TAMPEREEN TEKNILLINEN YLIOPISTO
TAMPERE UNIVERSITY OF TECHNOLOGY

JUSSI MÄKITALO

IMPROVING PROJECT AND PROJECT PORTFOLIO MANAGEMENT WITH THE HELP OF INFORMATION SHARING

Master of Science Thesis

Professor Mika Hannula and Associate Professor (tenure track) Nina Helander have been appointed as the examiners at the Council Meeting of the Faculty of Business and Built Environment on April 8th, 2015

ABSTRACT

JUSSI MÄKITALO: IMPROVING PROJECT AND PROJECT PORTFOLIO MANAGEMENT WITH THE HELP OF INFORMATION SHARING
Tampere University of Technology
Master of Science Thesis, 72 pages, 1 Appendix page
April 2015
Master's Degree Programme in Knowledge Management
Major: Knowledge Management
Examiners: Professor Mika Hannula, Associate Professor (tenure track) Nina Helander

Keywords: Project Management, Project Portfolio Management, Information Sharing, Information, Project Portfolio, Project

This research examines how project management and project portfolio management can be improved with the help of information sharing. Nowadays organizations are facing increased competition in everywhere and they need to be more cost-effective in order to survive in the markets.

The amount of information is enormous and decision makers need to have free access to it. By identifying information flows related to project management and project portfolio management it is possible to improve the project and project portfolio management in the case organization. The research consists of literature review and empirical study which was done in semi-structured interviews.

As a result of this study, several use cases were identified and each of them illustrates the information flow that should take place in different processes during the project execution. The implementation of these use cases to the case organization does not require large monetary investments. With the help of the results it is possible to improve overall project and project portfolio management in the case organization. Identified use cases will provide information from the project level to the project portfolio level and by that, project portfolio decisions can be made more accurately.

TIIVISTELMÄ

JUSSI MÄKITALO: PROJEKTINHALLINNAN JA PROJEKTIPORTFOLION HALLINNAN PARANTAMINEN INFORMAATION JAKAMISEN AVULLA
Tampereen teknillinen yliopisto
Diplomityö, 72 sivua, 1 liitesivu
Huhtikuu 2015
Tietojohtamisen diplomi-insinöörin tutkinto-ohjelma
Pääaine: Tiedonhallinta
Tarkastajat: professori Mika Hannula, Associate Professor (tenure track) Nina Helander

Avainsanat: Projektinhallinta, projektiportfolion hallinta, informaation jakaminen, informaatio, projektiportfolio, projekti.

Tämä tutkimus tarkastelee, miten projektinhallinnan ja projektiportfolion hallintaa voidaan parantaa informaation jakamisen avulla. Nykyään organisaatiot kohtaavat yhä enemmän kilpailua ja niiden on oltava kustannustehokkaampia selviytyäkseen markkinoilla.

Informaation määrä on nykyään valtava ja organisaation päätöksen tekijöillä tulee olla vapaa pääsy siihen. Tunnistamalla informaation virran projektin hallintaan ja projektiportfolion hallintaan liittyen on mahdollista parantaa projektin hallintaa ja projektiportfolion hallintaa case-organisaatiossa. Tutkimus koostuu kirjallisuuskatsauksesta ja empiirisestä tutkielmasta, joka tehtiin semi-strukturoituina haastatteluina.

Tutkimuksen tuloksena tunnistettiin useita käyttötapauksia ja jokainen niistä havainnollistaa informaatiovirtoja, joiden avulla voidaan parantaa projektin hallintaa ja projektiportfolion hallintaa. Näiden käyttötapausten jalkauttaminen case-organisaatiossa ei vaadi suuria rahallisia panostuksia. Tutkimusten tulosten avulla on case-organisaatiossa mahdollista parantaa sekä projektin että projektiportfolion hallintaa. Tunnistetut käyttötapaukset informaation jakamisessa auttavat projekteja tuottamaan informaatiota projektiportfolio tasolle, joka mahdollistaa parempien päätösten tekemisen projektiportfoliossa.

PREFACE

I want to thank everyone who have been supporting me during my studies. Now it is time to close the final chapter of my Master's Thesis which has been quite a long journey.

Special thanks to Mika Hannula, Nina Helander and Elli Kalliokoski who were guiding and supervising me during this project.

The biggest thanks goes to my family for their support and guidance throughout my entire studies, all the way from the first grade to this day.

"Eteenpäin on menty." - Antti Muurinen

Tampere May 3rd, 2015

Jussi Mäkitalo

TABLE OF CONTENTS

ABBREVIATIONS AND NOTATION

BSC	Balanced Scorecard monitors the performance of all or part of an organisation, towards strategic or operational goals. It can use either financial or non-financial metrics.
BCG Matrix	A matrix which has been created by Boston Consulting Group. The idea of the matrix is analyze the costs and revenues of the products or services which the organization is providing.
Explicit Knowledge	Knowledge, which can be easily transferred to an information system. Typically this kind of knowledge is in written format, but it can also be in other formats, such as video or audio.
Information	In this research the term information covers all the different terms such data and knowledge. There is no need to make difference between these three terms in the context of this research.
Information format	In this research information format is understood as a way of presenting this information. Such as text, graphics, video or even voice.
STECO	Steering committee. Typically project has steering committee, which task is to ensure that the project is on track. Project manager reports to the steering committee.
Tacit Knowledge	Tacit knowledge is a form of knowledge that is not in format of text, voice, video or any format that could be easily transferred to an information system. Typically tacit knowledge is understood as a knowledge that is stored only into human mind.

1 INTRODUCTION

"Due the globalization, has competition in the markets increased"

The sentence above is not a rare sentence while reading scientific articles related to research and development. Customers are more demanding everywhere. Increased competition in the global market can also be seen as one of the inputs for this research, there is a big need for creating more effective research and development function in the case organization. The current situation is forcing organizations in the world to be faster and more cost-effective, when they are developing new products or improving current products. Entry barriers have decreased in many industry areas and also the overall work costs have been decreasing, due the fact that more and more work can be done in the developing countries, where work costs are typically lower. There are several other reasons which have led to a situation, where organizations need to be cost efficiency. The case organization in this research does not make an exception, but it has to also improve their product development processes all the time, in order to remain their position in the global market. The case organization is powerfully aimed to global markets, where the competition is high.

Nowadays the way of working in organizations has changed a lot from the early days of research and product development. Organizations rely more and more on working in projects and in many organizations all product development is carried out through projects. If you take a look into organizations that rely highly to new product development and innovation, it is quite obvious, that most of the organizations can not state that their research and development projects are running in the optimum way and each project is delivered in the scheduled time and costs are within the budget. In most cases there are several issues that could be improved while trying to achieve the optimum state in new product development.

The research will concentrate to information sharing that takes place (or should take place) during project execution. The case organization has recognized problems in their information sharing processes, which affect straight to their ability to manage demanding and large research and development projects. Information sharing and project management are very broad topics and it is obvious that in the context of master's thesis it is impossible to discuss comprehensively of both of the topics and how these topics can be combined. In addition to project management, this study will also examine how information sharing could help project portfolio management, which can be seen as a guiding

factor for project management. More accurate limitations for the research will be set later in this introduction chapter, but as a starting point for a reader, information sharing and project and project portfolio management are the main terms which will be examined in this research.

1.1 Background for the research

Product development has been a big part of case organization's business for a long time and more or less, it has been a vital condition for case organization's exist already from the beginning. New product development and being successful on it, is also a big competitive advantage for the case organization. So it is quite obvious that the case organization wants to improve it all the time. At the moment there are recognized problems in information sharing and these problems affect to overall effectiveness of research and development projects in the case organization. Especially information sharing within and between projects, are areas that should be improved. Sharing information between projects can be considered as an area which also includes project portfolio management. Project portfolio management can be seen as a function which collects information from other projects that are currently in the same project portfolio. Based on the information which is received from the other projects, the project portfolio decisions can be made.

In a large organization, the amount of information is enormous and managing it is difficult. The amount of information is also increasing exponentially. The growth of used information systems complicates the process even more, especially if there are no clear guidelines of what information should be stored and where. The case organization is a large organization and it has a long exist in the markets, so it is not a surprise that the number of used information systems is high and people cannot always be sure, where the information should be stored. This naturally leads to a problem where getting the needed information can be occasionally hard. Naturally, the only problem is not just the information sharing, but the identification and also utilizing this information is a challenge. What information is needed in order to make right decision? How the organization can be sure, that the information they are receiving, is valid? These are quite common questions in the case organization.

When thinking of information sharing in the context of project execution, the base for information is naturally project itself and different reports that can combined from the project’s information. What is the actual meaning of project reporting? Why should organizations gather information from their projects? Badiru (1993) has presented an information model (see figure 1.1) which can be used as a starting point for this research. There is a need to understand that the information input is the most significant part of the whole decision making process, where organizations are trying to make better decisions and through these decisions, improve their operations. If there is no infor-

mation available, it is impossible to process information into a format that can be used as a base for decisions.

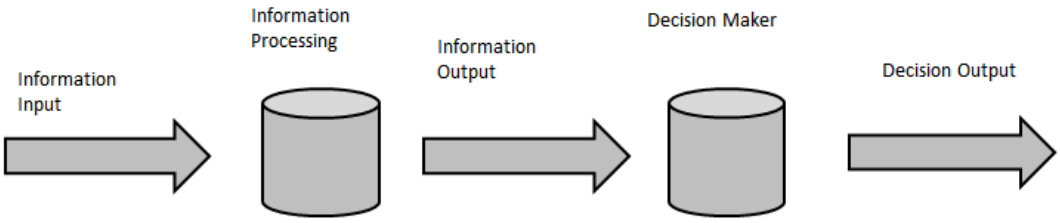

Figure 1.1 Information flow (adopted from Badiru 1993, p.28)

Somehow, the information flow model presented by Badiru (1993) is similar to a general business intelligence process. One old definition of business intelligence process is presented by Gilad & Gilad (1986). They have divided the process into five phases:

- collecting raw data
- evaluating the validity and reliability of data and information
- analyzing data and information
- storing information
- sharing the information processed with decision makers

(Gilad & Gilad 1986, p.53)

There are a lot of other different models related to business intelligence process that could be presented here, but each of them begins with a phase, where the raw data is collected and as a result of the whole process, decision makers should be able to make decisions. According to Thierauf and Hoctor (2001) the aim of whole business intelligence process is to provide a better understanding of firm's operations and through that they should be able to make better decisions (Thierauf & Hoctor 2001, p.5). Again, project management and project portfolio management are based on decisions, so there is a need for structured process for information creating and sharing. With the help of process model of Badiru (1993), it is possible to understand what information sharing in practice is and why it is essential. Simply, there is a need for information that is used as a base for decisions. In the overall process of information sharing and decision making, it is good to remember, that typically the one, who produces or collects the information and stores it, is a different one who will actually use the information as a base for decisions.

1.2 Limitations of the research

As mentioned earlier, the areas of information sharing, project and project portfolio management are very broad and that is why there is a need to set limitations for the research. These limitations are presented in this chapter.

Project managers' ability

It has been quite typical, that good design engineers have been appointed as project managers. A former CEO of ABB Mr. Percy Barnevik has stated in the mid 1990's that the importance of project managers has increased all the time (Berggren 1996, p.124). Almost twenty years have now passed and it is quite obvious that the nature of projects has not at any rate become easier to manage. However, in this research, the project manager's ability and capabilities are not examined. The reason for this is, that the research tries to improve processes which are supporting information flow in the case organization.

Organizational culture

Well…you could write dozens of books about organizational culture and of course, organizational culture has influence also to information sharing. Vitt et al. (2002) highlight also the importance of organizational culture while conducting business intelligence process successfully and effectively (Vitt el al. 2002, pp.26-27). In this research, the whole aspect of organizational culture has been left out.

Information systems

When examining information input phase of the information flow, it is quite obvious that organization needs to have an information system where employees can store the information. One of the definitions of business intelligence systems is that they combine operational data with analytical tools to present complex and competitive information to planners and decision makers (Negash 2004, p.177). Project management systems provide also "real time performance feedback", so they are essential in order to success in project management (Jaafari & Manivong 1999, pp.240-248). However, this research is not comparing different information systems and how they would fit to the case organization's needs.

Stage – gate model

The case organization is currently using a state-gate-model in project management. The model consists of five gates and each of them has certain requirements in order to pass the project to the next stage. In the context of this research there will not be analyze of

how the current stage gate model could be improved, even though it could also improve information sharing.

1.3 Research questions

There are many roles in the area of project management and for executing interviews successfully there is a need to decide certain roles which will be interviewed. Basically this is a background question for the research, so it is not analyzed in the research.

BQ: What are the most important roles in the area of project management and project portfolio management?

The selected roles for the interviews are presented in the following table.

Table 1.1 Roles for interviews

Project Manager
Project Sponsor
Chief Engineer
Project Portfolio Manager
Product Manager
Technology Manager
Product Portfolio Manager

When forming the first research question, there is a need to remember that time for information sharing is limited. People do not have limitless time for collecting information and storing it into specified information system, because the main purpose for individual is to manage and execute his/her own tasks. Also, typically in area of project work, team members' resources are fully taken and the project schedule is tight, so it is quite clear that only valuable information should be shared.

RQ1: What crucial information different roles need in order to improve project management?

Basically the term *crucial information* defines that the research will concentrate to the most important information areas related to the area of project management. After defining crucial information areas it is possible to analyze if there are any problems related to these information areas.

RQ2: Why different roles do not retrieve the information they need?

Behind the second research question, there is an idea about information flow in the organization and the research will analyze if there are any gaps on it. There can be different reasons why information flow has gaps on it. It is possible that the needed information is not created at all in the organization. Another possibility is that information is created but people have poor access to, i.e. they do not know where it is stored and managed.

Nowadays the amount information is great and again, decision makers have limited time to analyze it. That's why in some cases also the format of information can matter and this is a base for the third research question. With the right format of information, it is possible to make decisions faster, because the time of processing the information decreases. Third research question is only analyzed in the interviews, so there is no literature review about the third research question.

RQ3: What is the right format for information?

The main research question is quite broad and it is also one of the actual interview questions. The idea behind the main research question is to give freedom for the interviewees in order to create ideas for the future.

MRQ: How should information sharing be developed in order to boost project and project portfolio management?

After finding answers to the research questions, it is possible to describe needed future actions and form structured processes how information should be shared in the organization. Basically it means that the three first research questions work as a base for the main research question and by finding answers for questions 1-3, it is possible to find answer for the main research question.

The goal of the research is to create future actions that can be implemented to the case organization. What does this mean? The research tries to give guidelines to information sharing process so that the case organization can recognize information flows that should be supported in their organization. It is essential to find clear information flows and create use cases so that people know their responsibilities related to information management.

1.4 Research structure

In the following figure 1.2 is presented the structure of this research.

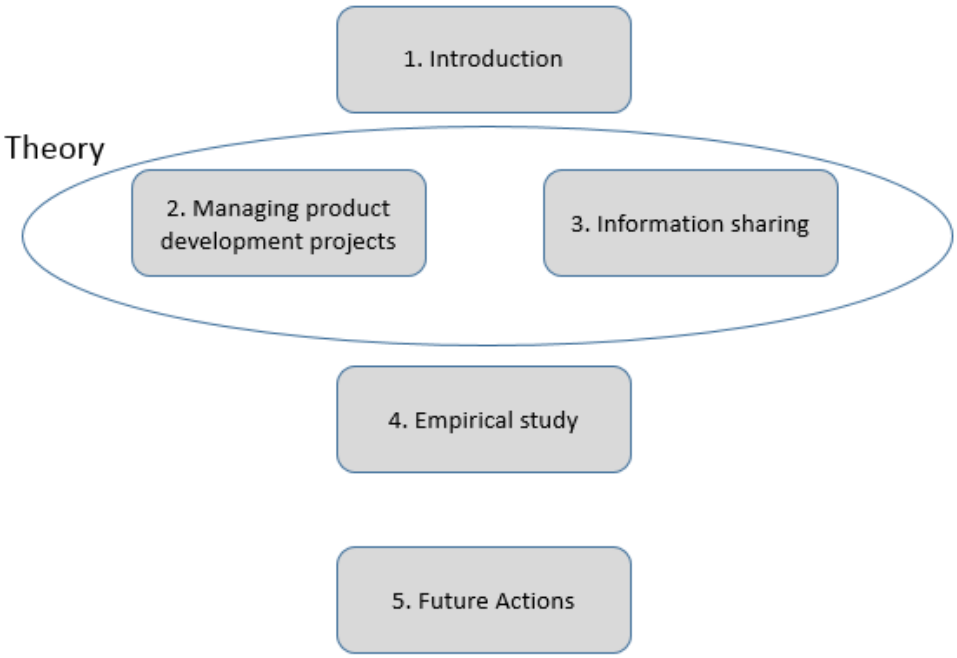

Figure 1.2 Structure of the research

The research starts with the introduction chapter which leads the reader to the subject. The introduction chapter also includes the research methodology and empirical study methods. Theory part consists of two different topics. Two different project management techniques are presented in the start of chapter two and also a short initiation to project tracking is given. The latter part of second chapter defines project management and multi-project environment and combines these two topics. It also gives an idea about the product development project and the special features of it. Project portfolio management is presented and the linkage between single project and project portfolio management is described in the chapter three. Project status sharing plays a big part in managing project portfolio, so the presented project management techniques, works as a background.

The third chapter is about information sharing. It defines different terms related to information sharing such as data, information itself and knowledge. It will create a linkage between project management and information sharing by using the project phases as an input for the linkage creation.

After the theory part, the fourth chapter analyzes the interviews and creates results of them. The results are answering for the origin research questions one, two and three. These results are the base for the sixth chapter, where future actions are being created.

As said, the fifth chapter gathers the results from the empirical study, compares them with the theory and creates different use cases that support the information flow in the

case organization. It also creates the linkage between the use cases and project portfolio management. In practice, the chapter five answers to the main research question.

1.5 Research methodology

According to Uusitalo (1995) researches can be divided into two categories: theoretical and empirical. Theoretical research focuses typically into one area of science and research can be based on theories related to the area of this science. Empirical research handles typically phenomenon of a real life. It is obvious that the border between these two researches is not so strict. Typically empirical research includes also theoretical aspects. (Uusitalo 1995 p.60) This research is not an exception, but there is a theoretical background even though empirical part plays big part in this research. Uusitalo's division is very simple and it is more or less made by using methods as a base for the division. (Uusitalo 1995 p.60)

According to Olkkonen (1994) researches can also be divided by using the purpose of the information which will be created as an approach for the division. By using this classification as a base, researches can be divided to descriptive and normative researches. Descriptive research tries to clarify a phenomenon by creating for example describing processes. Then, again normative research tries to create information that can be used as a base when creating something new, for example new processes in an organization. (Olkkonen 1994, p.50)

When analyzing a bit further the research methodology, it is possible to create divisions based on research grip. There are a lot of different variations available in the literature, but the main idea behind each model is somehow similar. One dividing of different research methodology is presented by Kettunen (1974). The division is divided into five different methodologies:

- traditional
- modelling
- empirical
- marxism
- clinical

Again, these divisions are not excluding each other, according to Kettunen (1974). In practice, there are no strict guidelines for research methodologies, but each research has aspects from several methodologies. (Kettunen 1974, pp.20-40)

According to Olkkonen (1994) there are two main philosophies behind research methodology. Those two philosophies are positivism and hermeneutics and the classification between these two is based on the available material. (Olkkonen 1994, p.50) One of the ideas in positivism is that the research should be independent and re-producible. Basically this means that it does not matter who makes the research, the results should be similar. Again, in hermeneutics the results can vary depending on who makes the research. The reason for this is that in hermeneutics approach researcher studies the material by creating understanding of it. (Olkkonen 1994, p.35)

By using the division (Kettunen 1974) it is easy to state that the research methodology is empirical, because big part of gathering material is done through interviews and the results of the research are based on the analysis of these interviews. The philosophy behind the research tries to be positivism, because the results of the research should not be depended on the researcher, but it is obvious the background of the researcher will affect to the results. Interview questions could be set differently and the results of them could be analyzed differently.

As described in the introduction chapter, the main purpose of the whole research is to find new better ways to share information. The information that is gathered during the theoretical analysis and interviews and this will be the input of the creation of new processes. Based on this, it is quite obvious that the research is normative, because it is trying to create new ways of working and especially, it is trying to set guidelines in order to improve information sharing.

1.6 Empirical study

As mentioned earlier, the research will rely hard on empirical study and interviews will have a big impact in order to success in the research. The research questions have been formed in a way that empirical study will give answers to them. Typically empirical studies and their results can be divided into two categories: quantitative or qualitative research. The main difference between these research categories is that results of quantitative research can be presented with numbers. Again, qualitative research and its results are more or less verbal. (Uusitalo 1995, pp.78-81) If we take a look into our research problem, it is quite obvious that the results of empirical study will be verbal and descriptive. The nature of interviews is semi-structured and interview questions were delivered before the interviews by e-mail to interviewees. The semi-structured method will allow interviewees to share their own opinions and the interviews will not follow the script strictly.

There is also a difference while collecting, processing and analyzing the material when reviewing these two types of empirical studies. If we have quantitative research, these

three steps are entirely separate. In the qualitative research these three steps are more or less interwoven. (Uusitalo 1995, p.81) During the interviews it is important to react to the answers and ask more detailed questions about the topic if needed. Naturally, the biggest and time consuming part of the empirical study is analyzing the collected interview material. This phase is also the most critical, because by combining the results of the interview with the literature review, the results of the research can be created.

2 MANAGING PRODUCT DEVELOPMENT PROJECTS

Why project management is so essential? Nowadays, when organizations are becoming more and more driven by projects and project teams, you can easily state that organizations' effectiveness relies strongly on success of different projects. How to manage projects and especially product development projects? This question interests many organizations and thousands articles have been written about the topic, but still organizations struggle when they are delivering their projects. They do not meet the time limits, budgets are exceeded and sometimes the project does not even fulfill the customer requirements. In the case organization new product development function is carried out through projects and these projects are currently facing problems. In this chapter is basic information of project management given. It starts with introducing the general idea of project tracking and also presenting two different project management techniques. Project management techniques works as an input for defining single project management. After defining single project environment can multi project environment be determined. Also the relation between single project management and project portfolio management is presented.

2.1 Project Management techniques

If you don't track your project, you can't control it (McConnel 1997, p.119). Most likely, it is impossible to find a single project manager, who would argue against this statement. It is an incoherent situation where project manager does not know the current status of the project. Of course, practices of tracking a project vary a lot, depending on the type and the length of the project. Very short and small project is tracked in different way than a large and globally executed project. But in any case, the project manager must know the status of the project and in order to receive project status, there are many several methods. Informal way to track the project status is just observe and walk around and gather needed information through this (Project Management Institute 2000, p.455). This kind of informal tracking can work in a small project, where the actual project team is also small. In bigger projects, some structured method to gather the information in order to create project's status, is needed. In short, project status reporting starts from the bottom. Each project member should inform project manager of the work progress (Thompson et al. 2007, p.197). Of course, there can be different variations in

the process, where the current status of the project is formed. For example, project team can work in smaller design teams and each design team has its own leader, who is responsible of the reporting for the project manager.

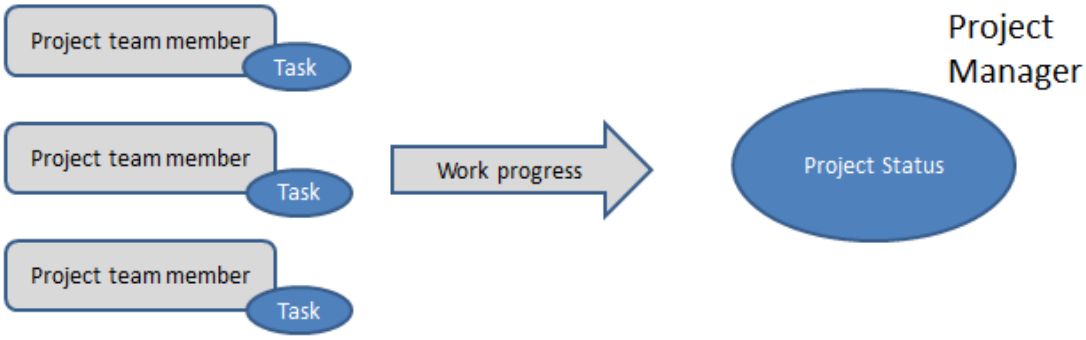

Figure 2.1 Project status creation

In the figure 2.1 is presented rough cut of one example of the process about project status reporting. The information of work progress from team members can be either in written form or in verbal form (Thompson et al. 2007, p. 197). After project manager has analyzed the information from project team members, he/she must form the overall project status and share it with project's stakeholders. In the following chapters, there are presented some models that can be used when tracking down the project status.

Tracking a project does not sound very complicated process, and people might think, what makes the project status tracking so hard, even though it sounds quite straightforward process? And even if the project status has been created, is the status actually believable? One issue, which is in a relation with project status reporting, is *selective status reporting*. It has been a recognized problem, that project managers tend to give more positive information about project's status than it really is. In the study of Thompson et al. (2007), the main research question was: *Is reporting quality associated with project outcomes?* The results showed that reporting quality has positive effect to an overall performance of a project. The same study also revealed a fact that project managers tend to give more optimistic statuses than they really are. (Thompson et al. 2007, p.198) It is quite obvious, that if project managers give more optimistic estimates, most likely project team members do that too. Parker et al. (2008) have also recognized this problem and they called it as a *mum effect – a project members' reluctance to report bad news about the project* (Park et al. 2008, p.409). It is easy to understand the root cause for the *mum effect*. Employees do not want let their managers down and they tend to give estimations that would satisfy managers.

2.1.1 Earned Value Method

The first presented model is earned value method (EAV), which involves the aspect of money used in the project. Earned value method is a methodology which measures the real physical progress of a project. The method also integrates three aspects of project management: scope, time and cost management. (Vandevoorde & Vanhoucke 2006, p.289). Even though organization is not using the full blown earned value method, it is still important to know and understand the earned value method (Budd et al. 2009, p.37). A quick literature review reveals that terms that are used in describing earned value methods vary a bit, depending on the author. The meanings behind the terms are somehow similar as the term itself. According to Budd et al. (2009) there are four primary metrics in the Earned Value Method. On the other hand, Marshall (2007) states, that there are three main elements in the Earned Value Method (Marshall 2007, p.23). The one, which is cut away from Marshall's list is Total Value (Budget at Compilation). In the following list are presented three elements, which both Budd et al. (2009) and Marshall (2007) have recognized.

- Planned Value (Budgeted Cost of Work Scheduled)
- Earned Value (Budgeted Cost of Work Performed)
- Actual Cost (Actual Cost of Work Performed)

Planned Value
In order to create planned value of a project, the project scope needs to be set. Typically the project is divided to tasks by using Work Breakdown Structure. With the help of Work Breakdown Structure, it is possible to create graphical presentation about the project progress. It will answer to the question, that how much work should be done at each stage of the project. (Marshall 2007, p.24)

Earned Value
In short, this metric reveals the original estimated costs for work actually completed at a certain stage of the project. In practice, the earned value reveals the current status of the project. (Budd et al. 2009, pp.37-39). Earned Value reveals the actual value of work performed, so if the project budget is 100 000 euros and half the time is spent, but only 35% of work is done, the Earned Value is 35 000 euros.

Actual cost
The term itself reveals the meaning of it. It is a measurement of used amount of money at certain point of the project. When presenting the Earned Value of the project, an example was given. If project budget is the given 100 000 euros and half of the time is spent, the actual cost is then 50 000 euros.

2.1.2 Critical Chain Project Management

The basic way of thinking behind critical chain project management is theory of constraints (TOC). A common sentence *a chain is no stronger than its weakest part* describes pretty well the whole idea of the theory of constraints.

The main focus of critical chain project management is project scheduling and controlling it. It also tries to reduce project changes. (Leach 1999, p.39) Typically Critical Chain Project Management is used in multi project environment, where scarce resources must be allocated carefully.

What is actually the critical chain? According to Rand (2000) it is the longest chain of dependent steps (Rand 2000, p.176). Typically these steps include some uncertainty that how long they would take to complete. In the critical chain technique these uncertainties are gathered together and they will create the project buffer (Steyn 2002, p.76). By doing this, every individual have precise due dates for their tasks (steps) and if they cannot complete the task in the given time, it will "eat" the project buffer and the delay is immediately visible for everyone (Steyn 2002, p.76). Cutting the buffers away from the tasks is also a psychological thing, because according to Parkinson's law (1957) there is a big possibility that work expands to fill the time which is given. (Cohen et al. 2004, p.40)

According to Wang (2011) critical chain approach in multi project managing can be divided into seven steps. The most important steps are the ones, which are created before the project is actually started. The first step is to reduce task durations by using safety margins. (Wang 2011, p.2) This was actually already mentioned. It means that the buffers are cut away from a single task. Typically this will require managers to change their way of thinking, because quite often they tend to quote late due dates in order to create certainty (Cohen et al. 2004 p.40).

The second step is to actually identify *the longest chain of dependent steps* and by doing that the duration of the project is created. In order to do that, the projects need to be divided into smaller pieces. Creating a Work Breakdown Structure is a useful method for doing that. Once the project is split into small pieces, it is possible to create the critical chain of these pieces (i.e. tasks).

Once the critical chain has been created, it is possible to actually create the project buffer. In the third step the buffers from each task are removed and stored to the end of the critical chain and it is called project buffer. This buffer protects project from variations in critical chain activities. (Cohen et al. 2004, p.40) As stated earlier, now it is easier to see if there is a delay in one task, would it have an effect also in the project level. Once the critical chain has been identified and the project buffer has been created, Cohen et

al. (2004) highlight the importance of also recognizing the possible bottlenecks of the critical chain (Cohen et al. 2004, p.41).

Altogether, the whole idea of the critical chain management is to create more visibility to the possible delays of the project. By cutting the buffers off from individual tasks, it is more transparent to see if there are any delays, that are affecting straight to the estimated due date of the project.

2.2 Single project environment

In order to understand overall multi project setting and project portfolio management, we need to understand also how single project management is carried out. This chapter will concentrate to single project management and basic information of single project management is given here. Naturally, new product development sets some special features to project management. One of the most remarkable special features of a product development project is naturally innovation. It and the need of it may cause one of the biggest problems of new product development projects, because project results and especially project timing are uncertain due the need of people's innovation (Hendriks et al. 1998, p.185). Before discussing more about the special features of a product development project, it is essential to define what is actually a project? Wysocki and McGary (2003) give a widely accepted definition for a project in his book *Effective Project Management* : *A project is a sequence of unique, complex, and connected activities that have one goal or purpose and that must be completed by a specific time, within budget, and according to specification* (Wysocki & McGary 2003, p.3). It is essential that project has a clear goal. Otherwise it is not possible to determine when the project is actually completed and delivered.

What happens when the project has achieved its goal? After the project goal is achieved and the project has finished it should have changed the organization's situation in some way. (Cardinal & Marle 2004, p.226) By using this definition, it is possible to state that after a new product development project, the organization should have a new product which will be sold directly to a customer or to a bulk market. With this new product it is possible that organization strengthens its position in the market.

After defining shortly what does term project actually mean, the next question is what does project management mean? How it can be defined shortly? According to Munns and Bjeirmi (1996) project management is *a process of controlling the achievement of the project objectivities* (Munns & Bjeirmi 1996 p.85). It is essential to understand, that project management is a process, which lasts for the whole project. The definition about the term *project management* and the previous one about the term *project* reveal together the difficulty of a project management. How to control a process, which is unique? How to estimate length of tasks if similar ones have never been done? These are hard

questions and typically project manager struggles with these, when trying to control his/her project.

On the other hand, the definition of a project and project management can be approached through the aspect of human resources. Project can be seen as a temporary organization, where team members are gathered from different parts of organization into a one unit, which has a common goal. According to Huamen et al. (1996) every time when a new project is launched, it changes the human resource configuration in the organization (Huamenn et al.1996, p.320). Again, the importance of human resource management rises up and proper resource allocation prevents organization from many problems. Human resources are the ones that deliver the project and the selection of team members requires lot of information from other projects and also from the structural organization. Who has the right set of skills? Who has enough resources to be in the project? These are typical questions, which need to be answered when forming the project team. Project portfolio management can be seen as a function that handles resource allocation decisions in a multi project environment.

When the project itself and project management are defined shortly, it is time to move on to the process where the project is formed and eventually delivered. What happens between the beginning and the end of the project? A typical project can be divided into five sub areas. These five phases are described shortly in the table 3.1. In the table Project Management Institute (2000) states that the project phase initiating does not include the actual go / no-go decision, but it has been decided earlier in the process whether to kick-off the project or not.

Table 3.1 Phases of a project (Project Management Institute 2000, pp.30-38)

Initiating	*Outlines the activities required to define and authorize the project or a project phase*
Planning	*Outlines the activities required to produce a formal project plan containing objectives, scope, budget, schedule, and other relevant information to guide the ongoing effort.*
Executing	*Uses the project plan as a guiding reference to integrate human and other resources in carrying out project objectives.*
Monitoring and controlling	*This process group of activities measures and monitors progress to identify plan variances and take appropriate corrective action.*

Closing	*A group of activities required to formally shut down the project and document acceptance of the result.*

As you can see in the table 3.1, the planning phase is crucial. Planning phase basically creates frames for the whole project. These frames are the ones that need to be controlled during the execution as described earlier when defining term project management. If planning is done poorly, it has effects on the later stages of a project. Especially if the project scope is not done properly, it is impossible to create believable schedule for the project.

Between project initiating and closing is the phase where project is monitored and controlled and simultaneously also executed. This is a phase where the information sharing plays a big role. The project must be tracked all the time and all needed stakeholders must have access to the information that they need. All the information should be transparent in the organization. As introduced earlier in this chapter, there are vary of methods to track project progress, some are very formal and some are informal. Also two specific models were presented and they can be used when project is tracked and controlled. Project monitoring and controlling is also a phase which should produce information to the project portfolio level. Project Management Institute (2000) separates the execution and controlling, which can be understood in a way where different people are actually executing the project and again, different people are controlling and monitoring the project (PMI 2000, pp.30-38). With a rough cut, it can be said that project manager is the one who controls the project, stakeholders monitor the project and the project team is executing the project.

Closing phase is very important phase and it can be really soothing phase for project team, if the project has been difficult to execute and it has already exceeded due date. For example in many information system projects it can be hard to draw a line, when the actual project has been delivered and it is time to move into the maintenance phase.

During the closing phase, it should also be measured how well the project succeeded. For organization, it is crucial to know whether the project succeeded or not. How is the success of project measured? This is not an easy question and project can be unsuccessful even though it would have met schedule and the budget did not exceeded. Milosevic and Panakul (2005) state that dominant approach for this question is to answer via stakeholders. In this kind of approach each stakeholder takes a bit different angle and estimates project's success. (Milosevic&Patanakul 2005, p.185) Traditional way of estimating project success is to use so called golden triangle: budget (cost), time and required quality (Westerveld 2003, p.412).

This research will not pay further attention to different project measurement techniques, but as you can notice, there are several approaches how to estimate project's success. There are certain similarities on each of them, but there is also a slight emphasis differences on them. That is why it is important to set criteria for project's success before the project begins, so that organization can measure the project success in specified manner.

2.2.1 Post project reviews

As mentioned earlier, project is a unique process of different tasks. By using this description, project is also a unique opportunity to learn new in organization. Similar tasks in similar order will most likely never occur. Collier et al. (1996) propose idea of standard process for post-project reviews. This is in line with the guidelines of information sharing, where literature typically highlights the importance of recognized and described processes. Why should post project review be highlighted here as a part of project management or project execution? Even though project is a unique process, certain similarities will occur in every project. With the help of post project review it is possible to provide valuable information for future projects. The reason why the post project review is highlighted in this research, that it should be considered as a part of a project execution. Post project review should be executed during the closing phase or after that.

As the term post project review already reveals, they can somehow be seen as a part of the closing phase. On the other hand, post project reviews can also be handled as an independent part of project and project management. According to Anbari et al. (2008) post-project reviews are not performed in many organizations, even though they have been recognized useful when organizations are trying to boost their project management function (Anbari et al. 2008, p.633). It is quite obvious that post-project reviews, or post-project evaluations, can help future projects, but only if they are well documented and stored so that the information is available for everyone. Even though post project reviews are an excellent situation to gather information about the project which was just delivered, they can be easily forgotten. Most likely the biggest reason for the lack of post-project review is multi-project environment and temporary project organization. When project is delivered, people are already assigned to other projects and they simply do not have time for post project reviews.

During a product development project it is obvious that all the design documents and similar documents are gathered and stored and these documents can be used later, but this is not the idea of post-project reviews. The idea is more or less to consider the project and analyze what went well and what were the biggest possibilities to improve. It is also essential to analyze failures during the project and analyze what kind of actions could have prevented them. Each project team member has sure some opinions of how well the project went and also improvement ideas.

As a result of post-project review there should be lessons learned documents available for everyone, even though some argue that it is impossible to learn between projects because the nature of projects is different. According to Cooper et al. (1997) this is a misconception, and there can be learning between projects, even though they are totally different (Cooper et al. 1997). Chang and Cho (2006) also state that organizational learning has big influence to new product development and again, it cannot be too much stressed that new product development has typically big influence to overall success of a firm (Chang&Cho 2006, p.13).

The term post-project review can be a bit misleading in some projects. Or at least, it should not be "slavishly" followed, due the fact that project can last several years. Most likely project team members will not remember issues or improvement possibilities from the early days of project, if the project is long. In this case, post-project reviews should take place several times during the project. For example if project is following a stage-gate model, post-project reviews could be done after each stage of the project.

2.2.2 Project manager's role

In the chapter 1.2, where limitations for the project were set, the ability of project manager was left out from the research. Despite that, it is important to give a short introduction to the role of project manager. Project manager's tasks have been referred previously in the research, and in this chapter the main responsibilities will be listed.

One old definition of project managers' duties is given by Gaddis (1956). He states that the main duty of a project manager is to deliver project within the given schedule and budget (Gaddis 1959, pp.89-90). The definition is old, but most likely no one would argue against it even today.

The count of stakeholders of a project is large and the importance of communication has become a remarkable thing. Project manager must ensure that each stakeholder has enough information about the project. Also information sharing and communication within the project team is important. (Tonnquist 2008, pp.161-166) Proper information sharing can prevent many problems and at least everyone is aware if there are any obstacles or delays. Especially in new product development project it is essential to share information how well different project tasks are proceeding. This is basically only option to create reliable time estimations while executing the project. The information which is gathered through open communication and information sharing, can be processed with the used project time management model. Earlier were two different project management models presented and especially the critical chain project management model would recognize immediately how a delay in one project task would affect to the scope of the whole project. One could say that the most important task and role of a

project manager is to gather information, process it by using some project management technique and share it.

2.2.3 Product development project

In order to understand the context where the case organization's projects typically rely, it is good to analyze some special features of a product development project. One special feature of product development project is that they rely more or less to innovation. Innovation and creating value of it, is crucial for organizations, in order to survive in today's market. John Seely Brown has mentioned that the great challenge of innovation is to link emerging technologies to emerging markets (Morris 1999 p.12). In the early days, when research and development function was arising, the whole process of new products happened through research labs and radical innovations played big part. But what does innovation actually mean and how it should be defined? Most people have certainly some opinion about the term innovation and typically innovation means that something new is created. Is that enough or can innovation be described more carefully? Hall (1994) gives a definition of an innovation as follows "*an innovation occurs when a new good, service or production method is put into commercial use for the first time*". (Hall 1994, p.2)

Morris and Miller (1999) have written a book *Fourth generation R&D* which describes the future trends of research and development. The book was published in 1999 and according to authors, the whole research and development –process should include: *partners, research & development itself, markets* and *customers*. (Morris & Miller 1999, p.16) As mentioned earlier, the overall competition in the markets has increased and customers have become more demanding, which have straight effect to research and development function, the end products must be delivered faster to the customers with higher quality. Also the market itself changes all the time. Overall literature review reveals that in the history research and development function was more concentrated to itself and the main focus was just be very technology-driven. Nobelius (2004) highlights this view when he writes about the sixth generation of research and development and he argues that the perspective of managing research and development projects has changed from technology centered model to a more interaction focused view (Nobelius 2004, p.369). The main driver in this course of change is the increasing complexity of research and development. The complexity itself is caused by several aspects that need to be taken into account such as increased competition and more customer focused point of view. (Nobelius 2004, p.373)

When summarizing research and development projects and the special features of them, it is obvious that innovation plays big part. Without innovations organizations cannot survive in the markets or create new products or services. It is essential to understand the aspect of innovation and also to manage it during the project execution.

2.3 Multi-project environment and project portfolio management

After defining single project management and special features of a research and development project, it is time to put projects into a one big bin and try to manage all the projects at the same time. This means that organizations are facing multi-project environment, which can cause problems and difficulties. Van Der Merve (1997) has written following: "*multi-project management requires a new perspective on the management of projects*" (van Der Merve 1997, p.224). If you take a look into current literature of project management, it highlights also the aspect of managing several projects at same time. One of the biggest challenges for project oriented organizations is that they tend to have more projects ongoing than they have resources for (Payne 1995, p.163).

The case organization does not make an exception, but it has several new product development projects ongoing at same time. Employees are typically assigned to more than one project. If thinking an individual side of project management, allocating persons into several projects causes also some problems, such as resource allocation and also role conflict at an individual level (Eskerod 1998; Zika-Viktorsson et al. 2006; Rau & Hyland 2002). For an employee, it can be difficult to know which project has the highest priority without a proper priority decisions from the upper level of management in the organization.

In literature the multi-project setting is often titled as project portfolio management (Archer & Ghasemzadeh 1996; Cooper et al. 1999; Dye & Pennypacker 1999) and the case organization has also noticed the importance of a structured project portfolio management. It is quite obvious that if organization is project oriented, there is a need for structured process and way of working should differ from "old fashioned" organization where daily work was not executed through projects.

As a base for project portfolio management is naturally single project and managing them. Without successful project management, it is quite hard to manage the whole project portfolio successfully. During the year 2003 Martinsuo and Lehtonen made a survey in Finnish firms (279 participated) and one of the hypothesis was following: *Availability of information on single projects for decision makers is positively related to portfolio management efficiency* (Martinsuo & Lehtonen 2007).

This hypothesis is very interesting in the context of this research. When thinking of information sharing, one of the main components of it is to get the information available for everyone. The study revealed that *single-project management is associated with portfolio management efficiency directly in the form of information availability and project management efficiency*. (Martinsuo & Lehtonen 2007, p.62). When analyzing this result a bit, it is not wrong to state that poor information sharing within the project

has a straight effect to project portfolio management and that is why the information creating and sharing in single project is essential. Constant availability to all information of single projects is a state that should be achieved. Without availability to the information the decision process in the project portfolio level becomes longer, because project portfolio level must ask and search for the information. The connection between single project management and project portfolio management is very strong, which is quite clear, and the research made by Martinsuo and Lehtonen (2007) gives scientifically reliable results. In practice, the result of the research highlights again the importance of information sharing during the project execution phase, or more closely during the project monitoring and controlling phase (see table 3.1). All together, the linkage between single project and project portfolio is clear.

2.3.1 Human resources in multi-project environment

Multi-project environment is very demanding when it comes to human resource management. Traditional way, where people are hired to organization and they repeat continuously similar tasks, is quite easy situation to handle. If organization is driven by projects, it causes problems to human resource management (Huemann et al. 2006, p.315). It is obvious, that human resource management can be seen as one of the critical success factors of a firm (Huselid 1995, p.660). Right people with right skills should be accessed to right projects. Organizations are getting larger and larger, employees are geographically dispersed and many other reasons rely behind the fact, that human resource management is so important. According to Gareis (1990;2005) project driven organization has some special features related to human resources management. One of these features is that people in the organization *manage a project portfolio of different internal and external projects* (Gareis 1990;2005). In practice it means that person is involved in several projects at the same time and even his/hers role can vary between projects (Huemann et al. 2006, p.317). As mentioned earlier, the traditional way of human resource management is simple and relative easily managed. Huemann et al. (2006) presents the situation with a following figure

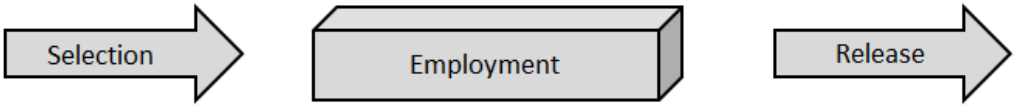

Figure 3.1 Traditional way of managing human resources (adopted from Huemann et al. 2006, p.318)

Basically a person is hired to the organization and he/she is set to one position and he/she will deliver needed tasks until he/she is released from the organization or transferred to a new position.

Naturally, when organization works in projects, the process is bit more complex.

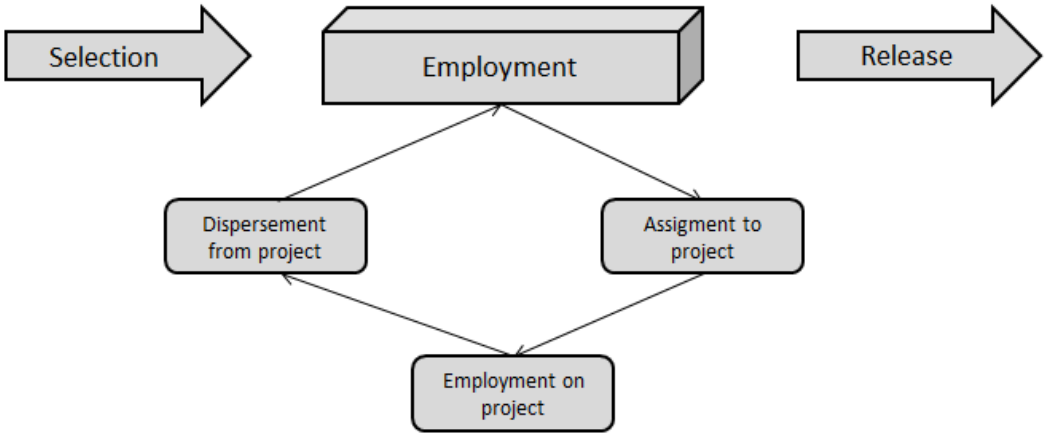

Figure 3.2 Managing human resources in project environment (adopted from Huemann et al. 2006, p.319)

In figure 3.2 is presented a model of human resource management in an organization where most of the work is carried out through projects. The model starts at the stage, where employee is hired into company and is pointed to project or to several projects, depending on organization's way of working. It is obvious that after the employment the model goes round and round, as we can also notice in the figure 3.2. In the case organization employees are also working in their functional role, so the process is even more complex and naturally complicates also the resource allocation decisions on a project portfolio level even more.

2.3.2 Project Portfolio Management

What does the term project portfolio management actually mean? In the previous chapter the relationship between single project management and project portfolio management was shortly described in the point of view information sharing, but it did not actually described the term project portfolio management. According to Cooper et al. (1997) project portfolio management can be shortly described following: *coordination and control of multiple projects pursuing the same strategic goals and competing for the same resources* (Cooper et al. 1997, p.19). Again, the importance of human resource decisions rises up in the definition. Project Management Institute has also published standards for portfolio management and in the area of project management research has project portfolio management achieved a stable position (Martinsuo 2012, p.1). Project

portfolio management handles several types of processes that all together can create successful project portfolio management. According to Artto (2001) project portfolio management includes following processes: *decision-making, prioritization, review, realignment* and *reprioritization* (Artto 2001, p.8). When taking a look into these processes, it is quite clear that information sharing plays a big role on each of them.

When taking a look into the process of reprioritization, it is a good example of a process which requires a lot of information from the projects in the project portfolio. In order to make reprioritization decisions, the project portfolio needs to know the current status of each project in the portfolio. Portfolio needs also to know the potential of different products which are currently developed within the portfolio and portfolio needs also know the estimated turnover of each project.

Why organizations should use project portfolio management as technique? According to Mikkola (2001) portfolio techniques are powerful when there is a need to analyze research and development projects in systematic manner (Mikkola 2000, p.425). One of the main questions related to portfolio management is, how to choose right variables and also the right amount of them. These variables ought to give information for decision making process, i.e. which project should be selected to portfolio and give also information how to prioritize them.

Though, the project portfolio should also include project initiatives and even just ideas of possible projects (Artto 2001, p. 10). This is quite important, because typically there are requests for a higher number projects that are possible effectively to deliver at the same time (Bhattacharyya et al. 2011 p.3858). There are several reasons why some projects should be rejected. For example it is possible that at the moment there are no market possibilities for the project idea. According to Luehrman (1998) decisions of project initiatives can be divided into six different categories:

1. invest now
2. maybe now
3. probably later
4. maybe later
5. probably never
6. invest never

(Luehrman 1998, p.93).

Luehrman argues that managing portfolio is like “a growing a garden of tomatoes” and sometimes, if the tomatoes “are ripe and totally rotten” the decision whether to go or not is easy. But most of the time, the decision is not that easy. (Luehrman 1998, p.90) According to Cooper et al. (1997, p.48) it is important to take all possible projects into the

project portfolio decision process. This means also projects like process improvement projects, cost reduction and different types of internal projects (Artto 2001, p. 48), not only product development projects, which can be considered as external projects. Even though there are several different models for project portfolio decisions, we have to remember that in the end, a human interference plays an important role in project portfolio management (Artto 2001, p.49). Martinsuo has found similar results in her study, which highlighted how project portfolio management is working in practice. According to her study, *the decision making on project and portfolio selection is less planned and rational and, instead, more political and path-dependent* (Martinsuo 2012, p. 3).

Goals can be set to single project, but can project portfolio have also goals? According to Martinsuo and Lehtonen (2007) portfolio management efficiency can be somehow set and measured. The main factor in portfolio efficiency is single project success, which is not a surprise. But also the strategic fit is important in order to have effective portfolio. (Martinsuo & Lehtonen 2007, p.59) Through this information, it is possible to realize, that achieving and keeping the strategic fit is one of the goals of project portfolio management. All the selected projects should be in line with the current strategy of the organization.

2.3.3 Project selection decisions

When thinking a project portfolio, maybe the most important question is what projects should be selected to the portfolio? The selection of projects into project portfolio is perhaps the most important process of the entire project portfolio management. Project selection is actually crucial if thinking the overall success of the whole organization. If wrong product development projects are chosen, it can affect straight to organization's turnover.

In short, the answer for the question that which projects should be selected to the portfolio, is to select projects so that they will maximize the possibility to achieve organization’s strategic objects (Nowak 2013, p.816), but the process should also take in to account resources that are currently available (Ghasemzadeh & Archer 2000, p.73). It is not hard to guess that the project selection is not an easy process, because there are a lot of variables which have an effect to the selection process. The process ought to be periodic (Ghasemzadeh & Archer 2000, p.73). The length period vary between organizations depending much to the lengths of projects. Choosing the right projects is essential for organizations’ success as already stated, but according to Stevens and Burley (2003) only 60 percent of new product development projects survive from *the fuzzy front end to commercialization* (Stevens&Burley 2003, p.16). Wei and Chang (2011) argue that typical selection process is not so strictly structured that unbeneficial projects would get not go decision at the go or no go -gate (Wei & Chang 2011, p.429).

What makes the decision so hard to make? In order to make selection decisions, organization needs information and it must set right variables for the decision process. These variables should naturally include monetary criteria, but there should be other criteria also. According to Stevens (1997) some monetary criteria such as return of investment, is not always suitable choice. Or at least, it should not be the only criterion, because if decisions are based only expected result of return of investment, it leads easily to a situation where potential market areas are not noticed. Another issue of using return on investment as a selection criterion is that it does not tell anything how well the project fits to the firms' strategy. (Stevens 1997, p.40). There are a lot of other evaluation techniques than return of investment. BSCs can be used when evaluating project initiations (Eilat et al. 2008, pp.895-897). All these different evaluation techniques are part of Ghasemzadeh's and Archer's (2000) five-phased framework for project selection. In their model, the first stage is called pre-screening, where the main focus is to ensure that a project fits to portfolio's strategy. Also the second stage, *individual project analysis* is important, where for example return on investment is calculated. (Ghasemzadeh & Archer 2000, p.75)

One approach for project selection is to use research and development project portfolio matrix, which is quite similar to well-known BCG matrix. Naturally, the metrics and terms are different.

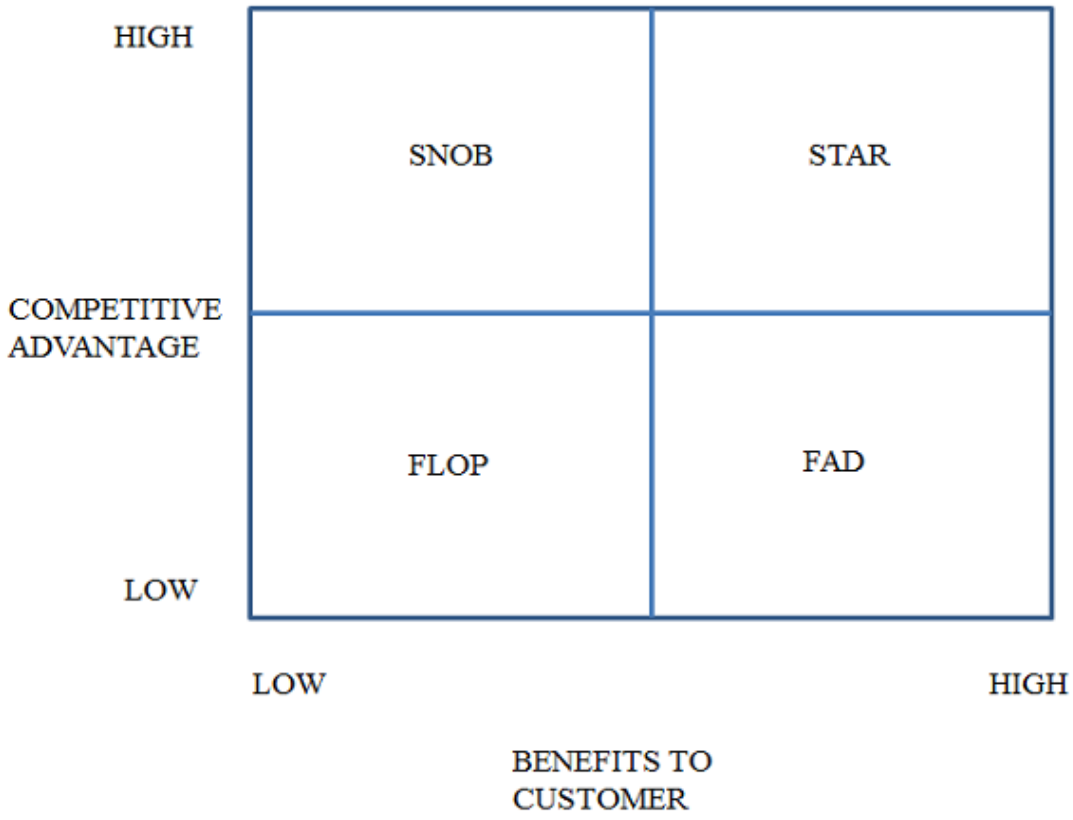

Figure 3.3 R&D Project Portfolio Matrix (*Mikkola 2001 p. 428*).

The presented model is more or less useful in the phase where projects are being chosen. The model is divided into two different metrics: benefit(s) to customer and competitive advantage. The matrix was first introduced to facilitate the research and development planning and competitive bidding. Via these metrics, the matrix is able to analyze firm's strengths and weaknesses and also link its distinct capabilities to perceived customer satisfaction. As we can see the matrix is divided into four sections: star, flop, fad and snob.

Star

Star can be described with a high competitive advantage and high benefits to the customer(s). Stars are potential breakthrough products or innovations.

Flop

These projects should be eliminated from the project portfolio. The end products do not give high benefits to customers and they do not offer competitive advantage. Most likely, these products will not have positive effect to firm's cash flow.

Fad

Fad has typically high benefit to customer, but it does not have high competitive advantage. These products are typically mass products and can easily be imitated from other companies. Lack of high competitive advantage is one of the main weaknesses of fads.

Snob

Typically snobs has high competitive advantage but it can be hard to find customers for such products or the actual product cost are so high that the final price of a product would get too high.

(Mikkola 2001 pp. 428-435)

The research and development matrix is just one way to categorize projects by using the final product as a metric. This metric is quite useful at the beginning of valuation different projects. It can still be used, when the actual project portfolio is set and all the human resources have been assigned to different projects. If an organization wants to use research and development matrix when the project portfolio has been already set to a stable situation and projects are ongoing, it has to be very sensitive and react to changes

in the market and through this information, the research and development matrix can be built again.

In the previous chapter the term BSC was mentioned, but how that method could be used during the actual execution phase, when the project portfolio has already been set to a stable situation? According to Eilat et al. (2008) BSCs could be a tool in *providing a relative measure of performance, evaluating the value of projects in the face of changing circumstances and priorities*". In order to use these BCSs, there must be some criteria that have been set by the managers. (Eilat et al. 2008, p.897).

BSCs and their measure criteria can be divided into different areas, where the financial perspective is usually the most important. Kaplan and Norton (1996) states, that every measure in this category should be part of cause-effect-relationship, in order to improve financial performance (Kaplan & Norton 1996, p.84). The model presented by Eilat et al. (2008) has four metrics in addition to the financial side. Those metrics are: customer's point of view, internal business processes perspective, the learning and growth perspective and the perspective of uncertainty. These four different categories split into smaller areas and each of them should be considered, when comparing project initiatives. (Eilat et al. 2008, pp. 897-898)

These kind of balanced scorecards are useful, when organization is trying to evaluate the potential value of their products. The model of Eilat et al. (2008) naturally goes further than the presented research and development matrix, which was just a short presentation of one possibility. Properly done balanced scorecards need naturally some mathematical calculations. The length of a cycle, that how often balanced scorecards should be made, must be decided within the organization. It is impossible to give one answer to the question of the length of the cycle, which would suit to every organization.

As mentioned earlier, the project selection phase and how to set criteria for measuring project initiatives is not in the scope of this research, but it is essential to understand that these decisions cannot be made on the project portfolio level if projects are not providing information.

It is also critical to have a structured process for new project initiatives, when the project portfolio has been closed and all the available resources have been taken. Can new projects then be taken into the project portfolio? How often project portfolio should go through this decision? What should be done if a very interesting project initiative rises up?

One approach could be to evaluate all the projects again and make decision if some project should be terminated and give resources to the new project. Operating by this way can easily lead to a situation where managers are not managing the projects, but more or

less evaluating the projects. (Artto 2001, p.48) In some cases it is possible to just give resources to the new project from the existing ones. This gives some flexibility between the portfolio comparisons to the management, and often it is argued to be a good approach. (Cooper et al. 1997, p. 47) On the other hand, this can cause frustration among the team members if they are forced to "jump" from project to another project all the time (Artto 2001, p. 48).

Some organizations have quite strict approach and they do not want to break the project teams by terminating projects and launching new projects. Artto (2001) argues that this approach, where new projects are not started once the portfolio is being set, is better. According to him, moving people from project to another project decreases the effectivity of the work. Again, if the origin project selection is done carefully, there should not be often situations where ongoing project should be terminated and new project would replace it. (Artto 2001, pp.48-49)

2.4 Relationship between project portfolio and single project

Previous chapters described the terms project management and project portfolio management and gave information about the most important sectors of them. It is still necessary to describe more detailed the relationship between single project and project portfolio.

The chapter 3.2.3 described well the project selection phase of the project portfolio management. This can be seen as the most important phase of the whole project portfolio. Selected projects must serve the organization and its goals. Also, there must be enough of knowledge and skills to complete the projects and enough human resources available to execute the projects.

According to LaBrosse (2010), the most important factors that can be improved through project portfolio management are listed below:

- *The best use of resources by focusing on high-priority efforts*
- *Elimination of redundant, underperforming, or outdated pro-jects*
- *Key projects that are monitored for performance so that corrective actions can be taken.*

(LaBrosse 2010, p.75)

By using the list as a base, it is easy to create a simple figure, which highlights the importance of free information flow from projects to the portfolio level.

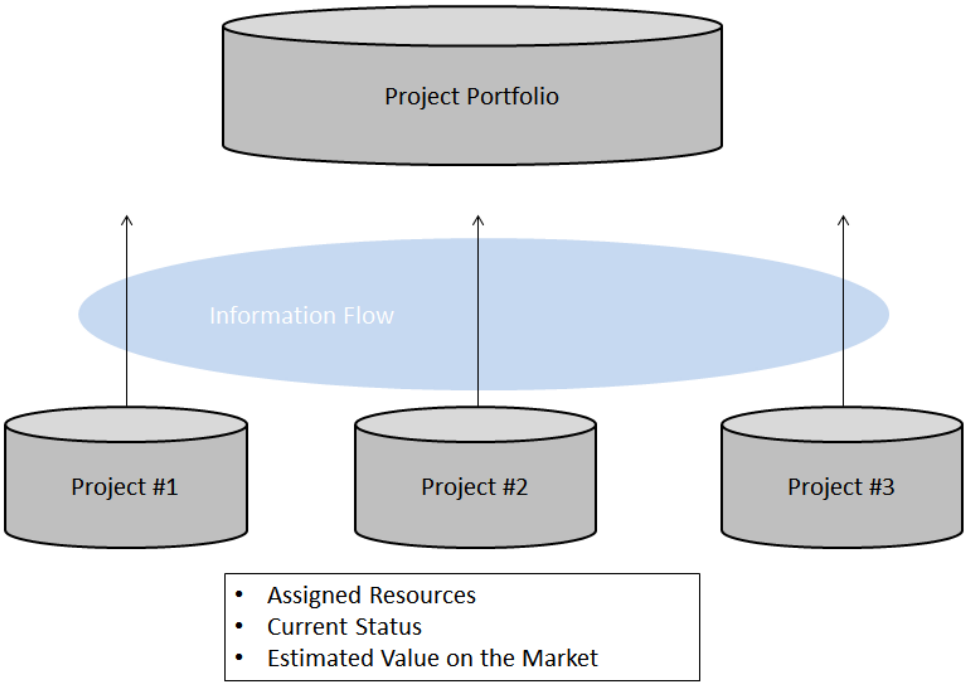

Figure 3.4 Information from Projects to the Project Portfolio

An old business intelligence process (Gilad & Gilad 1986) and simple decision making process (Badiru 1993) were introduced in the introduction chapter and by using these definitions, it is possible to determine that single project is the starting phase for the whole project portfolio decision making process. Single project provides the information for project portfolio managers who are the decision makers in this process. In the figure 3.4, the estimated value of the end product is highlighted as one of the information areas that should be available in the project portfolio level. This is an information area that can be provided either by the project management or product management.

3 INFORMATION SHARING

Information sharing is a broad term and in the context of this research it is sufficient to clarify what information actually does mean, what are the components of information and also give an introduction what effective information sharing means in practice.

3.1 Data, information or knowledge?

In order to understand what does information sharing actually mean, the term itself needs to be explained. Current literature discus much about knowledge and how to store and share it, but how to share information is not as common topic as sharing knowledge is in the literature. Are there specific reasons for that? How do the terms knowledge and information differ? One could state that the difference between information and knowledge can somehow be described as fickle. Allee (2003) has stated that "*there will never be a universally agreed definition for either knowledge or information…there is no such thing as pure information, data or knowledge"* (Allee 2003, p.81). By using this definition as a base for the information sharing it is possible to simplify theory related to information sharing. In this research, information and knowledge can be seen as a synonym to each other. With this conclusion, it is possible to combine references that are using either knowledge or information.

Naturally, data, information and knowledge can be thought as separate terms. When thinking them as separate terms, have Davis and Botkin described data as follows: "*data can be displayed as a form of numbers, words, sounds and images"* (Davis & Botkin 1994, p.166). By using this definition, it is quite clear that data can always be stored into some information system. Definition of information is more complex, but Davis and Botkin (1994) have given a good definition also for it: *"data that have been arranged into meaningful patterns"* (Davis & Botkin 1994, p.166). What does the term meaningful patterns mean? It can be understood as different reports where the data has been visualized. Allee (2003) has also given a definition for information:

"*information refers to anything in verbal, written, or symbolic form that can be read, viewed, heard and comprehended by another human being*" (Allee 2003, p.82)

The definition above is quite similar with the definition of data, but there is one additional term compared to the definition of data – verbal communication. It is relative easy to forget that verbal communication is actually a part of the information sharing. In practice, it plays a very big role when information sharing takes place in organizations.

Davenport and Prusak (1998) determines knowledge following: *knowledge is a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information.* (Davenport & Prusak 1998, p.5) The term knowledge is often described as something abstract that is created by individual and when forming knowledge, individual combines data, information and his/her own experience. It can be said, that knowledge is a hypernym for data and information. It sort of gathers all the terms under itself.

With these short definitions of data, information and knowledge it is relative easy to understand why current literature refers so often to knowledge. However, this research uses the term information. The reason for this is that knowledge typically involves the individual's own experience and this research concentrates on information which can shared through information systems.

3.2 Different types of information sharing

After defining data, information and knowledge, one could ask what information sharing then actually means? Can it be understood as a process? According to Sissonen (2006) sharing of information can be seen as a synonym for exchange of information or as a verbal communication (Sissonen 2006, p.26). When taking a closer look to these definitions, it can be said that exchange is something that happens between two or more partners at the same time and on the other hand, sharing is more one-way process where the sender and the retriever can be recognized quite easily. In the figures 4.1 and 4.2 are presented two different ways to share information. The division is quite strict. In the figure 4.1 is presented communication where two or more people share their information through conversations. In this case, the information is not necessary stored in any information system, which can be seen as a problem in some cases. What happens if most of the project information is shared through conversations? Most of times, the information will remain in tacit form and it cannot be shared in the organization. The second figure 4.2 illustrates the situation where information is shared through a platform. In this case the sender and the retriever are recognized more easily. Between the sender and retriever there is an information system where the information is stored.

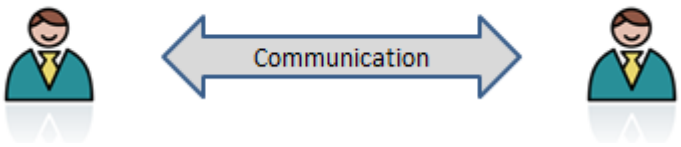

Figure 4.1 Face-to-face communication

Figure 4.2 Communication through information system

As mentioned, the division in the figures 4.1 and 4.2 is strict and there can be other ways to categorize information sharing and how it can be carried out in organizations. It is quite obvious that organization would want to have a situation where as much as possible of information sharing takes place by using some information system. This ensures that the information is also available for the others.

Sakthivel has introduced several other factors how information sharing can be categorized. According to Sakthivel (2005) the information sharing can happen in the same place or in different place (Sakthivel 2005, p.306). Actually, this division is pretty similar than the division in the figures 4.1 and 4.2. Also the type of communication matters and does the information sharing happen real timed. Information sharing that takes place during conversation is naturally real timed, but today's information systems have become so effective, that sharing information through information systems can be seen as real timed.

After defining short what information and information sharing actually are and how they are related to data and knowledge, it is essential to know what does information quality means. In today's business overall quality is important, customers demand more and more quality to the end products. It is relative easy to state, that if an organization wants to deliver a high quality product or services, all their processes, which are supporting the delivery, need to have good quality. Sharing quality information is one of these processes, because without it, decisions can be based on false facts or old information and this can naturally cause several problems when developing or delivering products. How is the term quality understood in the context of information sharing? Schurr and Pazer (2002) divide the answer into three sections.

- Accuracy
- Completeness
- Timeliness

(Schurr & Pazer 2002, p.7)

In today's business the overall speech in every area is increasing and this gives pressure also to information quality. In practice this means that information sharing must nowadays be as real timed as possible. Schurr and Pazer (2007) highlight this fact also in

their division of information quality. Timeliness is about the age and age sensitivity of data (Schurr & Pazer 2002 pp. 7-8). If we think project management and project portfolio management, it is essential that the information is not outdated and people can really trust that the information is based on the latest available information. For example, the information about project's progress cannot be old. How can organization manage their project portfolio if the current information of the projects' statuses is not valid? Decision makers cannot be sure when new projects can be added to the project portfolio, if they are not sure, when the resources will be available from the old projects. In the perspective of one project, customer can change their requirements or markets' requirements can change and in this kind of case it is possible that the project is following old information of the requirements.

In addition to timeliness, accuracy and completeness are factors that should not be forgotten. Without full completeness of information quality, there is a risk that something important is missing and then again, the decision is based on incomplete information. Accuracy will ensure the information quality, which is important and without it, organization can make decisions which are based on false facts.

In addition to the information quality factors, which were introduced by Schurr and Pazer (2002), have Lysons and Gillingham (2003) added some attributes also to information contents, which are also important when considering the quality of information.

- Economy
- Intelligibility
- Veracity
- Simplicity

(Lysons & Gillingham 2003, pp.280-300).

Economy is important, because it is quite useless to gather information, if the cost of gathering process is higher than the worth of information. In the context of project management this means that only must know kind of information should be gathered. As stated various time, the amount of information is so enormous today that organization needs to know what information is really needed in different decision making processes. Everyone understands that gathering and storing needed information requires time.

In order to retrieve the full potential from the information that is shared in the organization, the simplicity and veracity should not be forgotten. If the information is too complex form and it will require a lot of time to get the crucial information from the fuzzy information, the economy will again suffer.

After defining information itself and the quality of it, one could ask why the importance of information sharing has increased so rapidly? For organizations' success are effective communication and information processing crucial (Clark and Fujimoto, 1991; Mintzberg et al., 1995). According to Badir et al. (2009) new product development is nowadays being driven more and more by different types of partners and strategic alliances (Badir el al. 2009, p.1350). Practically this means that people working in a new product development projects can be geographically dispersed and the projects are much more complex than they used to be. The case organization has also external partners working in their research and development projects. Projects can also have team members from different countries from different time zones. It is natural, that geographically dispersed project team highlights the importance of project management and also information sharing. When the project team is geographically dispersed and people are working in different time zones, it will basically disable the possibility to share information through conversations, which is one way to share information (see figure 4.1). In these cases, the importance of structured information sharing process increases even more. Nidumolu has recognized that sharing clear and updated information is a crucial element of an effective project management (Nidumolu 1995; Nidumolu 1996).

How to share information? As stated earlier, there are both formal and informal methods for sharing information, but in this research the main concentration will be on formal methods. There are many different methods which can be seen as formal methods of sharing information. Hansen et al (1999) have presented codification strategy, which is a good example of formal information sharing process:

- Codification: the idea behind this strategy is to store the information into data bases so that it is available to everyone

Again, the origin reference (Hansen et al. 1999) discuss about knowledge, but in this stage the term knowledge can be replaced with term information. (Hansen et al. 1999 p.109).

When looking into area of project management and project portfolio management, it is quite obvious that there is a need to a codification strategy. Organizations need to have centralized data storage where all the information of the project is stored. Again, if we take a look into Badiru's (1993) information flow model, it can be used as a good base for creating right strategy. Questions such as:

- where does the information come?
- who needs the information?
- when the information is needed?

are good questions and by answering to these questions, organization should be able to create an appropriate strategy and with the help of it, should project and project portfolio management become more effective.

3.3 Information areas

Project management and project portfolio management is a base for the research, but there is need to create connection between project and project portfolio management and information sharing. How to create the linkage between managing projects and information sharing? The simplest way to do that is to determine information areas that are needed in order to manage projects successful. The chapter 3.1.1 discussed about post project reviews, but it didn't actually set what information should be gathered during project execution. By knowing these areas it is easy to understand the link between the main components (project management and information sharing) in the research. These information areas will also be used as a base for the empirical study, but this will be discussed more carefully in the chapter five.

Project Management Institute (2000) has divided project management knowledge areas into nine different areas (PMI 2000, p.39). Again, PMI writes about knowledge but as stated earlier, knowledge can be replaced with the term information. According to PMI these information areas are following:

- scope
- time
- cost
- quality
- human resources
- communications
- risk
- procurement
- integration

The last two areas (procurement and integration) were left out from the scope of this research, but the seven other areas are briefly presented.

Scope

Project scope definition is a process that should take place at the beginning of the project. It is actually a process that defines the whole project and requirements for execution. Usually incomplete project scope definition in the early stages of a project leads into troubles at the later stages of a project. (Fageha & Aibinu 2013, p.154) The main

idea in project scope definition is to provide enough information in order to identify the work to be performed.

Time and cost

Typically time and cost are handled together when it comes to project information. It is quite clear that longer the project lasts the higher costs are. Project Management Institute (2000) defines six processes that are related to project's time and schedule planning and tracking*: Define Activities, Sequence Activities, Estimate Activity Resources, Estimate Activity Durations, Develop Schedule Development, and Control Schedule* (Project Management Institue 2000, p.65). Two different methods to follow project's progress and schedule where presented in the chapter two. By using a defined method, the project manager should be able to perform project's time management.

Cost management begins with budget creation and during the project there must be some function that follows how well the project follows its budget (Project Management Institue 2000, p.83).

Quality

The golden triangle of project management is formed by time, cost and quality. Time and cost were described above. Atkinson (1999) states that project managers typically identifies the importance of all these three functions, but concentrate more on time and cost issues (Atkinson 1999, p.338). One definition of quality is *quality is what customer expects as a lasting experience* (Basu 2014, p.178). Now there is a need to differ project quality from the actual product quality. Central role while ensuring quality in a project is to understand the actual business case that comes from customer or from the market. By doing this, quality can be ensured, and the final product will answer for customer's or market's needs.

Human resources

In short, project's human resource –process should ensure that project has enough resources and also right kind of resources for different design areas, which require different kind of skills. Resource allocation is also a part of project portfolio management and allocating human resources is significant in order to achieve full potential of project portfolio management (Martinsuo & Lehtonen 2007, pp 60-63). Typically the situation is such, that employees are working in several projects and managing this is essential in order to get the full potential out of human resources.

Risk management

The goal of risk management is to minimize the possibility of negative effects for the project (Project Management Institue 2000, p.127). Risk management is a process that should last the whole project and the list of risks should be updated all the time. If the risk list is done only at the beginning of a project, but it is not updated, the whole risk management process is not done properly. Every risk should be identified and after that they should be analyzed. With the result of analyze each risk should have estimated possibility of occurring and also in case of happening the harmful rate.

Communications management

Project management institute (2000) defines communications management following: *it is designed to support the information needs of the project stakeholders* (Project Management Institute 2000, p.119). In this research the communication(s) management is understood more broad and the most important question is how to create transparency to the project communication and information sharing. So basically the communications management in this context was not analyzed in the way as Project Management Institute (2000) has described it.

The presented areas are important in order to create effective information sharing process to organization in the area of project and project portfolio management. These present information areas will be used during the empirical study.

3.4 Effective information sharing

The term information sharing was introduced in the previous chapter. When looking at the figures 4.1 and 4.2, it is obvious that each organization is sharing information at some level. Individuals share information and nowadays it can be also stated that all organizations are using some information system for sharing information. If information sharing takes place in every organization, what are the steps that need to be taken in order to create effective information sharing across projects? In short, there is a need for information sharing mechanisms. Earlier, the codification strategy (Huamen et al. 1999) was presented, where the main idea is to get all available information into a centralized data base. A centralized data base is a base for enabling structured information sharing in an organization.

How is this related to the case organization? It is quite obvious that in a large organization the mere information is in databases available for everyone, the better the situation is. Enabling effective information sharing is not an easy task and many firms struggle with it. There are vary of reasons why enabling information sharing across projects is so difficult. Andefelt and Lagenström (2005) have made a survey of how to enable information sharing in projects which are global. The case organization has also similar situation, because some projects are carried out globally and many projects use external

workforce. The case study by Andefelt and Lagenström (2005) was done in software firm, but by the context of this research it is possible to assume the new product development projects have similarities with an information system project. The study revealed importance of intranet, which is in practice an information system. However, it was important that each team member was actually using the intranet, not just part of the team. Each project members were also supposed to document their work. In the study, project members stressed out some problems like what information should be documented and where it should be stored. (Andefelt & Lagenstöm 2005, pp.192-196). Again, the same questions arise, where, what and when. The use of intranet on this particular case study was also important in order to know the status of the project. The case study revealed one problem which was the lag between *activities occurring and information being posted*. Basically people did not document their work immediately after they have executed it. When factors of information quality were introduced one of them was timeliness. If there is a gap between the reporting of any delays, the project status cannot be accurate.

Eppler and Sukowski (2000, p.335) have presented a good figure of project team's knowledge sharing and how to enable it.

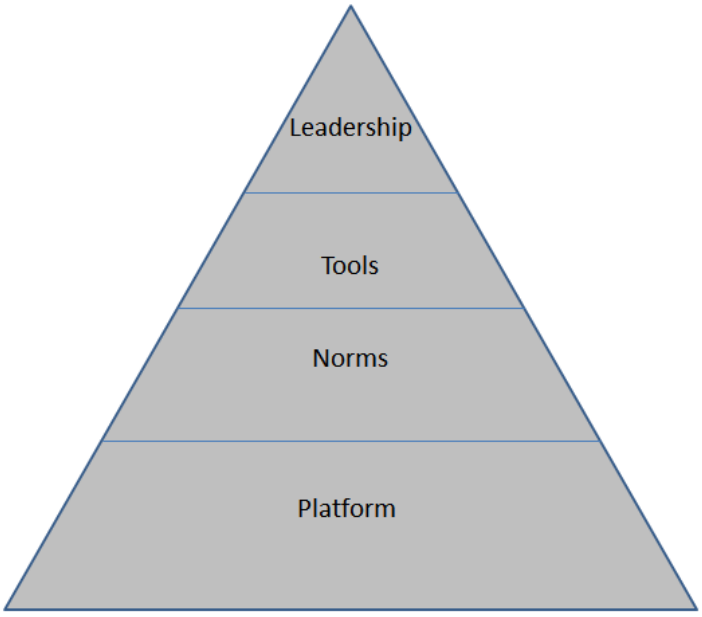

Figure 4.3 Project team knowledge sharing (adopted from Eppler and Sukowski 2000, p.335)

As we can see, technical issues (platforms) rely on the bottom of the triangle. Without a certain platform, it would be quite impossible to share information. There must be a platform where the information is possible to store. In practice the platform is an information system. The second layer is about norms and they can be handled as a part of organization culture.

The third layer in the triangle is tools. Eppler and Sukowski (2000) treat the tools in a way, that by using different kind of tools, it is possible to get the information transparent for everyone in the project. According to Eppler and Sukowski the most useful tools are tools, that are used when visualizing information. (Eppler & Sukowski 2000, pp.337-339).

On the top of the triangle is leadership. Even though Eppler and Sukowski (2000, p.340) use term *team leader*, it is easily drew a parallel to project manager. Project manager has typically lot of tasks such as team motivating, controlling and reporting to project's stakeholders. It should be also recognized fact that project manager works also as an example for the rest of the project team. He/she should act and work as a role model (Eppler & Sukowski, p.340). That is why is essential, that project manager is actively sharing information and also demanding other team members to share information.

As described in this chapter, it does not look a hard task to improve information sharing in the organization. Most of all, it requires guidelines and structured processes which need to be also followed and also measured. It is good to realize that effective information sharing is a continuous process, like any other process in the organization. It can and it should be improved all the time.

4 EMPIRICAL STUDY

Empirical study was done in interviews. There were seven different roles that were interviewed (see table 6.1). The background question for the role selection was given in the chapter one and the same roles were also introduced there. The number of interviewees in one interview varied a bit between the interviews. Maximum number of interviewees in one interview was three. The roles and lengths of each interview can be seen in table 6.1. There were also free discussion sessions with Program Manager and some thoughts of these sessions are also analyzed in the empirical study.

Table 6.1 Interviewed roles and length of interviews

Role	Length in minutes
Project Manager	50
Project Sponsor	45
Chief Engineer	50
Project Portfolio Manager	50
Product Manager	65
Technology Manager	70
Product Portfolio Manager	50

The style of interviews was semi-structured and the question list (see appendix 1.) was sent via e-mail to the interviewees before the actual interview took place.

Similar thoughts prevailed among the interviewees and biggest concerns related to projects' information sharing were also common. Not so surprisingly, the aspect of organization culture relied in the background all the time and sometimes answers began with sentence "*well, there has been a customary way for doing this"*. Organizational culture was left out this research, so it won't be analyzed more carefully. When analyzing the interviews, it is good to remember, that human mind tends to remember all the trouble and problems that have occurred. In practice this means, that the current situation can be better in some cases than interviewees actually described.

The common concern in information sharing was that there are no common guidelines or processes, how the information sharing should be carried out. Projects do not use same information systems for information sharing and too much information remains in tacit mode. A positive side was that in most cases the information exists, but it is just

not available. One of the Project Sponsors described the situation more than well, with one sentence:

"*You get the information if you ask it"*

By analyzing this sentence a bit, it is possible to say that the organization is an information pull, not an information push driven organization. Being an information push driven organization is naturally a target situation, because it is also very cost effective way to share information. People do not need to waste time for asking information, but they have immediate access to it. At the moment one of the issues was that if information is shared through asking, it causes easily a situation where the same information is actually shared many times, if people are using e-mails.

Of course, not all project information is shared through asking. There are certain project sites that are being used. These sites are located in the case organization's intranet. However, at the moment they are more or less used just for technical documents such as technical drawings, but they should also be used to share all other available information. Steering committee meetings were highlighted several times during the interviewees and these meetings are actually in the center of the whole information sharing process and the reporting templates that have been created for these meetings are actually "completely enough and well formed" as one of the product portfolio managers mentioned. Naturally, if most of projects' information sharing takes place in the steering committee meetings, the overall transparency to projects' information is lacking and only people who accessed the meeting, have the information. The lack of transparency was stressed out by Technology Manager, but also project managers mentioned that sometimes it is hard to get needed information from other projects.

4.1 Crucial information areas

The first research question was recognizing the most important information areas of project management. As a background for the interviews, seven different information areas were presented to interviewees.

4.1.1 Time management

Project schedule and time estimations were definitely the number ones of information areas, which interviewees raised up. Sharing the current status of a project was generally highlighted as a very important factor. The responsibility of sharing project's schedule and time estimations is project managers' duty and this process includes gathering

the information of the progress of the project. The biggest concern in project schedule and time estimations was the information quality.

"*You need to ask yourself, is this a realistic estimation?*"

Several roles (especially Project Sponsor and Product Manager) felt that the information that they get about the project status is not every time reliable. They must add their own buffer to the estimation and this buffer and its length is based on their own experience.

"You need to add your own buffer to time estimation which project manager gives. The length of the buffer is based on my own experience"

There are many different reasons behind the poor information quality related to the time estimations. Chief engineers mentioned that typically project schedule is made by the project manager and when the project schedule is presented to the upper management, they won't accept it. Project managers shared this opinion.

"*Well…you create a schedule and time estimation and then the upper management cuts half year away of it*"

This kind of approach and way of working can cause a situation where project managers feel that they must give too optimistic statuses of the project. This issue is also presented in the theory, where selective project status reporting is introduced. Also the motivation of creating high-quality time estimations during the project can decrease, because people feel that these estimations are anyway dismissed and there is no chance that the project would be delivered on time. On the other hand, interviewed project managers mentioned that they try to create the estimations alone, which was quite surprising. Why there is no information sharing when trying to settle the project schedule? Project team should be involved during this process. And again, there is no historical data available from old projects, where project managers could get information and with the help of it, create better estimations.

The situation in some projects is pretty good and overall there are lot of variation between projects. These kinds of results from the interviews tell the root cause, where there are no common guidelines for information creation and sharing during the project execution.

"*Some projects report well….and some projects not so well*"

Project managers' ability and experience were highlighted as a reason behind this issue. Typically project managers with more experience give better estimations. For inexperienced project manager, interviewees felt that the project organization does not give

enough support for project manager. In addition to this, the relationship between project manager and chief engineer is not very well described.

Project managers stressed also out the importance of dependencies between projects. At the moment the dependencies between projects are recognized, but again, the information quality concerns project managers. *Can I trust on this information about the project status?* - is not a rare question in the case organization.

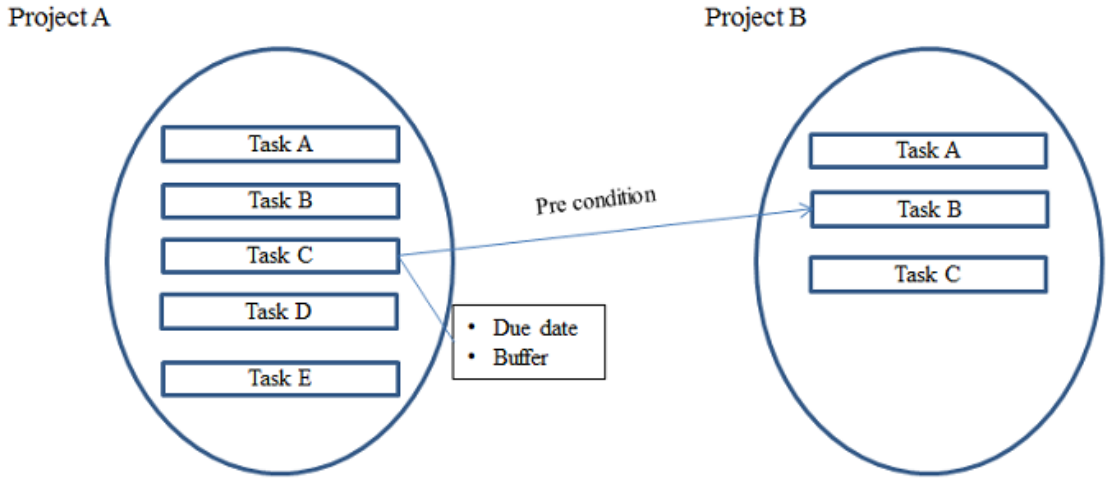

Figure 5.1 Relations and dependencies between different projects

One example of dependencies between projects is given in the figure 5.1. The *project B* has several tasks and *task B* has to wait *project A's task C* to be completed before the task B can start. These dependencies and relations are recognized, but the information about due dates and possible buffers are somehow lacking. Or more likely, the information quality is again poor. This leads to a problem where project managers' time estimation are based on poor information.

4.1.1.1 Risk management

Risk management was highlighted together with the time estimations and interviewees felt that these two information areas are more or less tied up. With the help of proper risk management it is even possible to generate estimations of how probably project or its tasks will follow the given due dates.

"*Typically identified risks are quite general and these risks could be part of any project*"

This kind of approach and very general risks do not serve the idea of risk management and the information you get from identified risks and risk management is more or less

useless. A proper risk management could be used as a part of project schedule and time estimations, as described earlier. With the help of it, project managers could add realistic buffers to project's tasks.

4.1.2 Project scope

Project scope creating and especially changes on it, during the project execution phase, have a big effect to project management and project schedule. Any added or changed requirement have an effect to the project's scope and during the execution phase it also affects naturally straight to project schedule and time estimations, because typically the changes to project scope increase the amount of needed work. In the case organization's process, has product manager a central role and he/she needs to cope with different functions like marketing and sometimes straight with the customer. Customer's business case should be transferred into technical requirements, which is the hardest part of the whole process. *What is the right solution for customer's need(s)* – is the main question and it should be answered during the scope definition process.

At the moment there are several problems in the scope creation process. Project portfolio manager drew a good figure about one of the issues that create problem(s) on the later stages of the project.

"*There are a lot of requirements that tend to be left to float round the project.*"

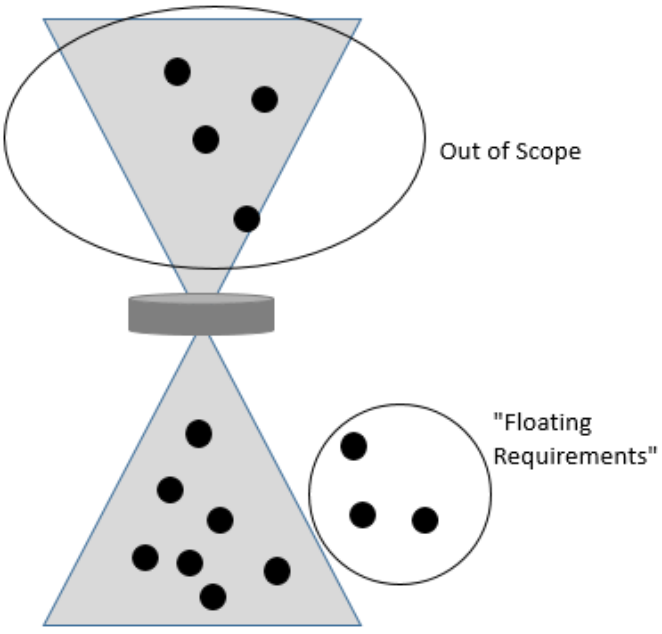

Figure 5.2 Floating requirements

When some requirements are left floating beside the project, they tend to be taken easier to the actual project scope, even if the project is in execution phase. This means that the filter should be stricter and the floating requirements ought to be cut away.

Innovation management was discussed in the chapter 3.1.3 and as said, it plays big part in research and development project. Interviewees also mentioned the aspect of innovation and it naturally has an effect to scope creation and to requirements analyze. It is impossible to know beforehand all the needed tasks in order to fulfill the actual business case. So it is quite clear, that research and development project's scope cannot be set to completely stable situation. One of the product managers also mentioned that at the moment there is no clear process how new requirements should be taken into the project scope. All new requirements should be analyzed and structured decision making process should be carried out when deciding should this change to scope to be made or not.

Another aspect in the project scope creation was that, the actual business case and the real need(s) straight from the customer or from market, can somehow be forgotten during the project or even worse, they can be understood wrong. At the moment, the scope creation phase (project initiation) is more or less done without involving the actual project team in the process. Interviewees felt, that there is a slight gap between product management and project management and this gap naturally affects to the understanding of the actual business case.

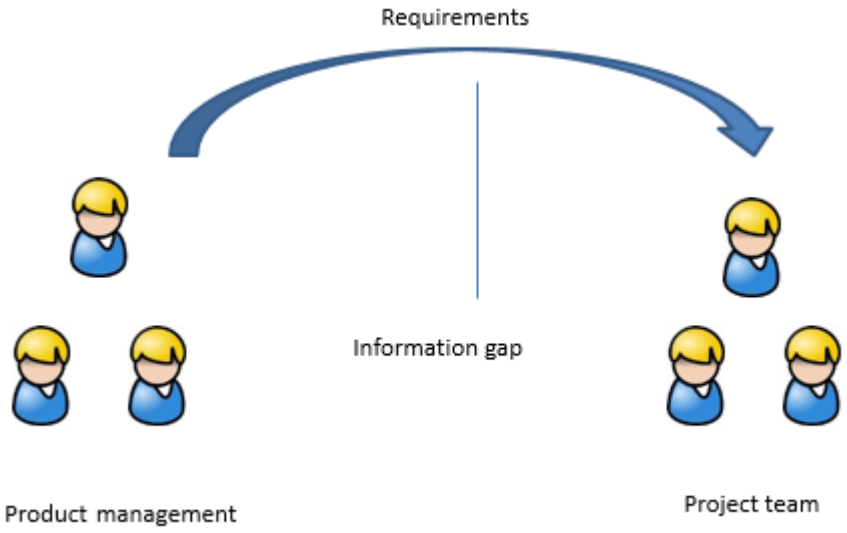

Figure 5.3 Information gap between the project team and product management

This kind of approach for project initiation, where development engineers are left out from the process, can lead to a major problem. There is a risk that some of customer needs are understood wrong. This misunderstanding can lead to a situation where the actual final product does not actually fulfill the origin customer needs. Product managers were also concerned about the fact, that if new requirements appear during the pro-

ject, it is possible that project team has made that kind of technical choices that new requirements are impossible to implement.

4.1.3 Project cost and budget

Tracking project's budget and sharing the information about it, is in a situation where there has not been paid that much attention on it. But the situation is now changing, and there is a need for more accurate project's cost. Reason for it is obvious, if we take a look into overall situation in global economy and markets. Project sponsor said that at the moment there are certain information available how much different research and development functions use money, but targeting that money into a single project is hard. When the actual work hours are missing of a single project, it is quite hard to calculate the actual cost of a project. Also tracking the budget during the project is almost impossible. Many of the interviewees stated that there are no clear instructions how project team members should report their hours. So again, clear guidelines and leadership are missing.

Chief engineer described well what kind of situation there has been.

"*the overall culture has allowed project to overrun its budget....there has always been money for extra cost*"

If the work hours are lacking or the information is no valid, it is impossible to create historical data about the project's different design areas. This historical data could be used for a base, when new projects are launched and work hours and project cost are estimated.

4.1.4 Human Resource Management

Human resource management is essential for organization's survival in multi project environment. This was also stressed out by the interviewees. However, interviewees felt that the current state in human resource management is not in optimal state and different methods are used.

"*Sometimes project managers gather together and give their estimations in percent, about employees resources. If you calculate percent together, you get sometimes a number two hundred."*

Human resources are allocated to different projects from line functions, but the overall feeling was that people are easily drift into a situation where they have too heavy work load and this naturally causes also delays to the projects. One reason for the human re-

source management's problems is that project prioritization is not made properly and it is hard to know which project is the most important.

One function in the case organization has quite ideal situation where practically one person is working in one project at the time and this situation is naturally easy to cope.

"Basically we have a document where each project is presented and each project has listed the members of the project"

The given example works when people are tied into one project at the moment, but when the organization is facing a real multi-project environment, the situation is more complex and everyone should also be able to know how to divide their work effort. The time span when the decisions are made should also be set. It is quite useless to allocate human resources too often, because it can increase uncertainty in the organization. Many of the interviewees shared this opinion and they felt that too often people thrown from a project to another project.

4.2 Accessibility to information

The second research question analyzed the situation of accessing information. The interviews revealed that most of the times information was actually stored to a common platform, but there are still too many cases where the information is missing. One of the interviewees described the situation following:

"*saved to one of the information systems, but you cannot be sure that which one is the right one in this particular case and in the worst case it is just in someone's personal files*"

E-mails were used quite often in order to retrieve the information, but people felt that it is not very effective way. Again, the fact that organization is more or less information pull driven organization, rises up. At the moment there are several information systems that are used while sharing projects' information. This causes naturally unawareness where the information should be stored, because people can work in many projects at the same time.

When the second research question was set, two hypotheses were given. By analyzing the interviews, it is easy to determine that the information is created but employees have poor accessibility to it.

4.3 Information format

The third research question handled the format of the information and through interviews this question was answered. A big part of information sharing takes place during the steering committee meetings. These reports are just PowerPoint (Microsoft Office) slides but according to product portfolio managers these reports are "*well enough if the reports are done carefully and data or information is valid and high quality on them"*.

Information format plays not that big role in the case organization and the overall feeling through information format can be described through one sentence which was given by one of the interviewees:

"It does not matter in what format the information is, the most important thing is the quality of information. Everyone should be able to retrieve the information and it should not depend on the format."

Of course, some information areas and format of the information were discussed and good examples were given. Practically everyone highlighted the importance of information quality, when asked about the format. With this information it is relative easy to make an assumption, that people in the case organization struggle more with the information quality and accessibility to it than with the information format.

In the future the situation will most likely change, because when the basics of information sharing (accessibility and quality) are retrieved, people will pay attention also to the information format. It is also very important to remember the aspect of information format and the case organization should also try to improve it.

4.4 Conclusion of the interviews

Interviews succeed well and especially free discussion phase give good ideas how to improve information sharing in the future. Not surprisingly, most of the problems which case organization is facing are also well recognized in the literature. Case organization struggles with quite typical problems and with a little effort some of the problems related to information sharing can be solved.

It also should be remembered that case organization is a big player on the market and as one of the employee described the situation:

"*We develop products and get them done and in that process we have to be very straight forward sometimes"*

It is obvious that when organization is under pressure and projects need to be delivered within the tight schedules with a limited amount of human resources, the most im-

portant thing is not a structured information sharing process, but the project itself needs to be delivered on time

5 FUTURE ACTIONS

In this chapter are future actions presented. The future actions, which case organization should implement, have been combined from both the theory and the empirical parts. These future actions are such, which should be possible to implement without large monetary efforts.

The idea behind future actions begins with recognizing use cases and with the help of them it is possible to answer for the following questions:

- *where does the information come?*
- *who needs the information?*
- *when the information is needed?*

What use cases actually are? They are typically used in the software area and they define interactions between different roles and the system in order to achieve a certain goal. In this research information system is understood as a general system and roles are the ones who are creating or using information as a base for decisions. Leadership can be seen as a surrounding process or a factor for the whole process, where information sharing is carried out more effectively. As a result, each use case is providing information which is stored to the used information system. The figure 6.1 illustrates the model, where leadership is surrounding the process and use cases are providing the information, which can be retrieved from the platform. These use cases and the model surrounding them, will answer for the main research question: *How should information sharing be developed in order to boost project and project portfolio management?* In practice, the use cases are structured information flows and by following these use cases, the project and project portfolio management can be improved.

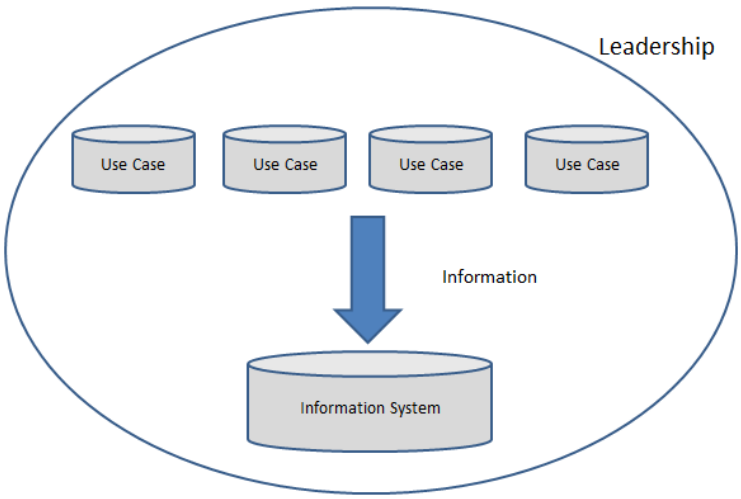

Figure 6.1 Use cases providing information

In the following chapters the most important use cases are presented and the idea of leadership is also given. The aspect of information system is described even though the proper analyze of used information systems was left outside of this research.

5.1 Leadership

Leadership is surrounding the whole process the figure 6.1. As described earlier, leadership means also project managerial tasks, especially when the whole process is trying to improve information sharing between projects and also give information to the project portfolio level.

"*Sometimes it feels that you are not even a project manager, but more like intermediary for the information, which project team members need*".

This is a straight citation from one of the project managers. It, together with other interviewees' opinions of project management, reveals that there are some problems related to the actual role of project manager. Project manager should be able to lead the project and keep stakeholders informed about the project. If project manager is not able to do these tasks and his/her time is taken to another tasks, it can be hard or even impossible to complete the project successful. Project manager's general role is described in the chapter 3.1.2 and case organization should also clarify the role of project manager in their organization. With the help of project manager's leadership, information sharing should be stressed out as an important factor and all team members should understand this and support the overall process of information sharing and share information.

5.2 Information system

As stated earlier, the result of each use case is information which is stored to the platform, which in this case is a defined information system. In practice there are different information systems for different kind of information. In order to improve the situation and create transparency to the project management, there is a huge need for standardized place(s), where the information should be stored. At the moment there are enough technological possibilities in the case organization, so this should not be the problem. The only decision which should be done, is where to store different information. It is obvious that the platform can be different, i.e technical documentation can be stored to a different information system than project managerial documentation.

In order to create a plan or a process for the case organization can refer to Hansen et al. (1999) codification strategy. That strategy was presented in the theory part (see chapter 4.2). For the future is essential to achieve a state, where every project uses same information system for information sharing. The decisions of different information systems should be carefully made and the decision-making process should include people from every function that needs project information. Otherwise there is a risk that small team makes decision by itself and it did not listen to the end users who are going to use the platforms. It is also important to include people from the project team -level, not just upper management. This is important matter, because project team members are the ones, who have biggest responsibility to actually store the information to selected information systems.

5.3 Use cases

Use cases have been created in a way that they are covering different information areas that were recognized as the most important ones. Each of them consists of four areas: Actors, Preconditions, Description and Result.

5.3.1 Scope Creation

In the figure 6.2 is presented use case of scope creation where as a result should arise a detailed and frozen project scope.

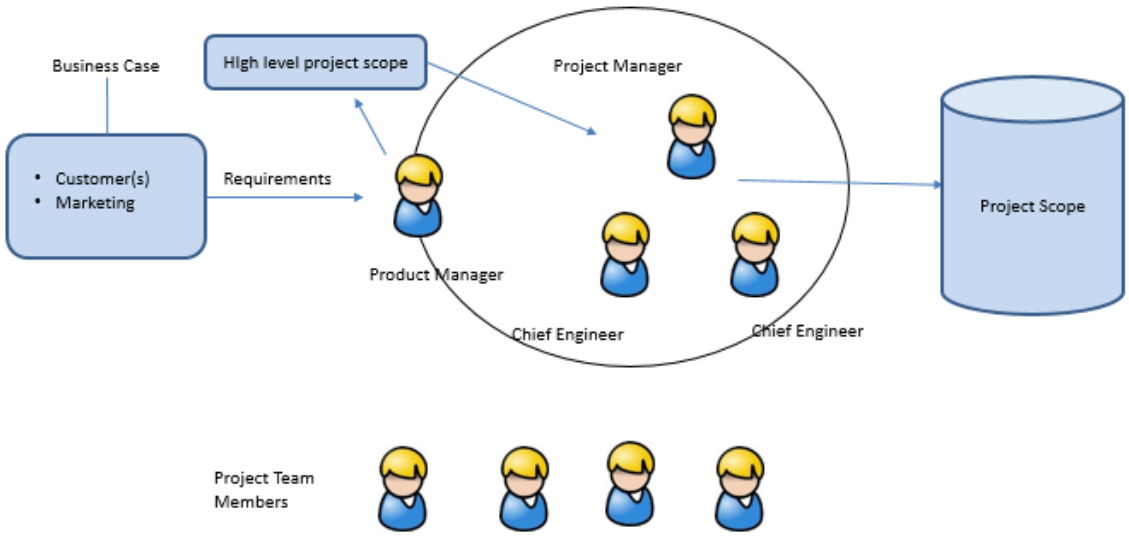

Figure 6.2 Scope Creation

Actors: Product Manager, Project Manager, Chief Engineer(s) (Project Team Members)

Precondition: The precondition can be seen in the figure 6.1. In order to create project scope product manager has to be able to gather all the requirements from customer and/or from marketing function. The business case and understanding it, is essential and precondition for the actual detailed project scope creation. As an input for the whole process, where project scope is determined, there is a need to have a high level project scope created.

Description: As mentioned in the chapter 5.1.2 one big problem in scope creation process was the actual transfer of business case to specific technical requirements and detailed project scope. In order to create detailed project scope, information sharing between product manager, project manager and chief engineers must be intensive. In practice this information sharing must happen face-to-face or via online meeting, so that product manager can be sure that the business case is fully understood by the project team. If it is possible, rest of the project team could also participate in these meetings, this would lower the risk that part of the business case wouldn't be transferred to actual technical requirements.

Result: Detailed project scope definition available for everyone in the case organization. The created project scope should be in a stable situation and every change to it should follow a structured process, where requested changes are analyzed carefully.

5.3.2 Project Schedule Creation

After project scope is finalized and approved, it is possible to create project schedule (also sub area schedules if needed) and during the execution of this use case, a proper risk management plan should also be carried out. A proper project schedule includes

naturally task estimations and the responsibility of creating task estimations should be on chief engineers and project team members.

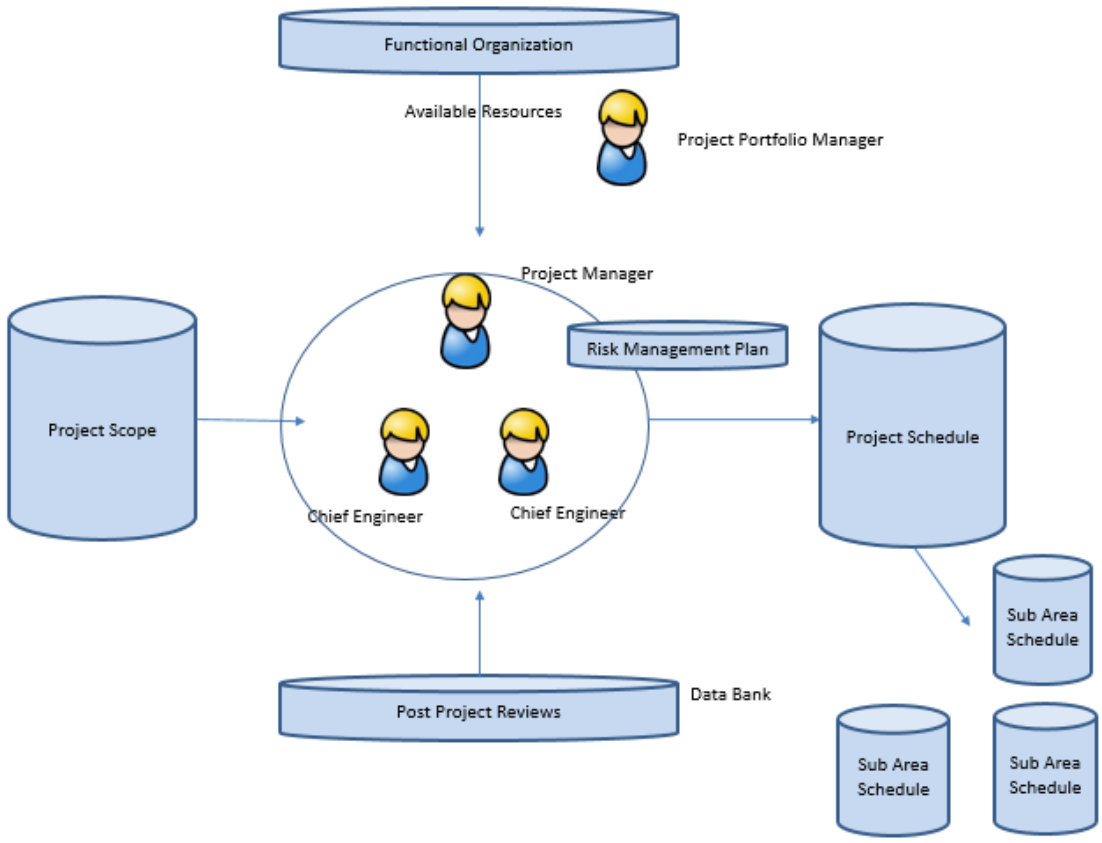

Figure 6.3 Creating project schedule

When project schedule has been set, it is possible to create more detailed plan which is divided into tasks. This process is presented in the following figure (6.4).

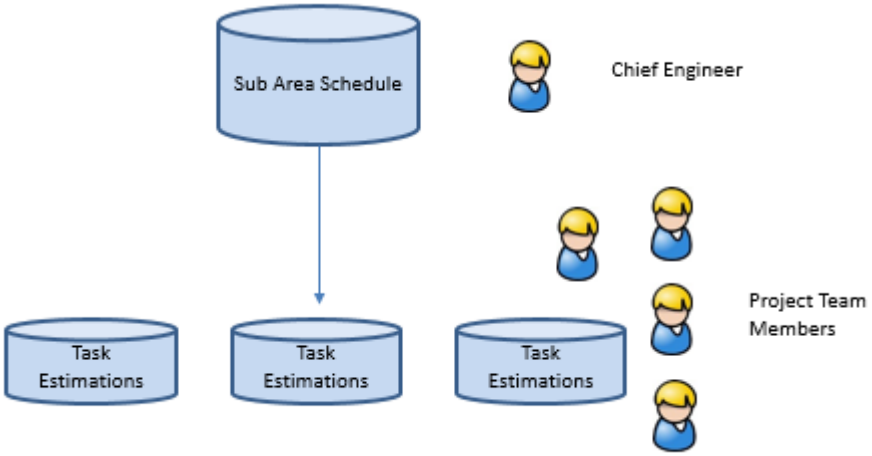

Figure 6.4 Creating task estimations

If the project is small, there is no need create smaller sub area schedules of the project but the task estimations can be created straight from the project schedule.

Actors: Project Portfolio Manager, Project Manager, Chief Engineer(s), Project Team Members

Precondition: Project scope must be in a stable situation before project schedule can be set. Project portfolio manager must also request human resources for the project from the functional organization. When project manager knows the available resources, it is possible to start project schedule creation. At this point, there should not be any restrictions from the upper management when project manager is creating the project schedule together with the project team.

Description: In order to create credible project schedule, it is essential to have information from old projects. This information can be found bot in tacit and explicit format. Chief engineers are typically experienced employees who have great experience of different projects so they should have great input to the project schedule creation. This information is in tacit format, because it is chief engineers' own experience which they are using when helping to create the project schedule. Information in explicit format should be found from post project reviews. These reviews can have a lot of input when trying to create project schedule and especially when identifying possible risks and creating risk management plan.

While creating project schedule, the sub area schedules should work as an input for creating task estimations. In this process project team members and chief engineers must work together, because project team members will eventually be the ones who are delivering and executing the tasks.

When precondition for this use case was set, it defined that project manager should be able to have "free hands" when creating the project schedule. Once it is done, it will be reviewed with the upper management and see if there is a need tighten the schedule.

Result: Detailed project schedule, task estimations and detailed risk management plan. These plans and estimations should be maintained and updated during the project if any changes appear.

5.3.3 Change request process

One of the problems related to project scope was that recruitments tend to be taken to the actual project scope too easily without clear guidelines. In order to prevent these situations, there is a need for a strict process for scope changes.

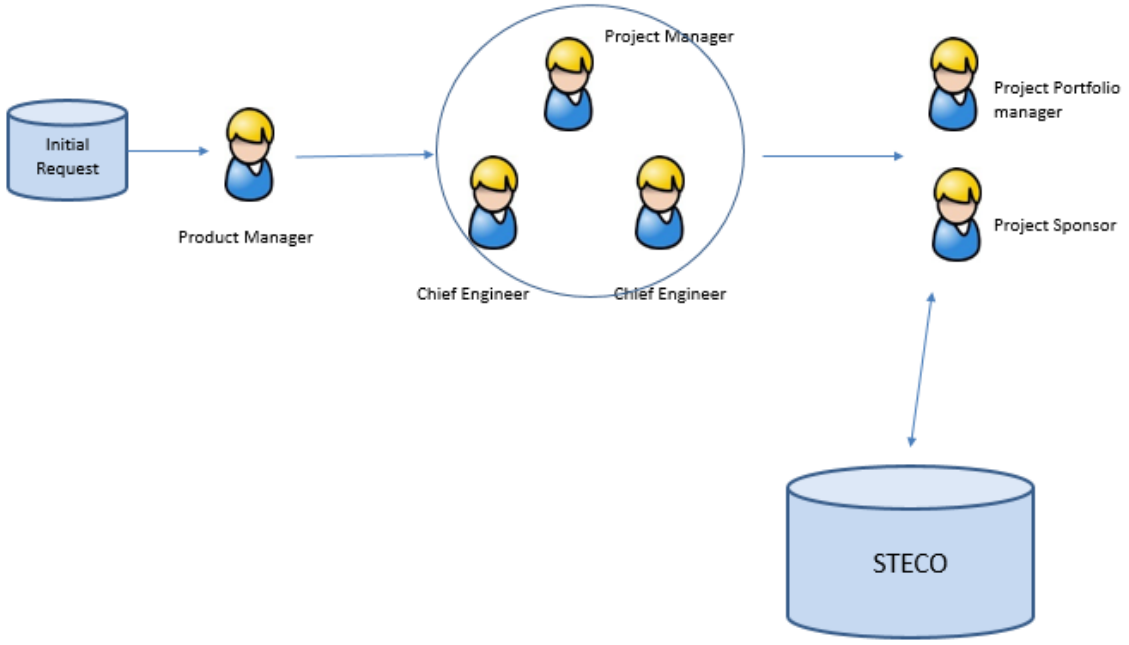

Figure 6.5 Change Request Process

Actors: Product Manager, Project Manager, Chief Engineer, Project Portfolio Manager, Project Sponsor

Precondition: The initial request for a new requirement has come and product manager must inform project management and also analyze the importance of the requirement.

Description: Project manager and chief engineers must analyze the requirement and what kind of affect it would have to project schedule. Project manager and chief engineers can also reject the request due the fact that implementing it would be simply impossible. If the change is minimal it is possible to just add the requirement to the project scope, but project manager must be aware all the time of every request. If the change would cause delay to project, the decision should be made by the steering committee. They can analyze how important the requirement is and should it be added even though it would cause a delay for the project. As on output of this use case is either updated project schedule or the request has been rejected.

Result: Updated project schedule and risk management plan if the request is accepted. Naturally the documentation related to the project scope should also be updated.

5.3.4 Project Status Creation

During the interviews it surfaced that the availability of project status and the overall transparency is lacking or the information about the project status is not credible. In the figure 6.6 is presented the use case of creation project status.

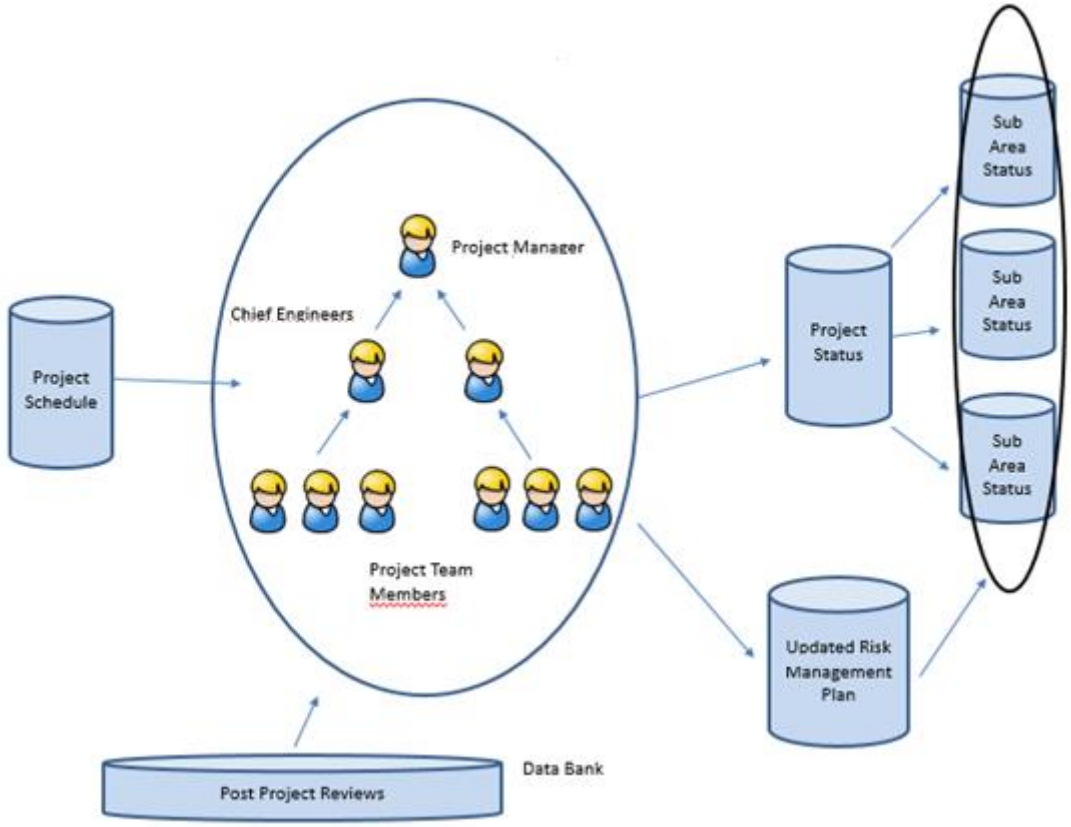

Figure 6.6 Project Status Creation

Actors: Project Team Members, Chief Engineers, Project Manager

Precondition: In order to update project status, the origin project schedule is used as an input for this use case.

Description: Based on the origin project schedule and project sub area schedule, it should be possible to create credible project status.

In order to create current project status project manager needs to gather information from team members. In an ideal situation project team members update information about the current status of their tasks into a certain platform. If this is not possible it is project manger's task to ensure that the information is collected in a way or another.

Result: Updated project status documentation which is available across the organization.

5.3.5 Project Cost

In order to follow up projects' cost, the only way for that is to gather information of realized hours. Information of these hours could also be used as a part of project status.

Figure 6.7 illustrates the situation how information should gathered and where it should be transferred. As mentioned earlier, there is a need for more strict process while gathering the information of realized hours.

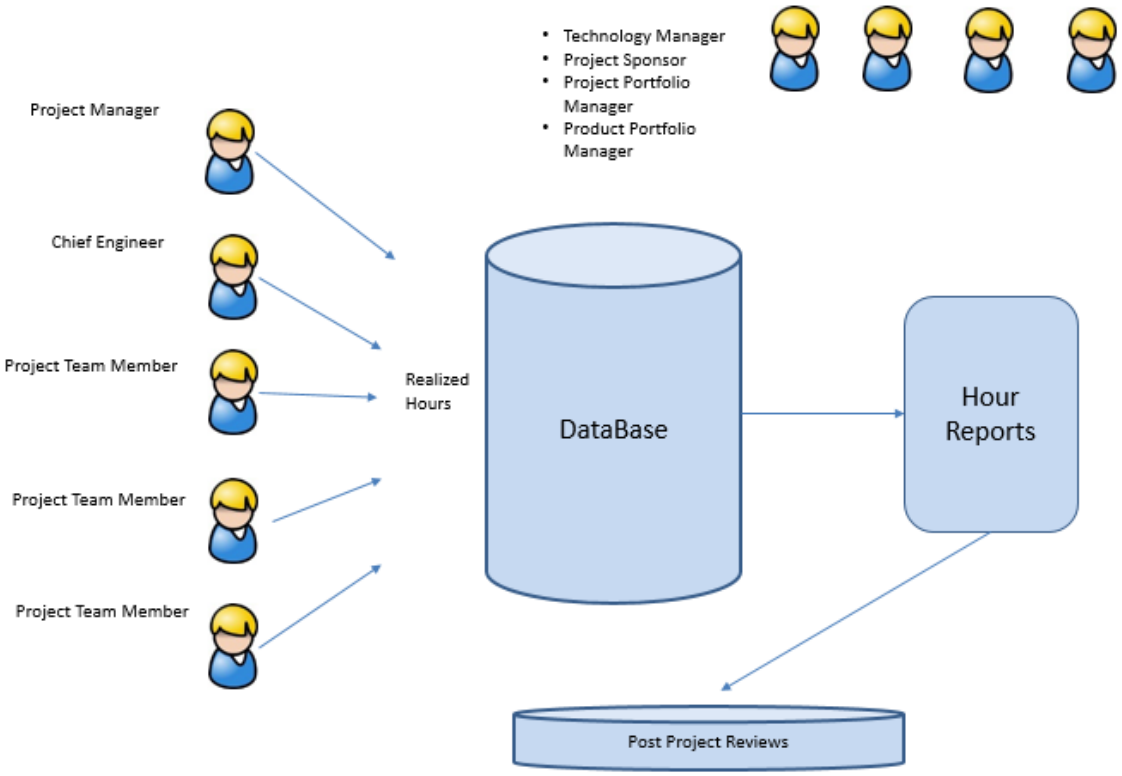

Figure 6.7 Project Cost

Actors: Project Manager, Chief Engineer, Project Team Members (Basically everyone

Precondition: In order to get the full benefit of gathering the information of realized hours, there should be a software system that creates automatically hour reports of the project.

Description: Every hour that is spent for the project should be tracked. Without it, it is impossible to achieve a situation where the case organization could know the actual cost of their projects. Everyone who is working for the project should track their hours into a certain platform.

Realized hours could also be categorized into project areas such as: project management, design work, searching new solutions etc.

Result: Detailed Project hours. This information should also be stored to the information system where all the post project reviews are stored.

5.3.6 Resource Allocation

In order to carry projects out successfully there is a need for resource allocation. Resource allocation should be based on the prioritization of projects and also the information of projects' status. The current status of the project portfolio should also be included in the resource allocation decisions.

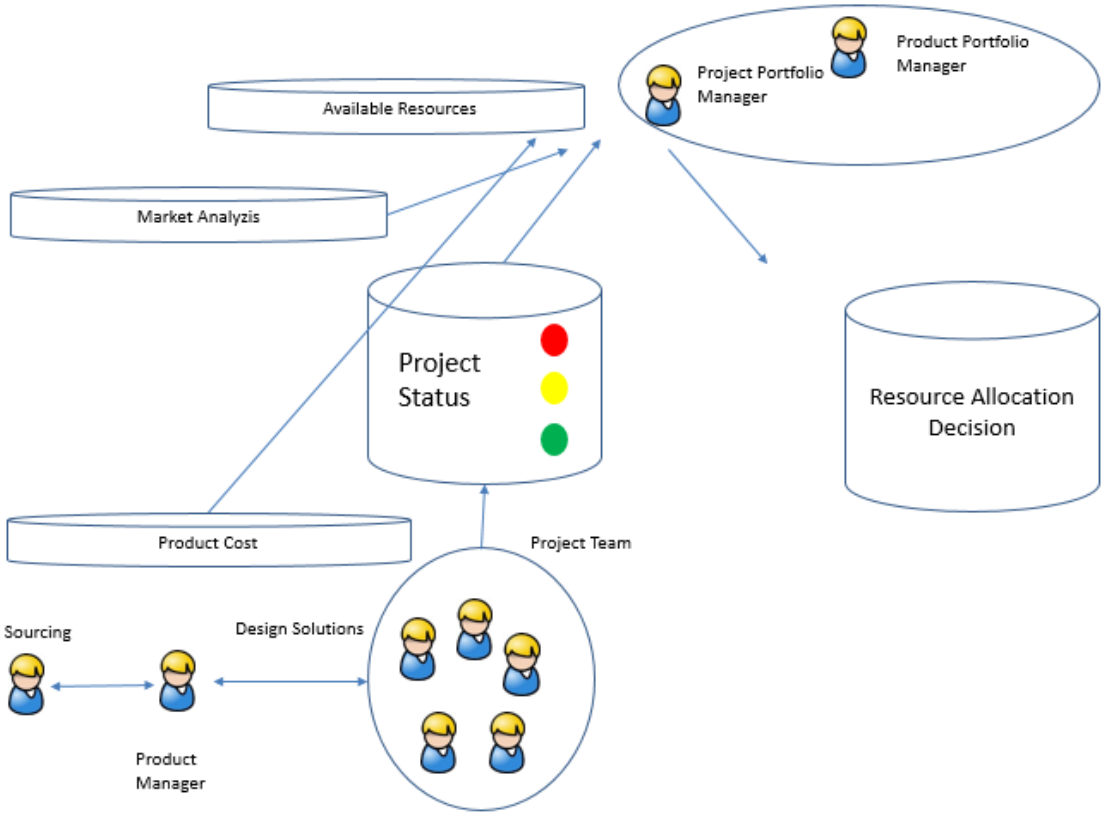

Figure 6.8 Resource allocation decisions

Actors: Project Team, Product Manager, (Sourcing), (Marketing), Project Portfolio Manager, (Product Portfolio Manager)

Precondition: The time period of previous resource allocation decision in the project portfolio has come into end and it is time for new resource allocation decision for the beginning time period.

Description: In order to make resource allocation decision project portfolio manager and possibly also the product portfolio manager needs information of projects' status and also the potential of the product in the markets. In practice balanced scorecards could be included in order to prioritize the projects. Sourcing function is providing information of material costs and product manager needs to combine this information with the information about design solutions.

The current status of each project must also be available in order to analyze and decide if some of the projects need additional resources. Market analysis should also be included. The analysis can vary a bit, depending on whether the product portfolio includes bulk products or products that will be delivered straight to a specific customer.

Result: Resource allocation decision should include all the projects that are currently managed in the project portfolio. Each project has assigned resources and if person is assigned to several projects, the percent of his/her workload is divided between the projects.

5.4 The aspect of project portfolio management

The latter part of the main research question asks how to boost project portfolio management with the help of information sharing. The presented use cases are more or less guidelines for a single project and managing it and they do not speak about project portfolio management. Only the last use case involved the portfolio level. How are these use cases then improving product portfolio management?

In the chapter three, the multi project environment and the term project portfolio management were described. It revealed that there is a clear correlation between project managing and project portfolio managing. The most important thing is to understand that from the single project level all the information is serving the portfolio level. In the presented use cases, many area of project information sharing are being improved. In the following table are correlations between the use cases and project portfolio level presented.

Table 6.1 Correspondences between use cases and project portfolio level

Use case	**Benefit in the project portfolio**
Scope creation	Carefully created project scope will reveal what kind of skills the project will require. It will ease the decisions of what human resources should be assigned to the project, based on their skills and knowledge.
Project schedule	A credible project schedule will give information to project portfolio level that how long certain resources are tied to the project. It will also give information, that when the project should be delivered and there is again space for next project to be taken in to the portfolio.
Change request process	After a change request is accepted it will

	reveal if different skills are needed in the project. As a result of the change request process is a new project schedule, which will reveal if there will be a delay in the project.
Project status	A detailed project status gives information whether the projects are within the schedule or not. Resource allocation decisions can be based on the statuses of different projects. Projects' status will also give information if future projects need to be postponed.
Project Cost	When projects are providing accurate information about the cost of the project, it is possible to create overall costs which can be assigned to a project portfolio level.
Resource Allocation	This process involves the project portfolio level already.

It is relative easy to see, that the information which is retrieved from the projects, are used as a guidelines when organization is managing the project portfolio. It is essential to know when new projects can be taken into the project portfolio. The importance of project selection was highlighted in the chapter 3.2.3 Project Selection. All the different use cases can be seen as an input for project selection. They are providing all the needed information in order to make decision if the project initiation can be taken into an actual project at the moment.

6 CONCLUSIONS

The presented use cases do not require lot of changes in the case organization, they are more or less instructional processes that should cover the information flow in the case organization. By supporting these use cases with a proper leadership and providing a good information system for information sharing, it is possible to boost information sharing in the case organization.

6.1 Discussion

The biggest problems in information sharing in the case organization were not surprising, but quite typical problems that are well recognized also in the literature. People who were interviewed did not feel that the problems are massive, more likely slight changes to the way of working and better guidelines like who creates the information, where it should be stored and how to ensure the quality of it. Information technologies and information systems were in sufficient level and people felt that if something, there are actually too many possibilities to store information. This can be changed easily by setting guidelines and rules, that what platform should be used.

It is quite obvious that the current situation in the case organization is not unique. Many large organization struggle with their information sharing and many studies reveal the fact, that people are spending more and more time in order to find information which they need in their daily work. Reasons for the problems are also quite obvious ones, the amount of information increases all the time and managing information becomes more and more time consuming, especially if there are no clear rules where the information should be stored and who is responsible to do it.

As mentioned earlier, the case organization relies heavily to new product development and the main focus is to improve products and fulfill customer's and market's needs. Employees are focused to product development and professionals on that area, but this can also be one of the root causes to the current state of information sharing. It is possible that organization has not understood the importance of structured information sharing process. This kind of situation develops slowly over the years, it is not a sudden change in the way of working and naturally the growth of the case organization has been a big composer for the current situation.

Even though the presented future actions and use cases can be implemented to the case organization, it still should be remembered that the results will not be immediately visible, it will take some time to really see what kind of effect the actions really have.

6.2 Evaluation of the research

Altogether, the research was successful. With the help of the research results, case organization is able to find their biggest bottlenecks in the information flow in the area of project and project portfolio management. There were four research questions set:

RQ1: What crucial information different roles need in order to improve project management?

RQ2: Why different roles do not retrieve the information they need?

RQ3: What is the right format for information?

MRQ: How should information sharing be developed in order to boost project and project portfolio management?

During the empirical study, the research questions one and two were answered well. Interviewees shared similar thoughts and the main problems in the information sharing were quite easily recognized. Not so surprisingly, the main problems were related to processes and guidelines related to information sharing. The interviewees did not raise the third research question as a very important question. As said previously, most likely the reason for this is that interviewees struggle more or less with the first two questions.

The first two research questions gave good input for the main research question. Especially the first research question worked well, when the information flows were defined. The interviewees also felt that structured information flows will improve the overall information sharing in the case organization.

6.3 Future studies

In the introduction chapter where the limitations for this research were set, revealed quite easily some possible future studies. In this research the main concentration was in the actual project environment, but in the future there could be a research of project stakeholders and their needs. In this context project stakeholders are for example marketing, purchase and even product management functions. Several different functions in

the case organization need naturally information of projects, not just the project portfolio level.

The third research question wasn't answered during the interviews, most likely the reason for it was that interviewees struggle with the basic problems of information sharing. In the future the situation will most likely change, when employees do not struggle any more with the availability of information. Once the organization achieves a state where they can say, that they are sharing information effectively, the information format could be researched.

REFERENCES

Allee, V. 2003. The future of Knowledge. Increasing Prosperity through Value Networks. Amsterdam, Netherlands. Butterworth-Heinemann. 294 p.

Archer N. & Ghasemzadeh F. 1996. Project portfolio selection techniques a review and a suggested integrated approach. McMaster University, Michael G. DeGroote School of Business, Innovation Research Centre.

Atkinson R. 1999. Project Management : Cost, Time and Quality, Two Best Guesses and a Phenomenon, Its Time to Accept Other Success Criteria. International Journal of Project Management Vol. 17(6), pp. 337-342.

Argyris C. & Schön D. 1978. Organizational learning: a theory of action perspective. Reading. Addison-Wesley. 344p.

Badir, Y.F., Buchel, B., Tucci, C. 2009. The performance impact of intra-firm organizational design on an alliance's new product development projects. Research Policy, Vol. 28, pp.1350-1364.

Badiru A. B. 1993. Quantitative Models for Project Planning, Scheduling, and Control. Westport, CT. Quorum Books. 380p.

Basu R. 2014 Managing quality in projects: An empirical study. International Journal of Project Management. Vol. 32(1), pp.178-187.

Bhattacharyya, R., Kumar, P., Samarjit K.S. 2011. Fuzzy R&D portfolio selection of interdependent projects. Computers & Mathematics with Applications. Vol. 62(10), pp.3857-3870.

Berggren, C. 1996. Building a truly global organization? ABB and the problems of integrating a multi-domestic enterprise. Scandinavian Journal of Management Vol. 12 (2), pp.123–137.

Blomquist, T. & Müller, R. 2006. Practices, roles, and responsibilities of middle managers in program and portfolio management. Project Management Journal Vol. 37 (1), pp.52–66.

Budd, C.I. & Budd, C.S. 2009. A Practical Guide to Earned Value Project Management. Management Concepts Inc. 403p.

Cardinal J., Marle F. 2004. Project: The just necessary structure to reach your goals. International Journal of Project Management. Vol. 24(3), pp.226-233.

Chang D. R. & Cho H. 2008. Organizational memory influences new product success. Journal of Business Research Vol. 61 pp.13–23.

Cohen I., Mandelbaum A., Shtub A. 2004. Multi-project scheduling and control: A process based comparative study of the critical chain methodology and some alternatives. Project Management Journal. Vol. 35(2), pp.39-50.

Collier, B., DeMarco, T., Fearey, P., 1996. A defined process for project postmortem review. IEEE Software Journal, pp.65–71.

Cooper R, Edgett S, Kleinschmidt E. 1999. New product portfolio management: practices and performance. Journal of Product Innovation Management. Vol.16, pp.333–351.

Cooper, R., Edgett, S., Kleinschmidt, E., 1997. Portfolio management in new product development: lessons from the leaders. Research Technology Management Vol. 40 (5), pp.16–28.

Cooper RG, Edgett S., Kleinschmidt E., 1998. Portfolio management for new products. New York. Perseus Books. 382p.

Cooper R., Edgett S., Kleinschmidt EJ. 2000. New problems, new solutions: making portfolio management more effective. Research Technology Management Vol. 43(2), pp.18–33.

Cooper RG. 2001. Winning at New Products: Creating Value Through Innovation Reading, MA: Perseus Books. 391p.

Dammer, H., 2008. Multiprojektmanagement. GWV Fachverlage, Gabler, Wiesbaden. 232p.

Dammer, H., Gemünden, H.G., Lettl, C., 2006. Qualitätsdimensionen Des Multiprojekt-Managements. Eine Konzeptionelle Analyse. Zeitschrift für Führung und Organisation. Vol.75, pp.148–155.

Davis S. & Botkin J. 1994. The Coming of Knowledge-Based Business. Harvard Business Review. Vol. 72(5), pp.165-170.

Dye L. & Pennypacker J. 1999. Project portfolio management. Selecting and prioritizing projects for competitive advantage. USA. Center for Business Practices. 421p

Engwall M., Jerbrant A. 2003. The resource allocation syndrome: the prime challenge of multi-project management? International Journal of Project Management. Vol. 21(3), pp.403-409.

Eilat H., Golany B., Shtub A. 2008. R&D project evaluation:An integrated DEA and balanced scorecard approach. Omega. Vol. 36, pp.895-912.

Eppler M.J. & Sukowski O. 2000. Managing Team Knowledge: Core Processes, Tools and Enabling Factors. European Management Journal Vol. 18(3), pp. 334–341.

Eskerod P. 1998. The human resource allocation process when organizingby projects. In: Lundin RA, Midler C, editors. Projects as arenas for renewal and learning processes. Boston: Kluwer Academic Publisher;. pp.125–31.

Fageha M. & Aibinu A. 2013. Managing Project Scope Definition to Improve Stakeholders' Participation and Enhance Project Outcome. Procedia - Social and Behavioral Sciences. Vol. 74, pp.154-164.

Freeman, R.E. 1994. Strategic Management: A Stakeholder Approach. Cambridge. University Press, 292p.

Gaddis, P. 1959. The Project Manager. Harvard Business Review. Vol. 37(3), pp. 89–97.

Ghasemzadeh F. & Archer N.P. 2000. Project portfolio selection through decision support. Decision Support System. Vol. 29. pp.73-88.

Gilad, T. & Gilad, B. 1986. Business intelligence - the quiet revolution. Sloan Management Review. Vol 27(4), pp.53-61.

Hall, P. 1994. Innovation, Economics & Evolution – Theoretical Perspectives on Changing Technology in Economic Systems. Harveste Wheatsheaf. 418p.

Hansen M.T., Nohria N., Tierney T. 1999. What is your strategy for managing knowledge? Harvard Business Review. Vol. 77(2), pp.106–116.

Hendriks MHA., Voeten B., Kroep L. 1998. Human resource allocation in a multi-project R&D environment. International Journal of Project Management. Vol. 17(3), pp.181-189.

Hoegl, M., Gemuenden, H.G., 2001. Teamwork quality and the success of innovative projects: a theoretical concept and empirical evidence. Organization Science. Vol. 12 (4), pp.435–449.

Huemann M., Keegan A., Turner J. 2007. Human resource management in the project oriented company: A review. International Journal of Project Management. Vol. 27, pp.315-323.

Huselid MA. 1995. The impact of human resource management practices on turnover, productivity, and corporate financial performance. Academy of Management Journal. Vol. 38(3), pp.653-672.

Imai K, Nonaka I, Takeuchi H. 1985. Managing the new product development process: how Japanese firms learn and unlearn. Boston. Harvard Business School. pp. 337–376.

Izack, C., Avishai, M., Avraham, S., 2004. Multi-project scheduling and control: a process based comparative study of the critical chain methodology and some alternatives. Project Management Journal Vol. 35 (2), pp.39–49.

Jaafari, A. & Manivong, K. 1999. The need for life-cycle integration of project processes. Engineering Construction and Architectural Management, Vol. 6, pp. 235–255.

Jonas D. 2010 . Empowering project portfolio managers: How management involvement impacts project portfolio management performance. International Journal of Project Management Vol.28. pp.818–831.

Jones, G. R. 1986. Socialization tactics, self-efficacy, and newcomers' adjustments to organizations. Academy of Management Journal. Vol. 29, pp.262–279.

Kaplan, R., Norton, D. 1996. Using the Balanced Scorecard as a Strategic Management System. Harvard Business Review. Vol. 74(1), pp.75-85.

Kettunen, P. 1974. Yrityksen tutkimisesta. Jyväskylä. Gummerus. 60p.

LaBrosse, M. 2010. Project-portfolio management. Employment Relations Today. Vol 37(2), pp.75–79.

Leach L. 1999. Critical Chain Project Management Improves Project Performance. Project Management Institute. Vol. 30 (2). pp.39-52.

Luehrman T., 1998. Strategy as a portfolio of real options. Harvard Business Review, Vol. 76(5), pp. 89-99.

Lysons K. & Gillingham M. 2003. Purchasing and Supply Chain Management. Edinburgh, England. Pearson Education Limited. 780p.

Marshall R. 2007. The Contribution of Earned Value Management to Project Success Contracted Efforts. Journal of Contract Management. Vol 47, pp.21-33.

Martinsuo M. 2013. Project portfolio management in practice and in context. International Journal of Project Management. Vol. 31 (6). pp.794–803.

Martinsuo, M. and Lehtonen, P. (2007) Role of single-project management in achieving portfolio management efficiency. International Journal of Project Management. Vol. 25(1), pp.56-65.

McConnel, S. 1997 Tool Support for Project Tracking. IEEE Software Vol. 14(5), pp.119-120.

Mikkola, J. 2001. Portfolio management of R&D projects: implications for innovation management. Technovation Vol. 21,pp.423-435.

Milosevic D., Patanakul P. 2005. Standardized project management may increase development projects success. International Journal of Project Management. Vol. 23, pp.181-192.

Morris L. & Miller W. 1999. Fourth Generation R&D: Managing Knowledge, Technology, and Innovation. New York. United States of America. Wiley. 342p.

Munns A.K & Bjeirmi B.F. 1996 The role of project management in achieving project success. International Journal of Project Management. Vol. 14(2), pp.81-87.

Müller, R., Martinsuo, M., Blomquist, T. 2008. Project portfolio control and portfolio management performance in different contexts. Project Management Journal. Vol. 39 (3), pp.28–42.

Negash, S. 2004. Communications of the Association for Information Systems. Business Intelligence Vol. 13. pp. 177-195.

Nidumolu, S. 1995. The effect of coordination and uncertainty on software project performance: residual performance risk as an intervening variable, Information Systems Research Vol. 6 (3), pp. 191–219.

Nidumolu, S. 1996. Standardization, requirements uncertainty and software project performance. Information & Management Vol.31, pp.135-150.

Nonaka, I. & Takeuchi, H.(1995). The knowledge creating company: how Japanese companies create the dynamics of innovation. New York. Oxford University Press. 284p.

Nowak, M. 2013. Project Portfolio Selection Using Interactive Approach. Procedia Engineering, Vol. 57, pp.814-822.

Novelius D. 2003. Towards the sixth generation of R&D management. International Journal of Project Management. Vol. 22, pp. 369-375.

Novak M. 2013. Project Portfolio Selection Using Interactive Approach. Procedia Engineering. Vol. 57, pp.814-822.

Olkkonen T. 1994. Johdatus teollisuustalouden tutkimustyöhön. Second edition. Espoo, Finland. Teknillinen korkeakoulu. 143p.

Park C., Im G., Keil M. 2008. Overcoming the Mum Effect in IT Project Reporting: Impacts of Fault Responsibility and Time Urgency. Journal of the Association for Information Systems. Vol. 9(7), pp.409-431.

Payne JH. 1995. Management of multiple simultaneous projects: a state of the art review. International Journal of Project Management. Vol. 13(3), pp.163-168.

Project Management Institute (PMI). 2000. A Guide to the. Project. Management. Body of. Knowledge. (PMBOK® Guide). Project Management Institute. Newtown Square, Pennsylvania USA.

Rau B, Hyland M. 2002. Role conflict and flexible work arrangements: the effects on applicant attraction. Pers Psychol. Vol. 55, pp.111–136.

Sakthivel S. 2005. Virtual Workgroups in Offshore Systems Development. Information and Software Technology. Vol.47(5), pp. 305-318.

Saunders M., Lewis P., Thornhill A. 2009. Research methods for business students. Fifth edition. Essex, England. Pearson Education Limited. 614p.

Schurr P. & Pazer H. L. 2002. Information Quality and Online B2B Relationships After the Purchase. Proceedings of the 18th Annual IMP Conference, September 5th – 7th. Dijon, France.

Sinkula J. M. 1994. Market information processing and organizational learning. Journal of Marketing Vol. 58(1), pp.35-45.

Sissonen H. 2006. Information sharing in R&D collaboration – context-dependency and means of governance. Lappeenranta, Digipaino. 232p.

Stevens, G. A. & Burley, J. 2003. Piloting the Rocket of Radical Innovation Research-Technology Management, Vol. 46(2), pp. 16-25.

Stevens, T. 1997. Balancing Act. Industry Week. Vol. 246(6).

Thierauf R. & Hoctor J. 2001. Optimal Knowledge Management: Wisdom Management Systems Concepts and Applications. Idea Group Inc. 286p.

Thierauf, R. J. 2001. Effective Business Intelligence Systems. Westport. Quorum Books. 370p.

Thompson R., Smith J., Iacovou C. 2007. The linkage between reporting quality and performance in IS projects. Information & Management. Vol. 44, pp.196-205.

Tonnquist, B. 2008. Project Management. Bonnier Utbildning AB, Stockholm. 401p.

Uusitalo H. 1995. Tiede, tutkimus ja tutkielma – Johdatus tutkielman maailmaan. Second edition. Juva, Finland. WSOY. 121p

Vandevoorde S. & Vanhoucke M. 2006. A comparison of different project duration forecasting methods using earned value metrics. International Journal of Project Management. Vol. 24, pp.289-302.

Vitt E., Luckevich M., Misner S. 2002. Business Intelligence: Making Better Decisions Faster. Washington, Microsoft Press. 202p.

Wang, Y., 2011. Study on critical chain project portfolio management. Management and Service Science (MASS), International Conference. pp.1-4.

Wei C-C. , Chang H-W. 2011. A new approach for selecting portfolio of new product development projects. Expert Systems with Applications. Vol. 38, pp.429-434.

Westerveld E. 2003 The project excellence model: linking success criteria and critical success factors. International Journal of Project Management. Vol. 21(6), pp.411–418.

Wiley VD, Deckro RF, Jackson JA. 1998. Optimization analysis for design and planning of mulit-project portfolios. European Journal of Operational Research. Vol. 107, pp.492–506.

de Wit, A. 1988. Measurement of project management success. International Journal of Project Management. Vol 6(3), pp.164-170.

Wysocki R. & McGary R. 2003. Effective Project Management: Traditional, Adaptive, Extreme. John Wiley & Sons. 504p.

Yu AG, Flett PD, Bowers JA. 2005. Developing a value-centred proposal for assessing project success. International Journal of Project Management. Vol. 23(6), pp.428–436.

Zhen L., Wang L., Li J-G. 2013. A design of knowledge management tool for supporting product development. Information Processing and Management. Vol. 49, pp.884-894.

Zika-Viktorsson A, Sundström P, Engwall M. 2006. Project overload: An exploratory study of work and management in multi-project settings. International Journal of Project Management. Vol. 24(5), pp.385–94.

APPENDICES (INTERVIEW QUESTIONS)

1. Describe your task related to the area of project management.
2. What kind of information you need in these described areas?
    a. Do you need the information in order to make decisions
    b. Who should provide the information
    c. What should be the platform for the information
    d. How often you need this information
    e. What is the format of the information?
3. What information you need to provide?
    a. What is the platform for it?
    b. Do you feel that you are sharing the same information multiple times?
4. Do you feel that the information that you need, is easy to get?
    a. If not, what is the main reason for it?
    b. What do you do in order to get the information?
5. What is the most used platform for sharing information?
6. Do different projects share information differently?
7. What are the main reasons for problems in the information sharing?
8. How would you boost information sharing?