisations use project teams to accomplish a specific tasks or goal. The most problematic for project-based organisations is to capture knowledge that acquires during a project and use it in the next similar project or context. There is a tendency to not use already gained experience from previous projects in an efficient way in the new project (Newell S. e.g., 2006). Maintaining project documentations and conducting project reviews is a way of sharing knowledge across projects. The most common way of sharing knowledge between projects is lesson-learned practice. Lesson – learned session are often conducted after the project is finished or meet a specific milestone. The common structure is that the key project members, such as project manager, risk manager, executive engineer, senior structural engineer and etc are invited to a couple of hours session to discuss what went well and less well. Often there is a written protocol on what should be asked during these sessions and the outcome is standardised written report. This report is shared with the rest of the project team and top management, to be later store in an internal database, such as Intranet. This gives opportunity for other persons within the organisation, which are not included in the specific project team, to search and use the information from the database. It is assumed that in this way knowledge can be shared, in an easy way, across the organisation and projects, which contributes to avoid reinvention in projects. (Newell S. e.g., 2006; MPBOK Guide 2008,)

Furthermore, if the project is successful or not, this need to be documented, to be able to identify best or worst company practice (Lin Y-C. e.g., 2011). However, problems have occur with this kind of knowledge sharing in projects when it comes to time, and the use of the documentation from the lesson- learned reports. With the time is meant that projects often do not have time left or budget to conduct lesson- learned sessions and documentation, partwise because it is necessary that all key members of the project contributes to the session (Newell S. e.g., 2006).

To preserve know- how knowledge or tacit knowledge is essential for the company. Today most of the KMS for engineering companies focuses on explicit knowledge within the organisation and what is gained from previous projects in terms of documentation and explicit or coded knowledge. However, there are some KMS developed to share tacit knowledge between project members. The system allows to share tacit knowledge by having discussion forums. In a discussion forum, such as web based messaging service, a more informal knowledge can be shared between members in the organisation or project (Lin Y-C. e.g., 2011).

Furthermore, it is helpful to advertise early success of KMS to the organisation, for example by having a project that result in success by having a KMS in place. Thierauf R. (1999, pp.11) mentions that *"In that way, everyone will be more likely to support continued work on the knowledge infrastructure when the benefits of sharing expertise start to crop up".* Communicating out the usefulness of the system will help the attitude towards the system (Maier R. e.g., 2005, Al-Ghassani A. e.g., 2006).

Researchers indicate that knowledge resources is a primary reason for success or failure of a KMS. Tesch D. e.g. (2009) research mentions that the quality of the knowledge workers and the selection of a suitable project team for the task is of greater importance for the project success, rather than the tools or the technology. There also indication that if the people do not know how to use the system can lead to troubled project development and cost overruns (Tesch D.e.g., 2009).

Planning is one of the key factors in all kinds of projects, therefore it is not different for KMS. With planning is meant that the organisation management as well as project management, plans well and thoroughly how the system is going to be used within the

organisation or in the project. It is also important do decided who is updating, facilities and sees over the system. The organisation members have a request of using a system that is updated to current technology as well as organisational changes. This needs to be implemented continuously, because today's technology and organisations are rapidly developing and a globalisation of projects and organisations takes place (Frost A., 2014; Wang Y-M. e.g., 2009).

3.2.4 The values of KMS

There have been changes in how the company's today operate, new ways of working have occurred, such as working from home, distributed teams and a globalisation. Companies need to stay on top of the changes to be able to keep a competitive advantage and make sure that their members are developing (Damodaran L. e.g., 2000).

One of the values with a KMS is the competitive factors, such as comparing and selling a way of working, especially in consulting firms where the product is knowledge. To see the actual value of the system there is a need to assess progress and have performance indicators. The ability to determinate if a project is succeeding or failing and if it's worthwhile for the organisation or the company, it is vital for the company success. Performance indicators can be such as management support and the ability to plan and evaluate, financial benefits, time saving and etc. KMS benefits if it is connected to financial factor, meaning that the value can be made apparent and measured (Frost A., 2014). Performance indicators and measurable benefits are difficult to identify, however there is a need for them within organisation to see if the system is successful or not, as well to see the effectiveness of the KMS (Heaidari M. e.g., 2011, Singh J., 2013). Without performance indicators and measurable benefits, it becomes difficult for management to track the effectiveness of the KMS and compare to how it was before the system was implemented.

A performance indicator can be a financial factor, a time management factor or resources management factor. With resources management factor is meant that people are satisfied to work with the system and that is shown in their performance of the work they do within a project or organisation. Financial factor is meant that the system helps the project to manage, oversee, control, and maintain the budget that is given for the task. The time management is another factor that can be measurable indicator, and it

means that the project should be able to manage the task in the timeframe that is given with help from KMS (Frost A., 2014).

KMS has a value towards the client as well in form of selling the way of working and including the client in the project phase. There is a need to gain knowledge and information from the client in the project or organisation. The involvement of the client in the project can be beneficial, and if KMS helps to deliver the product in time for the given budget with high quality the client will be satisfied. In this way KMS is creating a competition in the market. Singh J. (2013) has researched what the managers thought what function a KMS should provide the organisation with. One of the functions in the result shown was that the managers prefer the system to help with client communication.

Furthermore, there is a value of KMS when it comes to providing knowledge and information to the users, gathered in one place. However, Ren-Zong K. e.g. (2009) underlines in the research the importance of not just knowledge and information, but the quality of information and knowledge. If the information given in the KMS is not relevant enough to individual's needs, individual will not use it. Therefor the information must be easy to read and access. Further, the meaningfulness of information is important, because individuals tends to not be committed to share and receive information when they do not see any value in it to themselves (Nevo D. e.g., 2007; Ozlen K. e.g., 2014). Wu J. e.g. (2006) outlines that knowledge or information quality has a greater influence on user satisfaction and apparent benefits. To manage and distribute organisational knowledge and then leverage the knowledge value are one of the goals of a KMS. Wu J. e.g. (2006 p.737) states that: "*The user's perception thus depends on the quality of the contents and outputs of the KMS rather than the system performance and its functions"*. Study's shows (Wu J. e.g., 2006; Ozlen K. e.g., 2014; Nevo D. e.g., 2007) that relevant and quality information and knowledge is an important factor, for the value and use of KMS.

3.2.5 The functions of KMS

To implement and have as effectively usage of KMS within an organisation, there is a need to be a proper planning, continuous evaluation, good coordination, and design of the system. Moreover, the implementation requires a long term and practical outlook,

focus on the organisation business objectives and problems. That means that the system need to have a usefulness and a design that fits their requirements an users (Trusson C. e.g., 2014).

The functions of a KMS, include a consistent suite of email and web-based products, search engines, processes and storage of knowledge and information. As Wu J. e.g. (2006) points out that it is not necessary that KMS is a complicated IT system and the technology should be easy to use and understand, rather than complexity. The function of storage is that the knowledge occurs during a project or when completing a task is transferred and stored at the KMS so knowledge can be shared between the members in the organisation. However, to store knowledge that only can occur through communicative practice can be a challenge. Therefore, some KMS have a discussion forums and online based messenger forums where team members can communicate with each other and in that way share knowledge (Damodaran L. e.g., 2010).

Furthermore, KMS contains organisational norms and processes. The processes are tools that shows how an organisation works and how they are undertaking different tasks. The norms and documentation are stored in the system and by having search engines the members can easily find the relevant document or information. However, the information such as documents and processes need to be updated continuously to be relevant and suitable for its users. There is new knowledge occurring all the time and one of the functions of a KMS is to preserve new knowledge (Wang Y-M. e.g., 2009). To transfer one knowledge to another knowledge is made by the people that use the system. This can be by updating documents, processes, flowcharts etc. with new received knowledge from a completed project, or even so during the project. For example, if a project is successful and a specific process contributed to the success, this process can be stored in the system, so the information is used in the upcoming project. It is the same even if the outcome of the project is not successful, so the same mistakes can be avoided (Maier R., 2002).

4 Company Case Study

The company case study is conducted in an engineering consulting company RED, Sweden. The knowledge management tool for projects 'Design review' has been studied and critically analysed, comparing to the theoretical framework. In this chapter is outlined a description of the company and the tool introduced.

4.1 About the company RED

RED is a Scandinavian engineering consulting company that was grounded by two engineers in 1930s. The company has a holistic approach that create value both for the customer and the community as well look at the whole project lifecycle. Today RED has over 6000 employees and work with over 17 000 projects around the world.

Figure 1 shows the top organisation structure for company RED.

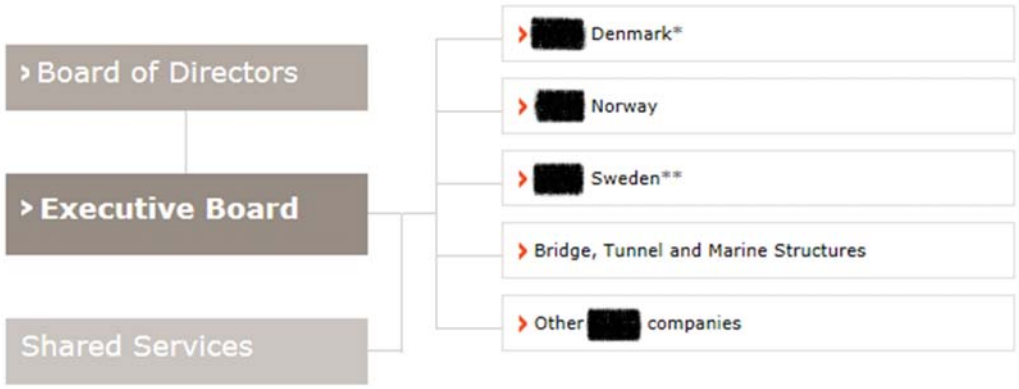


Figure 1Top organisation structure for company RED

RED Sweden has over 10 office in Sweden with approximately 1000 employees and the main office in Gothenburg with more than 500 employees. In beginning of 2000 RED bought, an existing engineering consulting firm in Gothenburg. This company was founded in mid. 1940s and the main purpose was to do construction design. The need of residential after the Second World War entailed an intensive residential construction. The company grew rapidly and a need to expand to new areas of competence arose. For example, designing building structures had a need for competence in geotechnical engineering. As the company expand the competence areas within the company increased by hiring experts in different areas, it could take on larger and more complex projects.

The organisation today in Sweden has five divisions, two subsidiaries and one office in Lithuania, in Figure 2 the divisions are outlined. The company offers advanced engineering and expert consultancy services in many engineering areas.

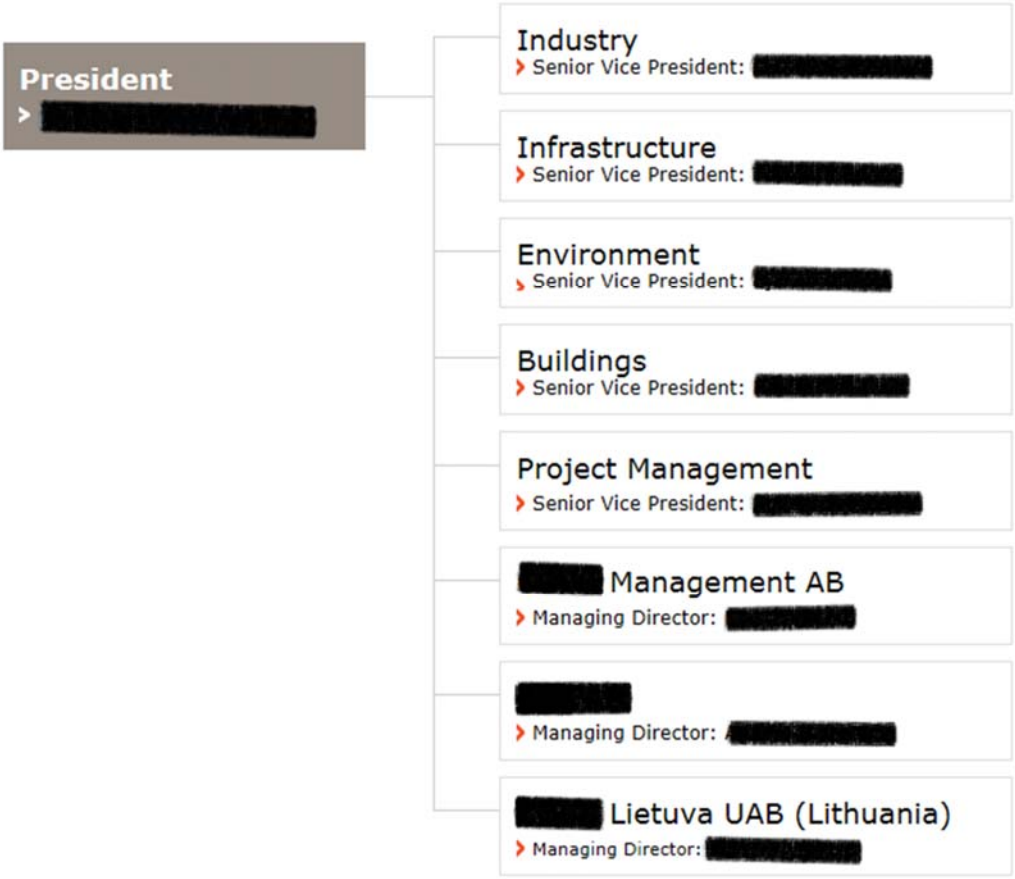


Figure 2 RED Sweden Division Organisation

The division Infrastructure have five departments: Bridges, Transportation, Civil Engineering, Infrastructure Stockholm/East and infrastructure/ South. The department Transportation is divided in four groups: Major Projects, Railway Design, Road Design and Traffic Planning. Each group is specialized in a specific technical area; group major project consist of project managers and project administrator / coordinator, group railway design consist of technical experts in railway and so on. A major infrastructure project can contain project participant from all or several above mentioned groups and departments within the divisions, it is even common to collaborate with offices or other company's outside Sweden.

RED have an education academy with different courses in project management, IT etc. The project manager courses are divided in different levels, where level 1 is the lowest. Projects in the company are divided in different levels depending on their size and the size considers the financial budget of the project. Lower size is a project with lower financial budget. To be a project manager for a major project there is requirement that the project manager has certain level of education within project management from the RED Academy. Other education or courses outside the company academy are not equal to their own courses, therefore every new project manager is required to attend the specific courses at RED to have the possibility to work with curtain size of projects.

4.1.1 Intranet and internal portal

The Intranet System Yellow and joint web-based portal is used for managing knowledge management within the organisation and coordination for projects. The joint web based portal works as a project site where the project participant for the specific project gather documentation and information. The specific project site can just be accessed from the project participant, which means employees outside the project cannot access the project site as well the documentation inside it. The web-based portal is in Swedish and English, the language can be chosen. Yellow ensures that RED, Sweden comply with quality, ethical and environmental requirements in every external as well as internal project. The Intranet is based on a combination of knowledge gained from projects and employees and knowledge from norms, regulations and so on. The knowledge and information are gathered in folders with row material and processes in how the employees should work. It is updated continuously to ensure that the tools and there work processes are current.

Yellow is a web-based tool that can be accessed from all RED Sweden employees, however it is inaccessible for other employees outside Sweden. It is a requirement in the company to use the processes and guidelines that are introduced in the system, for projects and organisational work. The employees can find information about project phases, project processes, document templates, software templates and guidelines, etc. Yellow have an own search function and process/ schedule structure, so information can be searchable, and the system is only in Swedish.

Each division in the company have their own page in Yellow where the processes that are concerning the division or department and are applicable for their work, is gathered in the same place. Design review is a part of Yellow process and all documentation about the system can be acceded in Yellow.

4.1.2 Project phase for infrastructure projects at RED, Sweden

Infrastructure projects often contain project participants from different technical areas fit in different departments within the company. A project can contain more than five different technical areas depending on the size of the project. RED, Sweden has an Intranet Yellow that describes different process and templates of project documentation. The project phase in an infrastructure project in RED Sweden can be described as the Figure 3 below shows. The process shown below is taken from Yellow, which also gives an indication of how the system process looks like.

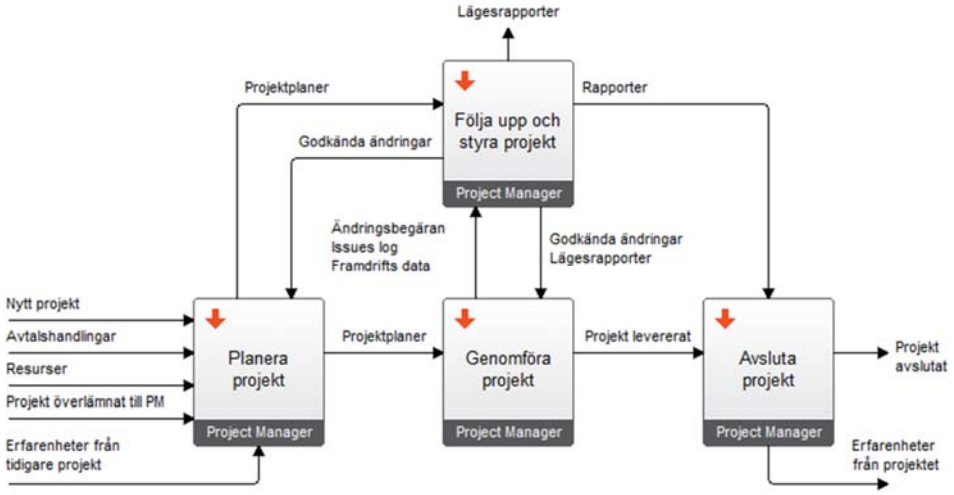


Figure 3 Project phase at RED Sweden for infrastructure projects

The four stages in the boxes above translated to English:

- *'Planera projekt'* – Plan a project
- *'Genomföra projekt'* – Implement a Project
- *'Avsluta projek*t' – Close a Project
- *'Följa upp och styra projekt'* – Monitor and control a project

Each box is one step in the project phase and the four steps are: *Plan projects, implementing project, close project and monitor and control project.* The arrows shows how the different steps are connected to each other and what are the outputs and inputs from each stage. The first step is to start planning the project and prepare the necessary

project control documentation. The resource allocation is conducted by the top management and the project manager does not have major influence on choosing its team member. This depends mostly on the fact that the company have several ongoing projects at the same time and there is not always the specific people available. The resource allocation is often flexible within a project, where project team members have quite high level of movement.

In the phase *planning,* the project manager is preparing document control documents such as risk management plan and time management plan together with the project team. This is where a first draft of Design review is produced and activities for executing the tasks are listed in the checklists. In the draft production of Design review is one technical manager for each technical area included. All necessary information and documentation that needs to be prepared for a project within the company RED can be found in there Intranet Yellow.

When the project is planned and all documentation for the planning executed, the project *implementation* phases starts. This stage can be six months long or three years, depending on the size and complexity of the project. This stage uses project management system Design review for controlling, planning and lesson learned documentation. It is here that, all the tasks are done and the requirements from the customer are met. In the end of this step the project produces a lesson- learned documentation that is send to the top management and quality manager at the department. The third phase, *closing a project*, means that the top manager is concluding the project together with the project manager. Here they discuss and look at the project success. This contributes a base to all documentation that is going to be archived, and the project is officially implemented and completed.

The last phase, *monitor and control project*, is a step that is going on during the whole project life time. The project manager is continuously reporting and interacts with the top manager, as well giving them reports of the project progress. The project manager also is monitoring and controlling the project team, to have the ability to detect changes and issues early within the project timeline. Design review is used to monitor and control projects. If some problems occur that the manager cannot solve alone, the top management will contribute with help.

In Sweden there are several types of project, depending in which phase they are, for an infrastructure project. The first step is called *Design Description/ project formation*, where the first phase of the project are taken. This is where the government/ local authorities decides that there is a need for the specific project and takes the decision to go forward with the project. Many of the requirements and investigations are made. The second phase is the *Planning* stage, where the project start to takes shape and the drawings and documentation produced for the specific task, if it's a road, bridge or tunnel. The last phase of the project is the *Construction* stage, where the actually task is conducted; build a road, bridge or tunnel. Often one company gets one of the phases, and RED, Sweden division infrastructure works with phase one or two. The company does not build the product, however they could contribute during the third phase with consulting services. Design review in current form can be applicable for just projects in the second phase of a project.

4.2 Design Review

Design review is a project knowledge management system, that's developed at the company RED Sweden, division infrastructure. The purpose of this system is to capture the knowledge that occurs during a project as well to help managers to control and supervise their projects more easily, and prevent some technical areas to move fast forward and other being after. This can lead to technical team not being sync and major mistakes with the technical documentation. It is as well tool that helps the customer and project team to understand the structure and phase of the project, and what is going to be completed in a certain time. Design review is mainly used for larger complex infrastructure projects where the project contains several technical disciplines, however it can also be used for smaller less complex projects.

4.2.1 Design Review background

Design review is a system that was developed already before the company RED bought the engineering company and the work started with a group of managers and technical directors that wanted to develop a system that can help project management to structure the projects in a more concrete way. The work started when there were clear evidences of, the lack of quality within the produced drawings and documents within a project. The top managers had a request to improve generally the project outcomes. The main problem that occur was that some technical areas worked faster than others and other

work slower than the medium phase of the project. This resulted in many retakes and repetition in the project, which affected the quality of the final product as well the budget and time aspect of the project. The concept is taken from the division Industry and how they worked in their projects, which at the time was a very successful concept. The main part that is taken from the industry system is the different phases.

The first versions of the system were just output and input checklist in Yellow for each step of the project phases. The user could see which inputs were needed in the specific phase of the project and what the outputs become in the end of the phase. Design review was a part of the Intranet Yellow, specific for infrastructure projects. The system was used in a few projects, but however it was not developed enough therefore the implementation was not successful. Project managers did not use it in planning and implementing projects, but also the top managers did not promote it externally and internally.

In 2012 the division Infrastructure decided to develop the system and make it more user-friendly and require that major infrastructure project should use the concept. A couple of project managers and technical experts worked with the development of the system during a year. The result was an easy understood process, with developed checklist, also called activity lists, with activities and a manual that explains how the system works. The system output and inputs point lists were as well improved. However, this was only applicable for infrastructure projects in the planning stage of the project.

After the work finished with publishing all documentation and processes in the Intranet, some education was hold. It was conducted in three offices in Sweden; Malmö, Stockholm, and Gothenburg. This education occasions were two hours long and only for project managers or technical managers within the division. Mainly they brought up during the education how the system works and what is the purpose of the system. Furthermore, the organisation has developed Design review checklist for railway projects and are developing new checklists for other phases of projects.

4.2.2 How does the Design Review system work?

Design review has five phases: DR1: Analyse requirements and Plan, DR2: Inventory and develop necessary documentation, DR3: Implementation of draft design, DR4: Implementation of detailed design and DR5: Final review and delivery. Each phase has a number DR1 to DR5 and they are connected to a time schedule. The phases reflects the project phases in the planning phase for an infrastructure project. After each phase the project team is required to have a knowledge management meeting where they discuss what has gone wrong and what went well. The system and all information in the system is in Swedish and for the phase planning of a project.

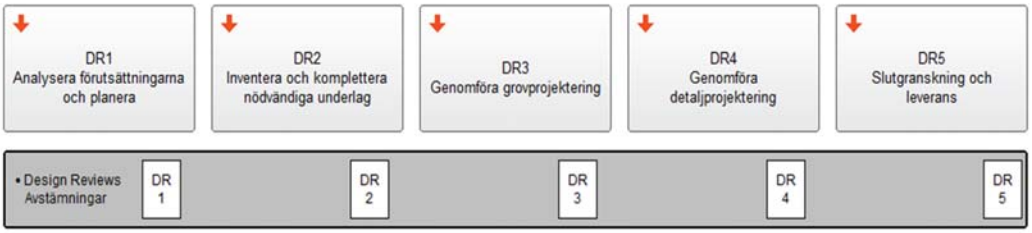


Figure 4 Design Review five phases

The Design review phase DR1 to DR5 contains information about the project process. One step further down in the system is a schedule of all common technical areas for a major road infrastructure project during the planning phase. Figure 5 illustrates the different technical areas within the Intranet, in the Intranet it is shown by clicking on the orange arrow shown in figure 4. An orange arrow indicate that it is a step lower in the system that shows more information about the topic/ area. This schedule is an example and the project manager can change the technical areas, either complete or remove an area, depending on the project. However, this can be changed in the project but not in the intranet Yellow. To change in Yellow a permission is needed from the quality manager and it is a few people within the company that have permission to work with Yellow.

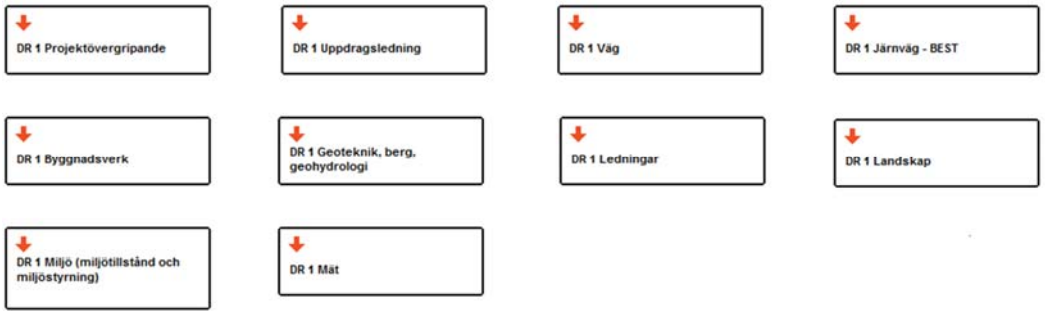


Figure 5 Design Review Technical areas

The next step in the process is the outputs and inputs lists. Every technical area contains an output and input list that is a step further down than the shown example in figure 5. It is not necessary that all technical areas have both input and output, some can have just inputs or outputs. The outputs /inputs list cannot be changed by a project manager or a project team, however they are just guidelines for the project manager and project team to understand what each technical area means and expected to deliver and produce during the project. Outputs are what each technical area will produce in the end of the phase, and inputs is what each technical area needs to be able to produce the task or tasks. For example, an input can be 'detail area map' of the project area from the customer delivered to the project and output finished meeting plan. Figure shows an example of output /input list.

[redacted] **DR 1 Väg**

Leveranser in
- Typsektioner
- Väggeometrier inkl. korsningsutformingar
- Trafiktekniskt PM
- Utformning sidoanläggningar
- Hastighetsstandarder
- Vägområdes- och detaljplanegränser
- Anläggningsmodeller

Leveranser ut
- Underlag till tids- och resursplan
- Underlag till genomförandebeskrivning och projekteringsbudget
- Genomförd Design Review Steg 1
- Lista över oklarheter och saknade underlag

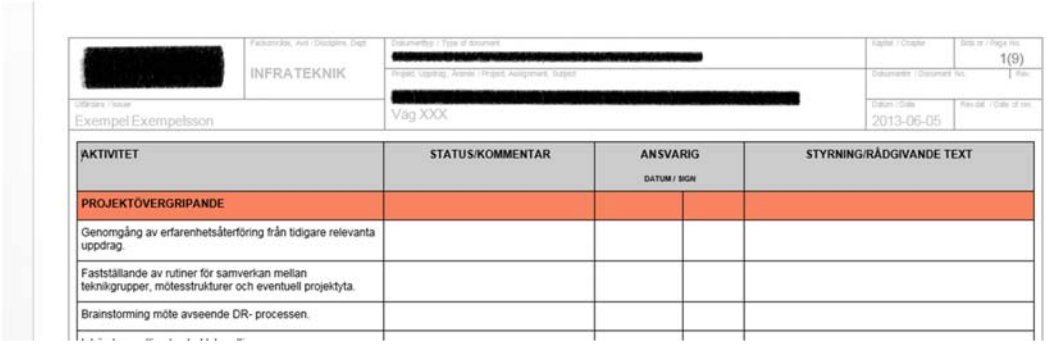
Figure 6 Example Outputs and Inputs list DR 1, Technical area Road

Each Design review phase have their own checklist that contains different activities for every technical group in the project. The project manager can get the lists from Yellow

and customize it for the specific project by complementing with activities or removing the activities that are not necessary. The list are as separate word documents in the system and they can be downloaded by everyone as well as edited and adapted for a specific task. Which technical groups and activities are included is decided by the project management team during stage DR1. It is in the planning phases of a project that Design review is planned and all activities are developed, however this checklist are so called live documents. Live documents in this concept means that the document should continually be updated during the whole project.

Furthermore, Design review has a manual that describes how the system works and examples are given for better understanding. Each phase of the system is explained and a short description of how the system was developed is given. The manual gives also a short description on how the project managers should work with the system, who should be the responsible in the project for the Design review checklist and how they can handle different challenges that can occur during the project phase. However, these are just recommendations and it is not written or expressed in the manual that the project manager needs to follow them. The manual is in word document and all information is given in text format.

4.2.2.1 Checklist



[redacted] | INFRATEKNIK | [redacted] | 1(9)

Exempel Exempelsson | Väg XXX | 2013-06-05

AKTIVITET	STATUS/KOMMENTAR	ANSVARIG DATUM / SIGN		STYRNING/RÅDGIVANDE TEXT
PROJEKTÖVERGRIPANDE				
Genomgång av erfarenhetsåterföring från tidigare relevanta uppdrag.				
Fastställande av rutiner för samverkan mellan teknikgrupper, mötesstrukturer och eventuell projektyta.				
Brainstorming möte avseende DR- processen.				

Figure 7 Example Gross lists with activities

The activity list is divided in four columns: activity, status, responsible person, and comments/ tips. The orange line outlines the technical area that the activities concerns. All activity lists, DR1 to DR 5 have the same layout and they contain the same technical area that are included in the project. The project manager or the person responsible for Design review cannot add a technical area later in the project phases, for example in DR3, this can only be changed during the planning phase. However they can amend the

task written towards each technical area within the checklist. The checklist have some activities that are general and concern all technical areas, therefore this activities are put in a category together in the beginning of each list to easily manage them. They are called general activities for the project.

The activities that are written should be of that nature that you can easily mark them as completed or not completed, for example, one activity could be: make the schedule for all planning meetings. One activity should have one allocated owner and they will be responsible for the completion of the activity. However, there should be one responsible person for monitoring and controlling all checklist for one specific technical area. For example, the technical manager for road design in the project should have control and monitoring all activities concerning road, and give feedback to the project member that is responsible for Design review process. Often the responsible person for Design review processes is the project manager, but if the project is complex and large the task can be delegated to someone within the project organisation.

The checklists are signed after each completed task from the responsible person for that specific task, and when the phases are finished, and all activities completed the project manager and / or the responsible person for Design review is signing the document and confirming that everything has been completed according to plan. As it is shown in Figure 7 each activity has tips/ comment column, where it is given opportunity to wright some examples, tips or recommendation for the activity or for further work. This is the knowledge management process.

In the end of each Design review phase the project needs to have a knowledge management meeting / lesson – learned session where they talk through what was produced and how it went. It is the forum where things that must be improved or change for the next stage or in general for other projects, can be discussed. The questions that are asked for example: What was good and went well, that can be used again and documented as success factor. What went less well and how can we avoid the mistakes from happening again? Who will precipitate in this meeting or session is up to the project manager or project management team to decided, but however it is recommended that so many a possible from the project team participate.

4.2.3 System functions

The functions with Design review are the following (division infrastructure RED):

1. Manage external and internal changes that can occur during a project
2. Monitor the technical areas phase in a project
3. Plan the activities in the project
4. Storage the knowledge that occur during a project
5. Lesson – learned documentation
6. Involve and work together with project client

Below will a short description of each function fallow.

1. Manage external and internal changes that can occur during a project.

In larger complex projects where there are several technical areas, often some changes occur during the project life time. The changes can be of different types, some are that the customer is changing the requirements for the project, the project team loses a key member, or some technical design changes occurs. This types of changes affects the project phases and can have a negative impact on the project. Furthermore, the division infrastructure uses Design review to minimise the damages that can occur from changed requirements. Design review allowed the project manager to discover and address the changes directly without necessarily meaning that it will be retakes for all work done within the project. Even so if it is not avoidable to do a retake, because the early identification of the change means the retake will be manageable.

2. Monitor the technical areas phase in a project

The second benefit with the Design review is that does not allow for the technical areas included in the project to move in different phases. This means that all technical areas move in the same phases and they are working in the same DR stage. To be able to go to the next stage it is required from the system that all technical areas are finished with the stage the whole project is in. However, it is not the system in itself that stops to go further on the project; it is the project manager and project management team that stops the technical area that is moving too fast forward. With the checklist the project manager or project management team evaluate and monitor the different technical areas progress and compare to the financial and time management.

3. Plan the activities in the project

The checklist with the activities are beneficial both for the project manager / project management team and the project team. They help to structure more precisely what is needed to be done during the different phases of the project. Project team is involved in the work with developing the checklist, which leads that there are more involved in the work of the project and can see the whole picture. Each activity has an owner and all project members can see who is working with what. The interaction and communication between team participants can increase with the design review system

4. Storage the knowledge that occur during a project

Design Review system allows and gives possibility to all project members to document knowledge successively during the project time. The checklist are live documents where the whole project team is working with and constantly updating if it's necessary. After each phase is finished the project manager evaluates the checklist.

5. Lesson – learned documentation

After each Design review phase the project members have a lesson- learned meeting where they evaluate the phases, to see what has gone well and what has not gone well. If some improvements are needed this is documented and taken to consideration to the next Design review phase. The meeting has an already specific agenda where a specific set of questions need to be asked and topics to be covered.

6. Involve and work together with project client

The project customer is involved during the whole Design review and can attend the final meetings for each Design review phases. The customer also receives the final checklist after each Design review phase. The system helps the customer to understand the project phase and see what is going to be completed in a certain time with in the project.

4.2.4 Projects that use the system

Design Review has been used in several projects during the last ten years. The pilot project was a road design project during planning phases, with the transport department as customer. The project was longer than five years and several project members were

replaced during this period. Design review was used until phase DR 3, Implementation of draft design. The reason to why the project did not continue with the system is unknown, however some indications from project participants and top management is given; the system could not handle the changes and retakes that occur in the project.

The second project where the system was implemented in, was a design of a bridge, in the planning phase of the project. A large project with more than 70 participants in the company and the customer was the traffic department in Gothenburg city. Well planned Design review process in the beginning with connection to the economic and time management of the project. One technical manager that had responsibility for the Design review checklist and the progress in the projects. Design review was used until Design review phase 3, Implementation of draft design. The reason to why the project did not continue with the system is unknown. Indication to the stop from project participant and top management is given; change of project manager and key members within project organisation, the lack of understanding from the project members, time management difficulties and changes within the requirements in the project.

Some others project such as railway design projects and road projects, as well projects that have a combination of both railway and road design are designed by using Design review. To ongoing major infrastructure projects, have the system Design review. One of the projects is in the beginning of the process and the other have reached DR 3. The implementation of Design review system is successful so far, for this specific project.

5 Result

The result, as described in the Method chapter 2, is established on interviews, interactions with the employees during the research time and my own experience from working at the company.

The first questions that was asked during the interviews was around which facts within a project are essential to it, in order to have a successful outcome, from their own perspective and viewpoint. The answer given by the participants can be summarised in three key factors: well-planned time schedule, well- planned structure of the project and good communication. One project manager added that it is also very important to have common goals to work towards to within the project and all participant of the project should have the same understanding what is expected from them to achieve and deliver. This is outlining what kind of goals a knowledge management system should have for the investigated organisation and what the company is striving for. Design review is develop to help, to organise and structure a project, as well set up a specific timeline where the different task can be completed in a specific order.

5.1 Organisational Culture

The organisational culture of the company case study shows that it has a view of knowledge as possession. The new employees are guided to gain information about the organisation from the already existing tools, process, and documents rather than talk to employees and observe the organisation behaviour. Observation during the research time at the company indicated that there is some tendency to see knowledge as practice between the co-workers; however, the organisation emphasis knowledge as possession.

The organisational culture and attitude towards knowledge within the organisation are positive and people tend to work, communicate, and share with each other. It often happens during the coffee or lunch break, or in some informal way. Employees tend to talk with each other about the projects and share their own experience from the project with other organisational members. There is a clear pattern that the organisation members are comfortable with shearing knowledge with each other and a trust between the company employees. During the interview many inform that they tend to ask each other on help if something was unclear or they needed to find some information.

The company RED has an Intranet where the most of the information about the company quality systems and other documentation such as process and templates is stored within. This is where as well the Design Review tool can be found. When the interviewees were questioned if they have used the intranet to find information about the Design Review and other relevant information, such as how to work in projects one employee stated that:

I know I can find information there, but it is too large and difficult to find information in an easy way. (TM2)

The majority of the respond were similar to the above stated example, and it was clear that the Intranet as a tool to receive information was not used by the employees.

Furthermore, the project managers were questioned on how they find information and knowledge about previous projects and if they use it. The answer that the majority of the interviewed provided with, was to talk with employees that have been working on similar projects. The new employees within the company gave similar answer to the question. Which develop further questions around the topic. The result was that they consulted with the people they knew, and by asking around, they found the information they needed. There were no evidence that the employees used design review or the Intranet to gain information about similar project that have been conducted within the company.

As it is stated above in Chapter 4 Company case study, in major infrastructure projects it is often a several technical areas that collaborate with each other within a project. The interviewee thought that generally the knowledge management in the company was in a good level, where knowledge was transfer between project participant, projects and top management. They had an open attitude towards a new system and open-mindedness and willingness to share knowledge between each other. There is a high tolerance regarding mistakes within the organisation, which enhance the trust based organisational culture.

Furthermore, questions around lesson learned sessions and if the employees know, where the lesson-learned documentation is stored, ware asked. The lesson learned documentation is captured in the project database and sometimes in a project place where all lesson learned documentation is stored. However, there was a confusion about where exactly this documentation can be found and all interviewed answered differently however, not depending on their background or position. Some of them thought that this was stored in the project website; other thought it was in a common storage place for this type of documentation and the rest did not know where this documentation was to be found.

5.2 Project management

Top management support is one of the key success factors if a KMS can be successfully implemented within an organisation. Open questions around top management support for the Design Review ware asked to the interviewed.

The main request, when it comes to Design review, from the interviewees was that they had a need for education of the system. Many felt that the system was pushed forward from the top management without any further explanation on why having this system and the functions of the system. The lack of information led to a resistance to use the system and misunderstanding of what its purpose is. During the interviews, suggestions were given on what kind of education they would like to participate in. Some suggested a short session on Design review during project meetings, team meetings or during lunch time. Even if the need of education was clear, many of the participants had not read the already existing documentation, such as design review manual, look at the output input list and the checklist in the Intranet.

Furthermore, Design review checklists are live documents and you can update the list after each project that it has been used in. The improvement is conducted by someone in the company, but it is not stated clearly who that person is. No information could be found about who is updating the checklist and putting new information in them. Neither was there any information on how often this checklist are updated, who is responsible for them and what the process of updating the lists is.

The interviewees did suggest that if the system is going to work and be a successful tool within the project, there is a need of a responsible person for the system during the project and after within the company. With that is meant that one person is responsible that everyone in the project team is using the checklist and updating them continuously, and one person within the company has the responsibility that the main checklists are updated after each project. Furthermore, questions about the Design review manual and output input list was asked. Almost nobody knew that there was a manual that explained the system and that it is output input lists in Yellow. Few employees from the interviewed had read the manual and they thought it was too much text and did not gave a clear picture on how the system works. The output and input lists are not used at all by the project team and no one knew that they existed from the interviewed.

Furthermore, before starting the interviews I wanted to see what kind of information was accessible in the Intranet and realised that none of the employees had access to the Design review system. By talking to the top management about this access restriction, it was clear that Design review was not accessible to any members of the organisation beside one top manager that had last updated the documentation in the Intranet.

5.3 User friendly

The question if the Design Review is user friendly was ask during the interviews. One employees pointed out that:

"It is too difficult to use because there is so much information in the checklist, and you do not know what to use" (TM1)

However the structure of the checklist is to have as much information as possible, so it covers all technical areas. One other interviewee stated that Design review is not user friendly because it has an IT system that is not suited for the purpose of the tool. To summaries the response from the all interviews; the majority thought that the Design review was not user friendly. Example from previous projects were given where Design review was used. Two of the exemplified projects stop using the system after DR3 due to time pressure and to many project changes, so the system could not handle them.

Follow up question around Intranet and if this is a user-friendly tool was examined. The largest problem that occurred with the Intranet was that it is too large, and the searching tool is too difficult. The searching engine is built in a way that you need to enter the "right word" to find the document or process. It is also possible to use the processes to search for documentation by clicking on links in the process schedule that guide to the document, however then the user needs to have knowledge in which part of the process this document or information is. The interviewees that had worked for a longer time in the company mentioned that they find information in the system, but they have already saved the search, and have the documents and process that they use as saved searches.

Furthermore, all participants were open minded towards the system and had high expectations of the potentials with the system. They say; “it is a good tool that can help them a lot in their work, no matter if they were project managers or technical managers”. However, the interviewees felt that the system needs to be further developed and have more functions. For example have links to main project templates, documents, more columns that the activity could be specified better and better IT futures to simplify the checklists structure and search method.

5.4 Competitive advantage

With competitive advantage is meant if the company benefits from having this system and it is competitive stronger towards other companies in the same expertise field. From interaction with line managers and my own experience from projects; Design review is giving the company a benefit and competitive advantage. The company clients have shown clear interest for the system and corresponded positively towards the tools. The opportunity to be involved as a client in the process and get information about the progress of the projects is appreciated by the clients of the two exemplified projects, where design review was used.

In one of this projects the client was involved with reviewing the design review checklist and participating in the process. Line manager explains that in this specific project the company had an advantage by having the system in place, because the client was interested and wanted to be involved in the projects different phases. Observations show that the client appreciated the involvement and it benefit the company’s reputation positively.

5.5 IT and IT Infrastructure

The technical aspect of the system was also brought up during the interview and if there was a need of improving the IT futures of the system, by for example using excel and /or other web-based system. The interviewee recognised that a better tool than Microsoft Word should be better to use and a more fit to purpose tool with more filtering functions. Some suggestions about using another web-based tool was made. There were also some that felt word was a good tool, because when you write it corrects spelling mistakes, however for example excel does not do that automatically.

Design review does not address the knowledge sharing in an officiant way. There are no technical tools provided to share knowledge between project members and provide them with a forum where they can interact with each other. During the interviews were clear that the technical tools were not suited for purpose.

5.6 Knowledge sharing, retrieving and storage

There have been three projects that have used design review, and all projects ended using the system when they achieved step DR 3. The project members of the last two project were interviewed and the question on why this has happened were asked, as well my own experience on being part on one of the projects. The result from the conversations and interviews showed that the main reason is such that, when the project begins to be complex and time critical, no one within the project has time to follow Design Review process. This is due to that design review is time consuming. Even the top management recognised that this is the main challenge with implementing the system. There is none project that use the system from start to end and there are no incitements in place to encourage use of the system. The value of the Design review has not been seen and no outlined indicators to help measure the benefits of Design review.

Often the project started with well-structured process, but overtime the process was poorly used, mostly because of the time pressure and budget overruns within the project. On the other hand, the project managers explained that they use Design review in their projects to have a structured process.

Furthermore, one of the purposes of being sustainable is to not reinvent and re- produce already existing information. KMS can help to have a sustainable approach within an

organisation by having stored and capture the already existing knowledge within the organisation. During the interviews, open questions were asked about lesson – learned documentation, what they thought about it and if they found it useful.

I think it is useful knowledge form the lesson learned meetings, and it captures the whole picture of how the project was and see that the all project members do not think in the same way about the project. (M3)

The result is that project managers and technical managers do not use the document after it is completed, however they think that it is beneficial to have lesson- learned sessions in the project. All interviewees agreed on that the session in itself help them to reflect about their own work and on the challenges that occurs and how they could be avoided. The interviewees point out that the lesson learned meetings can be made during the project, when a task or a goal is meet, to capture all knowledge when it is still new and not just in the end. The interviewed were not aware that Design review provides opportunity to have a lesson learned session after each checklist is finished.

5.7 Result Matrix

KMS futures	**KMS theory**	**Design Review**
Futures for the organisation		
1. Organisational culture	Is there a positive knowledge sharing cultural within the company?	Yes
2. Project management	Is there good top management support and management benefits?	No
Futures for the tool Design review		
3. User friendly	Is the system user friendly?	No
4. Competitive advantage	Does the Design review have competitive advantage for the company?	Yes
5. IT infrastructure	Does design review have the necessary IT and IT- infrastructure?	No
6. Knowledge sharing, retrieving and storage	Does Design review helps to share, retrieve and store knowledge?	No

6 Analysis and discussion

Managing knowledge within an organisation and a company has become a concept that many companies have taken into consideration and what is knowledge management and how to use it in a successful way, it is a topic that has been discussed in the last years.

6.1 Organisational Culture

The result of company case study shows overall that project members have an open attitude towards knowledge management, knowledge sharing and knowledge management systems both for organisation and projects. As Damodaran L. e.g. (2000) outlines in it is study the organisational culture is one of the important facts for successful implementation of a KMS.

The organisational cultural within the company RED shows a behaviour of sharing information by interacting with co-workers and that knowledge is seen both as practice and possession. Even so if the top management is emphasising knowledge as possession and the use of their internal knowledge management systems and tools, employees tend to share own experience from projects and what is known as best practice, because it is an informal way of sharing knowledge. This cultural behaviour is as well transferred to the new employees, where they are advised to use the different database with the organisational information such as Intranet but they as well find their way by asking around colleges. Observation indicates that the Intranet is used by a limited amount of people within the organisation. During interviews, it was clearly stated that it was difficult to find information within the Intranet, which led to resistance for using the database. As it is stated in the theoretical chapter organisational behaviour affects organisational culture, (Thierauf R., 1999) the general understanding within the company is that the Intranet is too big and difficult to find information in. Which indirectly leads to the conclusion that if a KMS is implemented within an already existing tool that is not used by the employees, then Design review will not be used either.

Furthermore, there is a trust between co –workers and they have a knowledge sharing culture. This could be observed during the interviews that many relied on the fact that they could ask a co-worker for information and guidance. However, by retrieving the

knowledge by verbal communication, this makes it difficult to employees that does not have established network within the organisation. There is a clear positive attitude between the employees and a positive attitude towards the design review system, which is underlined in the theoretical framework of this report that these factors are one of the key success factors for implementing a KMS (He W. e.g., 2009; Frost A., 2014).

Project teams usually are construct to complete a specific task for a specific time and budget. The team is build up from various people with different backgrounds or/and experience (PMBOK Guide, 2008). The major challenge within the project is communication and project structure, which are as well the key success factors for a project. Design review is enhancing the project communication and structure, and the purpose is to help project members to communicate with each other in a structured way. However, this is enhancing the communication regarding the work process; by having regular meetings to discuss project progress between team members. In the other hand it does not address the other project communication and does not provide any other communication tools. Due to lack of project that has used the system there is no evidence that the system improves the communication within the project.

During the research time at the company organisation employees and projects members showed a positive attitude towards the Design review tool and the general high knowledge sharing culture. There were clear benefits from having a lesson learned session and retrieve the information from previous projects. Even so, the question remains why no one within the company was aware of the fact that the Design review was not accessible to anyone and no one knew exactly where the lesson learned session's documentation were stored.

6.2 Project management

If a KMS will have a successful implementation, it needs to have the full support from the senior management. (Weber R., 2007) The top management within the company RED is supporting Design review as a system and encourages employees to use it in their projects. However, the results of the interview shows that employees had not the appropriate education and understanding on why to use the system. Top management request a use of the system without explaining the benefits, functions and purpose of the system. There has been some education provided in the beginning of the

implementation process. Among the interviewees, no one had attended that specific course and even if there was a provided education, it was reaching to a limited audience by not being continues and accessible to everyone. The education was provided to a specific group of people, usually working as project managers or similar positions. This is limitation to the implementation of Design review, because everyone in the project is required to use it but not everyone gets to attend the training. Even if there is a clear encouragement from the top management it could be difficult to implement something that the employees do not understand.

Furthermore, the ownership of the Design review is not defined, and it lacks a clear guidance of whom has the responsibility to update and develop the system. However, it's specified in the Design review manual who is responsible to own the checklist within a project, and there are given suggestion on who is the most suitable person for that task. The recommendation in the Design review manual are to use a technical manager in each area that have daily contact with its team, in that way it is more easy for them to monitor the checklists. The interviews result showed that few people have read the manual and knew that there was a manual. However, there is no responsible person/ team to develop the gross checklist, and manual and other system functions. By not giving or tacking an ownership for the development of a system, it results in being neglect. Therefore there is a need to won process and high top management support to be able to have successful implementation of KMS (Weber R., 2007)

Top project management attitude towards the system is clear; they are positive and are encourage and promoting the use of it. The lack of not providing the appropriate education and tool development is the key factor of not the tool being completely implemented and neglected.

6.3 User friendly

Knowledge management systems benefit from being user friendly and research shows that user friendly systems are more successful implemented within the organisations (Singh J., 2013). Design review is easy to use but does not provide the necessary functions, which often leads to misunderstanding the purpose of the system. This could be interpreted in different ways, but the respond during the interviews if they find the system user-friendly they responded "yes". However, the follow up questions about in

which projects it has been used and how the result showed; there was a clear failure. Even so if this was because of external factors, it shows that the system is not enough developed to handle time pressure and changes within a project.

In the result of this research was stated that the system is not user friendly and employees tend to not use the system during the whole project life cycle. The examples of the project show that projects tend to stop use the system when there is time pressure within the project and to many changes occur to the project scope. However, the system is built to help time management and changes, by having a clear understanding on the different task that are required to be completed at a specific time. The system does not meet the outlined facts regarding what is user friendly system.

If Design review has not been accessible for any of the projects member for a period and no one realised that this was the case, how can we prove that the system is user friendly.

6.4 Competitive advantage

The theory demonstrate that there is a competitive advantage by having a knowledge management system, due to the increasing amount of organisations with knowledge workers and increasing demand for knowledge management within projects and organisations. A knowledge management system helps the organisation to keep the knowledge and develop it within a structured and organised way. These systems are an advantage for project-based organisations, and helps the project manager to control and monitor the project objectives and goals (Damodaran L. e.g., 2000)

The company RED has used Design review in tenders for different projects and demonstrate a way of monitoring and managing projects. Design Review helps to understand where on the time line the project is and the checklist monitor the actual process of the work, by having measurable milestones. Design Review allows the client to be part of the system by receiving a copy of each checklist and have the opportunity to attend the projects meeting where the checklist are finalised. For an infrastructure project where it is common for the customer to receive its product in the end, Design review allows the client to be involved during the whole project phase and receive the Design review checklist as an assurance of the work process.

However, this has its advantages and disadvantages. During one project meeting at the company RED, where Design review was use and the client was involved, some difficulties occur. The client thought that the Design review checklist should be used thoroughly, and all activities will be meet to the given time without any change occurring to the process or documents. This causes problems, because as it is stated above infrastructure projects are complex and not isolated, therefore it always occur some changes during a project phase. Consequently, the Design review checklist will be updated and changed continually, depending on the changes of scope that may occur. One other challenge with including the client in the process is that some project members cannot fully be honest with the result of their task, because it is often a fear for failure and making mistakes in front of the client. It is difficult to admit that the progress of the project is not going in the phase that is calculated, in front of the client.

Design Review meets the goals as a competitive advantage system for the company. From a conversation with top management, there was a clear trend to use the Design review in tenders for infrastructure projects and its success as a system towards the client. There is a clear competitive advantage for the company to have Design review.

6.5 IT and IT Infrastructure

To have a suitable IT for a KMS is one of the key success factors for implementation of the system. Many organisations today have an internal IT infrastructure where a KMS could be connected and implemented to (Wu J. e.g., 2006). The company RED have a global IT infrastructure and they have implemented Design review within the existing IT structure by using the Intranet. However this just relevant for the specific department and not the whole company. As mentioned Design review is consisting of flowcharts, manuals, output/inputs list and checklist that all are stored in the Intranet. The checklist and manual are develop with the Microsoft office software, a word document, and the output/ input list are using the Intranets software. The checklist are alive documents and needs to be updated continuously during the project time and after each project for the next coming. (Chapter 4, Company case study) The word format is easy to use and the result from the interviews shows that it fulfils some of the desired functions by the organisations members, such as autocorrecting and a system that everyone knows how to use. On the other hand, the software does not cover some of the essential functions for a KMS. The system in itself does not give any opportunity

to communicate with project or organisation members and it does not have search engine to make the knowledge more accessible. KMS can have functions such as online forum where you can chat to co-workers and project members, and share knowledge in an informal way (Wu J. e.g., 2006)

Furthermore, the IT software of the Intranet is a web-based system were all organisational information and knowledge is stored in form of documents, flowcharts, process and checklist. (Chapter 4, Company case study) During the interviews it was clear that employees avoid to use the Intranet and think it is too complex and difficult to find information within it. The search engine was one of the functions pointed out as difficult to use. Implementing a system within an already existing system that employees find not user friendly is not increasing the accessibility of Design review. Design review does not meet the defined IT functions for a KMS.

6.6 Knowledge sharing, retrieving and storage

The main purpose with a KMS is to share, retrieve and storage knowledge in an officiant way. The challenge is that this depends on the users to share their knowledge and as well rely on using other organisations knowledge (Singh J., 2013). Design review relies on the users to update the system and use the knowledge that is there. After each project is complete, the thought is to update the checklist with more information. The checklist in itself could be compare to bullet list where each category has actions that need to be completed for a specific time. There is an owner allocated to each action/ task. (Chapter 4, company case study) Knowledge could be received from the checklist and the other documentation, but this is limited to just specific type of project and one kind of knowledge. It does enchase the communication between project members by giving them opportunity to see who is doing what and when. However, this in itself does not provide a forum for project members to communicate directly to each other and share knowledge. By not having access to the Design review for several months and no one had realised this, can be interpreted that the system is not use for day to day knowledge sharing. The result from the interviews strengthens that Design review does not have a completely developed knowledge sharing functions.

Furthermore, often after an infrastructure project is completed a lesson learned session is conducted to summaries the knowledge retrieved and document it to be later stored. What is not often considered that in larger complex projects there is a large movement

between members and if you have the lesson learned session in the end you may lose some of the knowledge. Design Review allowed to have the lesson learned sessions after each phase of the projects is completed, which minimise the risk of losing the knowledge.

For the projects that are not using Design review the company uses a lesson – learned documentation after each project is finished and this is a requirement from the top management. This documentation is given to the top management and the quality manager in the department for further evaluation. If some measures are needed to be taken to eliminate the problem, they will be further evaluated and implemented.

Furthermore, in many projects where the outcome is not successful the reason for that seems to be that the client changes the requirements and that the key resources stop working with the project. Design Review does not tackle this kind of changes within the project and it realise fully on the project members to have the allocated time to update and fallow the process. The client tends to change the requirements of the project without realising that this will have an effect of the project outcome, often as overruns of budget and time. Even if the change is a small it often affects the whole project and not just the specific technical area. By having a well-used Design review the risk for requirements change can be minimised, because it is easy to show the client what kind of effect the change may have to the project development. However, this depends completely on the user's knowledge and willingness to work with the system.

7 Conclusion

In this chapter the conclusion of the research will be outline as well, the question asked in the problem formulation will be answered.

- *What is the purpose of knowledge management system within a project oriented organisation and the company case study, RED?*

The purpose of KMS is to have a system where it enhances and helps to store, share and retrieve knowledge within an organisation. The implementation of such a system can be difficult and many factors can contribute to a failure. A KMS needs to fit within the organisation culture and have a top management support to be accepted by its users. If the organisations member are going to use the system it needs to be user friendly with a fit for purpose IT functions that enchase knowledge sharing. The conclusion is that a system in idea works good and all benefits can be easy retrieved, however in reality to find a system that fulfils all the functions of a KMS and as well it's accepted by the organisation and fully implemented, can be difficult.

Design review is a tool for a project and has project management functions. Projects have their own culture and way of working. This can have its advantages but as well disadvantages. In reality, one thing can work well for some organisations and for others it could be something else. If Design review was developed further to have more functions it could be a KMS.

- *What kind of challenges and obstacles can occur with implementing the KMS within an organisation?*

One of the biggest challenge with implementing a KMS, based on this research, is the organisational culture. If the organisations member do not see the benefits, it could result in not using the system. Organisational culture is difficult to change and the KMS will benefit of working around the cultural aspects and fit in the culture. However, it is essential that the organisational culture have a knowledge sharing, and trustfulness and mistake tolerance imbedded. To enable this, the key is the top management involvement and support. Lack of top management support in form of providing education, opportunity to use the system can resolve in unsuccessful implementation. One of the

other key factors is the IT system and how user friendly it is. Design review does not achieve the criteria for user friendly and an IT system that meets all needs. This is one of the most essential criteria's in showing how well the organisation members are using the system. The company RED had the willingness to implement Design review, and they have an organisational cultural that is suitable for a KMS.

- *How does Design review work and how well is the system implemented within the organisation?*

During the research time within the company, a positive attitude towards the system could be seen. However, all interaction with the company employees indicate that actually they do not know what the system is for and how they can use it. Especially new employees within the company. It is evident that there is a need of further education of Design review to all employees within the company and more top management support.

Furthermore, the knowledge management within the company is insufficient when it comes to create, capture, share and application the knowledge from a project in a formal way. The lesson learned documentation is not used more than the top management and none instruction on how to put knowledge in Design review is specified. The knowledge that the project participant has stays with them and it is not transferred or shared in an effective way, more than the informal way of sharing knowledge by talking to each other. Furthermore, the Intranet Yellow have a lot of information and knowledge, and contains more or less all functions that a KMS should, but is too much information and difficult to find. Here as well the IT functions are not fit for purpose.

- *Is Design Review a KMS for projects and how can it be improved?*

If the system Design review is compared to the definition of a knowledge management system, the conclusion can be made that Design review is not a KMS. It is a basic form of project management tool that have an essence of a KMS. However, Design review have a potential to be further develop to a more useful project knowledge management tool. The system in itself has a great potential and can help with project management, knowledge sharing, retrieving and storing in a non-complicated way.

7.1 Recommendation for development of the system

The Design review system can be further developed to be a complete knowledge management system for projects. Below are some development areas that are recommended:

- Develop a system for who is responsible to update the existing checklist after each project.
- Develop the information in the checklist, such as add more columns with information to be able to capture all knowledge occurring during the project
- Develop the technical aspects of the system, such as consider change of the technology and add more function to make the system more user friendly.
- Provided education for the whole organisation about Design review
- More support from the top management

7.2 Recommendation for further study

This research just scratches on the surface of how it works in projects and if the organisation use a knowledge management system. There is a need in further research on where the problems are, when that many projects have overruns in time and budget. There is documentation from the lesson learned meetings that can be over look at and see where the project tends to fail or not fail, as well look over the Design review checklist that are made in previous projects and analyses.

In a further study there could be look at the project management documentation and see what is causing the overruns in the projects. The project management of a project describes which technical areas are not finished with their tasks, and this can give an indication to where it is a need to put more resources as well make changes to improve the work. This study will show how to improve the Design review system as well the project success.

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