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TAMPERE UNIVERSITY OF TECHNOLOGY

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EVALUATING AND MANAGING A PROCESS DEVELOPMENT PROJECT PORTFOLIO

Master's Thesis

Examiner: Professor
Miia Martinsuo
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ABSTRACT

HENRIIKKA PILPOLA: Evaluating and managing a process development project portfolio
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Project portfolio management has been studied extensively in the past and recently the research has focused more on specific areas of project portfolio management, such as project portfolio risk management and portfolio management quality. The research on process development projects as a project portfolio is not extensive. New product development portfolios focus more on creating new and creative products and on analyzing technological trends. Internal process development projects, on the other hand, are not necessarily executed to increase the revenue of the company but they increase organizational capabilities.

This thesis examined the process development project portfolio management practices in a large Finnish company. The case company is experiencing major growth in the next few years which is why many process development projects are in planning or already in execution phase. The study was a constructive study with a multi-method qualitative research approach. This means that there were many methods used for qualitative data collection. The empirical data was gathered with semi-structured interviews and a workshop in the case company.

The study revealed that the current process development project portfolio management is fragmented in the case company and therefore the case company needs improved project management practices. The current challenges in process development project portfolio management were for example single project management inefficiency, lack of systematic communication and the fact that there were no clear project portfolio management practices at the company level. In order to improve the management of internal process development projects, an assessment system was created. The features of the assessment system were for example a scoring model for project proposals, categorization for projects and a project portfolio management process with integrated organizational model.

TIIVISTELMÄ

HENRIIKKA PILPOLA: Prosessikehitysportfolion johtaminen ja arvioiminen
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Projektisalkkujen johtamista on tutkittu jo vuosikymmeniä ja viime vuosina aiheen tutkimus on keskittynyt enemmän tiettyihin tutkimusalueisiin kuten projektisalkkujen riskeihin ja salkunjohtamisen laatuun. Prosessikehitysprojektien salkkujohtamista ei ole kuitenkaan tutkittu laajasti kirjallisuudessa. Tuotekehitysportfoliot keskittyvät enemmän uusien ja innovatiivisten tuotteiden luomiseen ja teknologiseen ennakointiin. Sisäiset prosessikehitysprojektit, sitä vastoin, keskittyvät enemmän yritysten sisäisten prosessien parantamiseen ja organisaation kyvykkyyden nostamiseen.

Tämä diplomityö tutki prosessikehitysprojektien salkkujohtamista isossa suomalaisessa yrityksessä. Yritys tulee kokemaan suurta kasvua seuraavan muutaman vuoden aikana, minkä takia moni prosessikehitysprojekti on suunnitteilla tai jo toteutuksessa. Tutkimus suoritettiin konstruktiivisena tutkimuksena ja aineisto kerättiin monella laadullisen tutkimuksen menetelmällä. Empiirinen aineisto kerättiin puolistrukturoiduilla haastatteluilla ja työpajalla yrityksessä.

Tutkimuksessa selvisi, että yrityksen tämänhetkinen prosessikehitysprojektien johtaminen on epäkoherenttia ja tämän takia yritys tarvitsee uusia menetelmiä johtamisen kehittämiseksi. Tämänhetkisiä prosessikehitysprojektien johtamishaasteita olivat yksittäisten projektien johtamisen tehottomuus, systemaattisen kommunikoinnin puute ja salkunjohtamiskäytäntöjen epäselvyys. Jotta prosessikehitysprojektien johtaminen kehittyisi yrityksessä, diplomityössä luotiin arviointisysteemi johtamisen parantamiseksi. Systeemi sisältää muutamia erilaisia osia, kuten pisteytysmallin uusille projektiehdotuksille, kategorisoinnin projekteille ja projektisalkkujohtamisen prosessin organisaatiomalleineen.

PREFACE

This thesis project has been a long and educational journey and I am pleased that is has come to a successful end. I had to challenge myself in ways that I was not anticipating. Fortunately, with the help and support from many people I was able to finish this thesis.

I would like to thank Matias Korpela and Kalle Pietinen who were my supervisors in the case company. You always had faith in me throughout the thesis process and you motivated me to aim for better achievements. Your feedback was always constructive and I appreciate that you had so much patience and time to help me with my thesis. In a broader perspective, I would like to thank the case company for giving me the opportunity to write a thesis for the company.

I would also like to thank my examiner professor Miia Martinsuo who with her extensive knowledge of project management supported me in structuring the thesis and my thoughts when the direction of the thesis was changing. Your contribution to the thesis was highly valued and I could always trust you to have an answer when problems came up with the thesis.

Lastly I would like to thank my family and friends who supported me during the spring 2017 and helped me to get back on track when there were challenges in writing the thesis. Finishing the thesis marks a pivotal moment in my life and I would like to thank all who have ever supported me in my studies. I especially want to thank my family members who have always supported my studies from the early beginning.

In Tampere, Finland, on 26 July 2017

Henriikka Pilpola

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ABBREVIATIONS AND SYMBOLS

KPI	Key performance indicator
PMO	Project management office
PPM	Project portfolio management
PPMO	Project portfolio management office
R&D	Research and development

1. INTRODUCTION

1.1 Background

In today's business environment, companies need to manage multiple complex projects at the same time. The amount of work done in projects is increasing and companies struggle to coordinate and optimize their project portfolios (Martinsuo 2013). Proactive management of the whole project portfolio has become increasingly important for achieving long-term success and competitive advantage (Heising 2012). Project portfolio management (PPM) deals with coordinating multiple projects that pursue the same strategic goals and that compete for the same resources, and the managers prioritize between projects to achieve strategic benefits for companies (Cooper et al. 1997a).

The amount of factors contributing to each project is vast and therefore the management of project portfolios might be challenging without clear assessment mechanisms (Cooper et al. 1999). In addition, the upper management should have up-to-date information about how the projects are progressing. By assessing certain factors of the projects, the evaluation of the projects can be made and the projects can be compared within the project portfolio (Cooper et al. 2000).

In the literature project portfolio evaluation models have focused on managing product portfolios of new product development projects (Cooper et al. 1997a). However, there have not been many frameworks in the literature that aim to create an assessment framework for internal process development projects. Shenhar et al. (2002) state that projects are different and that the same tools and frameworks might not work for all project activities. Process development projects aim to achieve performance improvements in a company and typical examples of internal process development projects are internal information technology development projects or investments in new manufacturing equipment (Elonen & Artto 2003). If projects are measured for evaluation and decision making, the nature of the projects should be taken into account.

1.2 Case company

The final products of the case company are complex and high-quality cruise ships. The unique cruise ship projects last multiple years and require extensive expertise in planning and design work. Due to the fact that the products are unique and complex, the products tend to be expensive which causes pressure to manage the financing of the products well.

When the production is planned individually for a ship and the production process is long, flexibility is of essence. It is common that the company gains income at the last stages of the production although the costs will arise in the early stages of the production and design. This is why the budgeting must be done as accurately as possible and the costs should be monitored throughout the design and production process. Another challenge with manufacturing complex cruise ships is the management of the long supply chain. The delays in the supply chain can cause serious delays in the whole production process and this can result in cost overruns. The quality of the process and the end product is important to monitor because a quality cruise ship that fulfils the customer requirements well is a prerequisite for future orders.

The case company will experience substantial growth in the next few years and many investment and development projects are in planning phase or already in execution. The case company's order book needs to be completed and this requires changes in manufacturing processes and other supporting processes. As can be seen in Figure 1, the case company has a functional organizational structure where company employees are classified according to their function they perform in the company. There are separate departments for example for production, sales and procurement where employees have one superior. However, the ship projects are managed in projects teams that are created for each specific ship order. This indicates that the case company is party a matrix organization because the ship project workers are part of the functional departments but also part of the ship project teams (Laslo & Goldberg 2008). The organizational structure in Figure 1 is suggestive and does not present the actual organizational structure of the case company.

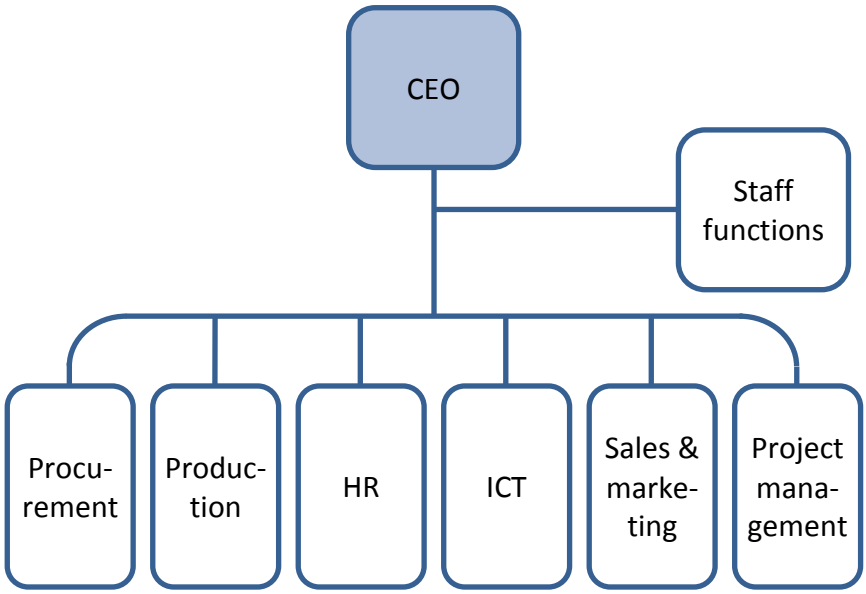


Figure 1: *Suggestive management organization of the case company.*

There is no separate department for development projects in the case company. There is a subdepartment called Research and Development (R&D) but this department focuses more on product development. The governance of development projects in the case organization is explained in detail later in this thesis.

1.3 Research problem, objectives and scope

The goal of this thesis is to develop an assessment system for process development projects in the case company. The case company will experience substantial growth in the next few years which is why many operations and processes will be reorganized. The growth, however, has been so fast that the monitoring and assessment of development projects has not been able to keep up with the current pace of change. Due to the change in the company's development effort, the current development project management practices need to be improved. Therefore, the case company needs a new assessment system to help monitor the progress of current and new development projects and support the project management.

For this thesis, the academic literatures of project portfolio management, assessment and measurement of development projects, performance management and project management offices are studied. The thesis is conducted as a constructive research study and it applies a multi-method research approach since many qualitative data analysis methods were used to create the assessment system construct (Saunders et al. 2009). The empirical data was gathered with semi-structured interviews and a workshop.

The case company requires more knowledge on how to manage development projects and how to measure their performance both on a project and portfolio level. The new assessment system aims to evaluate and improve the efficiency of the development project management. Furthermore, it is essential to develop a system that suits into the case company's current assessment systems and procedures.

There are two *research objectives* in this study and they are divided into sub-objectives. The research objectives are the following:

- To identify the case company's current development project and portfolio management practices
  - To identify the current development project performance measures and management practices
  - To find out how the development projects are evaluated on a project and portfolio level

- To determine an assessment system for development projects
  - To analyze what role the assessment system could have as part of development project management and decision making
  - To determine how the new assessment system would function as part of the new Project Management Office of the case company
  - To identify useful practices for successful development project portfolio management for the case company

The *research questions* for the thesis are the following:

- What are the current development project assessment measures of the case company?
- What kind of assessment system could support the management of development projects and portfolios?

The focus of the study is the creation of the new assessment system. The definition of the assessment criteria for the development projects is the scope of the study as well as analyzing how the assessment will function with the management of the development project portfolio. The full implementation of the assessment system will not be the focus of this study because the assessment system will give insights on how the management of the development project portfolio could be done. Furthermore, all of the development and investment projects in the case company are not studied in the thesis. The final construct is created based on some of the development projects and the goal is to design it so that all of the development projects could use the system for project assessment. Throughout the thesis the term development project is used to refer to the internal process development projects within an organization that increase the efficiency in manufacturing or other operations.

The assessment system is a supplementary part of a project management office project in the case company. The case company is creating a project management office (PMO) for the development project portfolio at the moment. A PMO is a structure in a company that supports project management with various ways (Hobbs & Aubry 2007). In the case company, the development projects are being brought under a PMO supported organization. The development of the new PMO will not be the focus of this study although the assessment system is strongly linked to the functions of the PMO.

1.4 Structure of the thesis

Chapter 2 introduces the literature review of this thesis. The first section introduces the key concepts of this thesis and the second section the theory about project portfolio management. The third section focuses more on project evaluation, PMOs and improvement the overall performance of process development project portfolio manage-

ment. In the last section of the literature review the initial construct for the thesis is presented which gives the guidelines for the empirical research and assessment system development. Throughout the thesis the process development project aspect will be considered because process development project management differs from new product development for example, although they have similarities.

Chapter 3 explains the constructive research approach more in detail and it also explains how the empirical data was gathered and analyzed. The empirical data was qualitative data that was collected with various methods. Chapter 4 introduces the results from the interviews and it gives the current state analysis of the process development project portfolio management in the case company.

Chapter 5 presents the new assessment system that is created based on the data gathered from literature, interviews, workshop and other case company data. The assessment system is a project portfolio management process with integrated evaluation models and organizational structures. In Chapter 6 the assessment system is analyzed and compared with prior academic literature and the usability of the system for the case company is studied. Chapter 7 presents the conclusions of the thesis and the results are examined critically and recommendations for future research are introduced. Figure 2 illustrates the structure of the thesis.

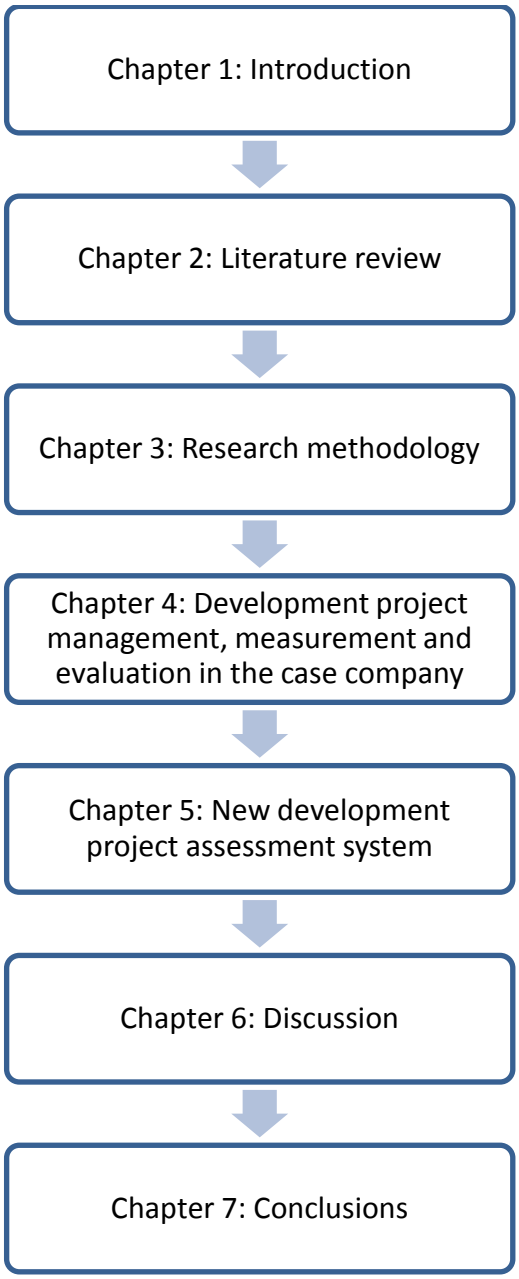


Figure 2: *Structure of the thesis.*

2. LITERATURE REVIEW

2.1 Key concepts

2.1.1 Development projects

In development projects knowledge is applied to develop current processes and capabilities. Development projects are usually internal investments in production technology, IT systems or other processes (Artto et al. 2008, p.23). With development projects the capabilities of a company are improved. Many of the development projects are related to IT improvements and therefore IT has an important role in development project portfolio management (Jeffery & Leliveld 2004). Development projects are very varied by nature but they all aim to increase the overall performance of a company.

According to Shenhar et al. (2002) internal development projects can be divided further into problem solving, utility, maintenance and research projects. They can be either strategic or operational in their nature. Shenhar et al.'s utility and research projects usually come from a long-term perspective and can be considered as strategic projects. Problem-solving and maintenance projects are relatively short-term and narrower in focus and they can be seen as operational projects (Shenhar et al. 2002; Artto & Dietrich 2004). Mikkelsen et al. (1991) define internal projects as organizational or operational development projects, for example systems planning and implementation, the introduction of new manufacturing technology and organizational change.

A popular definition for a process is: the transformation of inputs into outputs; the inputs can be resources or requirements, while the outputs can be products or results. The outputs may or may not add value and could be an input to another process (Adesola & Baines 2005). The term business process is used when the process concept is applied to commercial organization. Business processes are used to achieve business goals and the performance can be monitored with using performance indicators (Yen 2009). According to Bititci et al. (2011) there is a variety of business process classifications based on the purpose or function of the process. These categories can be operational processes, such as product and service development processes, management processes, such as strategy formulation or resource allocation, or organizational processes, such as decision making processes. Business process improvement, on the other hand, has the following definition: a methodology that is designed to bring about step-function improvements in administrative and support processes using approaches such as process benchmarking, process redesign and process re-engineering (Adesola & Baines 2005).

For business development projects, the time-to-market pressure comes through the internal customer and this pressure might not be as strong as in the case of external customers. This modest pressure for completion does not encourage business development projects to strive for their objectives similarly to delivering external customers. It may also lower the priority of business development projects in comparison to other types of projects. One challenge with development projects is that they might not directly increase the turnover of the company. However, they enable the increase, introduce cost savings or improve the performance of the company in another way. For example, a new customer relationship system can enable turnover increase and a business process re-engineering project can introduce cost savings. The benefits of both of these projects to the company, as well as those of most business development projects, are highly challenging to measure out, because most of the effects are indirect to the performance of the company. (Elonen 2002)

2.1.2 Project management

One definition for a project is that it is a unique process, consisting of a set of coordinated and controlled activities with start and finish dates, undertaken to achieve an objective conforming to specific requirements (Marques et al. 2011). They are managed by temporary organizations and the projects have fixed schedules, budgets and goals. There are several project execution models that can be used to manage projects. A typical example is presented in Figure 3 and it contains the phases that many projects go through. A well-management project follows a project management process and the project plan is updated and reviewed at regular intervals.

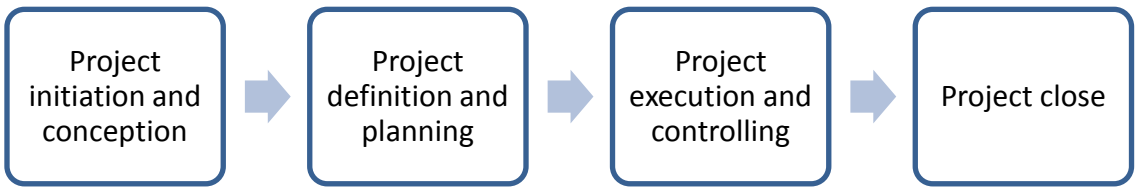


Figure 3: *Typical project management phases (modified from Artto et al. 2008, p.100).*

In larger projects, milestones and gates are used as decision points in projects (Artto et al. 2008, p.123). Especially the term decision gate is used in new product development project environment (Artto et al. 2008; Cooper et al. 2000). Gates are points of reflection in projects and in these points it is decided if the project is continued or killed due to lack of resources or other reasons. The Stage-Gate model (Cooper 2008) is a widely used framework for new product development projects from idea phase to product launch.

It is important to notice that in the ideation and initiation phases there might not be a project plan available and therefore a project description functions as a starting point for more detailed project planning (Artto et al. 2008, p.103). A project plan contains some typical aspects and according to Artto et al. (2008, p.100) these are:

- Project background and benefits
- Project goals and objectives
- Risk management
- Project organization and responsibilities
- Project scope
- Work breakdown structure and scheduling
- Resource management
- Procurement management
- Budget and cost management
- Reporting and communication

During the project the project plan might be updated. In project reporting the upcoming changes of projects need to be updated. Project reporting is executed to inform project team members and stakeholders of the project. Typically the reporting of projects is regular and is linked to time or deviations. (Artto et al. 2008)

2.1.3 Project portfolio management

The assessment system created in this study is developed for assessment of multiple development projects. These projects create a development project portfolio and the contents and management practices of the portfolio might change over time. Portfolio management is seen as a dynamic decision process where a company's list of active projects is constantly updated and revised. In this process, new projects are evaluated, selected and prioritized and existing projects may be accelerated or even killed (Cooper et al. 1997a). Strategic portfolio management is seen as strategic decision making and control regarding the portfolio using various management methods, with the objective of a portfolio in balance, with maximum value, and strategic alignment (Heising 2012). The project portfolio is a reviewed by upper management and as support for decision making the project information needs to be collected, for example by a project management office (Artto et al. 2008, p. 391).

As stated earlier in the thesis, a project can be defined as "a complex effort, made up of inter-related tasks, performed by various organizations, with a well-designed objective, schedule and budget" (Artto et al. 2008, p. 26). A portfolio, however, is a group of projects in an organization and these projects compete for the scarce resources available from the sponsor or the management of the organization. There are usually not enough resources to conduct all of the desired projects in the organization (Archer &

Ghasemzadeh 1999). In the literature it is acknowledged that single projects cannot be regarded as isolated entities, but they are influenced by the complex and uncertain character of their context. This context is set by the program or portfolio of which a project is a part (Müller et al. 2008). Figure 4 outlines the difference between project management and project portfolio management (Cooper et al. 2000).

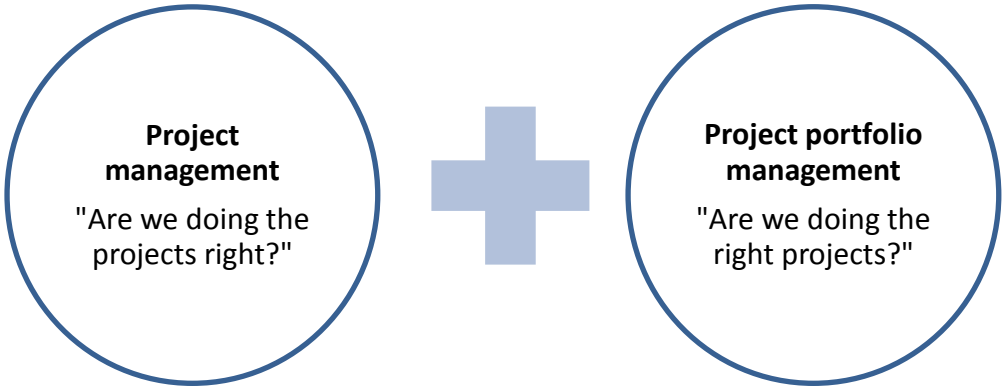


Figure 4: *Difference between project management and project portfolio management.*

The initial idea of portfolio management is that companies should not only focus on managing independent projects and their specific objectives but also to manage projects as an entity with shared objectives. Too often projects fall short on resources or lose direction because of lack of agreement among senior business managers. This misalignment of goals may lead to mistakes, such as killing useful projects or failing to take necessary actions (Elton & Roe 1998). Portfolio management is a link between the corporate strategy and the projects and offers a holistic view of the projects. In summary, project portfolio management helps companies to have the right number of projects and to select the best projects and it can also improve the performance of projects and ensure that more projects are successful (Cooper et al. 2000).

Even though business development projects may have second priority in the company, they offer a great potential for portfolio level management. As there is no signed contract to force the project to be completed, a business development project may be more easily killed or put on-hold as soon as the project is not anymore seen as a promising one or when a better project idea is introduced (Elonen 2002). However, it is important to remember that some of the development projects, such as investments, have signed contracts and this creates pressure to finish the projects on time. A challenge for the portfolio level decision making is how to compare several types of business development projects with each other and decide arguably on the project selection.

2.1.4 Project evaluation

Traditionally individual projects are evaluated based on the cost-time-quality triangle (Cao & Hoffman 2011). However, projects cannot be evaluated only based on these three dimensions (Marques et al. 2011). When project cost is evaluated, managers focus on handling the cost overruns of projects for example. When it comes to time, delays are under scrutiny. Instead of only assessing the projects with the triangle model, aspects such as stakeholder satisfaction must be taken into account (Biedenbach & Müller 2012).

Shenhar et al. (2001) distinguish between four success dimensions. These dimensions are project efficiency, impact on the customer, business success, and preparing for the future. Project efficiency is a short-term dimension and concerns the resource constraints of time and budget. Impact on the customer is also a short-term dimension and focuses on customer demands and meeting the customers' needs. Business success is a long-term dimension and it addresses the benefits to the performing organization. Preparing for the future is also a long-term dimension and considers the creation of markets and products, and the development of new technology. It should be also mentioned that research on project performance shows that it is impossible to generate a universal checklist of project performance criteria (Marques et al. 2011).

As said previously, in project portfolio management deals with managing multiple projects which is why the portfolio level decision making needs to be integrated to the project portfolio level evaluation. The process of project evaluation, prioritization and selection is one of the most essential issues in portfolio management (Ghasemzadeh & Archer 2000). There are many techniques that can be used to estimate, evaluate and choose project portfolios and those techniques are presented later in this thesis (Archer & Ghasemzadeh 1999).

2.1.5 Performance management

There are many points of view to performance management. For example, project business performance can be evaluated on a project, program or portfolio level. By choosing the right projects and following their performance increases the overall performance of a company.

Project performance is sometimes evaluated using certain success criteria. Project success is measured by the business objectives, while the project management success is evaluated instead with traditional criteria such as respect of costs, schedule and quality and these can also be called as examples of project key performance indicators (KPIs) (Cooke-Davis 2002). There are other success factors that have a positive effect on project performance such as advanced project team capabilities and an organization's gov-

ernance that supports project management (Mir & Pinnington 2014). However, there is no consensus on the way to assess the value of performance in project management (Archer & Ghasemzadeh 1999). The financial approach to projects alone cannot give a correct measure of the value of project management for the organization. Project success is a vague approximation and, as such, a rather imperfect system for measuring results (Aubry et al. 2007).

There are many points of view to project portfolio performance but one point of view to portfolio performance is that portfolio management is not simply the sum of project performance in the portfolio but it also includes project management efficiency (Martinsuo & Lehtonen 2007). It has been studied that project and portfolio control mechanisms have a positive impact on project and portfolio performance (Müller et al. 2008; Elton & Roe 1998). In the article by Müller et al. (2008) stated that portfolio management performance should not be one-dimensionally studied at only the portfolio level, but it should also include achievements at project level and organizational level (Martinsuo & Lehtonen 2007). Müller et al. (2008) also found out that successful portfolios have a practice for prioritizing and selecting their portfolios and there should be solid reporting approaches. Thirdly, successful portfolio management requires shared responsibility for decisions at the portfolio level. Figure 5 represents the relationship between portfolio control and portfolio success.

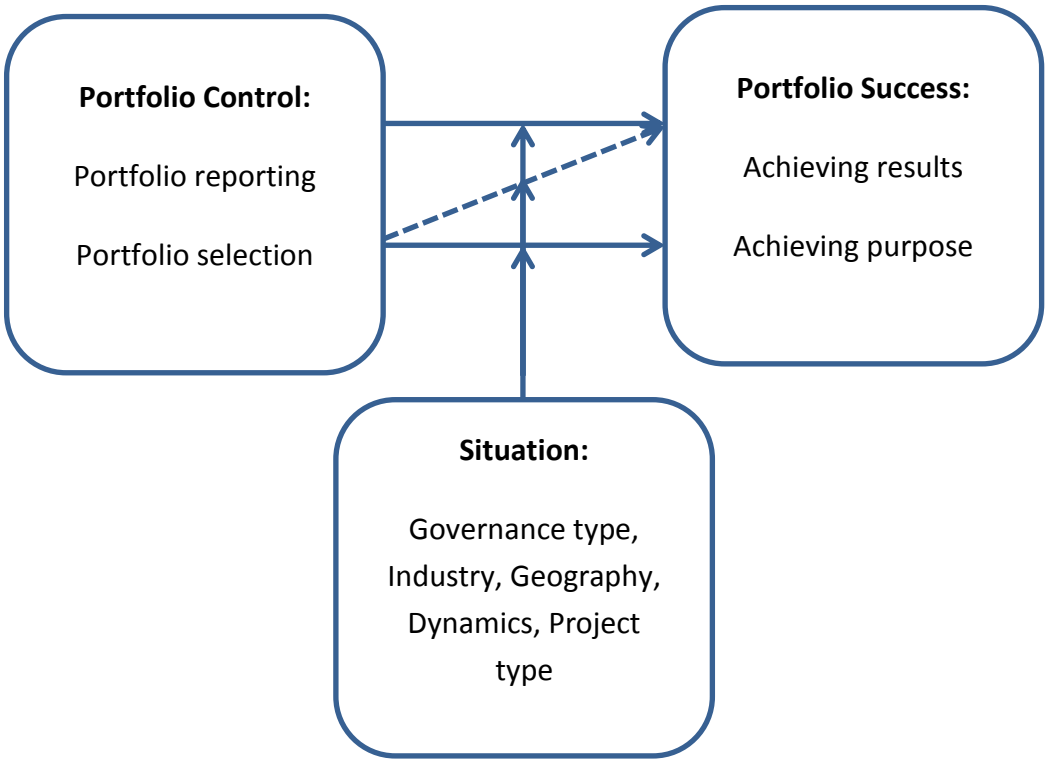


Figure 5: *The relationship between portfolio control and portfolio management success (modified from Müller et al. 2008).*

It has been studied that PMOs have a positive effect on project portfolio performance and organizational performance (Aubry et al. 2009). They provide support for project managers and control project management procedures and they also improve common methodologies for project and portfolio management (Hobbs & Aubry 2007).

Other than reviewing project and portfolio performance, there are other aspects to performance. Performance management has typically focused on performance measurement. Performance measurement has been an established concept in many organizations for many years (Amaratunga & Baldry 2002). Performance measurement systems are used in organizations to maintain organizational control and ensure that organizations are striving towards their strategic objectives (Amaratunga & Baldry 2002; Bititci et al. 2000). The Balanced Scorecard is a widely used framework for performance measurement at a corporate level (Neely et al. 1995). The Balanced Scorecard has four different perspectives to business and it enables the managers to see information from different points of view without sub-optimization (Kaplan & Norton 1992). According to the framework, organizations must choose performance measures from financial perspective, internal business perspective, customer perspective and innovation and learning perspective (Kaplan & Norton 1992). However, in this thesis the most important aspect of performance is to review a project portfolio's performance and especially focus on the evaluation of the projects inside the portfolio.

2.1.6 Key concept summary

The focus of this thesis is to develop project portfolio management practices for internal process development projects which are referred to as development projects in the thesis. The following Figure 6 presents the connections between the earlier mentioned key concepts. The next sections present more detailed information about project portfolio management, PMOs and project evaluation.

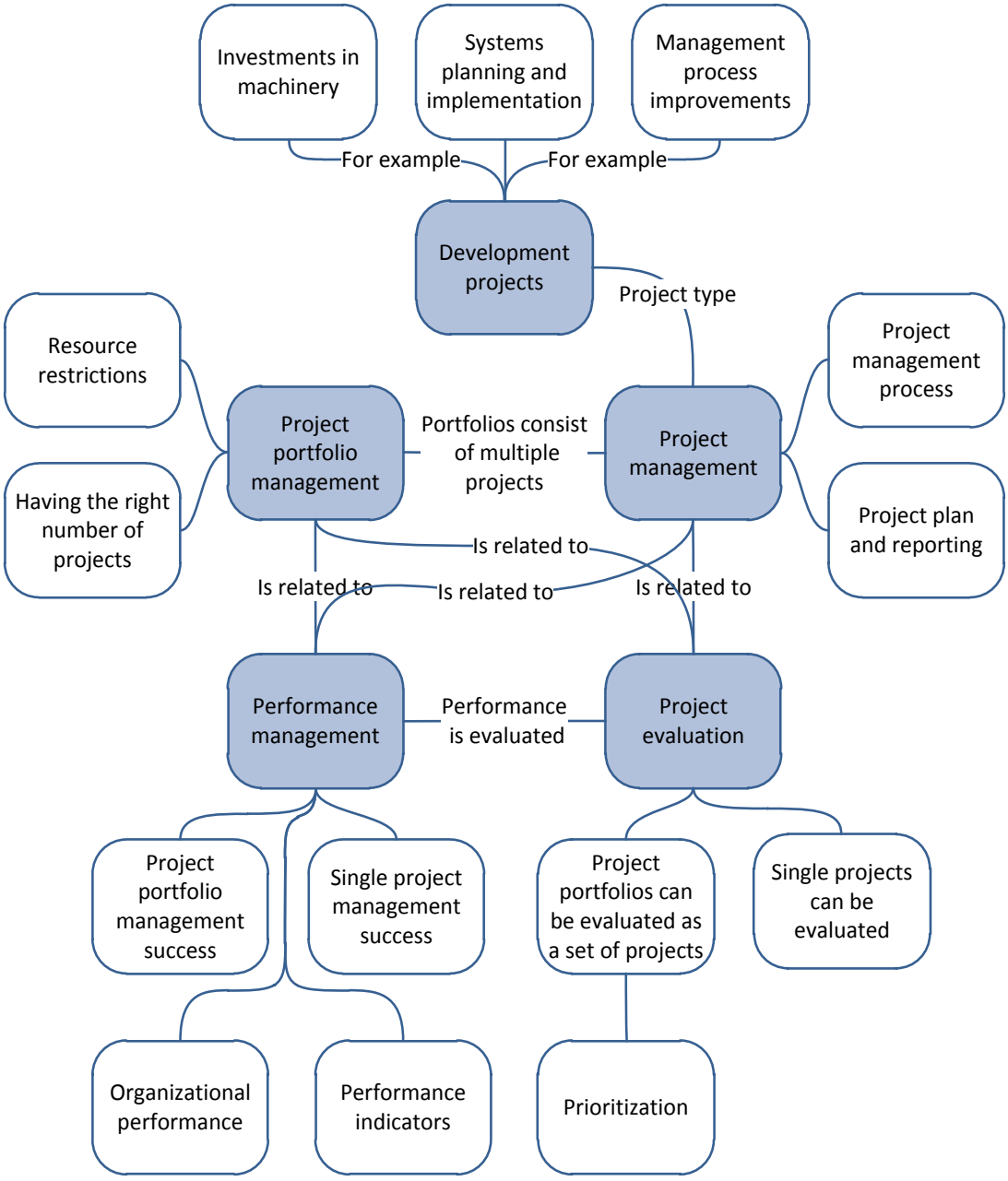


Figure 6: *Connections between key concepts.*

2.2 Project portfolio management

2.2.1 The objectives of portfolio management

Empirical research on project portfolio management has traditionally focused on measuring the three main macro goals of the portfolio and these measures are value maximization, balance and strategic alignment. These three objectives are strongly related to project portfolio decision making at both project and portfolio level. The strategy of a company forms guidelines for internal development projects and companies should ensure that the projects in the development portfolio are correctly maximized and balanced. (Cooper et al. 1997b; Elonen & Artto 2003)

Value maximization means that the value of the portfolio should be maximized in terms of some company objective. This can be for example long-term profitability or return on investment (Cooper et al. 1997a). There are a variety of methods to achieve this value maximization goal ranging from scoring models to financial methods (Cooper et al. 1997a).

The second objective of project portfolio management is balance between projects. The balance can be analyzed with a number of parameters, such as the right balance between high-risk and low-risk projects. One important aspect of balancing the portfolio is to ensure that the subjects of projects complement each other and they form a smooth entity without resource overloads (Dietrich 2002).

The final goal of portfolio management is strategic alignment. Strategy and resource allocation should be intimately connected. The chosen projects should be consistent with the business strategy. The breakdown of the spending should also reflect the strategies priorities. One general approach to achieve strategic alignment is to build strategic criteria into project selection tools. (Cooper et al. 1997a; Cooper et al. 1997b; Englund & Graham 1999)

2.2.2 Project portfolio management process

In order to manage portfolios successfully, firms must have a systematic approach for their portfolio evaluation, decision making and resource allocation. Project portfolio management frameworks describe phase by phase the management process of portfolios (Cooper et al. 1997b). Mostly the frameworks focus on project selection. Project portfolio selection is the a activity involved in selecting a portfolio, from initial project proposals and current projects, that meets the organization's stated objectives (Archer & Ghasemzadeh 1999). Next, three project portfolio management frameworks are presented.

An integrated framework for project portfolio selection

The integrated framework by Archer & Ghasemzadeh (1999) is a logical framework for project portfolio selection process. Although there are many techniques for project evaluation and portfolio selection, there are not that many frameworks that help organizations to organize these techniques logically in a flexible process. The framework is easily applicable for different organizations. In the framework there are three phases which are strategic consideration phase, project evaluation phase and portfolio selection phase.

In the first phase the strategic considerations are used to create a broad perspective of strategic direction and furthermore to invert the obtained focus and company vision to the portfolio level objectives. In other words it is important to determine a strategy for a company before considering individul projects. The second phase is project evalaution phase and in which different methods and techniques are used to evaluate each project. In each project, the project's individual contribution to one or more portfolio objectives is measured. Evaluation methods include measure of economic return, benefit/cost techniques, risk evaluation and market research approaches. What is chosen from these methods is dependent on the situation and project type. However, it is important to use common measures to allow the equitable comparison of projects. (Archer & Ghasemzadeh 1999)

In the third phase of the framwork projects are compared simultaneously along particular dimensions (Archer & Ghasemzadeh 1999). The idea is to rank projects according to their desirability. The most desirable projects are then selected for the portfolio taking into account existing resource constrains. The variety of portfolio selection techniques or tools used to help in portfolio selection is wide and they are introduced and discussed later in the literature review.

At the core of the framework is the strategy for the organization because it gives guidelines for portfolio evalutation and resource allocation. The following Figure 7 introduces the project portfolio selection process phases. After the strategy is set for the project portfolio, pre-screening can begin. In that stage project proposals are evaluated using strategic compatibility as an important measure parameter. This stage ensures that any project being considered for the portfolio fits the strategic focus of the portfolio (Archer & Ghasemzadeh 1999). The individual project stage is where the project candidates are analyzed individually. Common parameters are calculated for each project. Important parameters are, for example, project risk and net present value. After the individual project analyses the projects are screened to obtain a ranking order and the portfolio is selected. A simplified picture is presented in Figure 8.

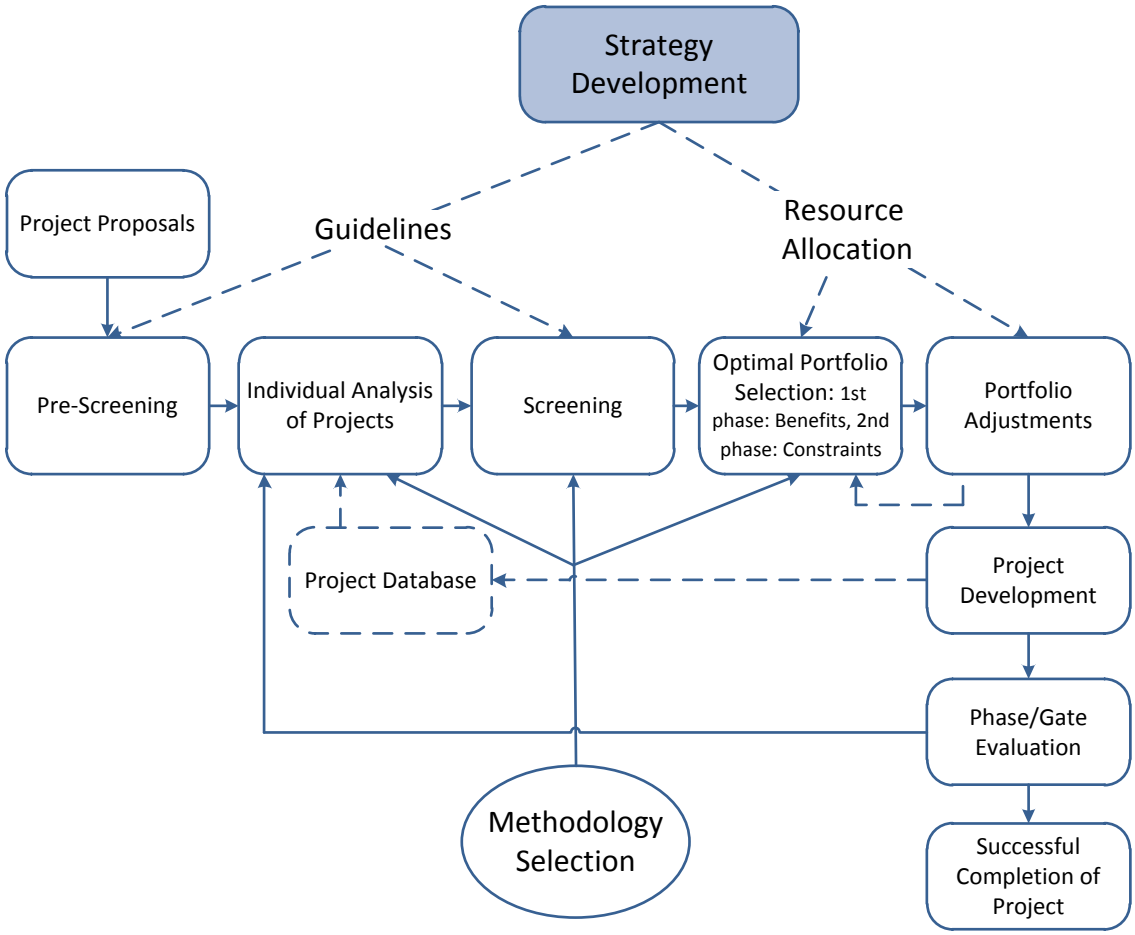


Figure 7: *An integrated framework for project portfolio selection (modified from Archer & Ghasemzadeh 1999).*

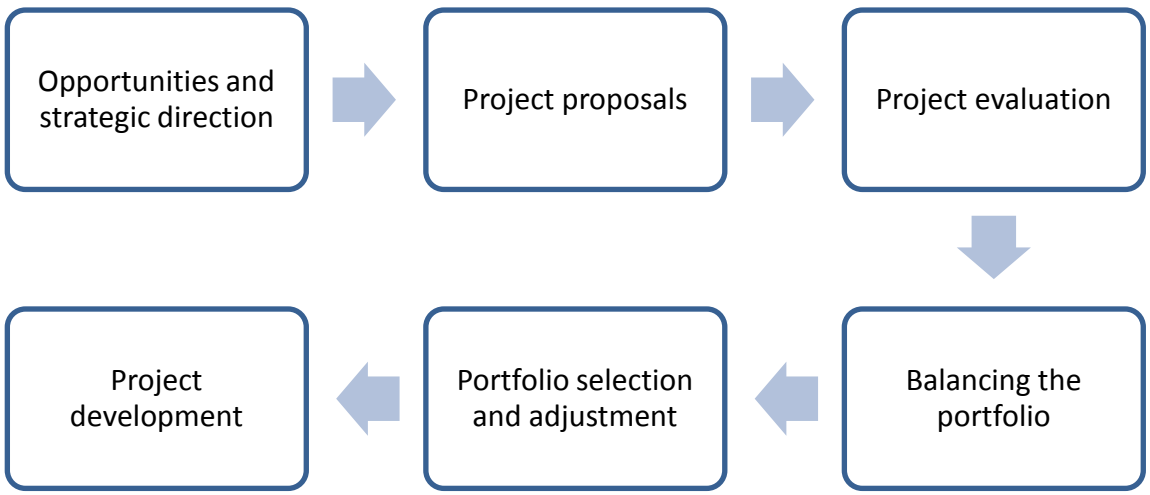


Figure 8: *A simplified picture of the portfolio management selection process (modified from Archer & Ghasemzadeh 1999).*

Strategic bucket model

Another model for project portfolio management is the strategic bucket model (Dietrich 2002). The central idea of this framework is to create "envelopes of money" or "buckets" in which existing projects are categorized (Cooper et al. 1997b; Chao & Kavadias 2008). The company must decide the spending for each separate bucket and the projects are prioritized within buckets in order to arrive at a desired combination of projects. Figure 9 displays the logic of this portfolio management model. The major strength of this model is that it links the business's strategy to the company's spending. Furthermore, the model recognizes that all development projects compete for the same resources (Cooper et al. 1997b).

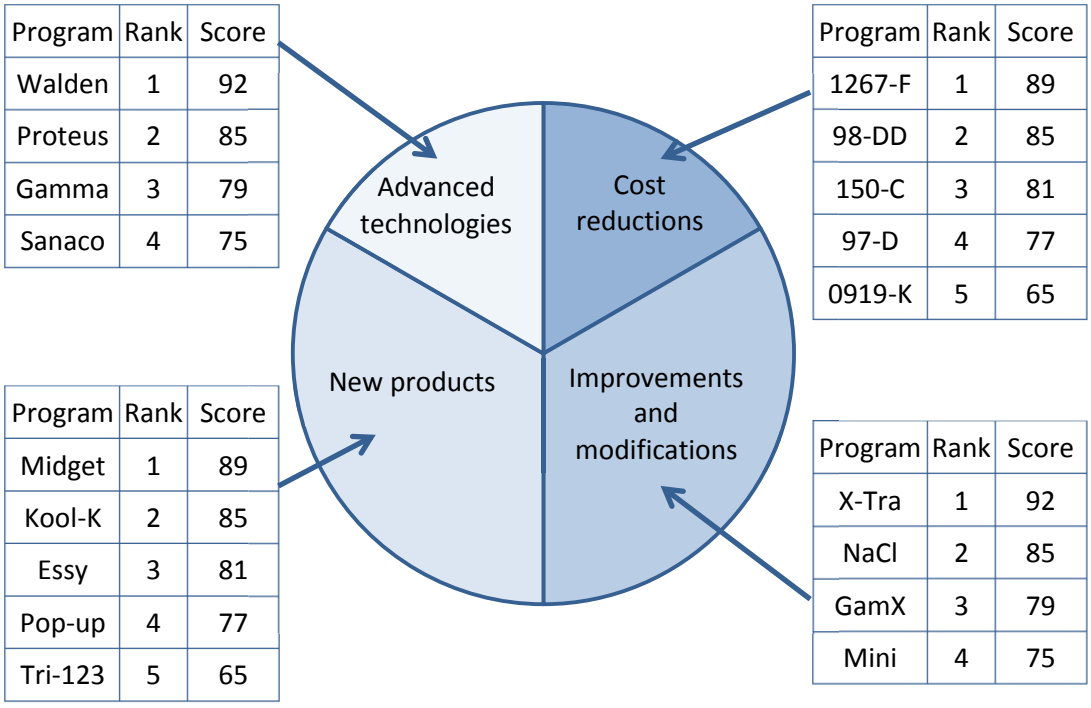


Figure 9: *Strategic bucket model (modified from Chao & Kavadias 2008).*

Projects are different by their type and by using strategic buckets or specific portfolios the management of the whole portfolios becomes easier. Managers could establish specific and tailored management models both at the project level and at levels above projects for each portfolio. It has to be ensured that these models enable strategic management in an appropriate way. (Artto & Dietrich 2004)

The larger picture

The larger picture model presented in Figure 10 closely relates portfolio management to the strategic planning and project level management processes. This model presents project portfolio management as a three-fold process. The basis of the portfolio management is organizational focus. In the first phase the organization needs to define the reason for their existence in the form of corporate vision, mission, organizational objectives and strategic plans. This is known as the strategic planning process and the aim of this process is to identify the goals and objectives of the organization. The first phase can be seen as a foundation phase for the selection process. (Dye & Pennypacker 1999)

The second phase include opportunity identification, organizational fit assessment, costs-, risk- and benefit analyses, development and the selection of projects for portfolio. The evaluation and analysis process is done to take into account the traditional goals of portfolio management which were balance, strategic alignment and portfolio value. In addition to these attributes it is essential to notice that effective portfolio management ensures the optimal use of resources which can be both financial and human. (Dye & Pennypacker 1999)

In the last phase of this three-stage process the focus is shifted from the portfolio view to project level management. This is done because only the right selection of the right projects for the portfolio is not enough to guarantee the success of a firm. Correct execution of the projects in practice is needed too to ensure the successful completion of the portfolios projects and furthermore the objectives of the portfolio. (Dye & Pennypacker 1999)

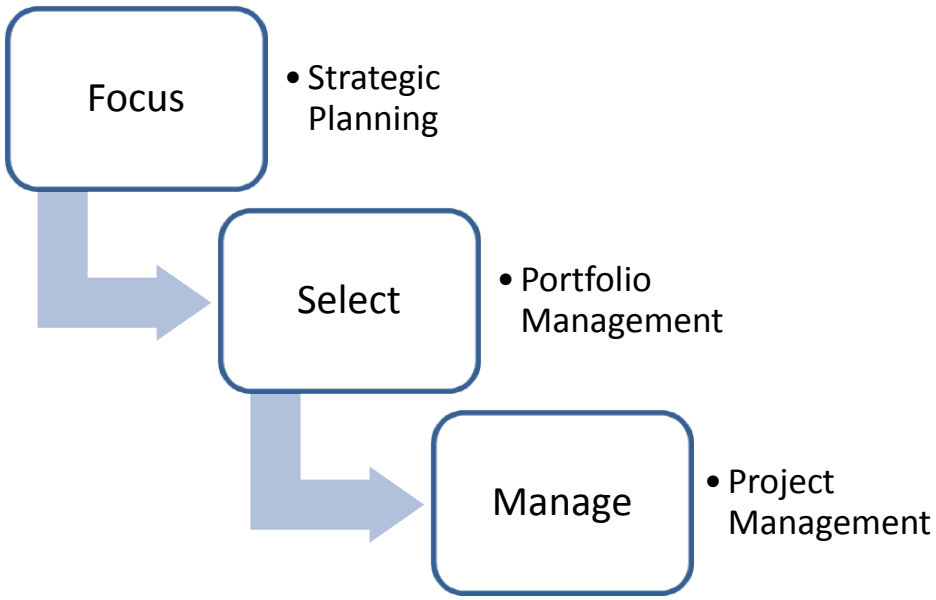


Figure 10: *The larger picture (modified from Dye & Pennypacker 1999).*

Project portfolio management integration with project management

The three project portfolio management frameworks mentioned previously have their own points of view. Some of them focus more on the portfolio level management and some on project level management. It has to be noticed that effective portfolio management requires that there are three elements in place and working in harmony with one another and these elements are; the strategy of the business, a project management process with gates, and the portfolio review with its various models and tools (Cooper et al. 1997b). After the strategy of the company is established, there is a need to develop projects management processes and portfolio management processes and these two should fit together (Cooper et al. 1997b). Figure 11 describes on how project management process and portfolio management process are aligned with each other.

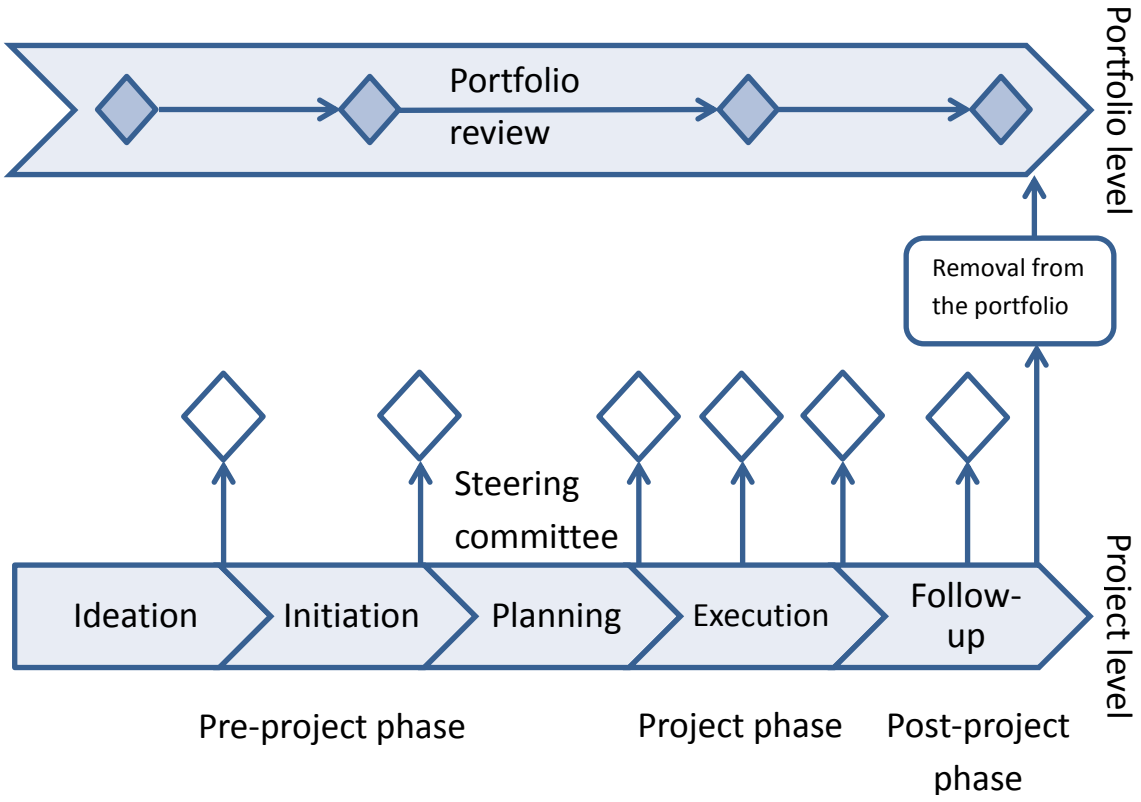


Figure 11: *Project portfolio management process aligned with a project management process.*

The portfolio management process requires integration with project management which means that the portfolio management process and project management process cannot be separated from another. Because decisions are made at different gates in individual projects, it is natural to integrate the project portfolio management to these decision points. However, the reviewing the whole project portfolio is usually executed as a separate session and not during the project management gates. The gate models are strongly connected to decision making which is discussed more in detail later in this thesis.

2.2.3 Succeeding in project portfolio management

As mentioned previously in section 2.1.5, there is no consensus on the way to assess the value of performance in project management (Aubry et al. 2007). This section deepens the concept of success in project portfolio management. The success factors range from competence management to organizational models.

The competence of managers and decision makers has a significant impact on project portfolio management success. One of the success factors of project portfolio management is to succeed in single project management which means that having competent and experienced project management teams and project managers ensures that the projects meet their predetermined goals (Jeffery & Leliveld 2004; Martinsuo & Lehtonen 2007). Another success factor in project portfolio management is the commitment of upper management and the experience of project managers. It has been studied that the support of senior and line managers has a positive impact on project portfolio managers as long as the project portfolio managers empowered enough to make decisions (Jonas 2010). High project portfolio management quality has also shown positive impacts on portfolio success (Jonas et al. 2013).

It can also be said that project portfolio management success can also be evaluated based on the three macro-level goals of project portfolio management. According to Cooper et al. (1997b) the portfolio is successful if the projects in the portfolio bring value to the company, have a suitable balance between them and are strategically aligned with the company strategy. The project portfolio has a higher probability of success if the portfolio is carefully structured based on the business strategy (Meskendahl 2010; Dietrich & Lehtonen 2005). Achieving the three macro-level goals entails that the project portfolio management is of high quality and that the management should take into account on how to ensure the fulfillment of those goals.

It has been studied that a project management office (PMO) can support the management of project portfolios. As a response to new challenges in project business many organizations have implemented PMOs because it has been studied that they support the fact that projects meet their goals and that the project value is delivered (Aubry et al. 2009). The functions of a PMO are explained more in detail in section 2.3.1. It has been studied that PMO functions and services have a favorable influence on project performance (Dai & Wells 2004). The PMOs are usually organizational units that work together with project teams and upper management and this organizational entity of employees is sometimes called portfolio governance (Mosavi 2014).

Project portfolio management processes have also on influence on project portfolio success. These processes can be single project management processes with decision gates, project portfolio management processes with portfolio review sessions or processes for information sharing (Killen et al. 2008). It has been studied that formalization or certain

bureaucratic regimes of single project management and project portfolio management can make resource allocation faster and increase reliability of commitment (Teller et al. 2012). In summary, project portfolio management success is an interplay between many factors, such as management quality, project portfolio governance design and portfolio management processes. The next section gives a different point of view to project portfolio management and this point of view is to give challenges in project portfolio management.

2.2.4 Challenges in managing development project portfolios

A business development portfolio is a concept that has not been researched extensively. Studies by Cooper at al. (Cooper et al. 2000; Cooper et al. 1997a; Cooper et al. 1997b) are limited to product development, and they do not specifically look into single-project management. Therefore some common project portfolio management problems are presented in the list below. These typical problems are:

1. Scarce resources, a lack of focus

One of the fundamental problems of project portfolio management is that companies have too many projects for the limited resources that have available. As a result the most beneficial projects for the company might not get sufficient resources. In addition, resources might get spent on projects that lack upper management commitment or focus. (Cooper et al. 1997a; Elton & Roe 1998; Engwall & Jerbrant 2003)

2. The project portfolio does not reflect strategy

In new product development is it essential that the new product development projects reflect the strategy of the business. This also applies to projects that focus on improving the business processes in organizations. Too many projects are “off strategy” and there are disconnects between spending breakdowns on projects and the strategic priorities of the business. (Cooper et al. 1997a)

3. Lack of single project management

From single-project management point of view, many studies indicate that project goals and benefit expectations are expanding from single-project level to the portfolio level (Martinsuo & Lehtonen 2007). According to the results in the article by Martinsuo and Lehtonen (2007), single-project management is associated with portfolio management efficiency directly in the form of information availability and project management efficiency.

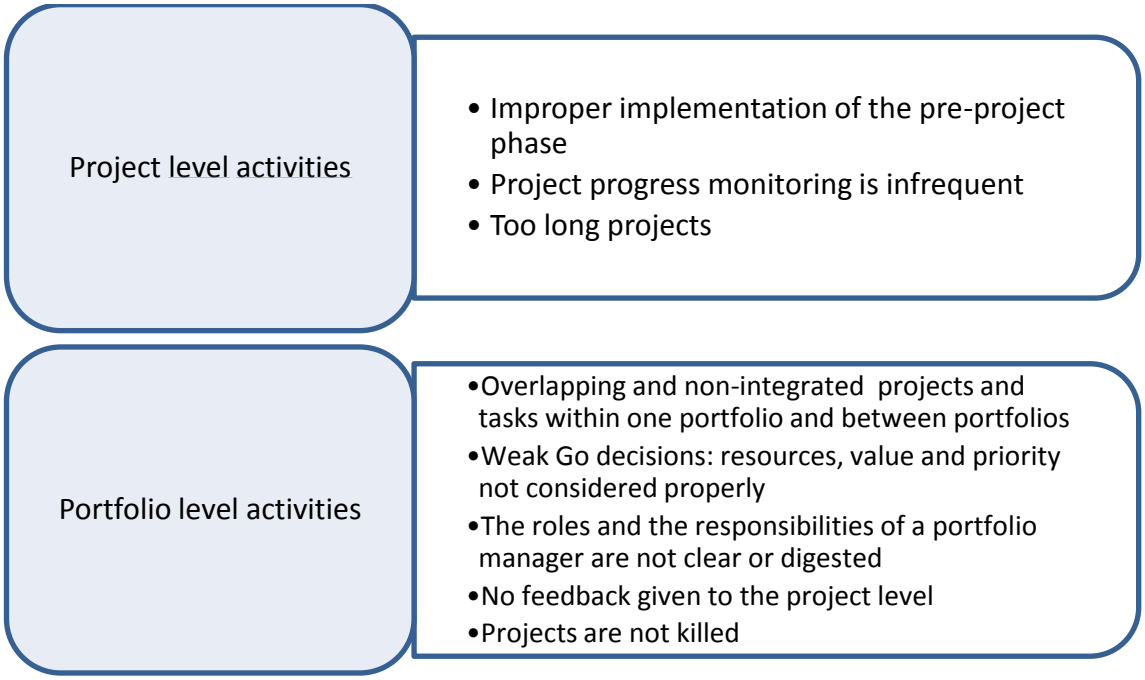
4. Lack of quality information and project transparency

A common problem with project portfolio management is that the managers become confused with the amount of information available for decision-making and they are not able to identify the most relevant information (Elonen & Artto 2003). The transparency of project information is sometimes also lacking and to solve this problem, there are information systems that enable more efficient decision-making with automated collection, calculation and presentation of data (Christiansen & Varnes 2008). Englund and Graham (1999) noticed in their study that when organizations were asked to list all of their projects, the usual reaction was to see that there were more projects going on than the organization was aware of.

5. Portfolio decision-making inefficiency

In many projects, decision-making follows a phase model with integrated fate- and portfolio meetings. The inefficiency in decision-making can result in delayed projects or cost overruns (Christiansen & Varnes 2008). Effective portfolio governance is the key to success of project portfolio management (Mosavi 2014). With a portfolio mindset and agility in decision making the portfolios can deliver maximal value (Kester et al. 2014).

The article by Elonen and Artto (2003) focuses on development project management challenges in particular. According to the paper, development project management poses challenges for organizations and they categorized the challenges into six different categories. Figure 12 summarizes the results from the article. The typical problems listed previously in this section can be found in Figure 12 even though there are slight differences. However, they all fit into the six categories presented in Figure 12.



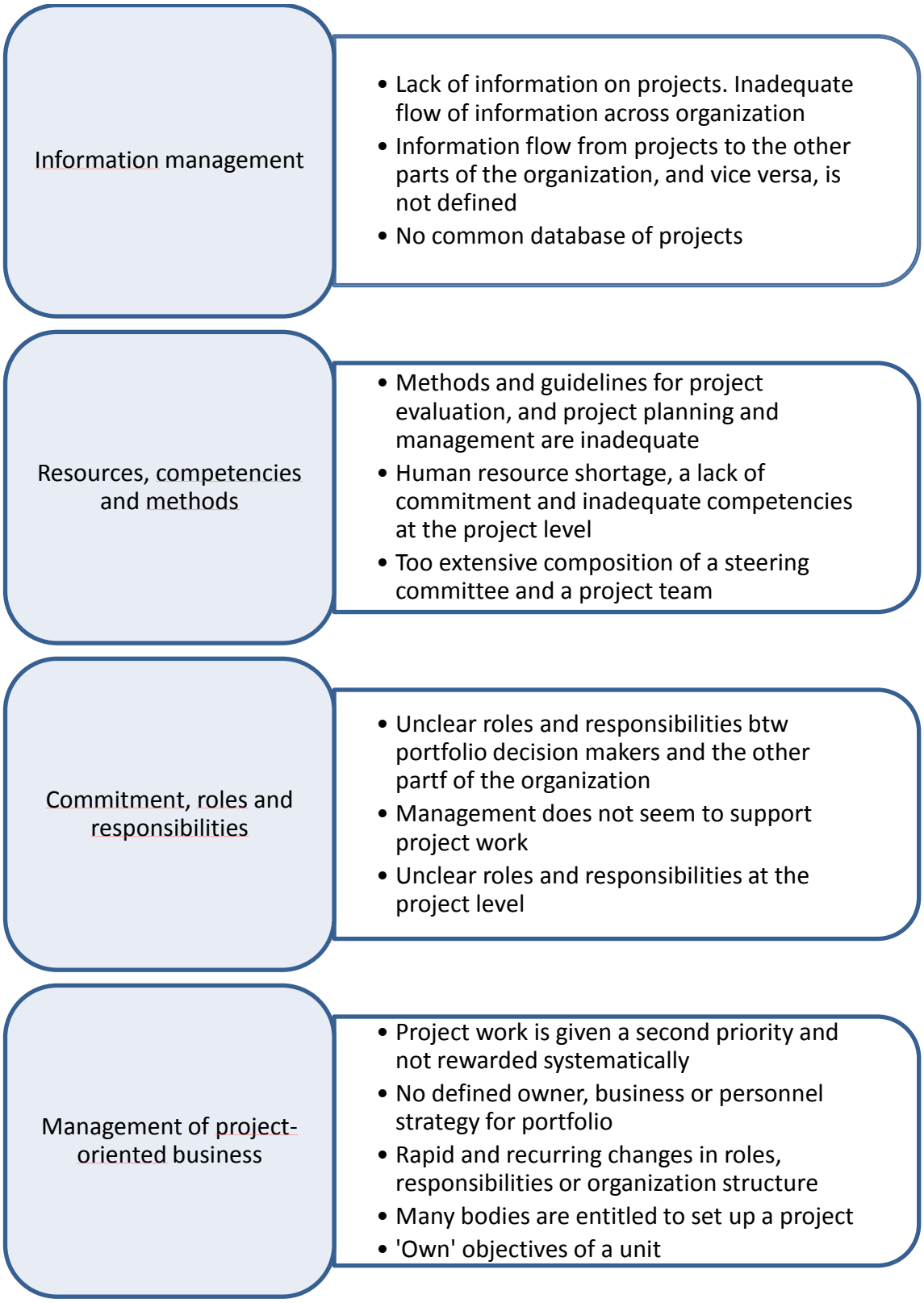


Figure 12: *Summary of problems in managing multi-project environments (modified from Elonen & Artto 2003).*

2.3 Project offices and project evaluation

2.3.1 The functions of project management offices

One important candidate for project performance improvement is the project management office (Dai & Wells 2004). PMOs are dynamic and regularly evolving features in project organizations and as stated in the introduction, their functions and practices differ widely between industries and organizations (Darling & Whitty 2016). In this thesis, the PMOs are studied together with portfolio management because the PMO in the company is aimed to support the management of internal projects. Internal-project-focused PMOs are more likely to engage in the following functions than external-project-focused PMOs: alignment of projects with strategic objectives, portfolio communication management and business requirements planning (Hobbs et al. 2008).

The role of a PMO has evolved over time. PMOs have existed since the early 1800s when they were collectives for running government strategy in Britain, particularly in the agricultural sector (Darling & Whitty 2016). Today, the PMO is an organizational business unit and it is claimed that it is established from the necessity to enhance the ability of the organization in the delivery of projects. Additionally, there are number of synonyms that are used to describe the PMO. These synonyms are for example project office and project management center of excellence (Hobbs & Aubry 2007). According to Hobbs & Aubry (2007) the structure of the PMO has also changed over time. Most PMOs have very little staff other than the project managers and the PMOs tend to be young in organizations. The role of a PMO in organizations might also change over the years, ranging from pre-PMOs to business unit PMOs (Aubry et al. 2008). PMOs have very different structures and roles in organizations and there is constant restructuring in PMOs (Hobbs et al. 2008). PMOs are deeply embedded in its host organization and the two co-evolve (Aubry et al. 2009).

There are many functions that PMOs have in organizations. Most importantly they monitor and control project performance. This category contains various tasks, such as reporting project status to upper management, implementing and operating a project information system and developing and maintaining a project scoreboard. The second category that was seen important was the development of project management competencies and methodologies. Project managers need to be trained and given useful tools for project management. Some PMOs are also actively involved in organizational learning and information sharing. Additionally, in recent years there has been a tendency for PMOs to become more involved with issues of strategic alignment and to become more closely connected with upper management. (Hobbs & Aubry 2007)

Some PMOs have to manage multiple projects in a coordinated way, which often involves program or portfolio management. Multi-project PMOs or project portfolio man-

agement offices (PPMOs) have been researched increasingly in the recent few years (Unger, Gemünden, et al. 2012). The PPMOs are responsible for coordinating between projects, identifying and prioritizing new projects and allocating resources between projects (Hobbs & Aubry 2007). According to Unger et al. (2012) PPMOs have three roles which are coordinating role, controlling role and supporting role. The first role emphasizes the importance of resource management and cross-department coordination. The second role involves information managemnet to deliver input in decision making, which is a prerequisite for project portfolio steering. The last role contains providing services and support to project members and leaders. Table 1 shows PMO functions collected from various articles and they are listed in three different groups.

Table 1: *PMO functions collected from various scientific articles.*

Project management efficiency	**Support, communication and learning**	**Strategic multi-project management**
Reporting the profitability of projects to management (Hobbs & Aubry 2007)	Develop competency of personnel, including training (Hobbs & Aubry 2007)	Manage one of more portfolios or programs (Hobbs & Aubry 2007)
Solvency of resource conflicts between projects (Dietrich et al. 2010)	Implement and manage a database of lessons learned (Hobbs & Aubry 2007)	Participate in strategic planning (Hobbs & Aubry 2007)
Resource acquisition and planning support (Dietrich et al. 2010)	Develop and maintain project historical archives (Dai & Wells 2004)	Allocate resources between projects (Hobbs & Aubry 2007)
Develop and maintain a project scoreboard (Hobbs & Aubry 2007)	Provide human resource/staffing assistance (Dai & Wells 2004)	Prioritize new projects (Hobbs & Aubry 2007)
Implement and operate a project information system (Hobbs & Aubry 2007)	Provide knowledge sharing forums (Julian 2008)	Support creating value for the business through organizational project management (Aubry et al. 2007)

2.3.2 Evaluating projects and portfolios

One of the functions of a PMO is to support the prioritization of projects in a portfolio (Hobbs & Aubry 2007). The prioritization, project selection and project evaluation can be supported with many tools and techniques which will be presented in this section. As said previously in this thesis, there are relatively divergent techniques that can be used to estimate, evaluate, and choose project portfolios (Archer & Ghasemzadeh 1999). The techniques vary which is why it is important to choose those techniques that are useful for the organization in question. The process of project evaluation, prioritization and selection is one of the most essential issues in portfolio management (Cooper et al.

1997a)**.** In portfolio selection phase a number of projects are simultaneously compared on particular dimensions, in order to arrive at a desired ranking of the projects (Archer & Ghasemzadeh 1999).

It has been well established that project selection criteria guidelines are the single most important mediator in the alignment of project portfolios to strategies, and therefore deserve the attention (Artto & Dietrich 2004; Crawford et al. 2006). Multiple criteria decision making methods have been regarded as suitable method for evaluation (Kornfeld & Kara 2011). Since people do not act with perfect rationality and their decisions are impacted by the systems which they work within (Rouwette et al. 2004), formal approaches to decision making can be beneficial (Rouwette et al. 2004). Formal methodologies enable better communication and they also help structure an organization's thinking by relying on the creation of models and the consideration of alternatives, which may aid in the reduction of subjectivity. In other words, formal evaluation models would be beneficial for project evaluation. Archer & Ghasemzadeh (1999) and Cooper et al. (1997a) identified classes of portfolio selection techniques and some of these are listed in Table 2 with more detailed explanations.

Table 2: *Selection and evaluation techniques.*

Selection or evaluation technique	**Description**	**Usage in practice**
Scoring models	Projects are evaluated with scores ranging from example from 0 to 5. The evaluation criteria can be related to project risks or business benefits. The scores are given to each project and then combined for an overall score. (Cooper et al. 1997b; Costantino et al. 2015)	The model is easy to use and therefore is can be used at decision gates. The scoring models can be applied for different kinds of projects.
Financial tools	The evaluation is based on financial values and forecasts. Projects can be evaluated based on their economic return for the organization which includes analyzing indicators such as net present value, internal rate of return and return on investment. (Cooper et al. 1997b)	Useful for evaluating the financial benefits of a project for a company.
Portfolio matrices and bubble diagrams	Projects are compared with each other with different parameters such as risk and reward for the company. The matrices and bubble diagrams provide visual aid for evaluation and prioritization. (Cooper et al. 1997b)	Matrices and bubble diagrams are widely used in project portfolio management for different types of projects.

Selection or evaluation technique	Description	Usage in practice
Traditional charts	There are numerous parameters, dimensions or variables to be used to analyze the balance of the portfolio. Projects can be compared with each other based on project phases, project types and project duration such as short-term and long-term projects. Projects can also be evaluated with project interdependencies or in-depth project risk analysis. (Dye & Pennypacker 1999)	Depending on the need of the organization, traditional chart are used to evaluate the statuses of project portfolios.
Checklists	At decision gates the projects can move to the next phase if certain project management tasks have been fulfilled. (Dye & Pennypacker 1999)	This technique contributes to successful project management and can be altered to specific organizational needs.
Roadmaps	Roadmaps can be used to plan for the future. They are a detailed plan to guide organizations towards goals. (Artto et al. 2008, p. 356)	Commonly used in new product development or technological forecast. They can also be applied for strategic planning.

Some of the most popular approaches of portfolio level evaluation were multi-criteria scoring models. These models use a relatively small number of decision criteria, such as cost, expected benefits and strategic alignment. The scores are given to each project and then combined for an overall score. There can also be weighted factor scoring, which means that some criteria are seen more important than others, which is why they are given a larger weight. The advantage of using a scoring model for portfolio evaluation is that projects can be added or deleted without re-calculating the merit of the other projects (Cooper et al. 1997a). The given scores are typically numeric, ranging for example from 0 to 5. The scoring models are widely used in organizations because they are relatively easy to understand and to customize (Archer & Ghasemzadeh 1999).

Scoring models have long been used to make Go/Kill decisions at individual project reviews or gates, but they are also applicable t project prioritization and portfolio management. The dominant form of project selection in scientific areas is called peer review. In peer review sessions projects are evaluated by peers who are individuals who are competent to assess the project proposals and ongoing projects. (Dye & Pennypacker 1999)

If organizations only use financial tools to analyze portfolios, the balance of the portfolio becomes harder to see. The greatest weakness of using only value maximization techniques is that they fail to ensure that the portfolio is strategically aligned and optimally balanced (Archer & Ghasemzadeh 1999). One of the goals of portfolio management was to balance the portfolio in terms of a number of key parameters. Portfolio matrices and bubble diagrams provide visualizations of the portfolio and consequently can support the management to see the balance of the portfolio. Perhaps the most popular of a bubble diagram is the risk/reward diagram. In a risk/reward diagram, one axis is some measure of reward to the company and the other is a success probability (Cooper et al. 1997a).

Depending on the need of the organization, different parameters can be used for the visualizations. Other diagram parameters are for example benefit to business vs. ease of implementation or technologies vs. markets. It has to be noticed that many dimensions may focus on markets or concept attractiveness which are related to new product development. That is why the dimensions must be chosen so that they support the prioritization of project of a certain type. (Dye & Pennypacker 1999)

While some of the evaluation models focus more on the project selection in the project proposal phase, it is important to evaluate project also during their lifecycle. As said before, projects follow a certain project management process and between project phases there are decision gates in which is it decided what should be done with the continuation of the project (Killen et al. 2008). This gate evaluation can be done for example with checklists which means that in order to continue with a project, certain tasks must be fulfilled accordingly (Dye & Pennypacker 1999). A checklist is also useful for the prioritization and idea evaluation.

A useful way to manage and prioritize projects is to use a roadmap. Roadmaps are typically used for planning for the future and they give guidelines for future projects and products (Artto et al. 2008, p. 356). This is why they can also be used as assessment criteria in project portfolio management. Roadmaps are used for strategic planning and technological forecasting and they can have a more science and technology emphasis or a products emphasis (Kappel 2001).

2.3.3 Decision making at different organizational levels

Project portfolio management includes decision making and evaluation at different levels and with different frequencies (Dietrich 2002). To appropriately manage a firm's project portfolio, decisions must be made about which projects to fund, to what levels, at what point in time (Kester et al. 2011). The decision making and evaluation should be connected to each other because the evaluation is done at different organizational levels and decision making is about assessing the current situation based on certain data and criteria (Cooper et al. 2000).

There are various decision making levels when it comes to portfolio management. Figure 13 presents the different organizational levels in decision making. The decision making and integrated portfolio management process presented in section 2.2.2 form a project portfolio governance model for an organization (Mosavi 2014).

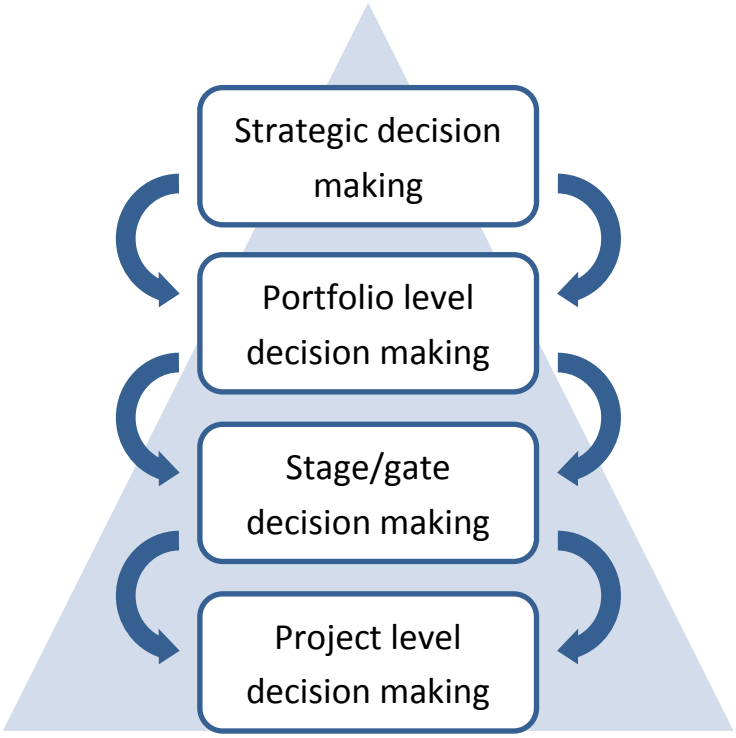


Figure 13: *Decision making in an organization (modified from Dietrich 2002).*

There are many actors in project portfolio management; portfolio managers, portfolio steering committees, project management offices and so on. In order to have proper portfolio governance, organizations must have clear roles and responsibilities at a portfolio level and clear decision making procedures (Mosavi 2014). At the project level, project managers are responsible for project execution and reporting. Project level decision making is integrated to portfolio level decision making through the stage/gate decision process. Projects must pass these decision making points before moving on to the next stage. The frequency of these decision points is determined by the type and size of the project (Artto & Dietrich 2004). These stage/gate decisions differ from periodically made portfolio decisions in the sense that they concern just one project while the focus in portfolio decisions is to review all the projects together.

As said before in section 2.2.2 there is a need to integrate gate decisions and portfolio decisions. Projects rely on project management process models and between project stages decisions have to be made on whether the projects are continued or killed. The potential for conflict exists between the gating decision process and portfolio reviews. These are two different decision processes and might even involve different people and different criteria. It is essential that these two processes function well and that they are

integrated and harmonized (Cooper et al. 1997b). As seen in Figure 13 the highest organizational decision making level is strategic decision making which is done by the upper management who give the principle guidelines for project portfolio steering. The portfolio steering committees could fill the second highest organizational decision making level since they are positioned between upper management and projects (Mosavi 2014).

Deciding on which projects to kill is at least as important as deciding on which projects to execute (Artto & Dietrich 2004). It is important to ensure correct and strict termination for projects that are not a strategic fit with the company's guidelines (Unger, Kock, et al. 2012). Organizations have a tendency to reluctantly terminate projects because some of the ongoing projects have money and effort invested in them. However, termination is sometimes vital for the success of the project portfolio. Senior management should adopt and cultivate a proactive portfolio culture in which termination of projects is not seen as a failure (Unger, Kock, et al. 2012).

A decision making process is a complex one and the process does not function without complexities. Some of these complexities are listed below:

- Interdependencies between projects often complicate the portfolio selection process. However, the interdependencies must be analyzed to see the full benefit of projects. (Ghasemzadeh & Archer 2000)
- In decision making it is challenging to create group consensus (Archer & Ghasemzadeh 1999)
- A large number of feasible projects can easily make a selection process very heavy and not so efficient (Ghasemzadeh & Archer 2000)
- The selection process usually includes both qualitative and quantitative factors that have to be included in the decision process. With some pure mathematical tools it can be quite problematic to compare pure qualitative and quantitative criteria in a consistent manner. (Ghasemzadeh & Archer 2000)
- Multiple criteria are usually related to the portfolio selection process. Even if the appropriate selection criteria are already selected it can be problematic to decide the importance of these different criteria against each other. (Archer & Ghasemzadeh 1999)
- Conflicting empowerment between portfolio decision makers, such as between portfolio steering committees and upper management, can cause portfolio management inefficiency (Jonas 2010)
- Uncertainty in resource management or other risks have an influence on project portfolio performance and these uncertainties and risks also affect the portfolio selection process (Martinsuo et al. 2014)
- Cultural differences in decision making in project teams have an effect on decision making processes and style (Müller et al. 2009)

2.3.4 Challenges in implementing project management offices and project evaluation

Implementing a project management office in an organization creates challenges. Hobbs and Aubry (2007) reported that almost half of all PMOs were seen as too costly and as contributing little to project and program performance. The high failure rate may be caused by unstructured management in PMO implementation.

The article by Singh et al. (2009) collected 13 of the top challenges in PMO implementation of which the top three were (1) rigid corporate culture and failure to manage organizational resistance to change, (2) lack of experienced project managers and PMO leadership and (3) lack of appropriate change management strategy. The article by Julian (2008) states that PMO leaders and other managers who improve the organization's ability to learn from past project experiences play an important role in PMO and project portfolio performance. PMO leaders can facilitate organizational learning and they can influence on the organization's project management routines. The PMO leaders must have experience in PMO management so that they can facilitate the organizational learning. In PMO implementation the organizational routines and resistance to change must be taken into account because resistance to change represents the chief obstacle to implementing a PMO (Singh et al. 2009; Becker et al. 2005).

Some other interesting challenges in the article by Singh et al. (2009) were lack of full support of the senior management and various stakeholders to the PMO, failure to align PMO implementation strategy to organizational strategy and lack of defined scope and size of PMO implementation. It is interesting to analyze the organizational role of a PMO in its host organization. For example, it is possible that organizational unites or departments stay unique and autonomous but there can be common governance goals (Tsaturyan & Müller 2015).When implementing a PMO in an organization the senior management must have clear objectives for the PMO and the PMO structure, such as roles and responsibilities. All management levels must be committed to the portfolio management process. The 13 problems from the article by Singh et al. (2009) are presented in Figure 14.

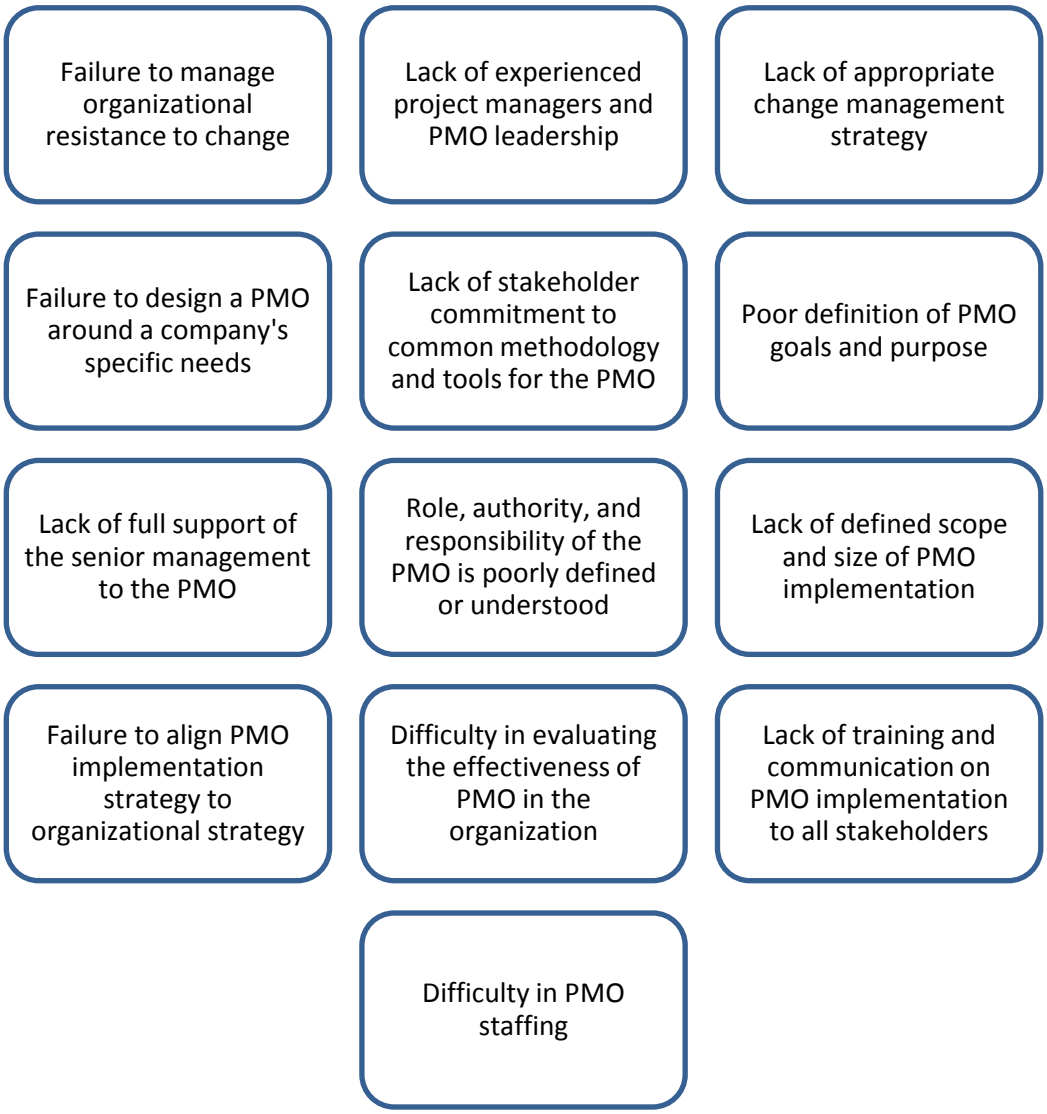


Figure 14: *Challenges to PMO implementation (modified from Singh et al. 2009).*

It also has to be noticed that implementing evaluation methods and criteria also changes the organizational processes in decision making and portfolio management. Tools, techniques and IT systems do not replace company employees as decision makers but they only support the decision making. Due to the fact that internal development projects vary by their nature and it might be hard to decide on common criteria for the evaluation. Formal methodologies aid communication and help structure an organization's thinking (Rouwette et al. 2004).

Decision making is always partly subjective which increases the importance of structured approaches. Decision making happens in its organizational context and decisions makers tend to observe others in the decision making process (Christiansen & Varnes 2008). Projects are usually evaluated in groups, such as portfolio steering committees or PMO committees. Group decision making can suffer from bias and power imbalances

although it has been studied that structured and group-based evaluation has its benefits (Rouwette et al. 2004).

2.4 Conceptual framework

At the end of this literature review a conceptual framework is presented which gives the guidelines for the assessment system creation. The literature review presented multiple success factors for project portfolio management but also challenges. The focus of this conceptual framework is to collect challenges in managing process development projects in companies and find out what solutions could solve those challenges. The challenges and solutions are collected from the literature review in this Chapter 2.

The initial construct of the thesis is presented in Table 3. There are three different areas that are presented in the conceptual framework. These are organizational design to support development project management in multi-project environment, structured decision making at the project and portfolio levels and development project information transparency and communication. The areas were chosen for the framework because they were present through the literature review and they are areas that contain multiple development project management challenges. It has to be noticed that the challenges and solutions in Table 3 overlap with each other significantly and are in no particular order. For clarity they are presented in the chosen three areas. The article by Artto & Dietrich (2004) and Elonen & Artto (2003) supported the selection of the framework areas.

Table 3: *The conceptual framework.*

Area	Development project portfolio management challenges	Solutions with the development project aspect
Organizational design to support development project management in multi-project environment	Too many development projects	Development project portfolio management process that is integrated with single project management process
	No defined owner of development portfolios	Clear roles and responsibilities for development project portfolio management
	Single development project management inefficiency	Setting up measurable goals for development projects
	The development projects fight for the same resources of an organization	PMO governance model for development projects with review sessions
	Undefined roles and responsibilities at the development project and portfolio levels	

Area	Development project portfolio management challenges	Solutions with the development project aspect
	Inadequate competencies at the development project level	PMO functions such as project team trainings
	Development project work is given a second priority	Categorizing projects by their type or strategic importance
		Efficient single project management processes
		Development project work is supported by upper management
Structured decision making at the project and portfolio levels	No common guidelines for development project evaluation and selection	Unified evaluation criteria that enable comparison, selection and prioritization of development projects
	Delays in decision making	Strategic consideration in the evaluation process
	Unclear responsibilities and decision making levels	Clear Go/Kill decisions integrated with project and portfolio management processes
	Decision making not sufficiently integrated with project or portfolio management processes	
	Power structures not considered properly	
Development project information transparency and communication	Developments projects are hard to see as a whole	PMO functions such as updating development projects database
	No common database for development projects and no communication platforms	Plan for systematic communication
	Overlapping and non-integrated development projects	Regular portfolio review sessions
	Communication of the strategy or development strategy is not sufficient	

The first area introduces challenges in development project management from the organizational support point of view. These challenges and possible solutions indicate that companies that succeed in project portfolio management have organizational structures that support portfolio management practices such as resource allocation guidelines and project portfolio owner definition. In addition, there are processes for single project management and portfolio management. It is also important to create a project business oriented environment in an organization. This means that the development project work is emphasized in an organization's strategy and development projects are controlled at regular intervals. In the literature review is has been mentioned that a PMO can support project work in an organization and act as an organizational part between project teams and upper management.

Successful development project portfolio requires structured decision making and at the project and portfolio levels and the challenges and solutions in this area are presented in the second block in Table 3. Too often organizations do not have clear selection criteria for development project assessment. Sometimes the decision making processes and levels might be unclear which can result in delays in decision making. In order to support the decision making, single project management and portfolio management processes must contain decision points with selected evaluation criteria. Decision making can be very subjective and due to the fact that development projects are different by nature and usually require cross-organizational co-operation the power structures must be considered carefully.

The last area is development project information transparency and communication. In the literature it has been mentioned that project portfolio management has a lot to do with communication and info ration sharing. This aspect is related to decision making, development project information databases and portfolio reviews. According to the literature review a plan for systematic communications has positive effects on project portfolio management and a PMO can also support the communications and information sharing in an organization.

The conceptual framework presented in Table 3 sets the guidelines for empirical data collection and assessment system creation. It is a summary of the literature review and in particular it collects the development projects portfolio management problems and their solutions. The conceptual framework is created based on various scientific project portfolio management articles in the literature review. However, most of the articles have empirical data from new product development projects even though some had empirical data from process development projects. The core idea of the conceptual framework is to collect various managerial problems and their solutions and apply them in the creation of the assessment system for internal process development projects.

3. RESEARCH METHODOLOGY

3.1 Nature of the research

The research methodology chosen for this study is constructive research. In constructive research, an understanding of the topic is built by studying prior academic literature about the research topic. To build a construction, information must be collected with various ways. The construction is created based on practical relevance problems found in existing literature that have research potential. The constructive approach requires that the design of a construct should be based on an in-depth interpretation and synthesis of the contextual literature review and the practicalities of the problems. (Oyegoke 2011)

Constructive research approach is a problem-solving method that both relies on different research tools and is also associated with interpretive epistemology, positivist epistemology and empiricism. Constructive research produces new solutions to both practical and theoretical problems and these solutions are often suggested through managerial problem-solving techniques through the construction of models, diagrams and plans. For this thesis the constructive research method was seen the most ideal because constructive research is used to define and solve problems, as well as to improve an existing system or performance, with the overall implication of adding to the existing body of knowledge. (Oyegoke 2011)

3.2 Methodology application in the thesis

The information gathering will start with reviewing existing academic literature on project portfolio management and assessment of development projects. As secondary data, academic journals, books and theses on the research topic will be used. When enough prior knowledge is gathered, the basis of the construct is created and it will be the basis for the assessment system in the case company. The created basis of the construct is the conceptual framework that is presented in section 2.4. The conceptual framework is a summary of the literature review and it gathers together all of the potential elements that the assessment system should contain. There are three general areas in the framework which are organizational design to support development project management in multi-project environment, structured decision making at the project and portfolio levels and development project information transparency and communication. The conceptual framework is created based on prior academic knowledge and it brings together the most relevant issues in regard to the research questions.

The assessment system is the final construct for the case company and it is a modified and a more detailed version of the initial conceptual framework. The assessment system is presented in Chapter 5. In the assessment system creation the initial construct was used as well as empirical case company data which will be discussed more in the next sections. With empirical data the original construct of the assessment system was developed and the assessment system features gained depth and details.

The thesis is a qualitative study and the data is collected with various methods. The first part of the primary data for this study was gathered with interviews in the case company. The managers of development teams and other potential users of the assessment system were interviewed by using semi-structured interviews. The sampling for the interviews is therefore purposive sampling since the interviewees were selected based on the judgment of the researcher (Saunders et al. 2009). The second part of the empirical data gathering was done with a workshop. The research approach is multi-method where many qualitative data collection methods were used (Saunders et al. 2009). The workshop was designed to get more depth to the assessment system features and that way also to the conceptual framework.

The conceptual framework worked as the basis for the assessments system feature creation and development. At the end of the thesis the validity of the original conceptual framework will be studied and it will be analyzed how well the conceptual framework supported the results and their creation. It will also be studied what elements the conceptual framework did not cover and what were its research gaps. The comparison of the assessment system and the original conceptual framework is discussed in Chapter 6 and Chapter 7.

3.3 Interview data collection and analysis

The first part of the empirical data for this study was gathered with semi-structured interviews. The interviews were executed to gather general information about development project management and current project measurement procedures. The interviews were therefore inductive which means that the interviews were not structured based on any specific predetermined theories or conceptual frameworks (Saunders et al. 2009).

The structure of the interview was designed to get information about the case company's current development project management. Qualitative data gathered with the interviews needs to be categorized or condensed in order to support meaningful analysis (Saunders et al. 2009). This in mind the interview had five parts that could be seen as categories. Before the actual questions, questions about work experience in the case company and participation in development projects were asked. The first part of the interview focused on the development projects in the department and the second part on their reporting procedures. The third part gathered information on the measurement of

development projects. In the fourth part the interviewee was asked to explain the measurement and reporting more in detail with an example project. The final part aimed at finding out how the measurement of projects and the overall management of development project could be developed in the case company. The interview structure is presented in Appendix 1.

To gain a comprehensive understanding of the case company's internal environment and development project practices, 14 case company employees were interviewed. The interviews were held in February 2017. The interviewees were selected based on their experience in the case company and job descriptions. The interviewees were also potential users of the assessment and measurement system that is created in this thesis.

All of the questions in the interview structure were not used in every interview. After a couple of interviews it was seen that some of the questions were slightly purposeless due to the fact that the information could be collected with another similar question. The five important categories were discussed but sometimes the example of a development project was left out due to time restrictions or lack of the interviewee's experience in the case company. The interviews were held in Finnish with the exception of one being held in English. The longest interview lasted for approximately 29 minutes and the longest 74 minutes and on average they lasted 46 minutes. The employees' average time spent in the case organization was approximately 10 years.

The interviewees had different positions in the case company. Most of them were managers of middle management with the exception of one interviewee being a member of the upper management. In Table 4 the organizational positions and departments of the interviewees are described. Upper management and middle management have different approaches to project management which is why employees with varied positions were interviewed. The upper management focused more on the overall performance of projects and their impacts while middle management had a more operative approach to measurement and project management. The interviews gave more insights on how the development projects are managed and how all of the development projects should be coordinated in the case company.

Table 4: *Interviewee information.*

Number of the interviewee	Main department	Current position	Organizational position	Duration (mm:ss)
1	Hull Production	Head of subdepartment	Middle management	58:34
2	Human Resources & Administration	Human resources manager	Middle management	36:24

Number of the interviewee	Main department	Current position	Organizational position	Duration (mm:ss)
3	Investments & Process Development	Head of main department	Upper management	47:42
4	Procurement	Head of subdepartment	Middle management	29:31
5	Investments & Process Development	Project manager	Middle management	53:46
6	Finance	Controller	Middle management	32:52
7	Design and Engineering	Head of subdepartment	Middle management	32:05
8	Research, Sales and Design	Head of subdepartment	Middle management	46:53
9	HSE & Risk Management	Head of subdepartment	Middle management	49:23
10	Hull Production	Development engineer	Middle management	54:39
11	Outfitting	Head of subdepartment	Middle management	47:50
12	ICT	Head of subdepartment	Middle management	56:19
13	Human Resources & Administration	Communications manager	Middle management	44:46
14	Design and Engineering	Head of subdepartment	Middle management	74:08

The interviews were recorded and then subsequently transcribed into separate document. The data was transcribed by using the interview questions as categories. The transcribing was executed in a way that not all that was said in the interviews was transcribed. In other words, data sampling was used which means that only those sections that were pertinent to the research were written down (Saunders et al. 2009, p.486). Word to word transcription was seen unnecessary because the interviews had parts that were not so relevant for the research. During the transcription some interesting quotes were written down for the description of the results. After the transcription the data was collected into one Excel file that had the same categories as the interview. The information from the interview transcriptions was condensed and summarized in the Excel file which made the analysis simpler to conduct. With categorization of data the rela-

tionships can be recognized easier (Saunders et al. 2009). The interview data analysis focused on finding similar answers and creating connections between answers.

3.4 Workshop data collection and analysis

The second empirical data gathering was done with a workshop. In the workshop a deductive approach was used which means that a framework developed from prior literature and the interviews was tested and developed further in the workshop (Saunders et al. 2009). The framework that functioned as the basis for the workshop was the initial assessment system created in the literature review. In addition, the interviews gave more insights on what should be discussed in the workshop.

There were three topics discussed in the workshop. The three topics were chosen because they gave the most information for the development of the assessment system. The topics were the following: project categorization, project prioritization and decision making in development projects. After the groups had done tasks about these three topics, the results were collected and discussion followed.

The workshop was held as a group workshop. This workshop was held in early May 2017 and it was executed to test the designed assessment model and gather information for its development. In Table 5 the interviewee information from the workshop is illustrated. As in the interviews, the workshop attendees were selected based on their experience in the case company and job descriptions. In the workshop the attendees were given three tasks to do, each of them having one topic. The attendees did the tasks in groups. The material presented in the workshop can be found in Appendix 2. The length of the workshop was two hours and the workshop had 10 attendees. There were five attendees in the workshop that were interviewed earlier for this thesis. The remaining five had experience in development projects. The numbers of the interviewees are listed in Table 4 and Table 5.

***Table 5**: Workshop attendee information.*

Number of the attendee	Main department	Current position	Organizational position
1	Hull Production	Head of subdepartment	Middle management
7	Design and Engineering	Head of subdepartment	Middle management
8	Research, Sales and Design	Head of subdepartment	Middle management
11	Outfitting	Head of subdepartment	Middle management

Number of the attendee	Main department	Current position	Organizational position
10	Hull Production	Development engineer	Middle management
15	Quality Management	Quality manager	Middle management
16	Project Planning	Head of subdepartment	Middle management
17	ICT	Project manager	Middle management
18	Investments & Process Development	Project manager	Middle management
19	Investments & Process Development	Project manager	Middle management

The qualitative data from the workshop was collected from answer sheets and notes taken during the workshop. The data was analyzed with MS Visio, Excel and PowerPoint and the results were integrated into the new assessment system. Due to the nature of the workshop, the workshop was not recorded and transcribed. Instead, all of the workshop material was collected and subsequently cleaned for better analysis. As with the interviews, it was important to see the connections between the answers of the attendees, which is why mind mapping was used to support the making of the connections. Visual tools were used to summarize the contents of the workshop which supports the analysis from qualitative data (Saunders et al. 2009). It was important to notice common factors between answers and how much some answers were emphasized.

3.5 Other empirical data

There were also internal documents of the case company used for this thesis and Table 6 below presents those documents. It can be seen that the amount of documents used in this thesis is extensive as well as the amount of notes from meetings that were not documented specifically for this thesis. However, the nature of the research was a constructive research with a multi-method approach and the data analysis from case company documents and meeting notes supported the thesis.

Table 6: *Other empirical case company data used for the thesis.*

Data content	Data type
PMO SharePoint content - Hi5 process material - Organizational charts - Presentations	Process charts and other content in Excels, Pdfs and PowerPoints slides
Development project material from departments - Status updates - Monthly reports - Process reports	Project information from main departments in Excels, Pdfs and PowerPoints slides
Strategy material - New strategy - Old strategy	Pdfs from case company intranet
Case company meeting notes - Project meetings - IT tool workshops - PMO meetings	Meeting notes from various meetings

In order to support the information gathering and analysis of the documents and meeting notes, separate files were created where information was gathered and summarized. Qualitative data such as organizational documentation may also be summarized and the summarizing should be done in a way that supports the other qualitative data collection methods (Saunders et al. 2009). With the documents and meetings notes the assessment system construct was development further.

4. DEVELOPMENT PROJECT MANAGEMENT, MEASUREMENT AND EVALUATION IN THE CASE COMPANY

4.1 Development projects in the case company

4.1.1 Departmental development projects

Currently there are multiple development projects in the case company and they are managed by various development managers and teams. The structure of the development organization in is shown in Figure 15. The structure is suggestive and not an actual representation of the case company. Currently, the development projects are not coordinated by a common organizational unit. Each main department has its own development projects that are managed by development managers or a development team.

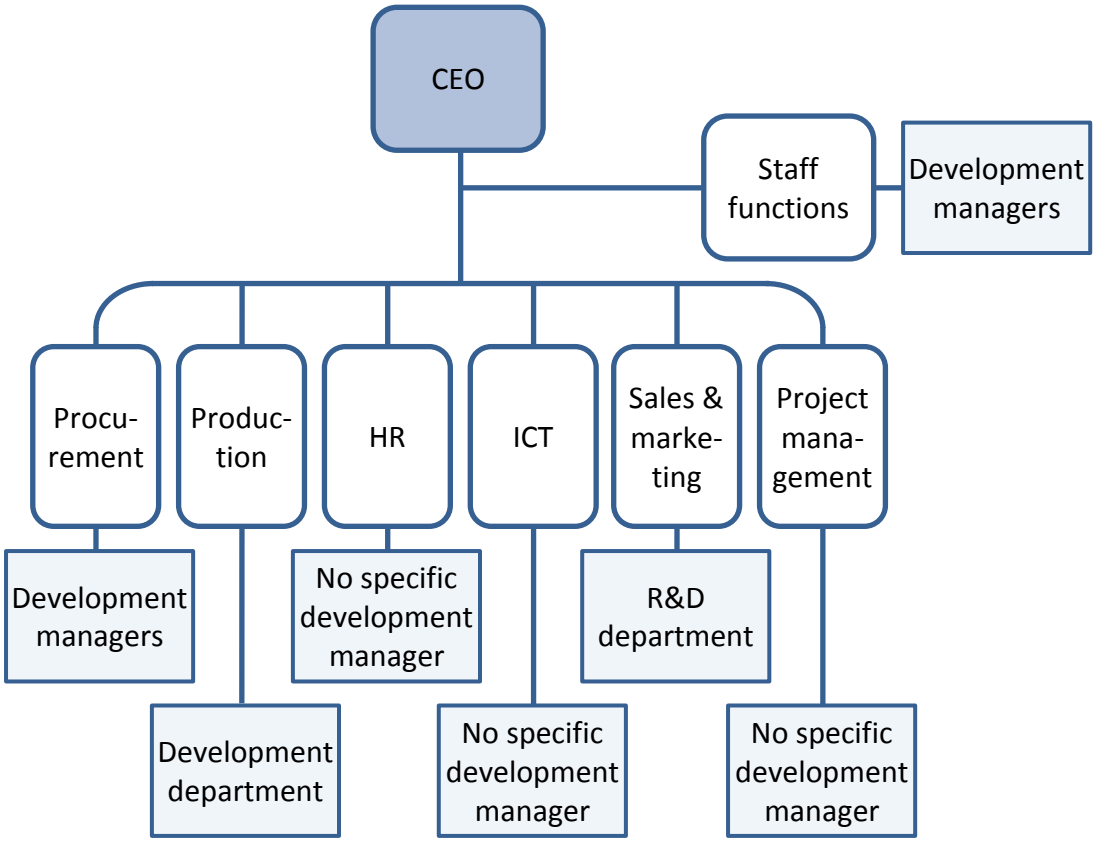


Figure 15: *The development efforts in case company.*

The different main departments have their own internal development projects and they are monitored differently between the departments. Some of the main departments have no specific development departments or managers. In these main departments the development work is done by managers whose main responsibilities are not just development but other activities. Some main departments in the case company have only development managers. There are a couple of main departments that have specific development teams.

There is a separate R&D department in sales & design main department but the projects that are managed there focus on external projects. The department handles technology forecast activities such as product sustainability and energy efficiency. There are very few projects that aim to improve internal processes; the department's projects focus more on product development.

Typical examples of internal development projects in the case company include development of business processes, internal information technology development and investments in new equipment, major software, and other capital projects. Typically the customers of development projects are internal company employees and departments. Depending on the type of the internal development project, the development projects are done either in the departments or as cross-organizational projects. The strategic and larger scale projects are usually done in teams that consist of managers from many organizational units. The smaller projects whose scope is not as extensive as for the cross-organizational ones are done within departments. In Figure 16 it is illustrated how the development projects are currently coordinated in the case company.

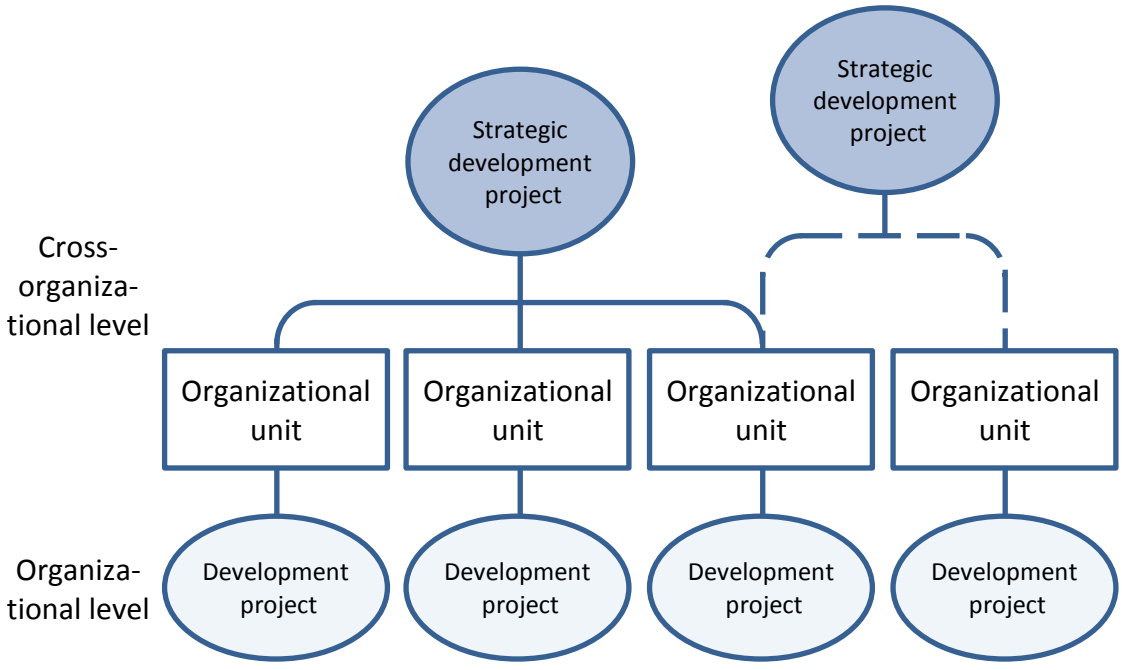


Figure 16: *An illustration of development project management in case company.*

In many cases the improvements in the main departments were not seen as development projects but as smaller tasks of continuous improvement. One human resources manager said that the Human Resources department's development efforts are more continuous improvements rather than major projects and that there are sometimes no clear projects to be executed. In other words, the departments are having problems with identifying which tasks are standard line improvement work and which are proper development projects. Many development managers said that the development projects done in departments are challenging to monitor since the company's strategic projects take up much of the time and there is no time left for other development projects. If there is no specific development manager in the department, the development work is sometimes seen as a second priority. Two development managers said that it is all about finishing the products on time which is why development efforts stay in the background:

"The focus is more on the product itself. There are some internal development ideas but those things are sometimes easy to forget." (Head of subdepartment, Design and Engineering)

"Because of day-to-day work, the development efforts cannot be done systematically." (Head of subdepartment, Procurement)

During the recent past few years, there have been efforts to bring together development projects so that they could be evaluated as a whole. In 2015 new ideas for development projects were started in departments and the responsibility of those projects was in the departments themselves. Since then the projects are either in progress of finished but some resulted in failures. One manager said the following:

"The development projects are easily forgotten in departments when there's no one or no group that asks after them. It is easy to let the development projects slide when the focus is so much on the final product." (Head of subdepartment, HSE & Risk Management)

One challenge with identifying the case company's development project portfolio was that there is no unified database where the project information is gathered. This makes it more challenging to monitor the projects' progress on a company level. Some of the main departments had clear guidelines for development, mainly those that had separate development departments, but some main departments lacked focus on development direction. One manager said:

"It should be clarified what are the development goals of this department. Otherwise it is hard to see which projects to choose and which not." (Human resources manager, Human Resources & Administration)

In many cases the development projects in departments are derived from the strategic programs that are causing changes in the production and other processes. The development projects in the hull production main department follow a roadmap that functions as a strategy for the hull production development team. The roadmap is derived from the strategic projects in the case company that are explained further in the next section.

4.1.2 Strategic development projects

The case company has major development projects that are commissioned by the upper management and the increase of orders in the order book. These investments are large scale investments in production facilities and technologies as well as IT system upgrades. These projects are done cross-organizationally and they are a clear priority in the case company.

One of the major schemes in the case company is the investment program. The investments include improvements in production technology and employee satisfaction. The investment program has clear objectives: to increase capacity and productivity and to shorten the lead time of final products. The investments are essential so that the case company can fulfill the requirements from the clients. Other strategic development projects focus on IT investments across the case company.

In the past 15 years or so, there were not that many improvement programs that were essential for the case company. That is why the case company has a need to monitor the development programs, large and smaller ones, so that the order book requirements can be fulfilled and enabling processes are functioning properly. The company strategy was implemented in 2015 and it contains the goals for years 2015-2018. The corporate strategy contains goals such as delivery of the current order book, financing of investments and reasonable requirement of new employees. There is a new strategy to be implemented in the case company in 2018, which will also have its effects on development project management. The new strategy emphasizes that the co-operation between other companies in the same company group should increase during the next few years. Therefore strategic development projects are done increasingly in virtual teams and across country boundaries.

In summary, the case company has many development projects and programs. Due to the fact that the development projects are done separately in different main departments, the management for the whole development project portfolio of the case company is fragmented. This results in doing overlapping projects and in having inefficient communication which indicates that there is no clear development project portfolio management. International co-operation also gives its own challenges.

4.2 Development project management practices and tools

In the case company there is a project management framework that has in many cases been applied to development projects. The framework is called Hi5 and it is based on a Swiss Hermes 5 method. The framework has an idea phase and then four project phases. These project phases are initiation, concept, implementation and deployment. The Hi5 framework offers documents and checklists to be filled out which help monitor the project's progress. This framework is the most commonly used framework in the case company, although development project managers have altered this framework to suit their own development projects. The project management process of the Hi5 is shown in Figure 17. For the reporting and progress monitoring there were not that many systems or IT tools that were in use. The reporting was done by filling appropriate PowerPoint slides and for some development projects tracking software called JIRA was in use. For single project management other IT based tools were also in use.

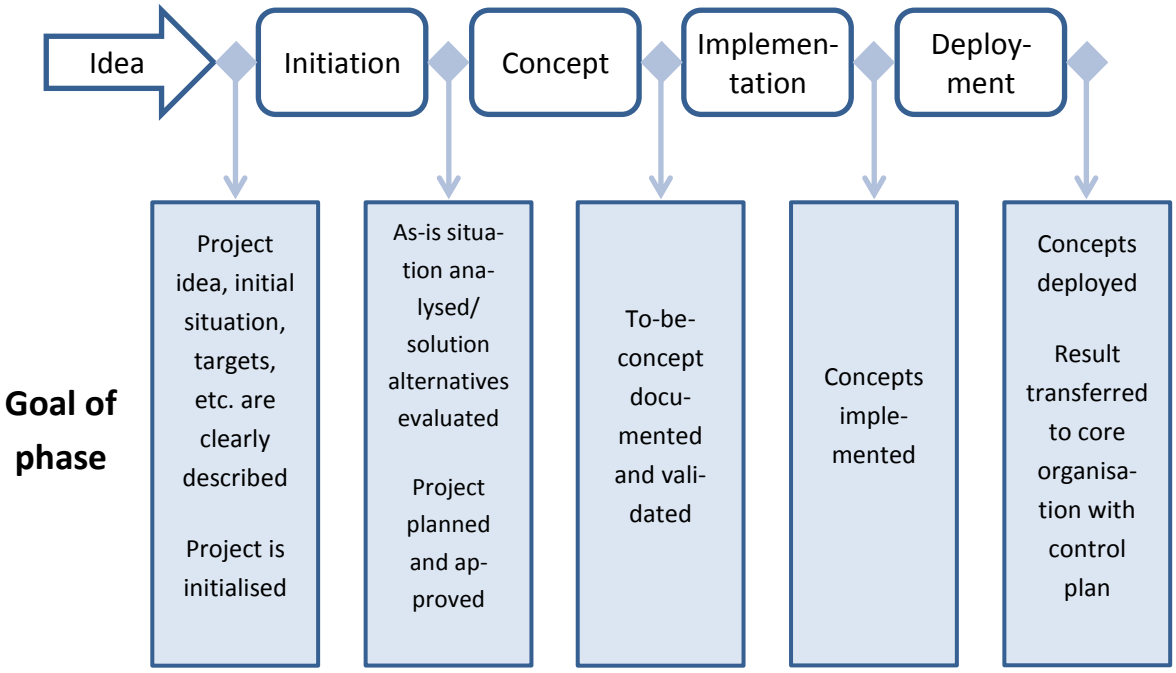


Figure 17: *The Hi5 project management process.*

The Hi5 process is sometimes not in use because it is too complicated for the user and therefore development managers tend to follow their own processes which make the reporting and project management not unified in the case company. The reporting was done depending on the project or the department and in many cases the reporting of the development projects was added to weekly or monthly reports of the departments. One development manager said that development project updates are also discussed informally or with an "ad hoc" style. The investment projects have regular reporting procedures due the high priority level. In summary, development project statuses were re-

ported depending on their department or priority. Some projects are reviewed on a weekly or monthly basis but some were under review every quarterly.

Based on the interviews, development project schedules, costs and quality were seen important project measures. Over many decades, these three factors have become linked with measuring the success of project management (Atkinson 1999). For the larger-scale investment projects and other development projects the scheduling of the projects was seen as high priority. One development manager expressed:

"The monitoring of the project schedule should not be regarded as a minor aspect. The production phases have many effects on other phases, and therefore schedules of the projects are vitally important." (Head of subdepartment, HSE & Risk Management)

Alongside with project schedules the budget and costs of development projects were carefully looked at. Quality monitoring was done for a part of the development projects because sometimes there was no special parameter that could have been used to assess the quality of the process that was under development. For high priority projects, such as the production capacity investments, risk evaluations are done systematically. Figure 18 illustrates the most important development project performance indicators and reported elements. They are collected from development project reports from various departments.

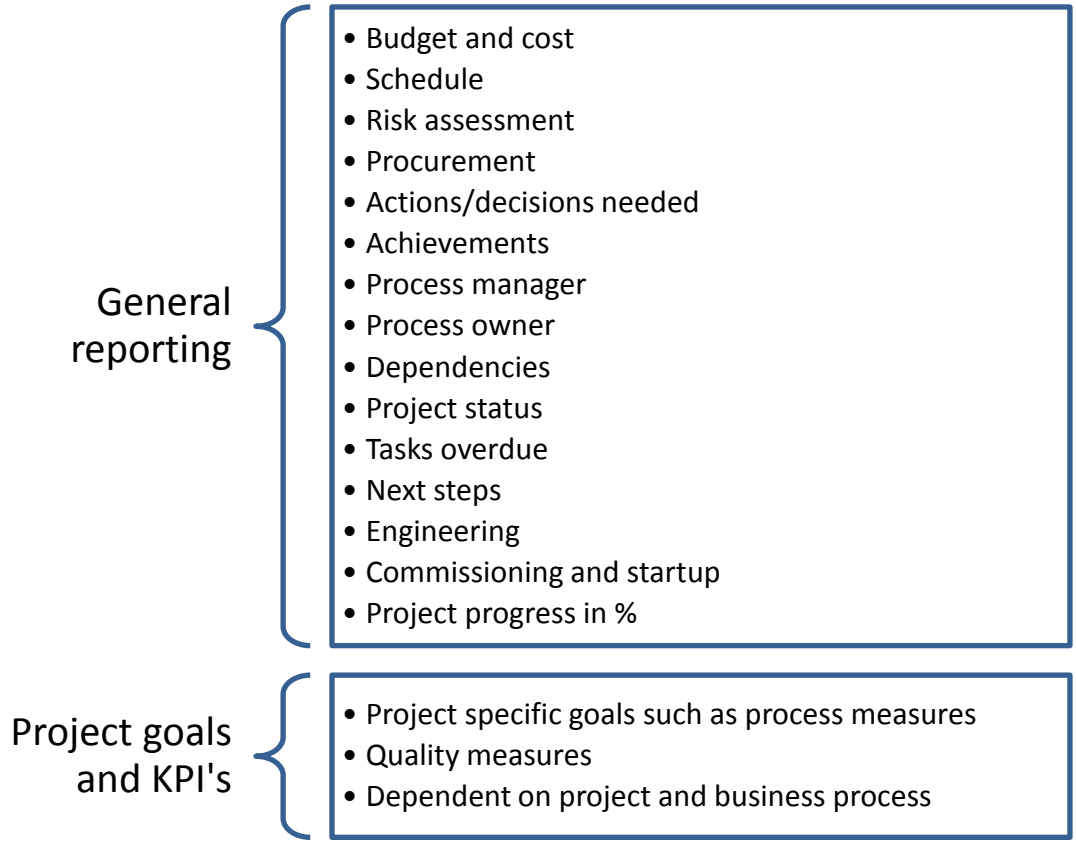


Figure 18: *Development project reporting and performance measures.*

4.3 Business process impacts of the development projects

When asked about the business impacts that the projects are aiming to have in the case company, the answers were varied. One interviewee said that it is difficult to determine common performance measures for project goals since the projects focus on very diverse areas. For production the operative metrics can be monitored as the project progresses but for some other development projects, such as the improvement of corporate social responsibility, the business impact is harder to measure. While one project aims to increase capacity, one is re-organizing reporting procedures. The parameters that were measured were qualitative or quantitative depending on the business effect and process. For production there are many operative parameters that can be measured to see the effect of development projects. However, many departments lacked performance measures, which is why the development projects in these departments lacked business effect measurement indicators. The monitoring and measurement was also difficult because there were no clear processes determined that could have been measured. One manager said:

"The business impacts of the different development projects need to be compared to the original goals that haven been given to them. The problem itself is often a good metric to be controlled. For example if the capacity has to increase, capacity must be the metric that is monitored. But oftentimes the results are seen only when the projects are completed. During the process there can be some indicators that tell if the project is heading towards the right direction." (Head of subdepartment, HSE & Risk Management)

The investment programs aims to increase the capacity in the production facilities, in particular in the hull production. The process which is in development is the production process which starts from the material arrival in the factory and ends when outfitting takes over the manufacturing process. There are many supporting processes that the smaller scale development projects are changing. They might not have a clear relation to the core process but they need to be changed to optimize the overall performance.

There are differences in the business processes that the development projects are improving. Most of the development projects improve operations management processes, and examples of these projects are the investment program and production department's projects. Typical production indicators that the case company uses are capacity utilization rates, lead times and the amount of scrap metal. However, there are supplier, HR and customer management processes that are changing with development projects. It can be said that the number of processes that the improvement portfolio is affecting is vast.

4.4 Development project assessment and decision making

The evaluation and assessment of development projects varied based on the department. The upper management level department head expressed the evaluation of projects as follows:

"At the moment there are no models for development project portfolio evaluation on a company level. The main departments have their own interests and visions on how to develop their functions. The vitally important development projects, such as the investment program, are commissioned by the upper management. I think that there are not that many developments ideas happening in the departments this year apart from the strategic development projects and that's okay since those projects are the vital ones." (Head of main department, Investments & Process Development)

The decision making in development projects focused on monitoring the budgets, schedules and completed task lists of the projects. Most importantly the monitoring focused on identifying the deviations in projects. In investment and development projects meetings the problems were discussed more in detail and in the meeting it was monitored whether the projects' goals were met or not. Major deviations in projects were typically delays in schedule, cost overruns or changes in project requirements. In some cases in cross-organizational projects the decisions had to be made in many departments, that is to say in all of the departments that were involved in the projects. This results in project management inefficiency because the evaluation is made in different organizational units.

In general the decision making in development projects varied based on department and the development project in question. The incentive to finish development projects depended partly on the upper management's interest in the development project, too.

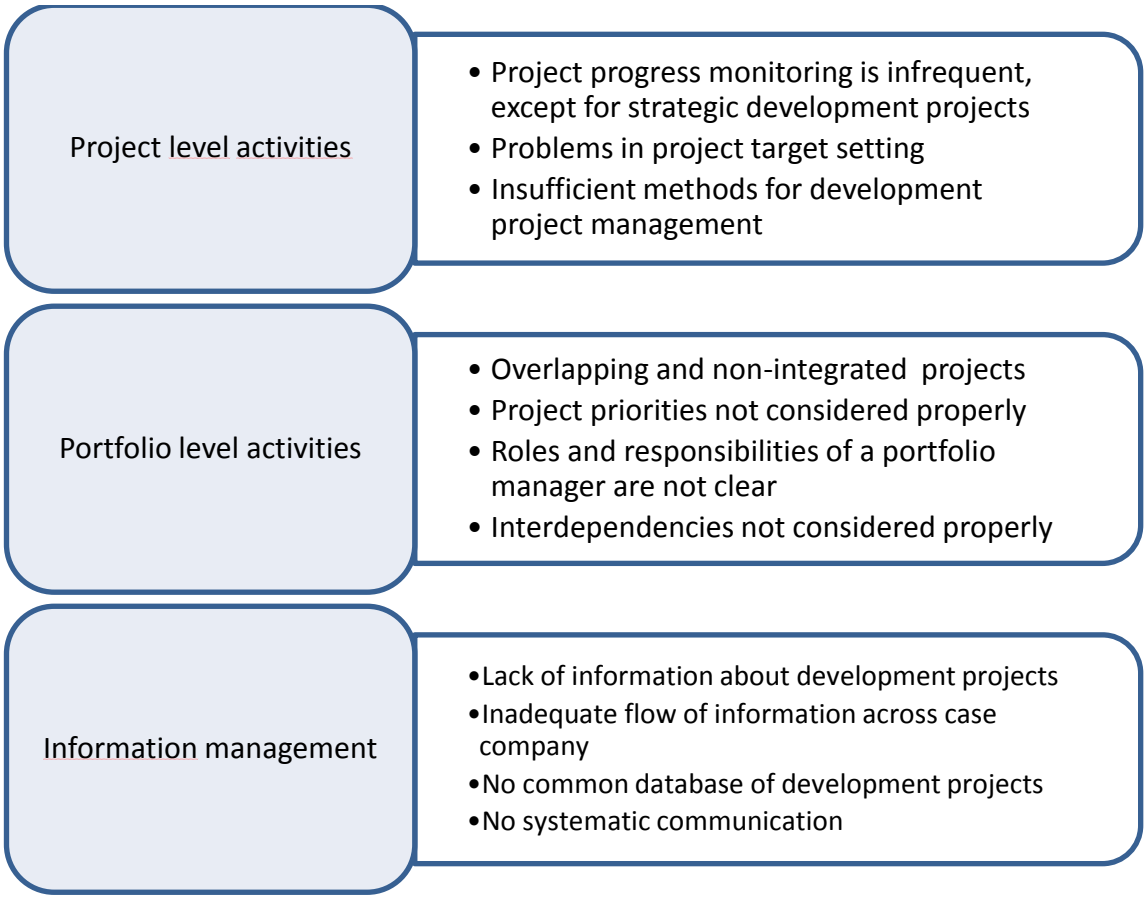
"The more the upper management is interested in the development project, the better the project is monitored and the more efficient the decision making is. For smaller projects, the monitoring and decision making are less efficient." (Human resources manager, Human Resources & Administration)

The development projects or ideas were not evaluated by a common evaluation team. The development issues in departments were discussed in their own departments and brought to the attention of the upper management when needed. The upper management discusses the strategic projects but currently there is no organizational unit that overlooks the development efforts between upper management and the departments. Due to this, the big picture of development projects is challenging to see. It can be said that in development project management the portfolio management process was fairly fragmented and unorganized.

4.5 Challenges in development project management at case company

In the interviews and the workshop the development managers expressed that the management of development projects was very fragmented in the case company and oftentimes problematic. One reason to why the case company is developing a PMO structure is to increase transparency of development project management. The case company is also considering development and investment project portfolio review sessions in which development projects are evaluated and supported. This review could help tackle the problems faced in the case company.

The article by Elonen & Artto (2003) that was presented previously in this thesis focused on problems in managing internal development projects in multi-project environments. Based on the interviews in the case company similar project management problems could be identified. Elonen & Artto (2003) categorized six relevant problem areas which could also be applied to the problems of the case company. The seventh problem area was identified based on the interviews and it was not originally part of the framework. The problems in managing development projects in the case company are collected in Figure 19 with the six problem areas from the article.



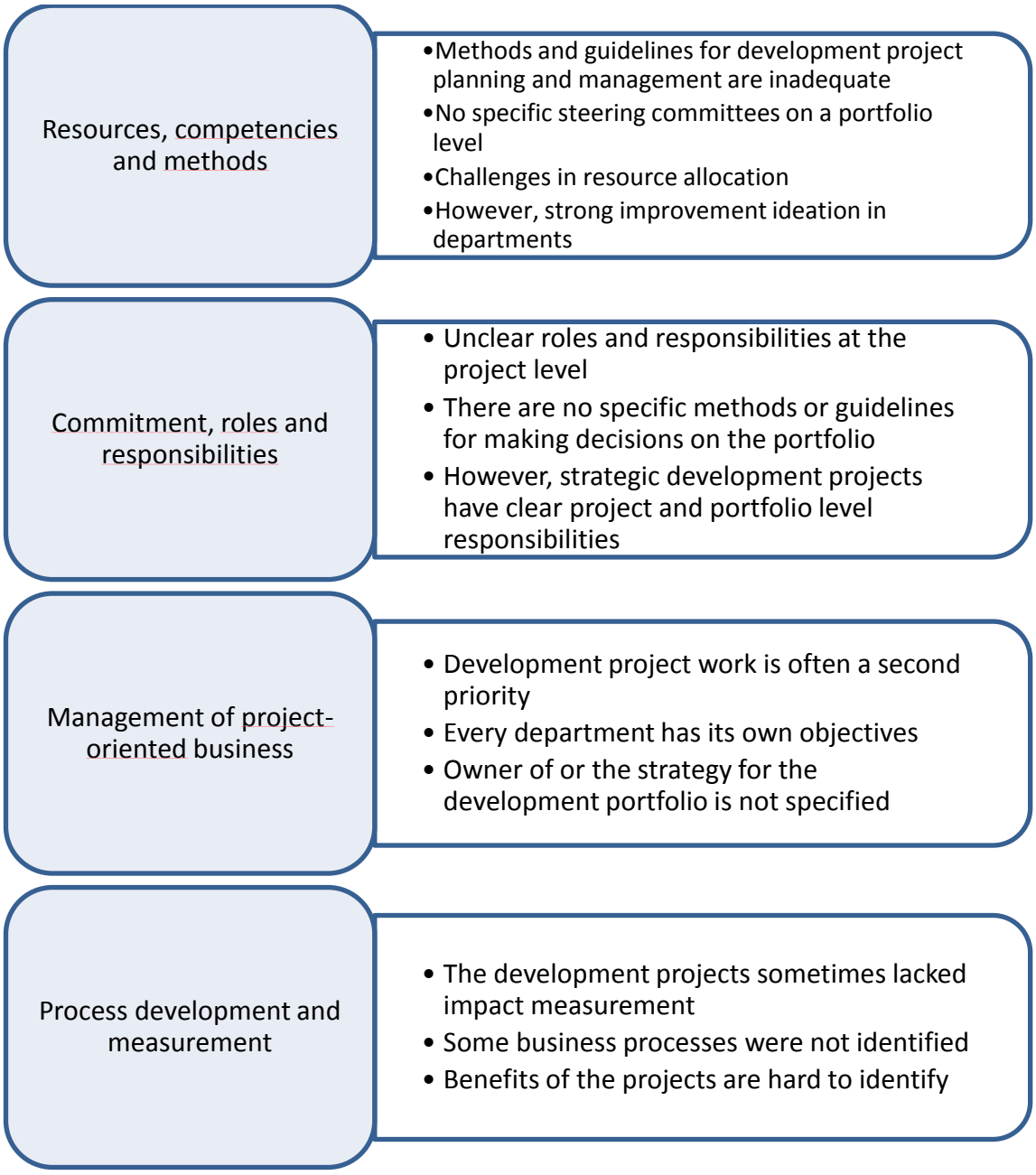


Figure 19: *Challenges in managing development projects in the case company (modified from Elonen & Artto 2003).*

The problems mentioned in Figure 19 are not applicable for all development projects in the case company. The development projects that are not seen as strategic ones often fail at having structured reporting processes, project teams or predetermined goals. Even though there are many issues regarding the management of process development projects, there are four key challenges that were emphasized in the interviews and workshop. These challenges were mentioned in most of the interviews. The challenges are presented in Figure 20.

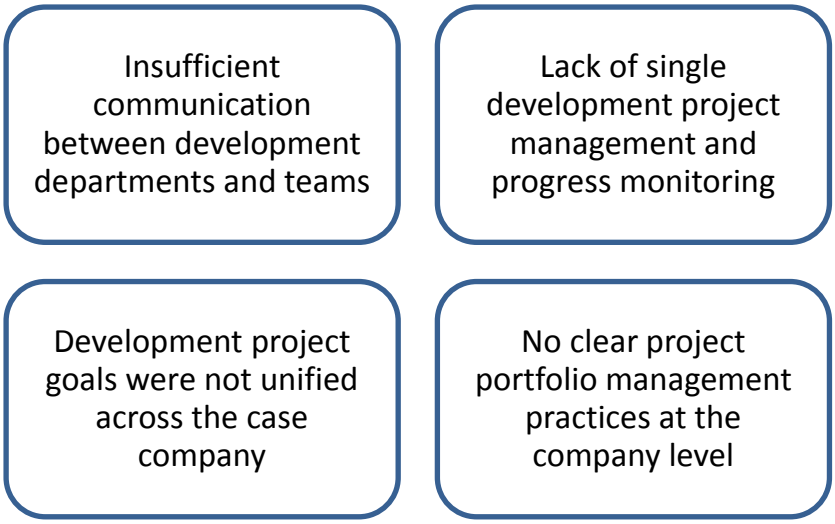


Figure 20: *Four key challenges in the case company.*

As can be seen in Figure 20 there are challenges regarding communication, single project management and portfolio management. However, during the upcoming years there are many development and investment projects to be started which is why the case company should take advantage of the situation by developing the development project management practices. The lack of insufficient development project communication results in doing overlapping projects. The lack of single development project management processes was a recurring theme in the interviews because many managers said that even though there are development ideas, only a few development projects reach their goals.

The company level development project goals are clear for strategic development projects but for other improvement work the goals were not unified across departments. The upcoming strategy has an effect on development project work because it encourages improving current development efforts. However, in many interviews the managers expressed that they wish they had more clear goals and targets for their development work. The last key challenge was to improve the portfolio level activities because at the moment there is no group that has an overview of all of the development projects.

The most important strategic projects, such as the investment projects, have clear responsibilities and reporting procedures and it can be said that the problems mentioned in Figure 19 and Figure 20 are least applicable to the strategic development projects. As said before, the strategic development projects are a priority in the case company which is why the project and program personnel are qualified and the upper management is involved in the project work. The case company has chosen the strategic development projects wisely because they focus on improving the most critical processes in the case company. The roles and responsibilities of portfolio managers were clear for the investments projects as well as the R&D projects but for other development projects the portfolio level responsibilities were not that clear.

Currently the development teams have efficient and creative ways to identify the processes that need the most attention. The ideation processes in departmental development teams are strong and development managers are constantly improving the ways of working in the case company. The positive development project management practices, such as strong ideation and strategic project management, are also included in Figure 19.

Overall the interviews and workshop provided similar answers and the four key challenges were always the most discussed topics. The most variation in answers occurred when business process impacts were discussed. The measurement of process improvement was extremely varied between development projects. Some development project indicators focused only on measuring project related metrics such as project schedule and cost overruns. Only a few projects focused on continuous business or manufacturing process measurement. For example hull production focused on capacity metrics and quality metrics but procurement used only a few process metrics. Based on the interviews the overall performance of development projects in the case company was varied.

5. NEW DEVELOPMENT PROJECT ASSESSMENT SYSTEM

5.1 Improvement ideas for development project portfolio management at case company

As said in the introduction, the case company's final products are executed as complicated projects that can last multiple years. However, the case company's other projects, such as the development projects, could benefit from better support. One suggestion from an interviewee was to implement a new project management framework that would be scalable for all types of projects, both small and large in scope. The current Hi5 project management process was sometimes seen as too complicated to use. The implementation of a new project management process would be a solution to one of the key challenges mentioned in section 4.5 and this challenge was lack of single development project management and progress monitoring.

Many interviewees said that a company level group that could evaluate the development projects and look after them would be useful for the case company. Not only would it increase the transparency of internal development efforts but also navigate the projects as a whole entity. This company level PMO could be a solution to the three other key challenges mentioned in section 4.5 because the PMO can increase communication between departments, provide strategic direction to development projects and support portfolio level decision making. One development manager expressed:

"The idea of a PMO is not a bad one. There should be a list of every development initiative that is happening in the case company. Then maybe there could be a second phase where qualified people are gathered and they evaluate new and current initiatives. Not all of the smaller projects should go to the evaluation since the members of the evaluation group might not be qualified to handle or discuss the smaller departmental projects. All of the small or everyday improvement should not go to the evaluation." (Head of subdepartment, Design and Engineering)

Another manager expressed the following:

"A company level PMO could be beneficial because it can report the development project statuses to upper management. The PMO should collect and condense information from the development managers and teams so that the upper management could see which projects need the most attention. Currently there is no one that looks after the

whole development portfolio but this company level PMO could help with that. Right now the departments know their own projects and they focus on them." (Head of subdepartment, HSE & Risk Management)

A third manager said the following:

"Right now there are so many changes to be made and the impacts are extensive which is why a company level PMO is a good idea. Earlier the few development projects that were done were so limited and they could be done in one department. At least the information sharing and reporting should be better because right now there is little information to be gathered." (Head of subdepartment, Research, Sales and Design)

A fourth manager expressed that a PMO with an evaluation group has its complications:

"The development project teams have 100 % of the knowledge. Only 5 % of that knowledge ends up in the upper management level. It is critical to determine what information is reported from the projects and who does the evaluation. The evaluation can't be done by people who don't have enough knowledge of the projects." (Head of subdepartment, Hull Production)

In Figure 21 improvement ideas were collected based on the same categories presented in Figure 19 at the end of Chapter 4. The improvement ideas were collected based on the development area and created based on the case company interviews and the workshop. In addition, the conceptual framework at the end of the literature review functioned as the basis for the assessment system creation which is why the development ideas in Figure 21 have similar content than the conceptual framework. For example, according to the conceptual framework, having a project portfolio management process and an integrated PMO in a company has positive effects on the success of project portfolio management. The conceptual framework provided solutions to project portfolio management challenges that the assessment system features are tackling in the case company. The four key challenges and the potential solutions to them are also presented in Figure 21.

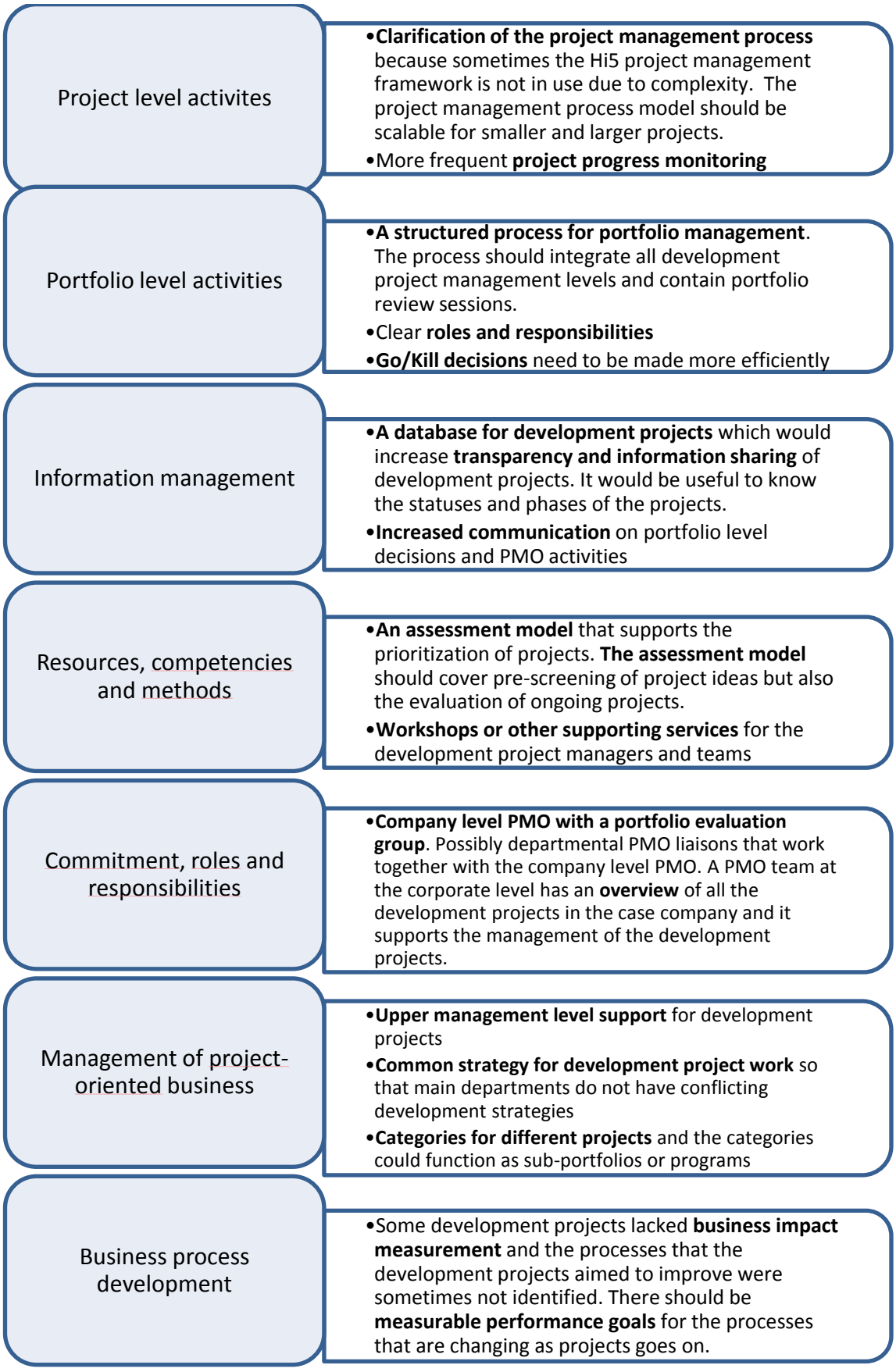


Figure 21: *Ideas for development project portfolio management improvement.*

5.2 Development project assessment system for the case company

5.2.1 Assessment system features

In this Chapter 5 the assessment system will be presented and this system is built on the answers of the two empirical data gathering rounds as well as internal documents in the case company. In the system the existing assessment mechanisms and project management practices are not ignored and they function as the basis for the system model. The construct tries to stay in line with the case company's strategic endeavors and project management practices. The created assessment system is an Excel based construct with which the assessment of development projects can be done in the idea phase or other phases. In addition to the Excel based construct there are other features that complement the assessment system. The features create an entity and the features are connected to each other. The features of the final construct are presented in Figure 22.

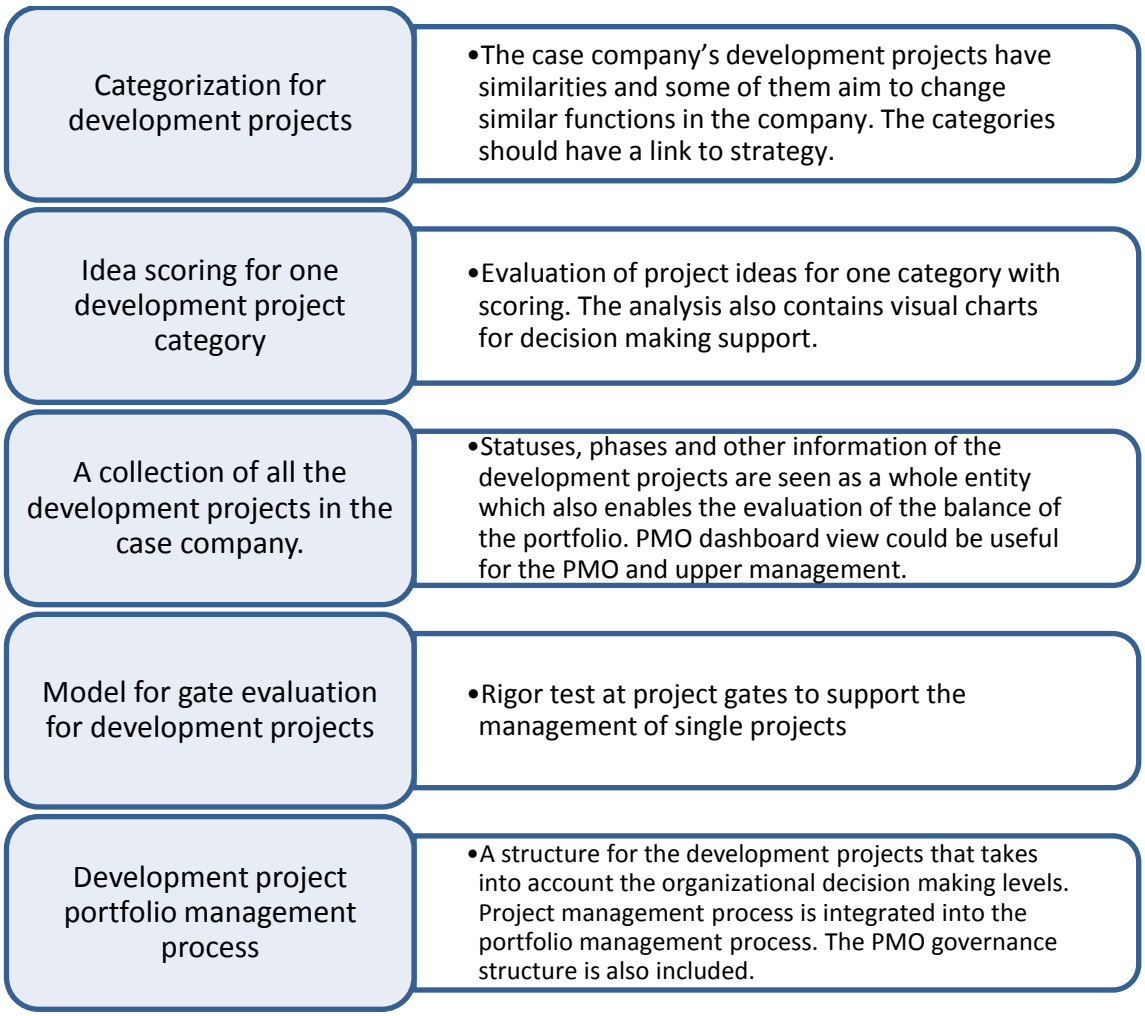


Figure 22: *Assessment system features and contents.*

The main purpose of the assessment system is to give insights and suggestions on how to choose the most important development projects in the case company and how to manage them as a portfolio. Each of the five features of the assessment system has its own section in this Chapter 5. Figure 23 shows the assessment system features as a figure.

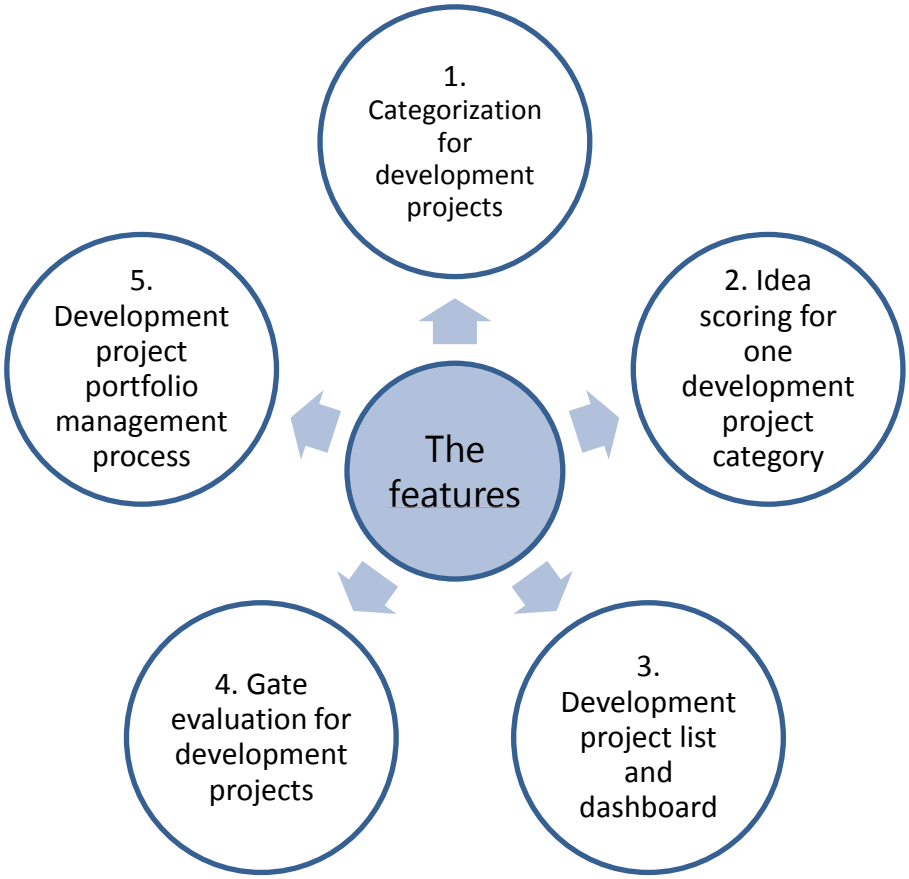


Figure 23: *Assessment system features.*

There are many reasons why all of the development ideas for development project portfolio management in Figure 21 were not included in the assessments system. The assessment system only focused on creating the portfolio management process with integrated assessment models. Especially the focus was on the prioritization and selection of development projects. One of the four key challenges mentioned in section 4.5 was to develop the development project management process model for different types of process development projects. The reason why this project management model was not the focus of this thesis was that the case company was already developing a new model and the assessment features in this thesis were created based on the new project management model.

The other development ideas such as increased communication and more frequent project monitoring are features that can be provided by the company level PMO. At the end of the thesis process the company level PMO was in development and the functions of the PMO were not entirely decided by the upper management. According to the inter-

views and workshop it was seen most essential to create the basis for successful development project portfolio management. This meant that there should be guidelines for development project management and development project portfolio management that increase the transparency of decision making and project work. The assessment features provide this basis for development project portfolio work in the case company and other development ideas can then be added to the existing features. The future development ideas are discussed more in detail in section 6.3. The conceptual framework provided the basis for the assessment system feature selection and development and later in this thesis it will be discussed how well the chosen features fit to the original conceptual framework.

As said before in this thesis, the case company is implementing a new strategy which modifies the departmental goals and this strategy implementation has also an effect on development project work. One of the key challenges was to unify the strategic goals across development departments and the new strategy implementation is focusing on that. The assessment features were created in a way that they support the upcoming strategy. It is very important that manufacturing process and other process improvements are linked to the strategy of a company (Kornfeld & Kara 2011).

5.2.2 Categorization of development projects

According to the interviews and workshop, it would be suitable to manage the development and investment projects with sub-portfolios, areas or strategic buckets (Chao & Kavadias 2008). There are even hundreds of development projects of which dozens are cross-organizational or strategic projects. In addition, according to Artto & Dietrich (2004) the categorization of projects by their type or strategic area is a prerequisite for successful strategic business management in multiple projects environment. The resources could be divided between the sub-portfolios. In the workshop the attendees were given a sketch of the upcoming strategy of the company and they were asked to create development projects categories based on the new strategy. As support, a list of current development projects in the case company was also given. The case company's new strategy consists of six areas which are presented in Figure 24.

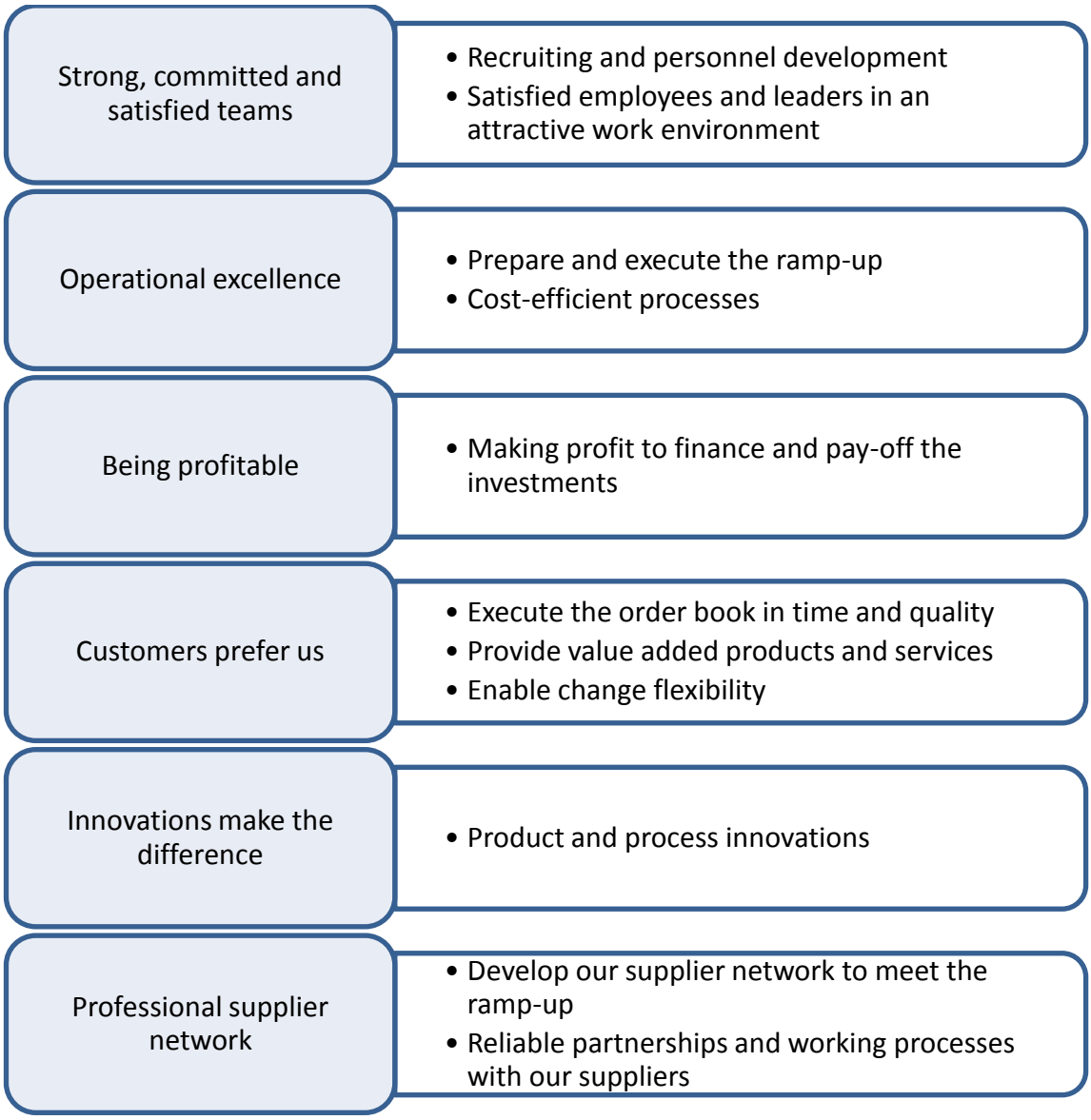


Figure 24: *The new strategy of the case company.*

The most important issue with the management of internal development project is to enable the completion of the final product of the case company and this is at the core of the case company strategy. This was also emphasized in the interviews because the order book needs to be fulfilled. If a development project does not support the completion, it should not be executed. This is also stated in the new strategy of the company. It has been suggested that the strategy or the case company could be divided into development areas. The completion of end products is a must win for the case company and the areas in the new strategy should work as guidelines for project development work.

Based on the case company strategy, four different project categories were seen as the most suitable in the workshop. These categories are presented in Figure 25. The first category is operational excellence that focuses on manufacturing processes as well as strategic business process improvements. The second category is investments. The in-

vestments are large cross-organizational projects that require much resources and effort. Innovations and R&D are development projects that focus on product development, not internal process development. Supplier network and personnel know-how development contains projects that increase the know-how of employees and supplier networks. It has to be noticed that not all of the development projects fall into these categories and some of them could be associated with many projects. The number of the development projects is so large that the categorization and subsequent project division into sub-portfolios could be a way to management the development project portfolio.

In the workshop there were other suggestions for the categories. One suggestion was to put all of the IT related projects into one sub-portfolio and have personnel development and supplier network development as separate categories. The most important aspect with the categorization according to the strategy is to emphasize that projects that are not supporting the strategy of the company should not be chosen in the development project portfolio.

The operational excellence category is the largest in terms of project amount. It encompasses the manufacturing development projects, ramp-ups projects, capacity increase projects and IT projects. It would be suitable for the case company to divide this category to smaller categories that have a clearer focus. The definition of the development categories is an issue that the upper management of the company must decide on and the four categories that are presented here is a suggestion for that.

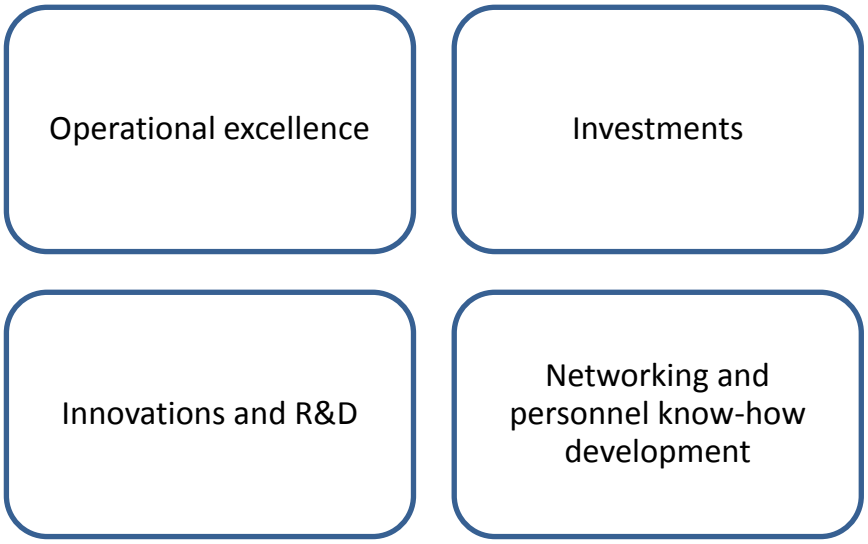


Figure 25: *Strategic buckets for development projects.*

5.2.3 Idea scoring for operational excellence

For the case company it was seen important to have a more structured approach to the selection and prioritization of development projects. In order to decide on the project that gain access the portfolio, initial evaluation of the project proposals must be done (Archer & Ghasemzadeh 1999). This is why a project idea evaluation model was created for one of the strategic areas, operational excellence. The evaluation is done with scoring from 0-5 and the total score is a weighted average. In addition to the total scoring, the evaluation model creates a risk-benefit bubble chart and financial resources-strategic alignment bubble chart as visual aids.

The evaluation criteria focus on assessing the benefits, risks, resources and strategic alignment of the development projects. The criteria are created with the manufacturing and business process aspect in mind and the results from the workshop supported the selection of the evaluation criteria. The first section, benefits, has five evaluation criteria that are effectiveness, co-operation, economic benefits, processes and efficiency and know-how. For example the evaluation criterion of processes and efficiency is the following:

The question: The project will provide more efficient operation of processes or the project will provide added value to the company extensively for other activities.

- 5 | Project will develop a new process, which is essential to the continuum of the operations
- 4 | Project will develop a new process, which is relevant to the continuum of the operations
- 3 | Project will develop a new process, which significantly enhances the company's operations
- 2 | Project will develop a new process, which somewhat enhances the company's operations
- 1 | Project will develop a small part of the existing process
- 0 | No effect

The second section, risks, has two evaluation criteria that are project risk level and project necessity. The resources section evaluates the human and financial resources of the project proposal. The last section, strategy, evaluates the strategic alignment of the project proposal. The assessment criteria with weighted averages are shown in Table 7. The weights are chosen based on the workshop. The person who does the evaluation chooses a score from 0 to 5 for all of the evaluation criteria in the different sections. In total there are 10 criteria in the four sections. An overall score is calculated based on the score selection and the total score can then be between 0 and 5. In section 5.2.6 it will be discussed who does the evaluation of project proposals and ongoing projects.

Table 7: *Project proposal evaluation criteria.*

Assessment section	Assessment criteria	Scale for scoring	Weight (%)
Benefits	Effectiveness	0-5	10 %
	Co-operation	0-5	5 %
	Economic Benefits	0-5	10 %
	Processes and Efficiency	0-5	10 %
	Know-how	0-5	5 %
Risks	Risk Level	0-5	10 %
	Project Necessity	0-5	10 %
Finance & HR (resources)	Human Resources	0-5	15 %
	Financial Resources	0-5	5 %
Strategy	Strategic Alignment	0-5	20 %
Total		**0-5**	**100 %**

It is for the case company to decide how much the total score has to be for the project idea to gain access to the development portfolio. From score ranging from 0-5 a suitable limit of 3.5 could be useful. The logic of the model is that the higher the score is the more reasonable it would be to choose to project in the portfolio. After the development project proposals are selected with the help of the evaluation model, the projects gain access to the development project portfolio. Figure 26 presents the funnel or the development project ideas.

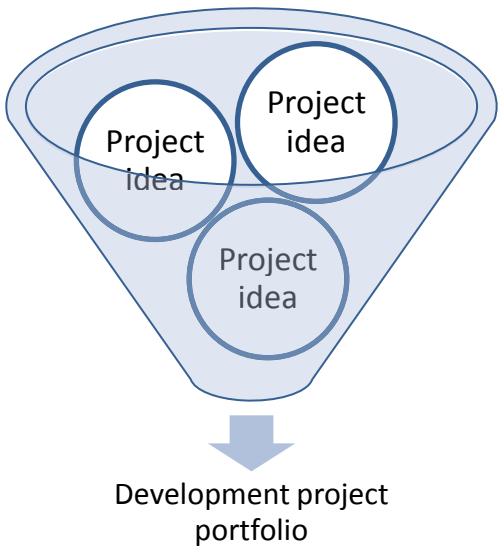


Figure 26: *The funnel of development project ideas.*

Ideally, the information from idea scoring moves to the portfolio view and qualitative information transfers into quantitative information such as used hours and financial resources. During an idea phase actual resources of the project are hard to estimate which is why a score has to be used in the evaluation first instead of actual resource data. The next section explains the Excel based portfolio view that could be used for the project information storing.

5.2.4 Development project list and PMO dashboard

As the thesis work continued, a development projects list was created and certain data from development project was collected in one Excel file. This development projects portfolio list gives an overview of the development projects in the case company. In this master Excel there is also additional analysis of the current state of the development projects, such as comparison of project statuses and phases. For the case company it was seen useful to create a development portfolio dashboard and projects list because this would increase the transparency of development project work. In the interviews and workshop the interviewees said that the development project information should be more transparent to development teams and managers and all of the projects should be listed in one database for portfolio level assessment. The dashboard view could be in the use of the PMO of the case company (Dai & Wells 2004). Figure 27 presents the connection of the idea scoring and development project list and PMO dashboard.

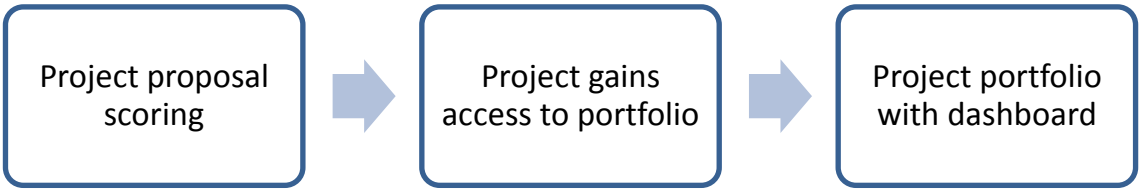


Figure 27: *Connection between idea scoring and development project portfolio.*

In the project list data from project proposal evaluation scores can be collected as well as other information from the development projects. The development project list and dashboard has specific content and the content is illustrated in Figure 28. The dashboard view analysis is based on the project information sheet that is in the same Excel. At the moment the dashboard view has basic information of the development projects but in the future as the PMO implementation has been concluded the dashboard view could have more features such as in-depth risk analysis, resources overview, expenditure between projects or departments and stakeholder analysis. An IT tool supports the maintenance of large information databases and this would also benefit the functions of the PMO in the case company.

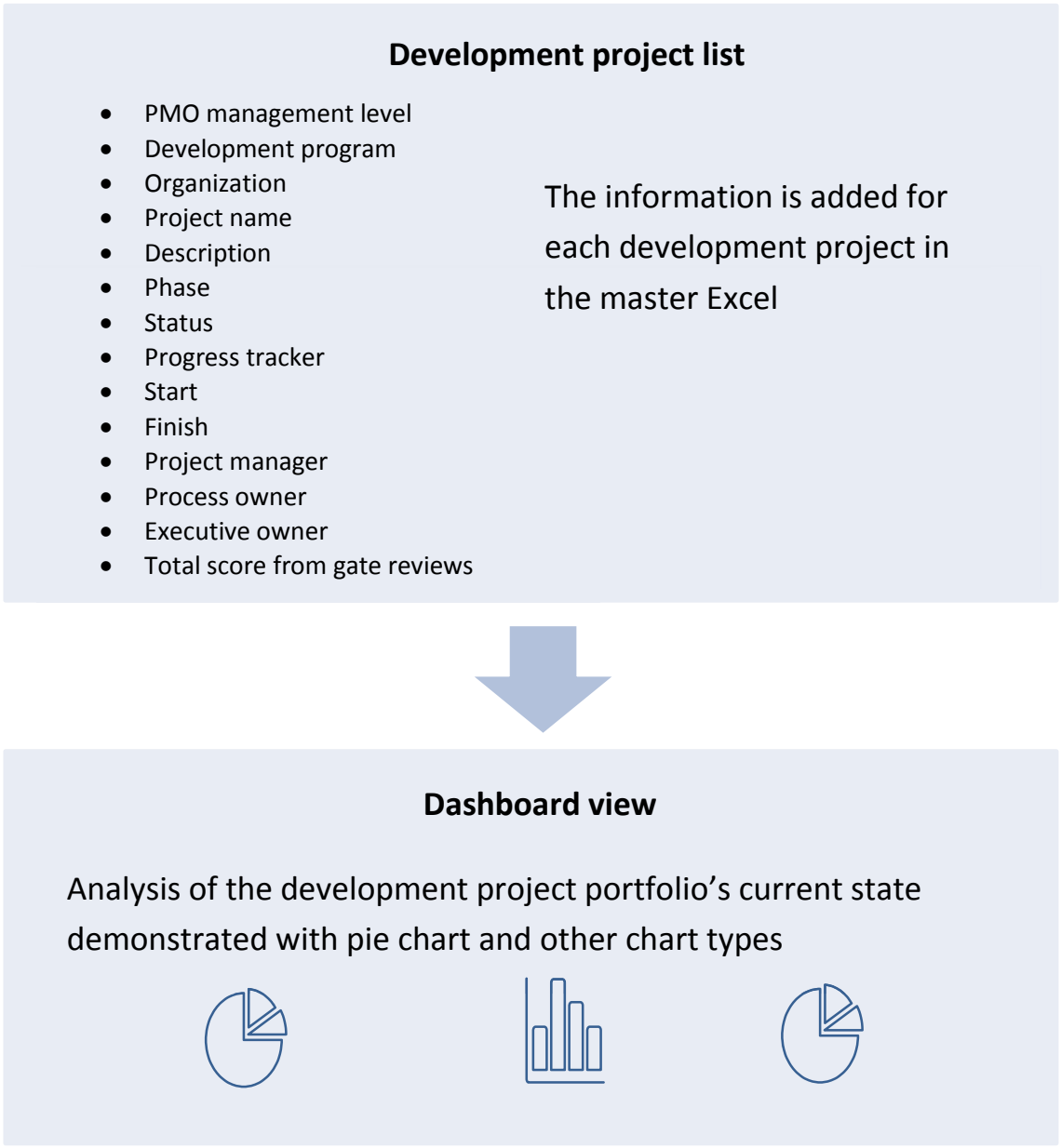


Figure 28: *PMO dashboard view illustration.*

5.2.5 Model for gate evaluation for development projects

One of the key challenges in development project management that was mentioned at the end of Chapter 4 was the lack of single project management and monitoring. As mentioned in Chapter 4 the departments have different approaches to project monitoring. During the thesis process, the case company established a model for project gate evaluation for development projects. The idea of the gate evaluation is to score the projects from 0-5 and the criteria resemble the checklists from the Hi5 project management process. This model has the same logic as the idea scoring model, the higher the score the better. This type of assessment is aimed to check the status of the development pro-

ject and to give suggestions for project management work improvements. Another word for the gate evaluation could also be project quality review or rigor testing. In project portfolio review sessions the projects are evaluated based on certain criteria and this assessment can be done with checklists or scorings (Artto et al. 2008, p. 393).

While the idea scoring model focuses more on the selection of development projects, this gate evaluation model focuses more on the evaluation during project lifecycles. Once the project has gained access to the portfolio, the individual assessment is done at decision gates for the ongoing projects in the case company. According to the Hi5 process there are 5 phases in development projects and these are ideation, initiation, concept, implementation and deployment. After each phase the projects are evaluated and then it is decided whether the projects move on to the next phase. The model for gate evaluation is designed to be used between project phases. Figure 29 presents the logic of the gate reviews.

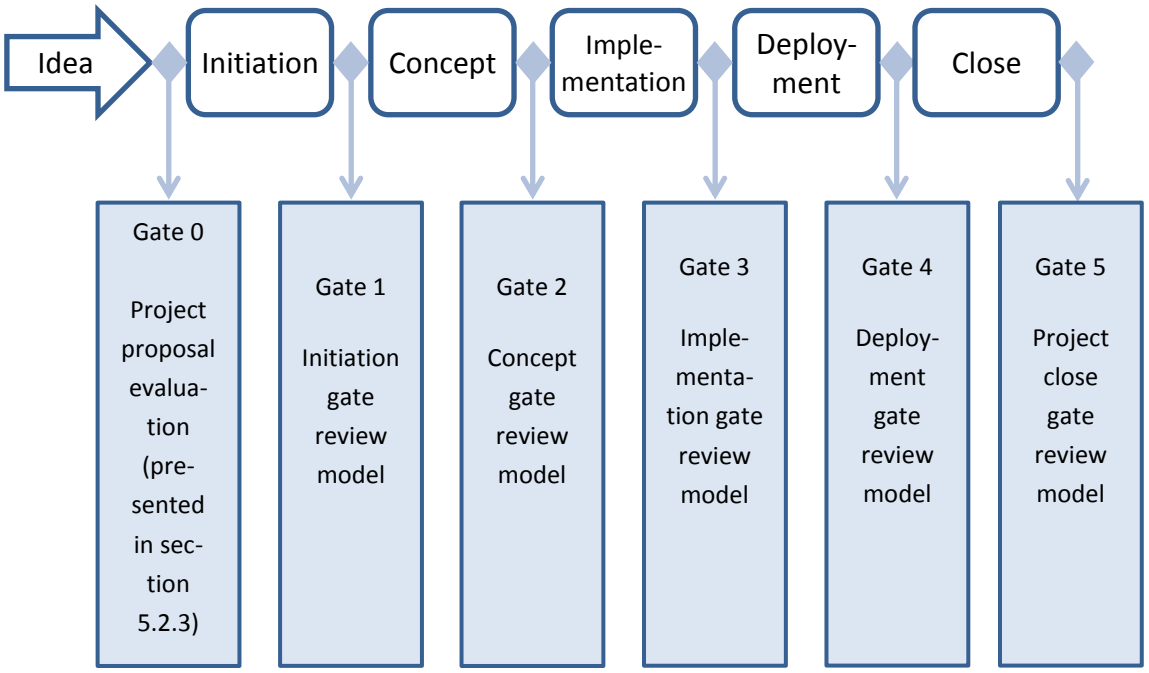


Figure 29: *The gate evaluation model integrated with idea scoring model.*

The gate assessment criteria should be based on the Hi5 framework and the evaluation criteria should be known to the project managers who provide information for the portfolio review session. The gate evaluation is highly linked to project management practices and reporting templates, especially the check lists and deliverables at gates. The gate evaluation model for the other phases, not just project proposals, was not the focus of this thesis. During the thesis process the evaluation criteria could not be set because the single project management model development was in progress. However, some ideas were created for this gate evaluation model. For example, for the sake of clarity

the final version of the gate evaluation model should have the same scoring logic as the project proposal model. Assessment criteria that are created based on the Hi5 framework checklists and deliverables could be used to evaluate ongoing projects and the criteria could have weights according to the importance of the criteria. Scores could be given with the scale ranging from 0 to 5 as with the idea scoring model. For example, the initiation gate review model could contain question such as:

- Are project milestones tangible and logically timed?
- Have stakeholders been identified and analyzed? Do project objectives reflect their interests?
- Has project organization been defined and does it include stakeholders?
- Do all partners have sufficient human resources with enough capacity and the necessary skills?
- Has reporting been established for project and core organization?

Each of the assessment criteria could be scored and then an overall score is given to the development project. The total score would then be different at each gate but with a score of more than 3.5 the project could gain access to the next project phase. If the score is too low, the project cannot proceed to the next phase. At the decision gates the gate evaluation model evaluates the project's readiness for the next phase. It does not have the exact same dimension as the idea scoring model because it monitors the progress of projects. While the idea scoring model focused on for example the strategic alignment of the project proposal, the gate evaluation model monitors the progress of the ongoing projects. The evaluation criteria should also be different at each gate because the project evolves. At decision gates the gatekeepers should base their decisions on scoring criteria and decisions must be based on facts (Cooper 2008). The portfolio review sessions and the project portfolio management process will be discussed in the next section and those are related to the evaluation models.

5.2.6 Project portfolio management process and organizational model

In addition to setting up evaluation criteria it is important to development the development project portfolio management process. It was seen important to create a business process that explains in detail how the projects go through project proposals to finished projects. It was discussed in the workshop that there should be a project portfolio management process designed because currently the information sharing is not sufficient and decision making levels are not completely clear. The evaluation of projects is closely connected to how the projects go through the organization and who does the evaluation. Project or portfolio selection is a complex and multi-faceted decision-making activity that becomes increasingly complicated as organizational size and the number of

potential projects increases (Kornfeld & Kara 2011). Without the process the usability of the assessment models might suffer.

The development project proposals come from various sources in the company such as the upper management, departments and single case company employees. In the pre-screening phase the project proposals are evaluated with the idea scoring Excel and other further analysis of the development project proposals. In the framework by Archer & Ghasemzadeh (1999) there are different phases for pre-screening and screening. In the case company the pre-screening is done in the ideation phase of the Hi5 process and in this phase the idea proposals are evaluated based on their strategic importance and benefit for the case company. In the screening phase more detailed analysis is required which in the Hi5 process happens at the end of the concept phase. In the concept phase more detailed analysis is made on the development project. Optimal portfolio selection is done between the development projects and especially the available resources are evaluated. Due to resources restrictions or poor development projects performances portfolio adjustments can be made at the portfolio level.

The case company is establishing a PMO and this site PMO of the company is aimed to support development projects of a certain scale. It has been suggested there are two types of development projects managed in the case company and these projects are main department projects and site development projects. Main department projects have manageable risks and the projects are relevant to one department only. Site level projects have high business or failure risk and they have high cross departmental impact. These projects are managed through the site PMO. The classification between main department development project and site level project can also be done based on project budget. A threshold could for example be 100.00 euros. This classification, however, focuses only on the monetary value of a development project, which is why the classification should be done based on the impact and risk levels.

The case company PMO is designed to be the connecting link between upper management and development projects teams (Aubry et al. 2007). Due to the organizational nature of the case company it would be useful to establish a PMO that does not intervene significantly with the development work that is happening in the departments. A centralized development department has its benefits but establishing a unified development department might threaten the success of single project management that currently happens in the main departments. The PMO is the case company supports the development projects with functions that ensure the successful overall management of the development project portfolio.

The PMO governance model is presented in Appendix 3. As can be seen from the figure, the site level PMO works together with the departmental PMO liaisons. These company employees coordinate the development projects in their own department and also provide information for the site PMO. The PMO liaisons are in the main depart-

ments that have many ongoing development projects and a separate development department. The PMO core team members support those departments that do not have a separate PMO liaison.

The PMO core team itself has employees who make sure that the PMO functions well in the organization. The new governance model of the PMO should include a financial controller to overlook the project costs and cost overruns. A controller should also be present at portfolio review sessions to give information on portfolio feasibility and resource uncertainties. PMO could also have its own budget which would distribute the development project resources to right projects. In the future the PMO could provide development projects with project managers from a separate project management pool. The site PMO should also have the following tools as its disposal. These are the evaluation criteria for both the idea scoring and gate scoring. The development project portfolio list and dashboard could also be at the use of the PMO. In the framework by Archer & Ghasemzadeh (1999) these functions are described as the project database.

As said in section 2.2.2 the decision making cycles of upper management, PMO and project teams should be integrated with each other. One suggestion is that the steering committee meets every month to decide on topics that have been prepared at the PMO level. There can also be steering meetings more often than once a month if there are many issues to be discussed. The PMO level represents the portfolio management level in the case company. In Appendix 3 there is a PMO committee between projects team and upper management and this PMO committee can also have members from the steering committee.

It has not yet been decided who are representing the PMO committee in the case company. It would be suitable that the PMO committee consists of main department heads and development department heads that are competent enough to discuss the development projects and make decision on the portfolio level. The PMO committee can have permanent members but also changing members that join the PMO committee meetings when projects of their expertise are evaluated. These changing members can be for example portfolio managers. The responsibilities of the evaluators must be clear to everyone because the PMO committee functions as the gatekeepers of projects and evaluate the projects as a whole.

The idea scoring model and gate evaluation models are in the use of the PMO committee. When projects are brought for evaluation, the scoring is done and suggestions are given for the development project teams. The PMO committee can have meetings in every two weeks to decide on what site level development projects can move on to the next project phase. In other words, the PMO committee does the gate evaluation for the site level projects. Figure 30 presents a simplified picture of the development project management levels and responsibilities.

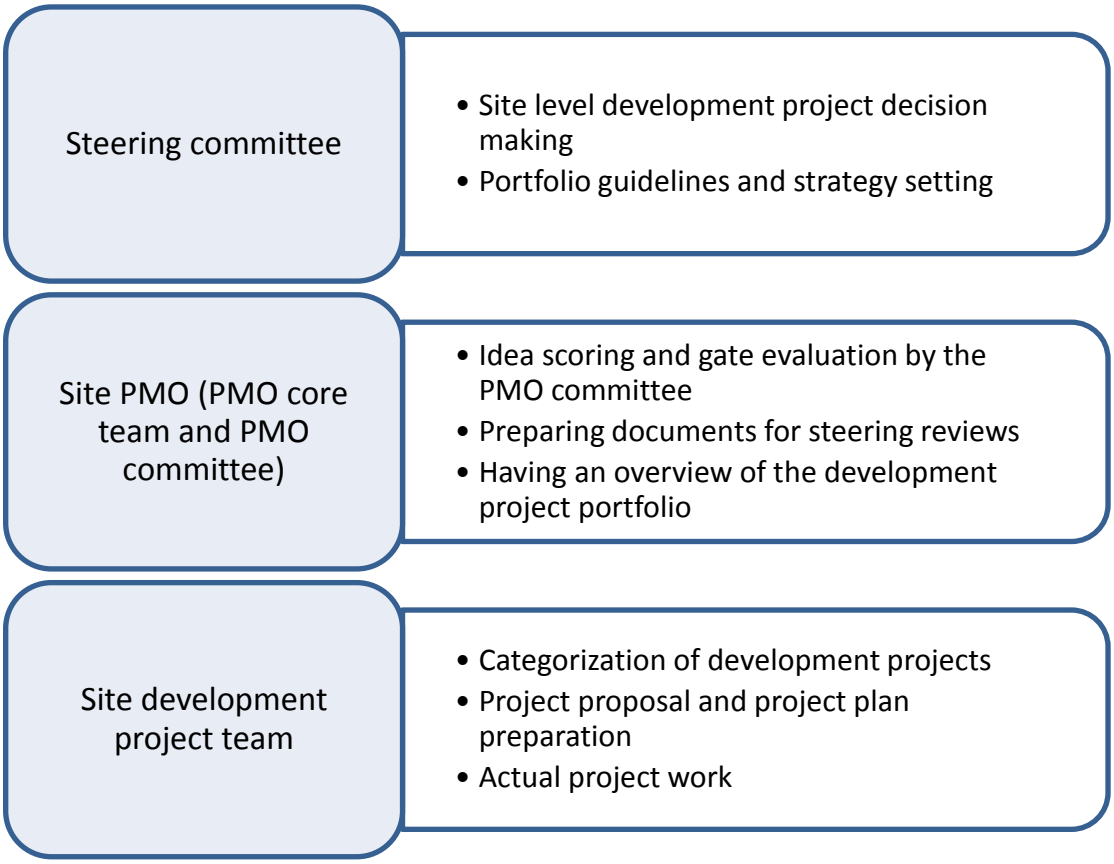


Figure 30: *A simplified illustration of the development project management levels and roles.*

The assessment system also provides a solution for the categorization. In the development project portfolio management process there could be separate decision making points for each category. The PMO steering committee can evaluate the development projects by category and not as a whole project entity. This management by category depends on the amount of development projects in each category and the importance of single development projects. However, the PMO committee can evaluate all of the site level projects at the same time.

The role of the PMO core team is vital in the portfolio management process because it collects information for the PMO committee and steering committee meetings. An illustration of decision making in multiple project is presented in Figure 31 and it demonstrates how the PMO evaluates the development projects. The site level projects are evaluated by the PMO committee and the PMO gives the portfolio details to the upper management.

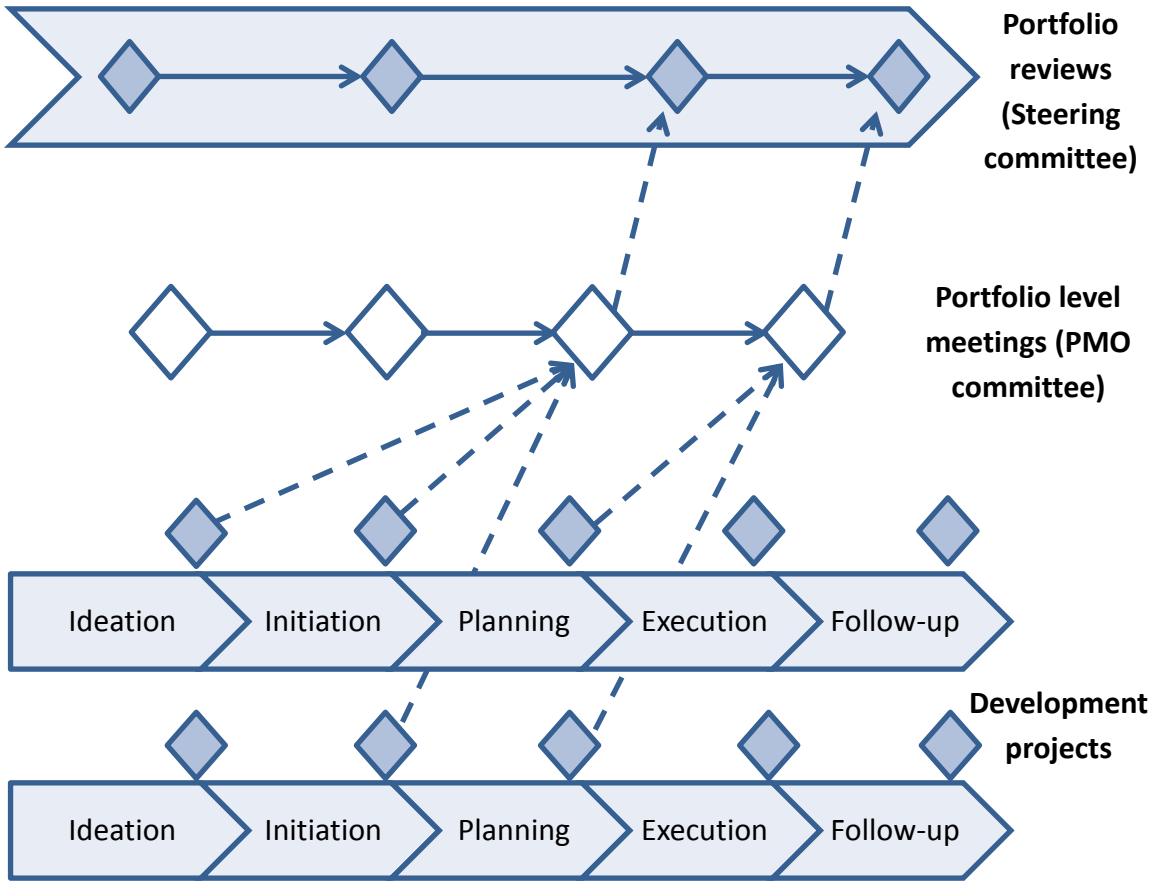


Figure 31: *Decision making in multiple development projects.*

In summary, the assessment system is a construct that provides solutions for the management challenges that the case company is currently facing. The system contains integrated evaluation criteria with process models and organizational structures. In Chapter 6 the assessment system is analyzed in relation to the conceptual framework, the usability of the assessment system and its features is discussed and additional suggestions for development project portfolio management improvements are given.

6. DISCUSSION

6.1 The assessment system in relation to the conceptual framework

The initial construct presented in section 2.2.4 had three different areas from project portfolio literature and the areas were organizational design to support development project management in multi-project environment, structured decision making at the project and portfolio levels and development project information transparency and communication. The empirical data from the case company revealed that the key challenges in managing development projects in the case company were insufficient communication between development departments and teams, lack of single development project management and progress monitoring, the fact that development project goals were not unified across the case company and the fact that there are no clear project portfolio management practices at the company level. The final assessment system had five features that focused on improving the development project portfolio management process with integrated evaluation criteria and organizational structures. In this section it will analyzed how the results of the thesis relate to the conceptual framework.

Of the assessment system features the categorization and development project portfolio management process with integrated PMO governance are related to the first area of the conceptual framework. The first area focused on creating an environment in a company that supports development project work. The categorization is a way to align the strategy of a company to project selection (Chao & Kavadias 2008). A portfolio management process, on the other hand, has proven to have positive effects on the performance of a company (Cooper et al. 1997b; Archer & Ghasemzadeh 1999).

The idea scoring model and gate evaluation model are related to the second area of the conceptual framework. That area emphasized that successful project portfolio management requires clear assessment criteria, decision making points or gates and established decision making levels. According to Elonen & Artto (2003), development projects in companies might suffer from unclear roles and responsibilities between portfolio decision makers and weak go decisions. The gate model and idea scoring model provide assessment criteria for the PMO committee which can then help monitor the progress of development projects.

The last area of the conceptual framework was development project information transparency and communication. The last feature of the assessment system was a collection

of all the development projects in the case company. The collection was an information database for development projects in the case company. An information database does not solely solve the communication and information sharing problems in development projects. The portfolio decisions, processes and major changes must also be communicated in the case company.

Project portfolio management is said to have three macro-level goals that are strategic alignment of projects, portfolio value and portfolio balance (Cooper et al. 1997b). With the evaluations models, both idea and gate, the value of the portfolio can be evaluated. In addition, having a controller involved in the core PMO team supports the financial management of the portfolio. The idea scoring model emphasizes the strategic importance of a development project and the categories are also derived from the case company strategy. Lastly, having a portfolio database helps to ensure the correct balance between projects. Figure 32 illustrates these connections.

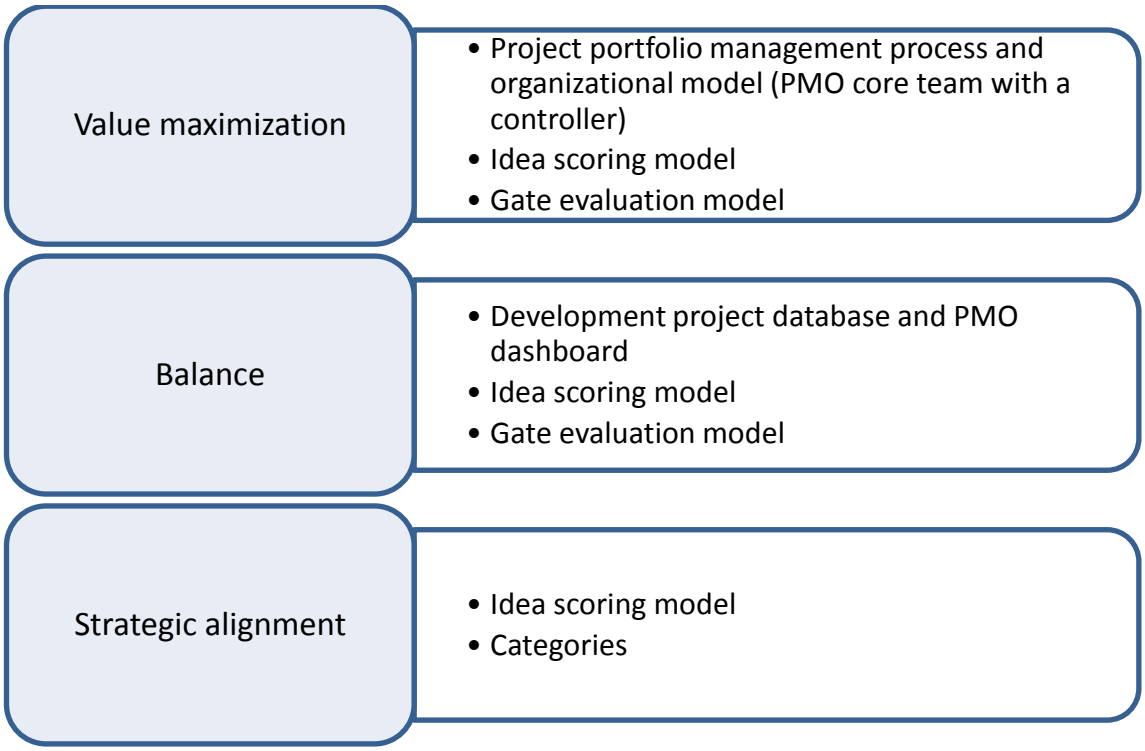


Figure 32: *The three macro-level goals of project portfolio management presented in the assessment system.*

The management challenges in the case company were very similar to the ones found in the literature review. Managerial practices such as having a single project management process integrated with portfolio management process and having upper management level support were viable development ideas for the case company. The development projects have the same macro-level goals as any other project portfolio and the development projects compete for the same resources of an organization as would new product development projects. In other words, the basic theory of project portfolios could be

applied for the case company even though the literature review had more of a new product development approach.

However, there were elements that were applicable to development projects only. For example, the customer of the development project is rarely the customer of the final product and most likely is an internal customer from a different organizational unit. In product development the pressure can be high when new products have to be finished and many times there are binding contracts that add to that pressure. In addition, the impacts of the development projects are hard to measure out because the development projects aim to support different processes in an organization, such as manufacturing processes, and impacts can be spread between many factors. This is challenging when development projects are given measurable goals.

The nature of process development projects is varied and this poses challenges when projects are compared with each other. The development projects in the case company consisted of manufacturing process improvement projects, IT projects and management process improvement projects, to name a few. The heterogeneity of the development projects makes it more complicated to compare projects, to assess their business benefits and to set measurable goals. As was mentioned in the conceptual framework and empirical data of this thesis, continuous development work can be given a second priority and oftentimes those development projects are emphasized that are critical for the manufacturing processes and the completion of the final product. Many times development work is continuous improvement that can be less coordinated than major projects.

The conceptual framework could have emphasized the difference between process development projects and other types of projects even more. The conceptual framework listed development project related problems such as information sharing challenges and the fact that development projects are sometimes given a second priority. The three areas and their content were therefore usable and had relevance in the case company. However, more detailed solutions to those development project management related challenges could have been presented in the framework. In the framework the solutions were very much based on findings from new product development research. For example, if development projects lack the pressure to finish the development projects, what are the concrete solutions to solve those motivational and managerial issues?

6.2 Usability of the assessment system for case company

The created assessment system gave the case company insights on how to improve the development project portfolio management practices across the development projects and project teams. In this section it will be analyzed how the system features will function as part of the PMO of the case company. The assessment system has five different inputs that each provides a solution to the challenges mentioned at the end of Chapter 4.

The different categories or sub-portfolios for development project portfolios is a suggestion for the case company and the case company might alter it even further to fit the current development projects (Cooper et al. 1997a; Chao & Kavadias 2008). As said before, the Operational Excellence category could be divided into ramp-up projects, capacity increase projects or quality improvement projects. The four categories are created based on the strategy which supports the idea that all development projects are strategically aligned with the case company's guidelines (Meskendahl 2010). The strategic bucket model also suggests that the strategic areas could also work with separate budgets (Cooper et al. 1997b). The development money could be given to projects that are inside the same strategic area. However, in order for this to work, it must be decided which areas need the most improvement and have the greatest strategic importance.

The idea screening evaluation with integrated visualizations provides a new way of evaluation when project ideas are screened for the case company (Archer & Ghasemzadeh 1999). Even though the Excel based model was created only for the Operational Excellence category, the evaluation criteria can be used for basis for other project categories. It can be said that the evaluation model is quite general by nature but it contains criteria that can only be associated with process improvement projects. The reason why there were no other idea scoring models created for the other categories was that the scope of this thesis was to specifically focus on internal development projects. For the Innovations and R&D strategic area, for example, the assessment system has to have more product development related criteria. Internal development projects vary considerably by nature which makes the assessment between projects even harder. The case company should take this into account when they develop their idea scoring.

It has to be noticed that the scoring model itself is not sufficient for the decision making. Business case and detailed risk management are suitable additional criteria for decision making. In the current idea scoring model these two are scored with scale of 0-5, but as the projects go on, the updated risk evaluation and business case become more vital at decision making points. It is natural that the project information is more of an estimation at the beginning of the project management process but as the project plan matures the information becomes more accurate and numerical. Financial evaluation criteria can be integrated when enough project information can be gathered from the projects.

The development project list and dashboard have multiple contributions to development project portfolio management improvement. They provide an overview on the development portfolio and provide management with up-to-date information of the portfolio status. In addition, the evaluation model scores could be added to the same database. The transparency of projects is difficult to see with internal development projects (Elonen & Artto 2003) and an updated dashboard view could mitigate this problem.

The next feature of the assessment system was the gate evaluation model. This thesis did not focus too much on this aspect but it was seen important that the case company would evaluate the development projects during their lifecycle. This increase of project control could make the management of single development projects more efficient and at the same time the development project information could be updated in the portfolio database. The larger picture project portfolio model emphasizes that the projects in the portfolio must be executed well and the quality check model supports the project work in individual development projects (Dye & Pennypacker 1999).

The fifth and last feature of the system was the portfolio process model. The project portfolio management process modified from Archer & Ghasemzadeh (1999) gives a suggestion for the case company for the portfolio review cycles and PMO structure. However, the process model still has gaps in it and further examination is needed. An important aspect is to decide on who is in the PMO committee and how much is the committee empowered to make decision on the portfolio level. At the moment decision making could benefit from better efficiency because many times issues go to the upper management level.

Furthermore, the company must decide on the proper PMO governance with PMO department liaisons and PMO core team. It also has to be decided that how much the PMO is involved in the departmental project work and what functions it has. At the moment development project work is reported to development department heads and main department heads. Having a PMO changes this setup significantly which is why the reporting procedures and responsibilities must be considered carefully.

The project portfolio management process is fairly new to the case company as well as establishing a PMO. This study revealed that implementing a project management office in an organization has its challenges (Singh et al. 2009). Applying more structured evaluation models and project portfolio management processes alters the current business processes and change resistance is therefore inevitable. The case company has not had a PMO organization before although some related efforts have been tried in the past. It is also important to notice that the project portfolio model or evaluation should not increase bureaucracy in the case company. The functions of the PMO must be chosen carefully so that the value of them could be seen. It is also an option that the case company does not establish a PMO but then it has to develop similar organizational structures that have the functions a PMO would have. The PMO core team can for example be integrated into departments if it is not a team of its own.

During this thesis process the company had two major changes that had an effect on the thesis. At the end of this thesis process, the company decided to acquire a project portfolio management software tool that had similar functions that the assessment system of this thesis. In other words, the Excel based assessment model and portfolio management process model functioned as a basis for the software tool development and consequent

implementation. The major objective of the tool is to provide information for portfolio decision-making. The tool should also support the resource allocation between projects. The tool enables better information sharing and it should make the dependencies between projects clearer. However, the most important advantage of the tool is in unifying the practices of portfolio management and in that way to enhance the use of appropriate and even standardized decision-making practices when constructing portfolios.

As mentioned in section 2.3.4 that implementing an IT tool for project and portfolio management has its challenges. First of all, there are many people related issues. If the new tool is too complicated to use, people might be discouraged to use the tool which would diminish the benefit of the tool. Regardless of elegant and sophisticated portfolio selection and decision tools, if the information input is poor, so will the decision making be (Elonen & Artto 2003; Artto & Dietrich 2004). This is why the case company should make sure that the information provided at the decision making points is sufficient and of good quality. This is an important issue with or without an IT tool.

In addition to the project portfolio management software acquisition the case company wanted to focus more on the global aspect of the development project management. The scope of this thesis was to improve the development project management practices on a site level but the company also has global projects that are done cross-organizationally. If the development project management is to be connected with international companies that are part of the same group, the PMO establishment should be aligned with the companies in the same group. However, all of the management practices do not have to be the same because there are many cultural and organizational differences in the practices.

6.3 Further improvement of development project portfolio management

The development project portfolio management in the case company still needs many preparations in order to function effectively across the case company. In Figure 21 there were many improvement ideas listed that were created based on the interviews, workshop and the initial construct. Figure 33 presents the key issues that the company should consider in the near future and they are partly the challenges in Figure 21 that were not covered in the assessment system. The next steps are given in the order of their priority and they are a suggestion for the case company for the next 12 months. Each of the steps covers two month. Some of the phases last multiple months but the development work should start in the suggested order. The roadmap does not only introduce new improvement ideas but also gives more details for the implementation of the assessment system features.

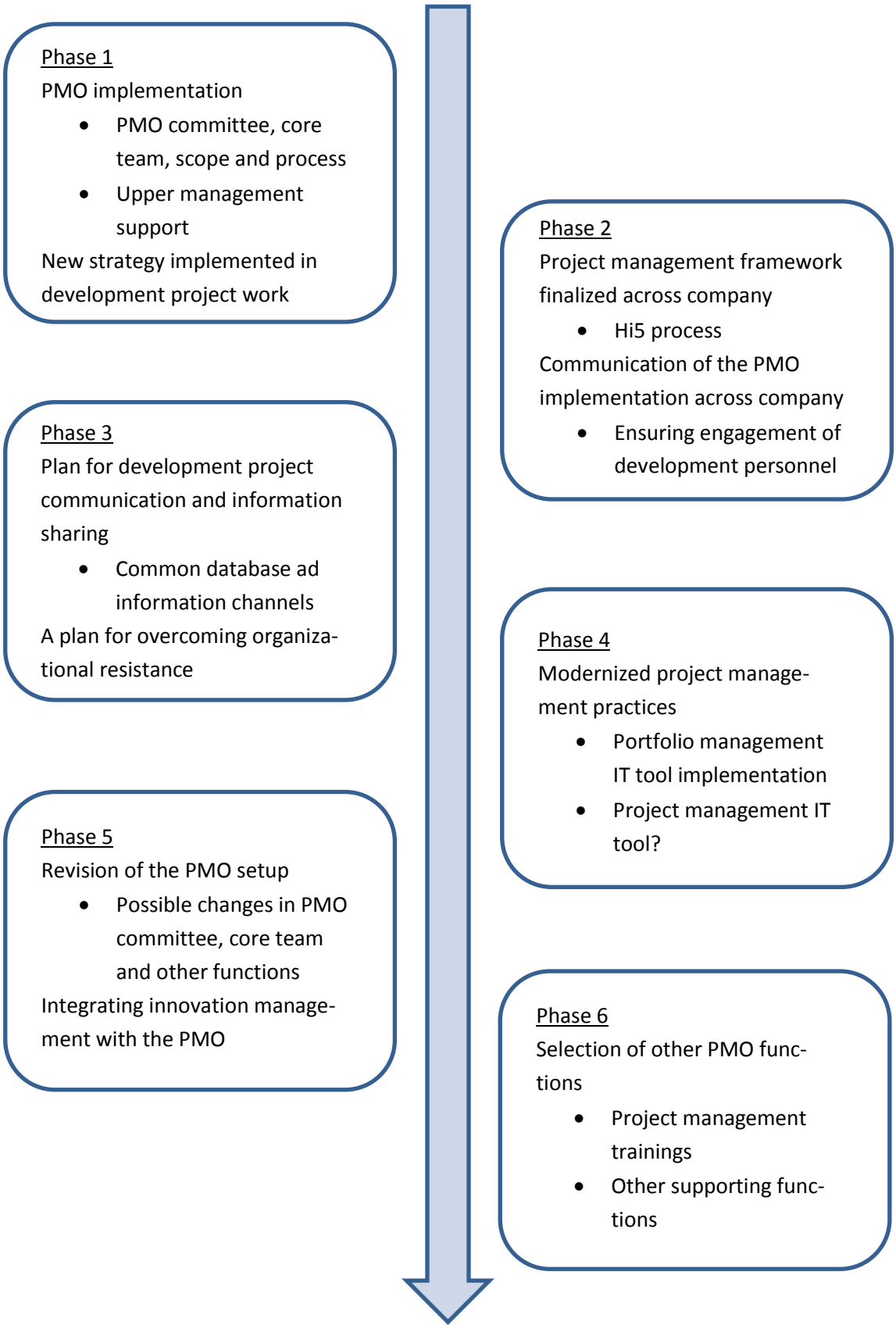


Figure 33: *Next steps for the case company.*

First, the case company should develop the company level PMO further or develop other structures that support the management of development projects. The foundation of a PMO or a similar organization that coordinates projects is a long process that could even require years (Hobbs & Aubry 2007). There are many challenges that might threaten the successful implementation of the PMO such as poor definition of PMO goals and purpose and lack of stakeholder commitment to common methodology and tools for the PMO and project management. The PMO itself is an organizational innovation and it evolves as the organization evolves (Aubry et al. 2009). The scope of the PMO might also change during the next years when if the amount of development projects changes. PMOs support projects and programs and due to this they have no purpose without any projects.

A heavy PMO structure might not be the solution for the case company due to the fact that project portfolio management and PMOs are a new concept to the company. However, it would be beneficial to develop common project management practices with development portfolios because the amount of development projects is estimated to increase and the ongoing development projects must meet their goals. The case company can start with only the strategic projects and then add other site level development projects later to the governance model. For the company level PMO a PMO committee should be named as well as PMO core team members. When the PMO governance is established, it has to be made known across the case company. In addition to setting up PMO committees and core teams, the project portfolio management process and meeting cycles must be developed.

Another important next step for the firm is the emphasis on development projects in strategy implementation. At the same time it could be useful to motivate company employees to contribute to development projects. The strategy has an impact on the employees and the employees might be discouraged to invest in development project work if there are no clear guidelines or motivating factors. As said in the beginning of the thesis, the case company has not invested in case company development in many years. This is why is it vitally important to change the company culture so that employees are motivated to improve the case company.

It has to be noticed that this thesis focused more on the portfolio management aspect rather than on project management. Still, there are numerous issues that have to be resolved in the case company to increase the efficiency of single project management. This was also one of the key challenges in the case company. The Hi5 process supports development project management but it has deficiencies. A said in Chapter 4, development managers are not really acquainted with the Hi5 framework, there are challenges in milestone and goal setting and difficulties in responsibility setting. This is why the case company should also integrate the development of single project management to the portfolio management improvement. Alongside with PMO implementation the single management project management process needs to be unified. If the ongoing pro-

jects have different structures, the upcoming development projects should follow similar project management structures.

The sheer amount of development work in the case company is large which makes it hard to make sure that there are no concurrent development projects. For the case company the modernization of management and information sharing could be a significant advantage in the future. At the moment the transparency of project information is missing and information cannot be collected in one place. The modern tools might help to make sure that there are no concurrent projects. The modernization can also create competitive advantage for the case company. The case company is implementing a software tool for portfolio level assessment but modernization of single project management could also be an option in the future. Phases 3 and 4 focus on the information sharing between development projects and the modernization of management.

Implementing a PMO can result in having organizational resistance. That is why the PMO implementation must be done together with all of the organizational units. This aspect is taken into account in phases 3 and 5. After some time the PMO setup must be checked so that alterations can be made. If the meeting cycles or organizational responsibilities do not work properly, alterations must be made in the setup.

The thesis did not focus much on innovation management in other words on how to innovate new development projects. If the amount of development project is to increase in the company due to capacity increase, there should be a way to collect the ideas and development them further into viable projects. The case company is good at project ideation and there are always too many projects to be done with the resources available. The PMO could be the supporting factor is this ideation aspect with providing support for the departments for project ideation and selection.

The first five phases focus on creating a management process for the case company with integrated tools and organizational structures. The final phase is the upgrade of PMO functions. If the PMO has established a position in the company and information sharing and communication are at a good level, the PMO or some other organization can provide project management trainings and other supporting functions. This ensures that the case company has qualified development project personnel in the future.

The amount of development projects in the case company in increasing and many of the projects require cross-organizational and even international co-operation. Therefore transparency and clear management processes are vitally important. The project portfolio process presented in this thesis along with the evaluation models could function as a basis for further discussion in the case company. It has been established that portfolio management can increase the overall performance of projects (Martinsuo 2013) and the case company should explore the benefits of portfolio management more extensively.

7. CONCLUSIONS

7.1 Achievement of objectives

This thesis was conducted as a constructive research for a large Finnish company. The qualitative data was gathered with 14 case company interviews and a workshop. In addition, internal case company documents and meeting notes were used to create the results. The initial construct worked as the basis for the assessment system construct which contained five different features. These features were development project categorization, idea scoring model for one development project category, development project list and dashboard, gate evaluation model and development project portfolio management process with governance model. The features addressed the problems that the case company was facing with its internal development project management. Development ideas were given to the case company about the issues that still needed attention in the future.

The first research objective of the thesis was to identify the case company's current development project and portfolio management practices. In the thesis the current development project management practices were analyzed and management problems were identified. The management of the internal process development projects was varied in the case company and the strategic development project had the most advanced project management practices. Four key challenges were found based on the interviews and workshop. These challenges were:

- Insufficient communication between development departments and teams
- Lack of single development project management and progress monitoring
- Development project goals were not unified across the case company
- No clear project portfolio management practices at the company level

The found challenges, both key challenges and other, created a base for the assessment system creation. The interviews revealed how to integrate new practices for the company so that old practices were considered carefully.

The second research question was to determine an assessment system for development projects. The assessment system had five features that provided solutions for some of the found problems in the case company. The assessment system had many features due to several reasons. Firstly, based on literature it was seen important to create idea scoring criteria that would be suitable to use in a development project portfolio environment. The scoring model is a commonly used tool for organizations for evaluation

which is why the logic of the scoring was also transferred to the gate evaluation model. Secondly, in the literature it is said that having a project portfolio management process has positive effect on portfolio success (Killen et al. 2008; Cooper et al. 1997b). The scoring models have a strong connection to the management processes which is why it was seen important to include the processes in the assessment model. The categorizations and PMO structures were added because they also contributed to project portfolio management success. The usability of the assessments system was analyzed in Chapter 6.

The assessment system did not address all of the development ideas listed in Figure 21 because the assessment system focused more on creating a development project portfolio management model with integrated evaluation models. Even though the assessment model did not address all of those development ideas, the thesis provided tools for the company PMO and a roadmap for future improvements.

7.2 Contribution to existing knowledge

The thesis contributed to existing knowledge by creating concrete solutions for portfolio management improvement in a development project context. The phenomena and frameworks found in the literature were analyzed further with the interviews and workshop and ultimately the assessment system provided solutions to problems found in the case company and in literature.

The literature review provided an extensive basis for the assessment system creation. The literature review provided suggestions for evaluation criteria creation, project portfolio management process modeling and portfolio governance. Because the literature review had more of a new product development project approach, the frameworks had to be applied to fit with the process development project aspect. The thesis therefore contributed to the application of prior academic knowledge for process development project environment. The thesis collected development project portfolio management challenges that can be issues in future research.

It can be said that internal development project portfolios is a field that has not been studied much as a whole. There are approaches ranging from IT project portfolio management to research and development project portfolio management. Few, however, focus on improving the management practices of various development projects in a manufacturing company. The key issue of the thesis was to find out how to apply different project portfolio literature to the development project context while focusing on project portfolio management success.

The scope of the thesis was large because it included most of the development efforts in a company. If the scope had been smaller, different problems would have emerged and the results of the thesis could have looked different. However, the thesis provided in-

sights also to strategic management and decision making in addition to project portfolio management. That is why the results of the thesis do not only focus on portfolio management but they have a larger scope. The literature review and conceptual framework focused mainly on managing new product development project portfolios but the thesis extended the scope to managing all of the development projects in a company and the projects included the R&D related projects as well as process development projects.

Based on the empirical evidence it can be said that managing process development projects in a manufacturing company is challenging and studying only project management and portfolio management research all of the challenges cannot be solved. Process portfolio management combines various factors such as continuous improvement management, process management, change management and organizational capabilities management. It is all about harnessing the organizational capabilities that enable the supporting processes that ultimately lead to the completion of final products.

7.3 Reliability and validity of research

The thesis was conducted in a large manufacturing company in Finland. The development projects in manufacturing organizations have a certain nature which is why the applicability of the results has to be studied. It might be that the assessment model cannot be applied in an ICT company or a service company. However, the development projects are partly universal in organizations, which make the portfolio management procedures also general regardless of organizations.

As empirical data, qualitative data was used. The sample of the interviews was 14 development managers and the workshop also had development managers as participants. For the validity of the research similar other companies could have been studied in order to have a deeper understanding of the research problem. The scope of the empirical data can therefore be seen as a limitation to the research. The data was analyzed accordingly with tools and visual programs which increases the reliability of the research.

The conceptual framework presented in section 2.4 was proven to be valid in the case company. The challenges and their solutions in the conceptual framework were relatable to ones in the case company and the conceptual framework gained depth when it was applied for the case company. However, the original framework did not cover all of the managerial issues that were relevant for process development projects specifically. The specific elements in managing development projects were found from empirical data of the thesis. Therefore it can be said that the conceptual framework was valid but insufficient and lacked detailed problems and solutions in the process development project management field.

7.4 Managerial implications

For other manufacturing companies that want to improve development project portfolio management there are a few managerial suggestions. From a practical perspective, the research results suggest that the companies should:

- Recognize the development project management challenges in the company and identify the key challenges
- Establish a strategy for future development work that works as a guideline for development work in different organizational units
- Ensure skilled project management personnel in the company that are familiar with project management frameworks and provide project management related trainings
- Establish a communications plan for development project members, development departments and other stakeholders
- Create project progress monitoring processes and establish clear responsibilities for development projects and portfolios

7.5 Recommendations for future research

During this thesis process it was clear that the thesis is not able to cover all of the problems found in the literature even though project portfolio management has been studied extensively. This is why recommendations for future research are given below:

- **Project portfolio management with modern tools and management practices.** The usability of IT tools in project portfolio management is an issue that could be studied further. Especially the software implementation and change management issues related to the implementation require further analysis.
- **Development project portfolio management in manufacturing companies.** The literature provides solutions to portfolio management with different points of view. It would be interesting to analyze what the differences in portfolio management requirements and needs in portfolios with different project types are. Is there need for different approaches depending on project type?
- **Decision making quality in development project portfolios.** Decision making is always connected to portfolio management and the information provided for the decision making is an interesting research topic. What kind of information should be delivered for the corporate level monitoring and reviews of a development project portfolio?

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APPENDIX 1: INTERVIEW STRUCTURE

Background information

- Name
- Department
- Current position and responsibility
- Experience in the case company
- How are you involved with development projects?

The questions

Analysis of the current situation

1. Development projects
   - For which kind of development projects is your department responsible?
   - How many development projects does your department have at the moment and what are their current statuses?
   - Are there any categories for the projects?
   - Do the projects have any differences? (related to categorization and difference in management practices)
   - Who are working in the development teams?
   - How do the development projects arrive in the department (department employees/upper management/clients)?
   - What are your objectives or strategy for the development projects in the department?

2. Reporting of the development projects
   - How are the development projects reported at the moment?
   - What kinds of systems are used with the reporting? (IT or other)
   - How often do projects report their progress?
   - How are the reports discussed in detail? Who handles the reports?
   - What kinds of project management tools or frameworks are used in reporting and management? (IT tools, frameworks etc.)

3. Business impact measurement of development projects and performance measurement
   - Setting the objectives
     - How are the goals set for development projects?
     - Is there any measurable data used to set goals?

- Monitoring project progress
    - What kind of performance measures are used at the moment?
    - Who is responsible for the measurement and with what cycle the measurement is done? (daily/weekly/monthly)
    - What systems are used for measurement?
    - How does the measurement system help concentrate on the right things?
    - How does the measurement support objective realization?
    - What kind of performance measures are used between projects and departments? (portfolio evaluation)
- Measurement in decision-making
    - What is the performance measurement used for?

Additionally to the upper management level

- How are the performance indicators used in project steering and decision making?
- How is the measurement used in evaluation of projects?
- Who makes the decisions in projects?

4. Example of a development project

The interviewees were asked to give one example of a development project. The example project had to be either

- A typical project
- Extremely successful project
- Extremely poorly execute project
- Some other specificity

- What was the development project?
- Who were involved in the project?
- What was the project executed?
- How was the reporting done?
- What were the project objectives?
- How was the progress of the project monitored?
- What kind of performance indicators did the project have?
- How were the decisions made?
- In what parts was the project successful?
- Which parts needed further improvement?

Improvement needs and desired future state of development projects

5. Improvement needs for performance measurement for development projects
    - What would be the right aspects to measure?
    - Should they be economic metrics, project management related, what other?
    - What would be the right metrics to be followed for the projects so that the evaluation could be one?
    - Who should set the performance measures?
    - Is there any need for performance management and measurement?
    - As a whole, how should the development project management and evaluation be improved in the case company?

APPENDIX 2: WORKSHOP STRUCTURE

Agenda of the workshop

9:00-9:10	Introduction to the workshop and division into groups
9:10-10:10	Groups complete the tasks
10:10-10:20	Coffee break
10:20–11:00	Results and discussion

Introduction

The objectives of the workshop

- Analyzing the big picture of the development project portfolio
- Gathering new ideas for portfolio management improvement
- Discussing the topics in a relaxed atmosphere

Tasks

1. Project categorization (20 min). The attendees were given a list of all the development projects in the case company and a company strategy picture.

- The problem: There are many development projects in the company, even hundreds. It is hard to see which strategic areas get the most improvement and which do not.
- The task: Create the categories for the projects in the development project list. Are they any similarities between projects? Try to take the strategy of the company into consideration.

2. Project prioritization (20 min). The attendees were given 10 unreal projects with some initial project information and a list of potential evaluation criteria. The projects were similar to the ones the company has currently.

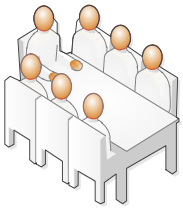
- The problem: The basic problem in project portfolio management is that there are too many projects for the resources available.
- The task: You have 10 projects available but only 7 can be executed. Choose the 7 projects. What criteria are you using to evaluate and prioritize the projects? Please write down your answers and try to come up with your own evaluation criteria.

3. Decision making (20 min). The attendees were given a blank paper in which they could sketch a mind map.

- The problem: The decision making in development projects is sometimes problematic. There is no clear process for the decision making.
- The task: Make a mind map about challenges in decision making in development projects. Try to think about the following factors: Hi5 project management process, different organizational levels and information sharing.

APPENDIX 3: PMO GOVERNANCE MODEL

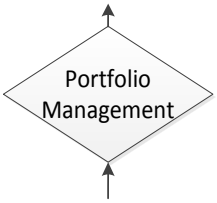
Development project portfolio management



Steering Committee

Meeting participants in steering group reviews

- PMO representatives
- Upper management level

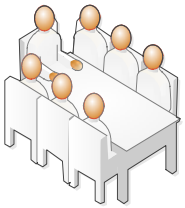


- Development project portfolio
- Prioritization support
- Progress reporting

Site Project Management Office

Overview to all stakeholders

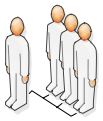
- IT
- Sales
- Design
- Hull Production
- Outfitting
- Procurement
- Etc.



- Project management
- Strategic prioritization
- Progress reporting

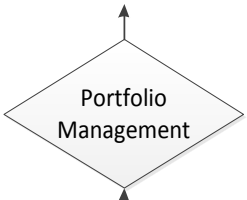
- Lessons learned
- Info sharing

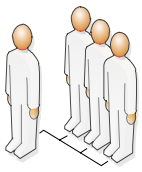
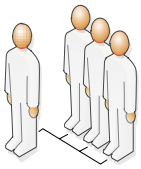
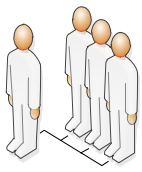
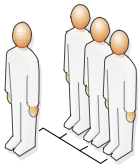
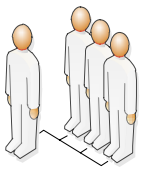
PMO committee / steering committee as evaluators



PMO core team

- PMO team (2-3 members) as facilitators
- Controller involvement
- Co-operation with departmental PMO liaisons
- Project reporting support if a main department does not have a PMO liaison
- Possible project manager pool



Ohter main department liaisons

Hull Production PMO liaison

Outfitting PMO liaison

Design & Engineering PMO liaison

R&D PMO liaison

Development project teams and departments

- Development project management
- Project execution
- Progress reporting

Development projects	Development projects	Development projects	Development projects	Development projects
Project teams	Project teams	Project teams	Project teams	Project teams