Thesis for the degree of Doctor of Philosophy

Project Portfolio Management
- an organising perspective

Ola Dawidson

Department of Technology Management and Economics
Operations Management and Work Organisation
CHALMERS UNIVERSITY OF TECHNOLOGY
Göteborg, Sweden 2006

Project Portfolio Management
– an organising perspective

by Ola Dawidson

To my wife Magdalena

Project Portfolio Management – an organising perspective

Ola Dawidson
Division of Operations Management and Work Organisation
Department of Technology Management and Economics
Chalmers University of Technology

Abstract

This thesis deals with aspects of importance for organising project portfolio management. Project portfolio management of industrial development projects is commonly agreed to be a way of maximising the value of the development effort, creating a balance of the activities undertaken, and ensuring a strategic alignment when choosing and compromising among development opportunities. For several years, both practitioners and researchers have developed tools and methods assisting managers in decisions regarding the project portfolio composition. During the last decade the research in the area has developed to include aspects of which participants to involve and how to arrange the project portfolio management activities.

In project portfolio management literature it is commonly agreed that no one best way to organise for project portfolio management exists. Despite diverse efforts, the literature has so far not provided a thorough knowledge of aspects in areas concerning the selection of participants to involve and how to arrange the project portfolio management activities. It is therefore such aspects that are addressed in this thesis. The research strategy has been to use case studies, and the main empirical data used in the thesis stem from a single case study at the business unit for Away-From-Home Tissue products at SCA. Supplementing the latter data is a multiple case study of six Swedish companies.

The findings in the thesis show that aspects of importance for organising project portfolio management concern three different areas: how the portfolio management activities are arranged (i.e. procedural aspects), how the tools and methods are used, and how to involve relevant organisational participants (i.e. organisational aspects). It is also seen that including different types of projects in the same project portfolio (i.e. product development, manufacturing process development, technology development) yields implications for how to organise the project portfolio management. The process must allow for taking into account different strategies, different ways of evaluating projects, different needs of updating the portfolio, and an involvement of managers with different knowledge in the activities. The findings demonstrate that the same tools and methods can be used in different ways throughout the process for assisting the project portfolio management. Lastly, it is found that how the project portfolio management activities are arranged, and which organisational participants are involved, will affect the use of tools and methods in project portfolio management.

Keywords: project portfolio management, organising, process, organisation, R&D management, product development, managerial issues.

Dissertation

This dissertation includes an extended summary of the following six papers, also appended in full. Three of them (papers 4-6) are used in an extended analysis to fulfil the specific purpose of the dissertation. The three other papers (1-3) are also important parts of the dissertation. How these three are related to the extended analysis is further elaborated on in Chapter 3 – Research methodology.

Paper 1:
Dawidson, O., Karlsson, M. and Trygg, L. (2004) *Complexity Perception – Model Development and Analysis of Two Technical Platform Projects in the Mobile Phones Industry.* International Journal of Information Technology and Decision Making, Vol. 3, No. 3, pp. 493-512.

Paper 2:
Karlsson, M. and Dawidson, O. (2003) *Product & Technology Roadmapping in the Mobile Phones Industry.* In the Proceedings of Management of Research and Development in the New Millennium Conference (Department of Management Studies, Indian Institute of Technology), New Delhi, India.

Paper 3:
Dawidson, O. and Karlsson, M. (2005) *Towards a framework supporting the management of product boundaries: a study of the new situation experienced by Ericsson Mobile Platforms.* International Journal of Mobile Communications, Vol. 3, No. 1, pp. 49-65.

Paper 4:
Dawidson, O. (2004) *Requirements to be fulfilled by project portfolio management.* An earlier version of this paper was printed in the proceedings of the 11th International Product Development Management conference (EIASM), Dublin, Ireland.

Paper 5:
Dawidson, O. (2005) *Project Portfolio Management at SCA, Tissue AFH – Process and Tools.* In proceedings of the 12th International Product Development Management conference (EIASM), Copenhagen, Denmark.

Paper 6:
Dawidson, O., Sandgren, E. and Sjöström, J. (2005) *Project Portfolio Management – a multiple case study of six Swedish companies.* In proceedings of the 12th International Product Development Management conference (EIASM), Copenhagen, Denmark.

Acknowledgements

The decision to become a doctoral student is, as I see it, not a trivial choice. I can see many different reasons for becoming a doctoral student, from more professional reasons to more personal ones of development. For me the primary motive was of the latter kind. Through becoming a doctoral student I saw an opportunity to develop my thoughts in the R&D management area. The journey of the doctoral process has been inspiring in many respects and has involved many different opportunities as well as challenges which I have not been able to manage by myself. Therefore I want to address my greatest gratitude to all who have been involved during my doctoral work.

First of all I am grateful to my main advisor Lars Trygg for giving me the opportunity to become a doctoral student. Without your industrial interaction which has stimulated the studies, this thesis would not have been possible. During the process we have had many inspiring discussions, and your knowledge of product development practices, rhetorical and logical strengths has been essential. Thank you!

Next I would like to express my appreciation to Tobias Holmqvist and Patrik Jonsson who have been part of my research committee during the last year of the process. Thanks a lot for your patience and great effort during the latter part of the doctoral work, which not has been straightforward all the way.

At the Division of Operations Management and Work Organisation, I would like to address special thanks to Pär Åhlström for providing objective perspectives and very important comments about my research on several occasions. Special thanks also to Magnus Persson for inspiring discussions on different topics as well as comments on my research. I would also address many thanks to my other colleagues during my time at the division. Martin, my co-researcher at Ericsson, Dennis, Peter, Fredrik, Dan, Klas, the more recent colleagues Torbjörn, Anna, Karin and Anna, the senior researchers Jan, Ulf, and Sten-Olof, and our administrative assistants, Anita and Eva. Thank you all for inspiring intellectual discussions and supporting atmosphere.

I have had the possibility to interact with two very interesting companies, Ericsson Mobile Platforms and SCA Hygiene Products and especially the Away-From-Home Tissue department. At Ericsson I would like thank Björn Ekelund, Jan Gunnarsson, Christer Swärdh, Anna Hawkins, Torbjörn Gärdenfors, Magnus Gerward and Fredrik Dahlsten. Thanks for your strong support and interest in my work.

At SCA I would primarily like to thank Göran Canbäck, Birgitta Sundblad, Pär Arfvidsson, Hans Wallenius, Anders Gustavsson, Jonas Janlöv, Annette Hanssen, Robert Kling and Bengt Järrehult, but also all of the others who have taken part, shown interest in and discussed my research. Thank you all very much for letting me take advantage of your work!

Table of Contents

1. Introduction to organising project portfolio management

This dissertation is about organising the management of project portfolios, and in this first chapter an introduction to the project portfolio management approach is given. In the first section is a background to why projects are managed as portfolios given, and in the following section the basics of the project portfolio management rationale are described. Then the research area for the thesis is described and the purpose of the thesis is presented and motivated. The chapter concludes with describing the construction and structure of the thesis.

1.1. Background to project portfolio management

Companies acting in markets characterised by intense competitiveness have to continuously develop existing products as well as new products for the market. To ensure long-term survival, the companies must develop attractive products for the market in regard to both product cost and performance (Hayes et al., 2005). Most high-performing companies do not face any problems in suggesting new ideas for this development; the majority have a plethora of both product and process opportunities for development. As a consequence of limited resources for development activities, companies need to choose and compromise among the opportunities for their development (Dye and Pennypacker, 1999).

When pursuing the need, companies evaluate which ideas are most capable of yielding returns. However, to stay competitive in the long run, it is not beneficial to focus only on activities that seem most promising in the short run; companies also have to take a more long-term perspective on the marketplace into account in their choice and compromise among opportunities for development (Roussel et al., 1991). To stay long-term competitive it is also important to provide a sound mix of projects focusing on incremental or more radical innovations of both products and manufacturing processes (Wheelwright and Clark, 1992). Companies do not only have to consider the future returns of their activities and aspects of balance – they must also ensure that the activities support and fulfil their strategic intentions.

It is to assist managers in achieving a maximum of value, a balance of the activities undertaken, and a strategic alignment in choosing and compromising among development opportunities that project portfolio management tools, techniques and methods have been developed. Among both researchers and practitioners, extensive efforts have been made to develop such tools, techniques and methods. During the past decade, the research on project portfolio management has expanded into a more complete managerial approach – beside the focus only on tools, techniques and methods – including aspects of how project portfolio management is practised. Recent studies also show that many companies have implemented tools, techniques and methods for managing their project portfolios during the last few decades (Cooper et al., 1999; EIRMA, 2002; Center for Business Practices, 2003; Szwejczewski et al., 2004). However, these studies have also established that there is still much room for improvement, especially of how

project portfolio management is practised in companies (Center for Business Practices, 2003).

The great relevance of project portfolio management for overall development efficiency, together with the opinion – among many companies that have implemented at least parts of the project portfolio management approach – that much room for improvement can still be found, makes this an interesting area for further research. That the project portfolio management approach also gains growing industrial interest (Center for Business Practices, 2003) is an additional incentive to continuing study of it.

In the literature it is commonly agreed that no single best way to organise for project portfolio management exists (Levine, 1999). Instead, how to organise for project portfolio management depends on the company's specific situation (Bridges, 1999; Meredith and Mantel, 1999). So far, however, the literature has not provided a thorough knowledge of which aspects to take into account when organising for project portfolio management. It is therefore such aspects of importance for organising project portfolio management that are addressed in this thesis.

1.2. The project portfolio management rationale

Even though research on tools, methods and techniques for the evaluation of projects and project portfolios has been focused for some decades (Archer and Ghasemzadeh, 1999; Cooper et al., 2001b; Stummer and Heidenberger, 2003), the area of project portfolio management – which also includes how the tools, methods and techniques are practically implemented and used in companies – must be said to be quite newly established (Dye and Pennypacker, 1999). The growing interest both in practice and in research has resulted in many publications during the last ten years, but project portfolio management is still not very well defined and agreement on what is really included does not yet exist.

However, project portfolio management can easily be described by an analogy with farming as *Seeding, Weeding and feeding, Cultivating* and *Plowing under* (Hayes et al., 2005). The analogy with *Seeding* means encouraging an extensive and rich mix of ideas for new projects, while that with *Weeding and feeding* means selecting which ideas to turn into projects and providing these with the right resources, people and managers. By *Cultivating* is meant that project portfolio management also entails maintaining an appropriate mix of active projects, prioritising among them, modifying them as new information becomes available, and bringing them to completion. As the environment of the project portfolio changes, i.e. the markets shift and technologies evolve, some projects lose their competitive position among other ongoing or potential projects, making the resources more profitable somewhere else. The task of maintaining a healthy portfolio of projects therefore also involves decisions to kill ongoing projects in favour of other projects, which is the last analogy with farming as *Plowing under*.

This analogy well shows the spectrum of issues involved in project portfolio management and represents how the rationale is referred to in literature. Further, it is commonly agreed in the literature that project portfolio management concerns resource allocation in the firm (Cooper et al., 1997; Dye and Pennypacker, 1999). With a more or less given amount of resources, the question to answer is what projects the company can and/or should fund in the light of the company's strategies. Hence, project portfolio management aims at being an important link between companies' strategies and daily R&D operations. The connections of the projects run today, with tomorrow's product and market profile is essential for success in the marketplace. Likewise, the balance between the projects a company carries out is essential for its long-term success (Cooper et al., 1999), which is also in line with the analogy described.

Another characteristic that is commonly agreed in literature to be important for project portfolio management is that the portfolio decision process is characterised by uncertainty (Archer and Ghasemzadeh, 1996). Project information is changing, opportunities are dynamic, and the decisions involve many different strategic considerations as well as different goals. The complexity in the decision process is further enhanced by interdependencies among the different projects and the fact that multiple decision-makers are involved, often located at different places (Cooper et al., 2001b).

Summarising this short description of the project portfolio management rationale, it can be concluded that project portfolio management generally is considered as a decision process in which the set of projects is continuously revised. The process deals with both ongoing projects in the portfolio and potentially new projects for the portfolio. A more thorough discussion on the definition of project portfolio management is found in Section 2.2.1.

1.3. Research on project portfolio management

Early attempts in the area of project portfolio management were much focused on developing tools, methods or techniques for evaluating projects and project portfolios (Archer and Ghasemzadeh, 1996; Cooper et al., 2001b; Cooper et al., 2001a). This research was to a large extent unempirical in the sense that the tools, methods and techniques were developed without considering their practical usability, nor were they tested in practice (Cooper et al., 2001b; Poh et al., 2001). Later on, during the late 1980s and especially the 1990s, the core of research on project portfolio management has changed into studies with a more explorative focus using breadth-based methodologies (Cooper et al., 1998; Center for Business Practices, 2003). These studies focus on the best practices for project portfolio management, and the studies' findings have contributed greatly to extending knowledge in the area. This research can be seen as setting a new stage for the research on project portfolio management. Studies previously addressed some specific parts of project portfolio management, i.e. the development and/or adjustment of specific tools, methods or techniques, but these breadth-based studies extended the research area into a more complete set of managerial considerations.

Much of the existing knowledge base relies fundamentally on either material from these quantitative studies or the most often theoretically developed tools, methods and techniques. The research is deficient to a large extent in using existing literature and knowledge in related areas to build up and reinforce the findings. Therefore the overall critique directed at the product development literature, that the findings are largely atheoretical and fail to take the next theory-building step (Brown and Eisenhardt, 1995), can be said to hold also for the project portfolio management research area. Nevertheless, the existing research has been important in building knowledge in the area, and creating an understanding of factors essential for successful project portfolio management. But there still exists much room for improvement regarding aspects important for organising project portfolio management.

The area of organising for project portfolio management is seen as highly relevant since the success of a project portfolio management initiative is dependent on how the organisation develops and supports an environment for project portfolio management, rather than just the development and selection of tools, methods and techniques (Levine, 1999). In establishing such a supporting environment, the aspects of how to organise for project portfolio management are important. Based on the understanding of factors for successful project portfolio management learned from the breadth-based studies, the natural next phase in developing the area would be to apply methods in which the researchers gain more thorough knowledge (Tashakkori and Teddlie, 1998) of how project portfolio management is really carried out, and understand why it is organised as it is. Such deeper knowledge would make it easier to exploit other existing theoretical areas in understanding aspects of importance for project portfolio management.

Most of the limited research dealing with issues of organising project portfolio management tends to focus managerial advice on how to set up the project portfolio management. Which people are involved, and how they are organised, is commonly stated to be critical (Levine, 1999; Cooper et al., 2001a; Cooper et al., 2001b). Even though arguing that the choice of which people to involve is critical, such contributions do not provide any understanding of who these people should be. Neither do the authors offer any insight into how they are involved, regarding for example the supply of information or responsibility for decisions etc. Other contributions have been made regarding which types of organisational functions should be represented in the project portfolio management work. Generally it is found here that the sales, marketing, manufacturing and R&D should be involved (EIRMA, 2002). Regarding accountability for the project portfolio management, the general advice found in literature is that this should be entrusted to high-level teams (EIRMA, 2002; Center for Business Practices, 2003).

Another area of organising aspects of project portfolio management where existing research focuses on rather general managerial advice is that of process aspects. It is generally agreed that project portfolio management processes should be formal, and should handle all kinds of projects in their entirety (Bridges, 1999). Further, the process of project portfolio management is dynamic and the list of

active and new projects should therefore be constantly revised (Cooper et al., 2001b). If, beside the general advice on formality and dynamics, one instead takes the view of how project portfolio management decisions really are made in a sequenced process, the contributions here must be considered sparser. Archer and Ghasemzadeh (1996) not only reach this conclusion, but think that there is a total lack of framework for organising the tools and methods logically in a flexible process.

Moreover, the presumption that there exists no single, general, best way to organise the project portfolio management work seems to underlie most of the contributions in the area. It is generally maintained that the best way to arrange the project portfolio management work is situation-specific (Bridges, 1999). Kendall and Rollins (2003), for example, say that every project portfolio is unique and requires that the people managing the portfolio are organised to suit the specific company's situation, as also Bridges (1999) states.

Since there seems to be no self-evident way of organising project portfolio management, it is here argued for an increased knowledge of how and why project portfolio management is organised in certain ways. Such increased knowledge would also enable better understanding of aspects that are of importance when organising for project portfolio management. The contributions in the area so far cannot be said to provide such understanding of important aspects, as they only give fragmented advice on how project portfolio management should be organised. Consequently:

> *The purpose of this thesis is to determine aspects of importance*
> *for organising project portfolio management.*

The term 'organising' has been used in different ways by many authors (Czarniawska-Joerges, 1996) in different areas of research. Instead of classifying how the term is used here in comparison with other authors, it is more relevant to clarify how the term is actually used in this thesis. Organising will be referred to as the arranging of project portfolio management activities (e.g. decisions, preparations, discussions) and the manner of using tools, methods and techniques in these activities as well as the way of involving organisational participants in the activities. Thus, organising project portfolio management is seen here as involving three areas: procedural aspects, organisational aspects, and aspects regarding the use of tools, methods and techniques for supporting the project portfolio management activities. Consequently, typical aspects of importance focused on in the thesis concern the arrangement of the project portfolio management activities, the involvement of organisational participants in the activities, and the use of tools, methods and techniques.

Within the framework of the purpose stated here, more specific research questions to answer will be developed as part of the next chapter, the theoretical exposition. But first, the thesis construction and structure will be described.

1.4. Thesis construction

One of the goals of project portfolio management is to operationalise the business strategy and ensure that the development activities are aligned with the strategy (Cooper et al., 2001b). Consequently this thesis deals on a general level with the operationalisation and implementation of strategic considerations in the development operations. Several authors have emphasised the importance of the strategic management of technologies and how to implement strategic choices, to take effect in the daily operations (Wheelwright and Clark, 1992; Smith and Reinertsen, 1998; McGrath, 2001; Hayes et al., 2005). During my Ph.D. process, diverse studies have been carried out, all addressing strategic considerations of managing R&D operations. However, not all of the studies have specifically dealt with organising project portfolio management.

When choosing a direction for my thesis topic, I saw different possibilities for which particular purpose to select. I decided to focus on project portfolio management even though some of the papers already written by then (two of them also published) had not addressed the topic of project portfolio management. All of the papers written during the Ph.D. process, however, have in common that they deal with strategic management of technology development and how to put strategies for such operations into action. This is to some extent supported by the fact that many of the authors referred to, and sometimes also specific references, have been the same throughout several papers. Hence, the papers not dealing with project portfolio management have still contributed to knowledge and understanding of working with strategic management of R&D operations. Since these papers have also contributed to the knowledge-building during the Ph.D. process, I chose to retain them within the thesis, although this has had some implications for the structure of the thesis.

1.5. Thesis structure

As Figure 1 shows, the thesis is structured in six parts. This introductory chapter constitutes, together with Chapter 2, the theoretical exposition of project portfolio management literature, the first part of the thesis. The second chapter is concluded by presenting the research questions for the thesis.

The second part includes Chapter 3, the research methodology, and Chapter 4, a framework for studying the organising aspects of project portfolio management. As a consequence of including all the six papers in the thesis, even though not all of them contribute to the purpose of the thesis, the extended summaries of the first three papers are presented as part of Chapter 3, when outlining the different research studies. In Chapter 4, the framework for structuring both the empirical data and their analysis is presented.

The third part of the thesis concerns the findings from the studies contributing to the purpose of the thesis. In Chapter 5 the extended summaries of papers 4–6 are presented. Two of these papers are based on a single case study, and one of them on a multiple case study. Chapter 6 describes the single-case company's approach

to organising project portfolio management. This single case is the same as the one dealt with in papers 4 and 5.

RESEARCH AREA & THEORETICAL REMARKS	**1.** Introduction to Organising Project Portfolio Management	**2.** Theoretical exposition of the project portfolio management literature	
RESEARCH METHODOLOGY & FRAMEWORK	**3.** Research Methodology	**4.** A framework for studying the organising aspects of project portfolio management	
FINDINGS FROM THE STUDIES	**5.** Extended summary of papers focusing on project portfolio management	**6.** A description of how project portfolio management is organised at SCA AFH Tissue	
ANALYSIS, CONCLUSIONS & CONTRIBUTIONS	**7.** Analysis of SCA AFH Tissues' approach to organising project portfolio management	**8.** Aspects of importance for organising project portfolio management	**9.** Concluding discussion
REFERENCES	**10.** References		
APPENDED PAPERS	Paper 1. Paper 2. Paper 3. Paper 4. Paper 5. Paper 6.		

Figure 1: Thesis structure

The fourth part of the thesis includes Chapters 7 to 9. In Chapter 7 the case company's approach to organising project portfolio management is analysed on the basis of the framework presented in Chapter 4. Chapter 8 aims at synthesising the findings and answering the research questions.

Chapter 9 provides a concluding discussion, primarily examining the results and conclusions from the thesis. It also tries to clarify the contributions and considers the managerial implications of the results. The last two sections of the thesis comprise the references and the appended papers.

2. Theoretical exposition of project portfolio management literature

This chapter provides a short review of the project portfolio management research area, but also presents and justifies the specific research questions for the thesis. The first part gives a general motivation for project portfolio management and a historical background to how the area has evolved during recent decades. The second part takes its point of departure in portfolio management in general, and describes project portfolio management's connections to related concepts and processes. The next part of the chapter gives an overview of tools, methods and techniques suggested for project portfolio management, followed by two parts dealing with procedural aspects and organisational aspects of project portfolio management. The chapter concludes with a summary and presentation of the research questions.

2.1. Motivation and historical background to project portfolio management

As commonly argued in literature during recent decades, development activities are among the most important activities that companies undertake in order to stay competitive in the marketplace (Martino, 1995; Cooper, 2001). Most companies that perform well have an abundance of new ideas for their development of both products and processes (Wheelwright and Clark, 1992; Archer and Ghasemzadeh, 1999; EIRMA, 2002). They can for example expand product lines, develop new products, create new differentiated markets, or enhance existing technologies. The dilemma facing most companies is that they cannot do everything they would like to do; they have to choose and compromise. In a business world characterised by high competition, technology and marketing resources are too scarce to allocate to wrong projects (Wheelwright and Clark, 1992). Therefore companies have to set priorities and allocate their available resources to the most prominent ideas (Archer and Ghasemzadeh, 1996) in order to yield as much value as possible for the resources put in. Many companies today face problems in this choice and compromise among project ideas. For example, far too many companies resource too many ideas in relation to their available resources (Center for Business Practices, 2003). This is, however, not hard to understand as it is easy to add an extra project when a very important and good idea emerges, for example to back up an important product or market area. It is not easy to stop such an important idea from becoming a project and then justify to the organisation that the idea must wait until resources are available. The other possible way, to stop another important ongoing project in order to free resources, is not an easy task either. Often such managerial situations result in adding yet another project to the portfolio, without analysing the consequences for the portfolio of projects as a whole (Wheelwright and Clark, 1992). The facilitation of such questions regarding resource allocation among projects and project ideas is one of the main purposes of project portfolio management.

Another and slightly different view of the importance of choosing the right projects is obtained if one looks at the costs of the failure to select the "best" projects (Martino, 1995). The cost of such failure involves two different types of costs. First, there are the resources spent on poor projects. This means spending valuable resources on projects with little or no gain in return. An even greater cost, however, may be the opportunity cost of marginal or apparently healthy projects that might have succeeded with additional resources, and the new starts that were deferred or not undertaken because of lack of resources. Thus, expending resources on poor projects is not only a loss in resources; it is also a loss of benefits that might have been achieved if the resources had been allocated to good projects. Hence, selecting the right projects is a critical decision in managing R&D project portfolios (Martino, 1995).

The second focal area in project portfolio management is that of strategic alignment of the development efforts. Research in the area of technology management has shown that it is of importance for successful development to have a strong connection with, and support for, the company's strategies and specifically the product strategies (Griffin, 1997; Castellion, 2005). It is also stated that one of the most important ways to operationalise the strategy is through the new products that are developed (Cooper et al., 2001b). To select individual projects that connect with and support the product strategies is normally seen as manageable by companies. But when it comes to quantifying the connection and support, thereby enabling a prioritisation among different project ideas, companies more often face problems (Nelson et al., 1999). Likewise when it comes to evaluating the overall development effort's strategic connection, companies often experience problems (Nelson et al., 1999). What further complicates the situation is that even if each single project supports the strategies, it does not mean that the strategies are fulfilled. Different aspects of the product strategies have to be taken into account and be evaluated in order to ensure a satisfactory level of strategic fulfilment.

Summarising the aspects of strategic alignment, it can be concluded that three different aspects are relevant: *Strategic fit*, i.e. consistency of all projects with the articulated strategy; *Strategic contribution*, i.e. which projects have to be pursued in order to realise the strategy and achieve the goals set; *Strategic priorities*, i.e. ensuring that the break-down of spending reflects the strategic priorities. All the three aspects are important areas in project portfolio management, even though just two of them explicitly call for a broader view than that one of the projects is needed (Nelson et al., 1999).

Another question for managers in charge of R&D operations to take care of is the balancing of resource spending. Success in tomorrow's market requires the ability to select the right mix of projects for today (Cooper et al., 2001a). For example, many businesses find it insufficient in a long-term perspective to spend all resources on short-term development; some effort also has to focus on more long-term development (Roussel et al., 1991). The same holds for the degree of change in the development, from incremental to more radical innovation of both products and processes (Wheelwright and Clark, 1992). A further example of

division among types of activities may be that between different products or groups of products. Without an aggregated view of the projects undertaken in the portfolio, it is hard to evaluate such aspects of balance among resources spent (Levine, 1999), and consequently this is another important area focused upon in project portfolio management.

The three areas of high importance in managing R&D operations described here reflect in a clear way what leading literature defines as the most important reasons (goals) for project portfolio management. *Value maximisation* means allocating the sparse resources to where they are found to yield best value. *Strategic direction* involves ensuring that the sum of all projects truly reflects the overall business strategy. *Balance in terms of different parameters* refers, for example, to long-term projects versus short-term ones, high-risk versus low-risk ones, or balance between different markets, technologies, product categories and project types. The goals of project portfolio management are also summarised in Figure 2.
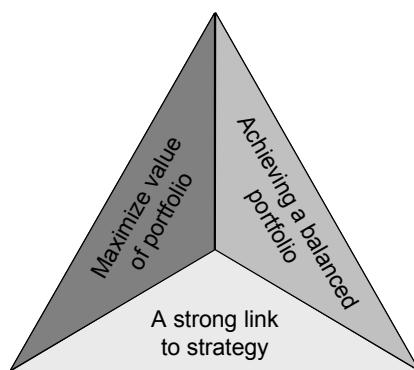
Figure 2: The goals of project portfolio management
(developed from Cooper et al., 2001b)

Beside the three general goals of project portfolio management, some more specific driving forces of project portfolio management can be noticed. The overall goals are extended by Cooper et al. (2001b) with three specific reasons for the importance of project portfolio management: to yield the right balance of projects and investments; to communicate project priorities both vertically and horizontally within the organisation; to provide greater objectivity in project selection. These reasons are, to some extent, more concerned with internal driving forces of project portfolio management, as they deal with the balance between projects and investments, the internal communication of priorities and the objectivity of project selection; but still they are important for the management of project portfolios.

2.1.1. Growing interest among practitioners

We have seen that choosing the best portfolio of projects for the development and managing that portfolio over time are essential in gaining as much value as possible for the resources put in, and require that management consider the aggregate of both ongoing and possible development projects in the context of its business strategies and objectives (Nelson et al., 1999). As companies nowadays are facing increasing requirements on the return of invested capital, managers have

been forced to thoroughly scrutinise the value earned by money invested in the R&D activities (Levine, 1999). As most of today's R&D activities are accomplished in projects (Kendall and Rollins, 2003) it is natural that project portfolio management attracts growing interest among practitioners.

In the beginning of the last decade it was suggested that project portfolio analysis and planning would grow in the 1990s to become as important as business portfolio planning became in the 1970s and 1980s (Roussel et al., 1991). Recent studies (Center for Business Practices, 2003; Cooper et al., 2004; Szwejczewski et al., 2004) have confirmed the growing interest among practitioners in the US and UK, where many of the companies involved in these studies also have implemented project portfolio management practices. Even though many companies have implemented project portfolio management, still many of them are unsatisfied with the performance of the practices (EIRMA, 2002; Center for Business Practices, 2003). One of the studies also states that many organisation's project portfolio management practices are immature (Center for Business Practices, 2003). According to this study, more than half of the companies that have implemented project portfolio management practices are at level 1 or 2 (on a scale of 1–5) in project portfolio management maturity (Center for Business Practices, 2003).

2.1.2. Historical background on managing projects as a portfolio

To assist R&D managers in managing their projects aggregated, different types of support have been elaborated for some decades both within academia and among practitioners (Archer and Ghasemzadeh, 1996; Henriksen and Traynor, 1999). The early steps in the area did not have a focus on managing project portfolios; rather they concerned evaluations and selections of projects for the portfolio. However, as this is one part of what is included today in project portfolio management, it can be seen as the beginning of such work. The research on different techniques for project evaluation and selection has been extensive, and well over a hundred studies describing different types of techniques have been published during more than forty years (Henriksen and Traynor, 1999). Common to the different types of techniques is their highly mathematical character, employing techniques such as linear, dynamic and integer programming (Henriksen and Traynor, 1999). Beside these evaluation techniques for individual projects, techniques for optimising the portfolio composition have also been presented. The overall goal for these types of techniques is to develop a portfolio of new and existing projects that are optimised according to a specific objective (e.g. reward, profit) under a given set of resource constraints (Cooper et al., 2001b).

During the 1980s and 1990s when companies were attaining basic control over their research and development projects, they began gaining more interest in setting strategic priorities across the single projects. They also saw a need for better understanding the characteristics of the company's project portfolio in order to, for example, balance their risks against opportunities or get a grip on which types of projects were receiving resources (McGrath, 2004). As these types of questions arose, companies started to apply, in addition, techniques borrowed from

investment portfolio management to analyse their development efforts. These techniques provided a link between the companies' product strategies and the execution of the strategy through the product development (McGrath, 2004).

Managers also started to ask themselves questions about the product development pipelines. Under constraints on resources, which projects should be started and what priority the project should have in comparison to other ongoing or possible projects were typical questions to answer (McGrath, 2004). These types of questions extended the project portfolio analysis to establish project priorities and then compared these priorities against some basic resource data. The benefits were significant and the senior managers realised that portfolio and pipeline management should be regular and ongoing management processes (McGrath, 2004).

2.1.3. Criticisms of the project portfolio management rationale

In literature as well as among practitioners, there exist some criticisms of the project portfolio management rationale, even though it is seen by many as a very important approach for managing R&D operations. One such criticism is that it is not feasible to start and stop projects as new ideas emerge or the projects' environments change. Whether or not companies think it is possible to start and stop projects in the portfolio, this has consequences for how to organise for project portfolio management in term of frequency of portfolio updates. A related criticism is that the implemented portfolio management process often does not work as it is intended to do in the literature. In many companies the portfolio management process stops with the follow-up of the project portfolio, and the portfolio is not managed (i.e. no action is taken as a consequence of the portfolio follow-up) (Spradlin and Kutoloski, 1999).

Another argument which can be treated as criticism is that it is possible to manage a portfolio of projects only to some extent: there will always be certain projects on a so-called hidden agenda that, for one or another reason, is not put up officially (Blichfeldt and Eskerod, 2005). The most common example is curious personnel working with R&D that may not want to accept a specific portfolio decision of killing a project. Or there may be an idea that is not accepted by management but, for a single person or group of persons, is of such interest that they carry out the project without the management's knowledge. However, project portfolio management in this thesis deals only with projects and project ideas which are known to the organisation.

2.2. Portfolio management in general

Thoughts borrowed from investment portfolio management were first applied on a business level and given much attention during the 1970s and 1980s (McGrath, 2004). Some of the questions relevant in managing such investment portfolios are also pertinent when managing project portfolios. But the differences between business and project portfolio management are perhaps greater than the similarities. Business portfolio management has its basis on a general level in companies, and

concerns questions on the level of which businesses to be in and how the effort should be divided between them.

The next level in the organisation where portfolio thinking gained applications was the product level, i.e. within the businesses where companies are active, regarding how the mix of products should be at present and in the future. The main difference between business and product portfolio management is that, in managing businesses, existing products in the business are dealt with, compared to product portfolio management which involves far more uncertainties (Cooper et al., 2001b). Product portfolio management deals with future events and opportunities where much of the information required to make the decisions is very uncertain (Cooper et al., 2001b). Examples of further differences are the more dynamic decision-making environment for product portfolio management and the fact that it deals with projects at different stages of completion, in contrast to business portfolio management.

The next distinction to be made is the one between product and project portfolio management. If the differences between business and product portfolio management appear quite obvious, this is not the case for the differences between product and project portfolio management. Most processes that are used for product portfolio management focus on the new product development efforts alone (Kendall and Rollins, 2003). The intention with these processes is to assist an organisation in allocating the limited resources to the development of new products for the market. The definition of a product portfolio stated by the Product Development Management Association (PDMA) is *"a set of products and product lines the firm has placed in the market" (http://www.pdma.org/library/glossary. html).*

As most product development efforts are carried out in projects, the connection between product and project portfolio management therefore must be said to be close. However, the new product development efforts constitute only a subset of all the projects an organisation undertakes. For example, they do not include projects aiming at internal improvements, maintenance projects, and projects focusing more on unprejudiced development (Kendall and Rollins, 2003).

2.2.1. Project Portfolio Management defined

As we have seen in the historical background to project portfolio management in the first chapter, the area is rather recently established if one takes the broader view, beyond the techniques developed for evaluation, and includes also questions regarding processes and organisation of the project portfolio management work. Thus, authors contributing to the area are quite limited and few formal definitions of project portfolio management exist.

Starting out by analysing the meaning of the different terms in the concept, a 'project' is very well known in academia and everyone has an apprehension of what a project is. However, one of the formal definitions widely referred to is the one used by the Project Management Institute: *"a temporary endeavour undertaken*

to create a unique product, service or result" (Project Management Institute, 2004). Within the R&D and product development management literature, the term 'project' is most often used without a specific definition, and the one stated above holds for most of the usage also in this body of knowledge.

The term 'portfolio' has already been analysed to some extent when dealing with the differences of managing business, product and project portfolios above. The formal definition of a portfolio stated by PDMA (http://www.pdma.org/library/ glossary.html) is *"a set of projects or products that a company is investing in and making strategic trade-offs against"*. Even more interesting is the definition of a project portfolio by the same organisation: "*a set of projects in development at any point in time"*. In connection with the definition, it is also stated that the projects will vary in the extent of newness or innovativeness, which is an important characteristic of a project portfolio.

The same organisation (http://www.pdma.org/library/glossary.html) has further defined portfolio management as *"a business process by which a business unit decides on the mix of active projects, staffing and dollar budget allocated to each project currently being undertaken"*. In this definition only projects are mentioned, even though the definition of a portfolio alone concerned both projects and products. However, this definition is largely similar to the one used by many authors contributing in the field (e.g. Archer and Ghasemzadeh, 1999; Dye and Pennypacker, 1999; Graves et al., 2000; EIRMA, 2002). *"Project portfolio management is a dynamic process wherein the list of active projects is constantly revised. In this process, new projects are evaluated, selected and prioritised; existing projects may be accelerated, killed or reprioritised, and resources are allocated and reallocated among the projects in the portfolio"* (Cooper et al., 2001b). Also the EIRMA working group report on project portfolio management (EIRMA, 2002) uses the same definition. Practitioners from companies all over Europe with interest and experience in the field have contributed to this report, and therefore the definition can be said to represent practitioners' views as well. As this definition is commonly used, it is also the one employed in the present thesis.

An important distinction to be made is between projects and operational work. Organisations perform work to achieve a set of objectives, and the work can generally be classified as either projects or operations (Project Management Institute, 2004), although the two sometimes overlap – often they share same characteristics as performed by people, constrained by limited resources, and are planned, executed and controlled. The main difference between them is that operations are ongoing and repetitive, while projects are temporary and unique (Project Management Institute, 2004). Project portfolio management as interpreted in this thesis does not deal with operational activities, even though they influence the availability of development resources.

2.2.2. Related concepts

In the literature, the project portfolio management concept appears in various ways (Elonen and Artto, 2003). Pipeline management, Programme management

and Multi-project management are examples of closely related concepts. The different concepts do, however, show some important differences even though they focus on similar areas. In this section, their relations to project portfolio management are described.

The concept of pipeline management is used widely in the product development literature (McGrath, 2004). Pipeline management is a concept grown from the need for higher internal product development performance through better utilisation of internal resources (Rosenau et al., 1996). The concept is very closely connected with portfolio management, and PDMA defines pipeline management as *"a process that integrates product strategy, project management and functional management to continually optimise the cross-project management of all development-related activities"* (http://www.pdma.org/library/glossary.html). The definition of project pipeline management by the same organisation gives additional understanding of the concept: *"Fine-tuning resource deployment smoothly for projects during ramp-up, ramp-down, and mid-course adjustments"*. From these definitions we can conclude that it refers more to the daily work of synchronising the available resources for use in projects and line activities, in order to fulfil the product strategy (Rosenau et al., 1996). Thus, pipeline management can be seen as the link between the project portfolio management and the daily management of the product development operations. McGrath takes one step further and states that pipeline management generally is considered a part of project portfolio management (McGrath, 2004). But in line with the reasoning above, he also states that pipeline management is at a lower level of process detail (see Figure 3).
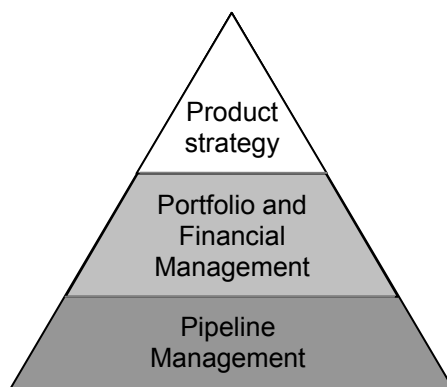
Figure 3: Process levels of pipeline management, portfolio management and product strategy (McGrath, 2004)

Program management is most often used as the integration and management of a group of related projects with the intent of achieving benefits that would not be realised if they were managed independently (Lycett et al., 2004). Whilst projects here are connected with each other and the main purpose is creating value beyond the sum of the individual projects included, this concept is distinct from project portfolio management (Lycett et al., 2004). Projects may be connected with each other also in project portfolios, but need not be. The actions taken within this concept focus largely on the dependencies among the projects in order to improve the co-ordination and resource utilisation (Turner, 1999; Lycett et al., 2004).

In literature on multi-project management, the primary focus is on allocation of resources among simultaneous projects (Wheelwright and Clark, 1992; De Maio et al., 1994; Payne, 1995; Engwall and Jerbrant, 2003). A multi-project environment is normally constituted by a business unit that executes a considerable share of its operations as projects. This multi-project environment can be a result of an intended strategy or it can be an unintended result, where many projects are run simultaneously, independent of each and with separate goals. In a multi-project setting, several projects are run in parallel and use at least some resources from the same resource pool (Engwall and Jerbrant, 2003). This concept shares many characteristics with project portfolio management, but the main difference is that multi-project management has a stronger focus on the resource allocation among the different ongoing projects. This is to some extent also important within project portfolio management, but is not the primary interest, as the main purposes here focus on a more general level – evaluating, prioritising and choosing among projects for the portfolio (Cooper et al., 2001b).

2.2.3. Project Portfolio Management's connections with related processes

The process of project portfolio management has important connections with other processes in a development organisation. The view of different process levels for product strategy, project portfolio management and pipeline management, presented in Figure 3, can be further extended in order to get a more complete description of the connections of project portfolio management with other internal processes (see Figure 4).
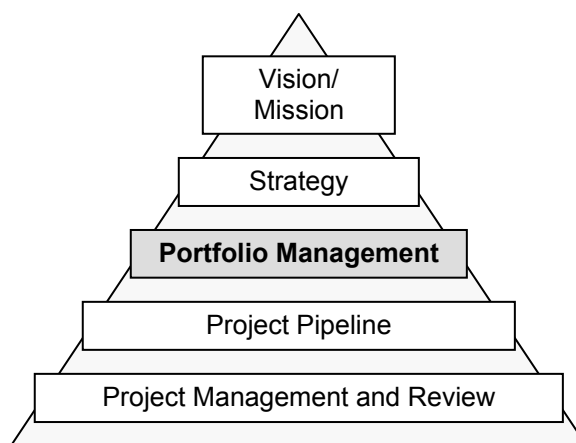
Figure 4: The context for project portfolio management (adapted from EIRMA, 2002)

As one of the purposes of project portfolio management is to secure a strong connection with the business strategy, the first connection upwards in the process hierarchy presented in Figure 4 is toward the strategy. The project portfolio management approach does not deal with the creation of the business strategy; instead it is the process of putting the strategy into effect. The strategy on this level refers both to the business strategy and to the product strategy supporting the business strategy. The next connection upward is the connection towards the vision

or mission of the business. As the vision's role is to guide the strategy (McGrath, 2001) it thereby connects the portfolio management level to the most upper level of the business objectives.

In the paragraph dealing with related concepts, project pipeline management was described as the next process level below the project portfolio management level. The project pipeline management level plays an important role in realising the project portfolio plan derived from the project portfolio management process. But it also provides important input on the state of the ongoing projects in the portfolio. The process level further down includes the individual projects' management, which entails leading and following up projects in relation to purposes, schedules and budgets (EIRMA, 2002).

2.2.4. Project portfolio management – a complex decision process

Within the literature on project portfolio management, there has been little progress towards achieving an integrated framework that simultaneously considers all the different aspects of determining a suitable project portfolio (Archer and Ghasemzadeh, 1996). This is, however, not surprising as project portfolio management is a complex managerial task, with many aspects adding to the complexity.

Project portfolio management involves multiple and often conflicting objectives for the process. The overall objectives of maximising the portfolio value, achieving a balanced portfolio and ensuring strategic connection often conflict each other. In addition, often also relations to other organisation-specific objectives exist, which render the process even more complex. Making trade-offs among the different projects and project ideas are very often seen as difficult since the decisions involve many different criteria to take into account. Often the criteria also involve both qualitative and quantitative measures which have to be compared in the evaluation (Archer and Ghasemzadeh, 1996).

Adding further to the complexity is the fact that interdependences among the projects and project ideas usually also have to be taken into account. The interdependences bring both constraints and possibilities into the decision on the portfolio composition. In almost all portfolio decisions, other constraints are also involved, such as the availability different types of resources. Even though there are multiple constraints to take care of, the number of possible combinations of projects can be enormous (Archer and Ghasemzadeh, 1996). Another aspect that increases the complexity of the decisions is that the projects in the portfolio which have to be compared are usually at different stages of maturity, and often the uncertainty as to when they can be finished is high. Last but not least, decisions on project portfolio composition involve more than one individual and therefore also different personal perceptions have to be taken into account (Archer and Ghasemzadeh, 1996). These complicating aspects of project portfolio management are summarised in Figure 5.

• Multiple and often conflicting objectives
• Difficulties of determining trade-offs among different criteria
• Qualitative and quantitative measures must sometimes be compared
• Interdependences among projects
• Multiple constraints for the project portfolio to take into consideration
• The number of possible combinations of projects can be enormous
• Projects at different stages of maturity are compared
• Usually several individuals with different perceptions are involved in the decisions

Figure 5: Complexities involved in project portfolio decisions
(Archer and Ghasemzadeh, 1996)

2.3. Tools and methods for project portfolio management

In the literature dealing with tools, techniques and methods, no distinction between the different expressions can be found. Different authors use different terms for the same thing. Cooper et al. (2001b), for example, use 'methods' as an overall term, as does Martino (1995), while Chiesa (2001) uses both 'evaluation technique' and 'methods' in parallel. Archer and Ghasemzadeh (1996) use 'evaluation techniques' as an overall expression when later dealing with tools, methods, models and approaches. It is hard if not impossible to find a pattern in how the different expressions are used.

By looking in a dictionary (Makins, 1995) to find out what is really meant, it can be seen that the different expressions are all quite similar. A technique seems to be almost exactly the same as a method but has a more practical focus. The term 'tool', on the other hand, appears to be more specific and it seems that a tool can very well be a part of a method or a technique. The conclusion is that both the terms 'tool' and 'method' are useful in the area of project portfolio management, as we shall see in the following sections. Some of the procedures described are just tools while others are closer to methods with or without support by specific tools.

2.3.1. Classifications of tools and methods

There are many divergent tools and methods that can be used to evaluate, prioritise and choose projects for a portfolio as well as to evaluate portfolio compositions (Archer and Ghasemzadeh, 1996). Many of the tools and methods developed in literature are sparsely used in practice, simply because they are too complex and/or require too much input data that often are hard to get control of (Archer and Ghasemzadeh, 1999). Others are too difficult to understand and use (Cooper, 2001b). Different attempts have been made to classify the tools and methods but no single division has been agreed on. Instead different authors make their own division in order to support their specific needs. In order to provide a view of tools and methods available, some different divisions are therefore described.

One approach is to divide the tools and methods in two types: multiple-criteria decision-making methods and subjective decision-support systems (Linton et al., 2000). In the former, all projects are individually rated, usually according to a number of quantitative and qualitative criteria, capturing for example the possibilities of technical and commercial success and the projects' consistency with the business strategy. In a general way, with these multiple-criteria decision-making models, projects are rank-ordered relative to each other, without taking much if any account of the composition of the project portfolio as a whole (Linton et al., 2000). In the group of subjective decision-support systems, the tools are used to guide managers in their decisions on the R&D project portfolio's composition. The projects are here described by discrete variables used together for all projects, to give the managers an overall picture of the R&D project portfolio as a guide for decisions on the future portfolio composition (Linton et al., 2000).

Another division that can be made is among the tools and methods in the two primary categories, Benefit measurement techniques and Project selection/resource allocation techniques (Archer and Ghasemzadeh, 1996). This division is not absolute as some of the tools and methods can belong to both of the categories. The benefit measurement methods are described as systematic procedures for obtaining and integrating subjective and objective benefit data, and can be compared to the multiple-criteria decision-making methods (Linton et al., 2000) described above. The other group is seen to represent a second stage in portfolio selection. Here different types of input of the projects, which also can be outputs from the first group, are used to select projects and allocate resources in the project portfolio.

Moreover, one can divide the different tools and methods into Discounted cash-flow techniques, Options-based techniques and Non-financial techniques (Chiesa, 2001). Within the first group, common financial techniques used for investment calculation can be found, for example Net Present Value. The second group of methods is based on options pricing theory, and the general idea is that an R&D investment is analogous to an investment in a call option. In the third category, Profile methods, Checklists and Scoring models are included (Chiesa, 2001).

Yet another common division, which well describes what types of tools or methods are dealt with, is a division into no less than eight groups (Martino, 1995): Ranking, Economic, Decision theory, Portfolio optimisation, Simulation, Cognitive modelling, Cluster analysis, and Ad hoc methods. These groups can be said to cover very well the different types of tools and methods presented in literature so far, but some of them may fall into the group that is too complicated and difficult to understand for practical use.

The division that is found most appropriate for this thesis is to organise the tools and methods according to the aims for which they are used, in other words according to the goals of project portfolio management This division is found most appropriate here since the thesis focuses on organising aspects of project portfolio management and a presumption is that the overall project portfolio management approach should have the possibility to fulfil the overall goals.

If divided according to the goals of project portfolio management, the tools and methods can be categorised as those for achieving balance in the portfolio, for maximising the value of the project portfolio, and for ensuring a strategic alignment of the project portfolio (see Figure 6). The tools and methods exemplified in the figure are only some examples of the ones available. As this thesis is not focusing specifically on choosing tools and methods for evaluation, just some of the more frequently used ones are brought up as examples. For a more complete description of available tools and methods, it is referred to Martino (1995).
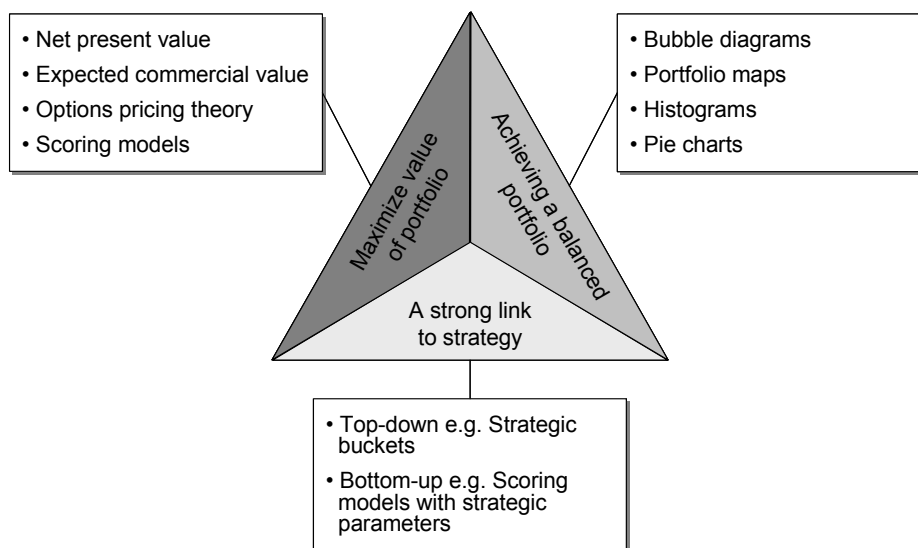
Figure 6: Project portfolio management tools and methods, and their use to support the goals of project portfolio management (developed from Cooper et al., 2001b)

2.3.2. Tools and methods for maximising the portfolio value

The tools aiming at reaching the first objective are tools that evaluate individual projects on the basis of, most often, financial estimates. According to these tools, the projects with the highest financial value are the ones to proceed with; theoretically this gives a portfolio with maximum value. EIRMA (2002) and Cooper et al. (2001b) do, however, point out that financial tools should be used with care. The estimates concerning financial values are difficult to make and their reliability is often low. Consequently, a portfolio that is originally considered to be the most valuable can subsequently be reassessed by using new data and found to have a very poor overall value. The decision of whether to rely upon such financial tools is dependent upon which industry the company is active within, the strategic directions of the organisation, guiding principles, capacity, constraints and complexity (Bridges, 1999).

A frequently mentioned critique against the economic tools and methods within this group concerns the availability of, and possibilities to collect, reliable data (Cooper et al., 2001b). The nature of development involves much uncertainty, not least regarding economic estimates, and during early phases of development it is often hard to get reasonably reliable data for the calculations. If uncertain data are

used in multiplicative economic formulas, the results of the calculations become even more uncertain. Other authors, however, think that some kind of economic judgement always has to be included in evaluating projects (EIRMA, 2002). It has been found in studies of project portfolio management practices among US companies that these economic tools and methods are widely used in practice (Cooper et al., 1999; Center for Business Practices, 2003).

The last type of tool that is classified as a tool aiming at maximising the value of the project portfolio is the scoring model. In scoring models a project is evaluated and scored according to a set of criteria that are defined beforehand. The different scorings are then summarised to get an overall value of the specific project which can be compared with other projects' values. Fundamentally the same critique as above is brought up for scoring models, since they normally include some economic evaluation criteria, but scoring models are more frequently mentioned as a good substitute for purely economic evaluations (Cooper et al., 2001b).

2.3.3. Tools and methods for achieving a balanced portfolio

The second group of tools aims at meeting the objective of creating a well-balanced portfolio. The composition of the portfolio that gives the proper balance is, however, company-specific, and ultimately it is dependent upon the company's business strategy (Power, 1986). For example, in a company that has a "middle" strategy the challenge is to find the proper balance between short-term projects and long-term projects.

The tools classified to be used for achieving a balanced project portfolio are different types of visualisation tools. They are not decision tools *per se*, since they do not create a list of which projects to conduct. Instead they should be used as an outline for a qualitative discussion about which projects to proceed with. Examples of such tools are pie charts, histograms, portfolio charts and bubble diagrams. The visualisation tools all use different parameters for displaying the balances, and it has been found that the following parameters should be considered: risk (technical and commercial) versus revenue (based on financial expectations), difficulty to conduct (technical and commercial) versus importance, duration of competitive advantages versus costs, time-to-market versus quality, and long term versus short term (Cooper et al., 2001b).In studies of project portfolio management practices it has been found that bubble diagrams are the ones most commonly used (Cooper et al., 1999; EIRMA, 2002).

Neither have these tools escaped criticism. The same critique that is frequently mentioned for the portfolio value tools and methods, regarding the availability and reliability of data, is brought up also for these tools and methods (Cooper et al., 2001b). Another critique is that they tend to produce information overload (Cooper et al., 2001b). Firstly, each diagram often involves too many parameters to be manageable at the same time. Secondly, many companies introduce too many tools showing different balances of importance without defining how to use them, so that it becomes hard to say anything about the portfolio balance.

2.3.4. Tools and methods for ensuring a strong link to strategy

The third objective, to ensure alignment with business strategy, can be met by using either Top-down or Bottom-up approaches (Cooper et al., 2001b). Top-down approaches are designed to ensure that the money spent mirrors the business strategy and strategic priorities. Strategy and resource allocation must be linked, since strategy becomes real only when it is translated into spending money on specific activities or projects. The most common method for doing this is the strategic bucket approach (Cooper et al., 2001b; Szwejczewski et al., 2004); here overall resources are allocated across key strategic dimensions. Another top-down approach is called product roadmaps (Cooper et al., 2001b) where the resource allocations are based on a map of future products.

By contrast, Bottom-up approaches begin with projects and their relative attractiveness. The normal situation is that companies have several potential projects to conduct and must also consider new suggestions from all parts of the organisation. This approach therefore focuses on selecting the best individual projects in the light of business strategy. This can for example be done by using a scoring model including strategic parameters, and ensuring that projects aligned with strategy are favoured. However, the problem is that the overall balance of resource spending may be wrong, even if all individual projects are strategically aligned (Nelson et al., 1999).

These methods have not suffered such criticism as the other ones, but some comments are still important to note. The general critique of the top-down approaches is that they rely on management decisions which are often experienced as very hard. As the environment changes, it is difficult to predict future products for the market and how the split across strategic buckets can be made before considering the project's quality within each bucket. Another complaint is that of sub-optimisation. If too many high-quality projects are found in one strategic bucket according to the preferred balance, a situation of sub-optimisation has occurred. A specific critique of the product roadmap approach is that the strategy should not always drive the project portfolio in a top-down fashion; sometimes the projects must be allowed to drive the strategy (Cooper et al., 2001b). Another critique of product roadmaps is that they tend to stultify the creativity and entrepreneurship in the organisation as they introduce rigidness in the organisation. The last kind of complaints about these tools and methods is that they seem just too complex and difficult for management to understand and walk through (Cooper et al., 2001b).

2.3.5. Choice and use of tools and methods

In order for a project portfolio management process to fulfil the overall goals of project portfolio management, perhaps no tool or method at all is needed. It depends on the number of projects in the portfolio and the project portfolio environment (Bridges, 1999). If for example just a few projects are undertaken yearly, it is not hard to grasp the overall development effort without the support of tools or methods. Many organisations that today undertake research and

development activities have, however, clearly passed the level of complexity in their portfolio of projects that can easily be managed without support by tools and methods. Earlier research has stated that project portfolio management in these types of settings is facilitated through support by simple tools and methods (Martino, 1995; Archer and Ghasemzadeh, 1996; EIRMA, 2002).

Earlier research has also stated that no single tool or method does better than the others in fulfilling project portfolio management goals (Cooper et al., 2001b). Several authors instead stress the importance of not relying on one single tool (e.g. Archer and Ghasemzadeh, 1996; EIRMA, 2002). This is also supported by recent studies which have shown that the best-performing companies use more than one single tool (Cooper et al., 2004). According to this and earlier research, the best performers are using 2–3 tools on average (Cooper et al., 1999; Center for Business Practices, 2003).

As an abundance of tools and methods exists to choose among, the question of how to choose among them arises. According to Meredith and Mantel (1999), the type of tool or method to choose for the specific evaluation/selection process should depend on the philosophy and wishes of management. This gives an indication that the right set of tools and methods is company-specific and is dependent upon the goal on which the management wishes to focus. Bridges (1999) adds further knowledge to the question as she states that the decision of whether to rely upon financial tools or not is dependent upon which industry the company is active within, the strategic directions of the organisation, guiding principles, capacity, constraints and complexity. This means that the choice of tools and methods should fit not only the environment (management style, guiding principles, strategic directions etc.) but also the external environment (industry characteristics).

2.4. Procedural aspects of organising project portfolio management

The tools and methods frequently elaborated on in literature (Archer and Ghasemzadeh, 1996) are, however, only one part of getting project portfolio management to work. The tools and methods also have to be applied to the project portfolio management process (Cooper et al., 2001b) to support the activities in the process. Examples of such activities can be discussions, preparations or decisions.

The existing research on project portfolio management focuses on a rather general level with much practical advice for managers. It is generally agreed that project portfolio management processes should be formal and should handle all kinds of R&D projects in their entirety (Cooper et al., 2001b). New product projects as well as other types of projects should be included, such as process improvements, cost reductions, fundamental research, platform projects, customer request projects, maintenance items and infrastructure projects (Bridges, 1999; Cooper et al., 2001b).

The process of project portfolio management is seen as dynamic, and the list of active and new R&D projects should be constantly revised. In the review process, new projects are evaluated, selected and prioritised against each other and against projects underway. Existing projects may be accelerated, killed, or re-prioritised and resources reallocated to the active projects (Cooper et al., 2001b).

In literature it is further generally agreed that, in order to succeed with project portfolio management, it is essential to have a formal process for the individual projects' development in place. Such formal development processes (e.g. Stage-gate processes) have been found to be common practice in companies today (EIRMA, 2002). This formal individual project process must be integrated with the formal project portfolio review process so that they can feed each other with information about the projects.

The overall management of the project portfolio is therefore done in support of both the formal project development process and the portfolio review process. The two processes can interact at two extremes, with either the formal project development or the portfolio review as the dominant process (Cooper et al., 2001b) (see Figure 7).
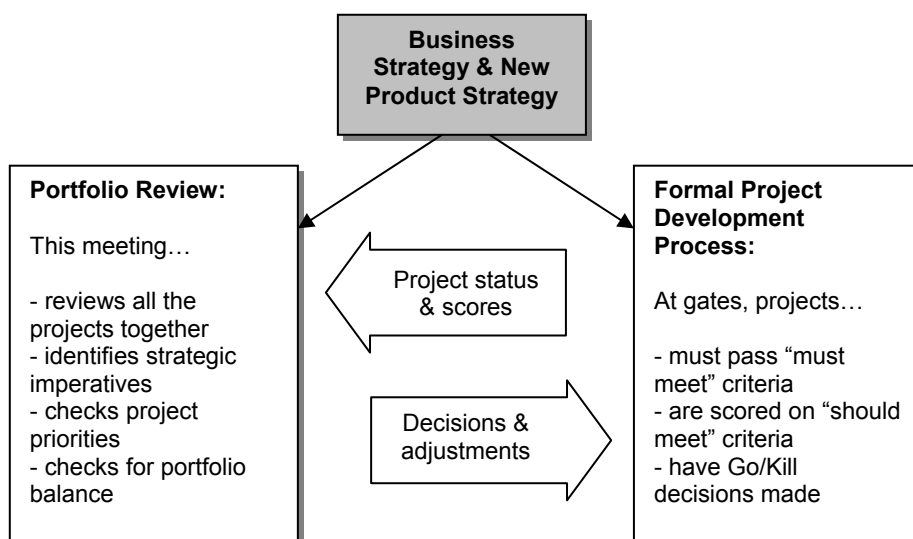
Figure 7: The linkage between the project portfolio management review process and the formal individual development process (Cooper et al., 2001b)

The "gates dominate" approach is often used by companies that already have a well-working formal project development process in place. They then add portfolio management to their gating process, almost as a complementary decision process to make smaller corrections in the portfolio. This approach is commonly used in larger companies, in science-based industries, and where project development cycles are lengthy (Cooper et al., 2001b).

The second approach, where all projects are questioned and ranked against each other at the reviews (several times per year), is said to better suit companies in fast-paced industries such as software, IT and electronics. Here all projects are brought

up for auction, and the review process can consequently result in large adjustments and resource reallocations (Cooper et al., 2001b).

2.4.1. Frequency of project portfolio reviews

In order to ensure that the set of active projects is continually updated and that they are in line with the intentions of the company as new business opportunities arise, the existing project portfolio must be reviewed from time to time (Sommer, 1999; Cooper et al., 2001b; EIRMA, 2002). The review process should be a periodic one where all projects are reviewed and compared against each other (Cooper et al., 2001b). The most common frequency of portfolio reviews is four times per year (Cooper et al., 2001b; EIRMA, 2002; Kendall and Rollins, 2003; McDonough III and Spital, 2003). This is further supported by the study made by Szwejczewski et al. (2004) showing that their case companies reviewed the entire portfolio of projects on a quarterly basis. According to McDonough and Spital (2003), portfolios that are revised more frequently are more likely to be successful. They point out that the appropriate frequency of the reviews is likely to differ between companies, and that it depends upon factors such as the type of projects that are considered in the portfolio, the lead time of the development, and the dynamics of the industry. If the company is operating within a competitively intense and/or technologically intense environment, it is probably in need of more frequent reviews.

2.4.2. Project portfolio decision-making process

On a more detailed level of the portfolio management process, the one of how the project portfolio management activities are carried out, the contributions are sparser. As mentioned earlier, Archer and Ghasemzadeh (1996) take one step further when arguing that there is a total lack of a framework for organising the tools and methods logically in a flexible process which supports the project portfolio selection process. However, they themselves have proposed a generic framework for the project portfolio selection process (Archer and Ghasemzadeh, 1999).
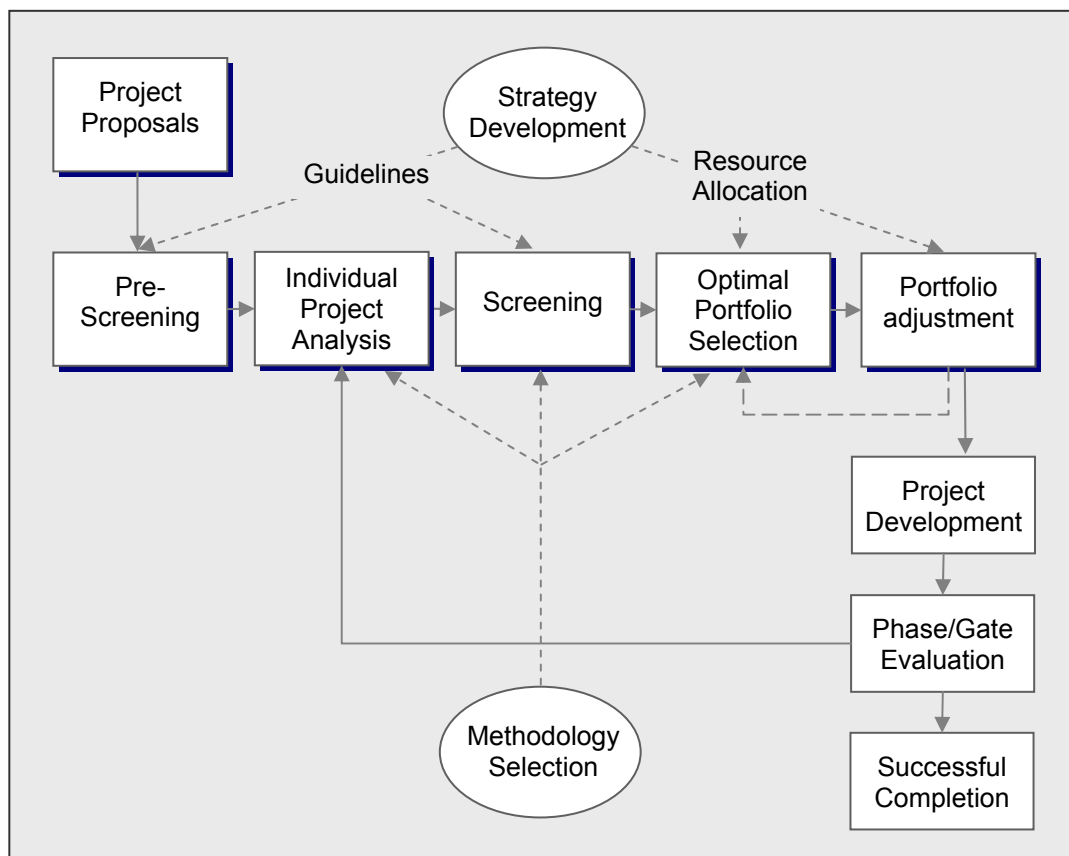
Figure 8: Framework for Project Portfolio Selection (Archer and Ghasemzadeh, 1999)

In an earlier version of their proposed framework (Archer and Ghasemzadeh, 1996) they divided the process into three general stages, which they called Pre-Process Stage, Process Stage and Post-Process Stage. The pre-process stage includes the collection of Project Proposals and the Pre-Screening of available projects and project ideas in Figure 8. The next stage, the main one, is called the process stage and includes the Individual Project Analysis, the Screening, and the Optimal Portfolio Selection in Figure 8. These are rather generic stages of individual project evaluation followed by a screening and then the composition of the project portfolio. In the third stage, the post-process stage, the portfolio is balanced and adjusted (Portfolio Adjustment). The process also includes a loop back to the last stage of the main process if the adjustment of the portfolio calls for a new portfolio selection (see Figure 8). Beside the direct project selection process, the framework also includes the project development and a connection of project information with the analysis of the individual projects.

The framework also includes the strategic connection with the project selection process. In their model, the strategy influences the project selection in the form of guidelines for the screening and individual project analysis stages (Archer and Ghasemzadeh, 1999). In the later stages, the project portfolio composition is strategically connected by directives for the resource allocation. The methodology selection refers to what in this thesis are called tools and methods, and is applied to the process stage according to the framework.

This model seems to include all activities of importance for project portfolio management. But the model assumes that all decisions are made in a linear logical process like the one described, where all of the projects that are or may be part of the portfolio are dealt with in the same process. Further, the model does not take into account how different people are involved in the different stages, which may have consequences for how the process is arranged.

2.5. Organisational aspects of project portfolio management

The research on organisational aspects of project portfolio management, like that regarding the procedural aspects, must be considered not very well developed. Also the organisational aspects are to a large extent characterised by general advice for managers to take into account. This general advice focuses on which people to involve, but not on how they are involved, in the project portfolio management activities. There is, however, no doubt that the question of which people are involved and how they are organised for the project portfolio management is critical (Levine, 1999). It is commonly stated to be the people handling the process who constitute the critical factor for success (Kendall and Rollins, 2003). With the wrong set of people it does not matter how well designed the project portfolio process is. The literature states accordingly that the way in which the people involved in the process are organised is vital (Cooper et al., 2001b), but without giving guidance on how to involve and organise the people in the project portfolio management process.

Some contributions have also been made regarding which types of organisational functions should be represented in the project portfolio management work. In the study by EIRMA (2002), for example, it has been found that managers from sales, marketing, and R&D should be involved. Kendall and Rollins (2003) state that a balance between market side and supply side is needed in the portfolio process; including both sides is said to be a good way to minimise risks of future complications. Cooper *et al.* (2001b) have found it common that the same people who attend the more important gates in the new product process are involved in the project portfolio process. In most businesses, this means some kind of executive team.

2.5.1. Responsibilities for project portfolio decisions

The main responsibility for the project portfolio's management can lie with different persons in a company – for example, the CEO, the senior management of a business unit, the senior management of R&D, a specific "project office", strategic planning units, a portfolio development group, or a project planning group (EIRMA, 2002; Center for Business Practices, 2003). The ultimate project portfolio decisions should be entrusted to high-level teams. Ultimate accountability remains with the company's senior management or the board of directors (EIRMA, 2002). In practice, however, the responsibilities are said to be delegated to various levels in the company (Kendall and Rollins, 2003). But at the same time one common reason for project portfolio management implementation failures is said to be that

the people responsible for success are at too low a level in the management reporting structure, without direct links and support from the senior management team (Kendall and Rollins, 2003).

In organising for the project portfolio management work, it is also important to note that many companies today establish project offices with the aim, among others, of collecting and distributing project information in a common format (EIRMA, 2002). But these project management offices, according to that study, do not share responsibilities for the project portfolio planning. Neither are portfolio planning groups commonly found in companies involved in this study (EIRMA, 2002).

2.6. Summary and presentation of research questions

The theoretical exposition has shown that issues of organising project portfolio management are an area which not is very well developed, in terms of arranging the project portfolio management activities and connecting people with the activities. This is supported by, for example, Levine (1999) and Archer and Ghasemzadeh (1999) in stating that it is an area which needs to be further developed.

From the early statement of what in this thesis are referred to as organising aspects of project portfolio management, the different aspects dealing with the use of tools and methods, procedural aspects, and organisational aspects have been described separately. The explicit separation between the procedural and organisational aspects has not been made previously in project portfolio management literature, although several authors have emphasised their importance individually (Archer and Ghasemzadeh, 1996; Levine, 1999; Cooper et al., 2001b).

Much focus has, however, been put on the development of tools and methods assisting the project portfolio management (Archer and Ghasemzadeh, 1996) and different authors have chosen to divide the tools and methods based on different premises for their own purposes (Martino, 1995; Archer and Ghasemzadeh, 1996; Linton et al., 2000; Chiesa, 2001). Here the division according to the three overall goals of project portfolio management was chosen for giving a short review of tools and methods available. The different tools and methods must be seen as extensively developed both in theory and in practice. But how to use the tools and methods to assist the project portfolio management activities is an area where more research is needed.

Summarising the contributions regarding the procedural aspects, it has been shown that the theoretical contributions have been made on a rather general level. It is commonly argued that the project portfolio process has to be formal, should include all types of projects, and is generally dynamic, and therefore calls for constantly revision (Cooper et al., 2001b). On the more detailed level of how project portfolio management activities really are carried out, Archer and Ghasemzadeh (1996; 1999) have made attempts to establish a generic model for how different decisions can be made in a structured process. The presented model provides a good understanding of the general stages in managing project portfolios,

but the model is so generic that it leaves many questions open as to how decisions really are made in the process. Examples of such questions are who carries out the activities in the process and which type of tools and methods are used to support the activities.

In summarising the area of organisational aspects of organising project portfolio management, it was stated that the research is even more general regarding this area than on the area of procedural aspects. Generally it is stated that every project portfolio is unique and requires that the people managing the project portfolio are organised to suit the specific company's situation (Kendall and Rollins, 2003). At the same time it is commonly stated that the personnel involved in the decision process are the keys for successful portfolio management (Cooper et al., 2001b). Managers who generally are involved in portfolio decisions come from sales, marketing, manufacturing and R&D (Center for Business Practices, 2003) and the responsibilities for the project portfolio decisions can lie with different persons in the company, but the ultimate portfolio decisions should be assigned to high-level teams (EIRMA, 2002). In practice the responsibilities are normally found to be delegated to various levels of the company (EIRMA, 2002). Even though it is commonly agreed that every project portfolio is unique and requires that the people involved area organised to fit the specific situation, little attention has been paid to aspects which are important when organising for project portfolio management. This is accordingly seen as an area where more knowledge is needed.

2.6.1. Research question 1

Even though it is stated in literature that the project portfolio management process should include all kinds of R&D projects in their entirety (Bridges, 1999; Cooper et al., 2001b), project portfolios focused on in literature most often include projects that are rather homogeneous – for example projects aiming at developing new products to introduce on a new or existing market, or projects aiming at more unprejudiced development such as technology development or applied research. If a company is interested in such different development activities, this implies that separate resources have to be used for the different activities in line with the early reasoning by Wheelwright and Clark (1992). As the same base of resources is used for all projects in a project portfolio, this gives separate project portfolios, each focusing on a specific type of development activities. Consequently, the portfolios can be managed separately with different goals and requirements of, for example, return on invested resources. But in order to be able to provide such a critical mass of resources for each project portfolio, rather large companies with considerable overall yearly spending are required.

Many companies, however, do not provide such a considerable amount of resources for their overall development effort that they find it suitable to divide the projects into separate project portfolios with dedicated resources for the different types of projects. Such types may be, for example, projects aiming at product development, manufacturing process development, or technology development. But even though the amount of resources spent on each type of projects is not large

enough to be managed as one project portfolio, the total amount of resources spent on all types of projects can still be so great, and include so many projects, that the companies still are interested in managing their development efforts as a portfolio of projects. If the same pool of resources can be used for all the different types of projects, the arguments for managing all the projects as one portfolio are even stronger. Even though we have seen here that the homogeneity of the resources used for the projects in the portfolio yields implications for how to arrange the project portfolio, the resources' homogeneity is generally not considered in the literature.

Adding further to the complexity here is the fact that often the projects can vary widely within each type. Product development projects may, for example, involve development of different groups of products. Manufacturing process development projects may involve different parts of a complex manufacturing process, and technology development projects may involve development of different technological areas. Project portfolios including such distinguished types of projects are generally not considered in the project portfolio management literature so far, even though it states that all types of projects should be included in the same project portfolio (Bridges, 1999; Cooper et al., 2001b). Therefore, the first research question to focus upon in this thesis is:

> *RQ1*: *Which are the implications for organising project portfolio management if different types of projects are managed as one project portfolio?*

The ambition of identifying implications in this research question is not to bring up a complete set of implications, but to identify implications of importance for organising project portfolio management if different types of projects are managed as one project portfolio. The implications focused on here concern the different aspects of organising project portfolio management that have been described earlier as important to consider (procedural aspects, organisational aspects, and aspects regarding the use of tools and methods).

In line with the reasoning when motivating the research question, the type of different projects considered here are projects with such different aims as product development projects, manufacturing process development projects, and technology development projects.

2.6.2. Research question 2

As we have seen, literature elaborating on different tools and methods supporting project portfolio management is extensive (Archer and Ghasemzadeh, 1996). However, the tools and methods are usually developed in isolation from each other and aim at fulfilling different parts of the overall goals of project portfolio management. Research reporting on the practical use of tools and methods shows that companies most often use different tools and methods for fulfilling the goals of project portfolio management (Cooper et al., 1998; EIRMA, 2002; Center for Business Practices, 2003; Szwejczewski et al., 2004). Best-practice studies have

shown that the companies which are most successful at project portfolio management use a limited number of tools and methods.

The tools and methods chosen, adapted and used for supporting the project portfolio management have to fit with the specific situation in terms of managerial style (Meredith and Mantel, 1999), which industry the company is active within, strategic directions of the organisation, capacity, constraints and complexity (Bridges, 1999). But the selection of tools and methods must not only fit with the specific situation, they must also fit with and complement each other to fulfil the requirements on the project portfolio management decision process. However, even though it is clearly stated that more than one tool and method chosen for the specific situation is recommended, earlier research has not focused on how tools and methods can be used in combination when organising for project portfolio management.

According to the process framework of Archer and Ghasemzadeh (1999) tools and methods (called methodologies in Figure 8) are applied to all of the three different stages – individual project analysis, screening, and optimal portfolio selection. Nevertheless, research has not focused on the implications of using such combinations of tools and methods. One reason for this may be that the same group of managers is assumed to be involved in all of the stages. Further, all stages can be carried out on one and the same occasion. In such situations the implications of using combinations of tools and methods may be less interesting to study.

But if the process is not as linear as the one suggested by Archer and Ghasemzadeh (1999), the implications of using combinations of tools and methods are more interesting to study. If the project portfolio management activities are arranged in such a way that the activities are separated in terms of when, where and by whom they are carried out, the implications of using combinations of tools and methods assisting the different stages become intriguing. Here it is argued that these implications are important to take into account when organising for project portfolio management, and consequently the second research question in this thesis is:

> ***RQ2****: Which are the implications for using combinations of tools and methods in project portfolio management?*

As for research question 1, the ambition of identifying implications is not to bring up all possible implications, but to identify those of importance for organising project portfolio management when using combinations of tools and methods. The implications focused upon in this research question concern the choice (which type of tools or methods), the adaptation (which parameters to use in the tools and methods), and the application of the tools and methods to the project portfolio management activities.

2.6.3. Research question 3

In organising for project portfolio management, it is not only important to choose and adapt a combination of tools and methods that together have the potential to fulfil the expected outcome. It is at least as important that the organisation develops an environment that supports the project portfolio management (Levine, 1999). When arranging project portfolio management activities, it is therefore important to take into account also how the tools and methods are intended to be applied to the activities already when choosing and adapting them.

For example, it is relevant to consider which different activities will make use of the tools and methods during the process. Will they, for instance, be used in reviewing the portfolio compositions or in selecting projects for the portfolio, or both? Further, the tools and methods can be used for different types of activities such as discussions, preparations and decisions, which are also relevant to consider, as is the sequence of the activities. Such procedural aspects of managing the project portfolio are therefore argued to influence the use of tools and methods.

As stated earlier, the type of tool or method to use in the project portfolio management should depend on the philosophy and wishes of management (Meredith and Mantel, 1999). Hence it is also important to consider which organisational participants to involve in the project portfolio management when choosing, adapting and applying the tools and methods. The organisational structure of the development organisation is yet another organisational aspect that influences the use of tools and methods in project portfolio management.

Consequently, the procedural and organisational settings for managing the project portfolio are relevant to consider when choosing, adapting and applying the tools and methods to the project portfolio management. Therefore it is interesting to study how the procedural and organisational settings affect the choice, adaptation and application of the tools and methods, and the third research question to focus upon in this thesis is:

> **RQ3**: *How do the procedural and organisational settings affect the use of tools and methods in project portfolio management?*

Procedural and organisational settings here refer to the way in which the project portfolio management activities are arranged and how the organisational participants are involved in the activities. As can be understood from the motivation above, and from the clarification of research question 2, the use of tools and methods refers to the choice, adaptation and application of tools and methods in project portfolio management.

3. Research methodology

In this chapter the methodological considerations for the thesis are described. It starts out with a discussion on my view of research and knowledge, followed by a description of the evolution of the research studies in my Ph.D. process. Then different methodological approaches used in the project portfolio management area are explored and the premises behind choosing the case study research strategy are discussed. After this follows a description of the frequent interaction between the empirical observations and theory which has characterised the research process, and connected with this a description of the analytical path in the thesis.

Thereafter follow presentations of the different research studies that have been part of the Ph.D. process: the SCA case including one longitudinal study, the multiple case study, and the Ericsson case including two separate studies[1]. Beside the specific case descriptions, also the sources of data and the data collection methods used in the different studies are described. The chapter concludes with a discussion on the quality of the data and the possibilities for generalisation.

3.1. My view of research

In the process of obtaining a Ph.D. there are many different influences that might impact the choices made during the journey, some being important while others are not. In this section I will try to give a view of the more important influences that have had an impact on my choices.

Within the area of project portfolio management there are many possible interesting courses to follow, more or less theoretical. The focus for the thesis could for example have been an increased understanding of projects that are run without being formally assigned and part of the portfolio. Or it could have been to study discussions underlying decisions taken with regard to project portfolios. There are many such different topics that possibly could have been chosen as a specific topic for the thesis. But I think my background as an engineer has largely influenced the choice of specifically studying aspects of importance for organising project portfolio management. The most interesting research to me personally has always been research that can easily be applied and used in practice. Therefore, organising related issues of project portfolio management was a natural choice of specific topic for my thesis.

This view of what constitutes interesting research is probably a result of being an engineer. As a former colleague wrote: *"being an engineer is being normative"* (Lundqvist, 1996). This background has influenced the choice of topic of research

---

[1] The two separate studies within the Ericsson case have been important parts of the Ph.D. process, but do not contribute to the specific purpose of the thesis. As these studies do not focus on project portfolio management, the results from them (papers 1-3) are described as part of this chapter, instead of Chapter 5 (Extended summary of papers focusing on project portfolio management). These results are described in connection with the description of the specific studies.

with more normative final aims, in favour of more theoretical questions. This is not to say that theory generation is not essential, because theory building must be the essence of research. However, the theory developed can certainly have some managerial implications as well.

Not only has my background as an engineer influenced the choice of topic for the thesis – so has the environment in terms of colleagues and the research tradition at my department. The Division of Operations Management and Work Organization has a long tradition of close collaboration with industry, and of focusing on issues with high relevance in practice. The close collaboration with industry is a result of free and open access to Swedish companies' internal information, the tradition of industrially relevant research results, and to some extent also financial support from industry (Nobelius, 2002). Such support from the collaborative companies can influence research in a negative way if the companies steer the research direction on a detailed level. But in my experience this is not a problem if the importance of not directing the specific research is stated before initiating the collaborative relationship. Instead I have found that the companies and the personnel involved share a great interest in the research and are more committed to participating in the studies if these are financially supported by the company in question.

However, the tradition of such research with high industrial relevance, and in close collaboration with the industry, was important for me when deciding to initiate my Ph.D. studies. This tradition, together with my own view of interesting research, has also influenced my choice of studying the organising issues of project portfolio management.

Another way in which the academic environment has influenced the Ph.D. process is the preference for case-based research, often with qualitative approaches. This is closely connected with the topic's relevance for practitioners and the fact that it is often related to an interest in how and why things really work inside the companies in focus. Even though a case-based approach with qualitative analysis is used frequently, the approach chosen must always be based on the appropriateness of the specific purpose. The tradition of commonly using case-based research strategies does, however, also affect the choice of specific topics to study. As for this thesis, the focus on the organising aspects of project portfolio management calls for a thorough understanding of company-internal mechanisms, which is an inevitable strength of the case research strategy (Yin, 1994).

Summarising this discussion, it can be concluded that a rather pragmatic approach (Tashakkori and Teddlie, 1998) to research, or pragmatic realism (Alvesson and Sköldberg, 1994), is what characterises my view of good research and how to conduct such research. The practical application of the research results is important. However, for me such practical application often relies on an understanding of the underlying meanings of the obvious evidence (Alvesson and Sköldberg, 1994). How to conduct research depends on and influences the specific purpose, for me. There simply does not exist any *"guaranteed methodological path to the promised land"* (House, 1994 in Tashakkori and Teddlie, 1998, p.11). The

research question is more important than either the method used or the world-view that is supposed to underlie the method, which is symbolic for pragmatism (Tashakkori and Teddlie, 1998). For me the research question to focus upon, the method to use, and the applicability of the results are closely connected with each other and, therefore, pragmatism is appealing as it presents a very practical and applied research philosophy: *"Study what interests and is of value to you, study it in the different ways that you deem appropriate, and use the results in ways that can bring about positive consequences within your value system"* (Tashakkori and Teddlie, 1998, p.30). As being a researcher, an underlying presumption is also that the topic is theoretically relevant for extending knowledge.

3.2. Evolution of the research studies

The tradition of working in close collaboration with companies on topics highly relevant both for the research community and for the practitioners involved in the studies has had implications for the evolution of my Ph.D. process. When my Ph.D. studies were initiated during spring 2000, a research project at Ericsson had already begun with a pre-study during 1999 by two of my colleagues (see Nobelius, 2002 and Karlsson, 2004). The aims of the research project were therefore already set when I became involved. This first study at Ericsson resulted in the first paper, focusing on perceived project complexity in technology development projects (Dawidson et al., 2004). The other part of the research project was carried out by a colleague and dealt with strategic actions in Ericsson's management of Bluetooth (Nobelius, 2003).

When the second study at Ericsson was initiated, some preliminary research questions were presented for a steering committee at the company. The discussions resulted in two different focuses which were highly relevant for the company at that time, but also interesting from a theoretical perspective. The questions chosen to emphasise were not directly in line with the initial thoughts, but still within the area of R&D management. This study, which was finished during 2002, resulted in the second paper on product and technology roadmapping (Karlsson and Dawidson, 2003) and the third paper on management of product boundaries (Dawidson and Karlsson, 2005).

In 2003 a new research collaboration was initiated with SCA (Svenska Cellulosa Aktiebolaget), and specifically the Away-From-Home (AFH) Tissue business unit. After an initial pre-study at the company, which generally focused on R&D management challenges, the project portfolio management area was chosen, which differed to some extent from the Ericsson studies. Project portfolio management also came to be the focus for a multiple case study during 2004/2005. The SCA case study resulted in two papers (Dawidson, 2004; Dawidson, 2005), both of which contribute to the purpose of the thesis and are consequently appended to the thesis. Beside the papers based on the material from the SCA study, additional empirical data are added to the thesis in Chapter 5. The multiple case study, which also focused on project portfolio management and resulted in the sixth paper (Dawidson et al., 2005), was made with support by a master thesis. The sequence

of the case studies at Ericsson and SCA and the multiple case study is schematically described in Figure 9.
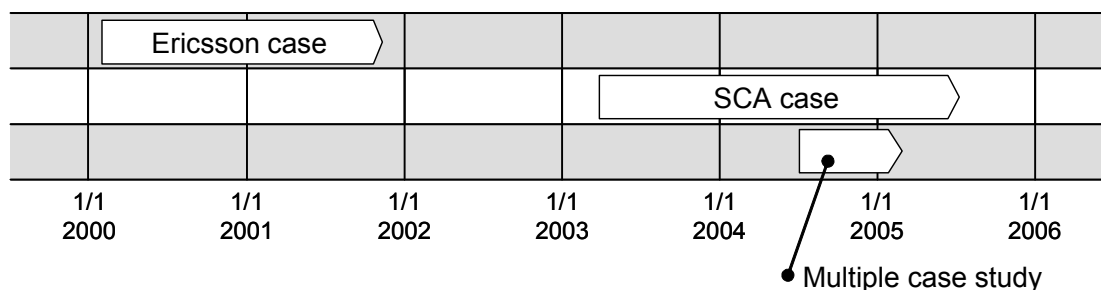
Figure 9: Overview of the research studies

When the SCA case study was initiated with a different focus compared to the Ericsson case, it was also decided to focus on project portfolio management as the overall subject of the thesis. The choice was mainly based on a wish to get a more focused topic for the thesis and a possibility to make better use of the empirical data from the SCA case. However, it implied that the results presented in the three papers based on the Ericsson case could not be used for the overall topic in the thesis. The reorientations in the thesis process into slightly different focus areas are also a result of the pragmatic approach to research (Tashakkori and Teddlie, 1998). What has been of interest and of value to myself, in combination with the interests of the cooperating companies and, last but not least, the relevance for the research community, has guided the choice of research topics.

Even though the three papers that resulted from the Ericsson studies do not contribute to the purpose of the thesis, they are still appended to it since they have constituted a main part of my Ph.D. process. However, as the results of these papers do not explicitly contribute to fulfilling the purpose of the thesis, they are separated from the main empirical part of the thesis. Instead they are described as part of this methodology chapter in connection with the description of the studies. After the latter, a discussion follows on how the Ericsson studies have contributed to my Ph.D. process (see section 3.10).

As the SCA case together with the multiple case study constitutes the empirical data for the purpose of the thesis, the SCA case and the multiple case study are here described before the Ericsson case, even though they were not carried out in that sequence. But prior to describing the methodological considerations in the different cases, a short review of methodologies applied to the area of project portfolio management will be given.

3.3. Methodological approaches within the field of interest

In section 1.3, Research on project portfolio management, the different topics that have been mainly focused upon in recent years were described. In this section, methodological aspects regarding this research will be further elaborated on.

Research in the area of project portfolio management has been conducted using different methodological approaches during recent years. As already noted in the introductory chapter, the early attempts within the area of project portfolio management had a strong focus on developing tools, methods or techniques for evaluating projects and project portfolios (Archer and Ghasemzadeh, 1996; Cooper et al., 2001b). This stream of research was to a large extent conducted without direct support by an empirical base (Cooper et al., 1999). Practitioners were seldom involved in testing or evaluating the tools or methods, and many of the developed tools or methods never found applicability among practitioners.

Another stream of research in the area with a wider focus on project portfolio management, i.e. not only the tools or methods, has primarily used breadth-based methodologies. Three explorative studies of companies in the US have attracted great interest during the last decade (Cooper et al., 1999; Center for Business Practices, 2003; Cooper et al., 2004). The first study by Cooper et al. (1999) involved 205 responding companies, and the study by Center for Business Practices involved 64 responding companies. The third and latest study has a more general focus on product development, but more in-depth questions of project portfolio management are also included. The results of these studies focus largely on how the use of project portfolio management tools and methods is perceived by managers in the companies and how well the companies perform in their project portfolio management work.

Beside these two streams of research, which have gained the most interest, some other methodological approaches have been used as for example, literature reviews and theoretical analyses (Archer and Ghasemzadeh, 1996; Archer and Ghasemzadeh, 1999; Meredith and Mantel, 1999), multiple case studies (Szwejczewski et al., 2004), and some single case studies which often have focused on the application of a specific tool or method in a specific company (Braunstein and Salsamendi, 1994; Sharpe and Keelin, 1998; Linton et al., 2000).

The area of project portfolio management as interpreted here, i.e. beside just the development of project portfolio management tools and methods, must be said to be rather new and not very well developed. Many of the findings presented so far are based on best practices and are rather atheoretical. Based on the knowledge provided in the area so far, it is therefore argued here that an important next step in developing the area is to increase the understanding of how project portfolio management can be organised. The purpose of this thesis, to increase the knowledge of aspects important for organising project portfolio management, is consequently one such step of developing the knowledge in the area. Such increased understanding of organising project portfolio management requires that methods aiming at in-depth understanding of the phenomenon are applied.

3.4. The case study research strategy

The case study research strategy was found appropriate basically because of the nature of the problem. As argued above, an important step in increasing the knowledge in the area is to increase the knowledge of how project portfolio management can be organised. Being able to answer the research questions stated calls for a thorough understanding of how project portfolio management is organised, but also of why it is organised in certain ways.

In the theoretical exposition it was described that how project portfolio management is applied in practice depends on the specific situation (Kendall and Rollins, 2003), which implies that, in order to understand how project portfolio management is applied, an in-depth understanding of the specific situation is crucial. That the case study research approach is appropriate for studying such interplay is stated by, for example, Yin (1994) and Eisenhardt (1989). Yin (1994) states that case studies are appropriate when the studied phenomenon cannot be separated from its context, and Eisenhardt (1989) argues that the case study strategy focuses on understanding the dynamics present within single settings.

The case study research strategy is also argued to be well suited for questions which are not thoroughly researched (McCutcheon and Meredith, 1993), which is valid for the understanding of how and why project portfolio management is organised in certain ways. The possibility to generate theory in such new research areas is a further strength of the case study method (Eisenhardt, 1989; Tashakkori and Teddlie, 1998; Voss et al., 2002) which contributed to the choice of case study approach.

3.5. Frequent interaction between empirical observations and theory

In Chapter 2, Theoretical exposition of project portfolio management literature, it was noted that no complete framework for understanding how and why project portfolio management is organised in certain ways has been provided in literature so far. However, in order to fulfil the purpose of the thesis, which involves thorough understanding of both how and why project portfolio management is organised in certain ways, a framework is needed for basically two reasons. Firstly, the framework is needed for structuring the empirical data. In order to provide a description of how project portfolio management is organised, a framework of aspects important to include is essential. Secondly, the framework is needed for structuring the analysis of why project portfolio management is organised in certain ways.

In developing the framework for structuring and analysing the empirical data, both inductive and deductive approaches could have been used. This study, however, cannot be classified as either inductive or deductive, since the framework has been developed in frequent interaction between empirical observations and theory. Without the frequent interaction with the empirical world, it would have been impossible to understand which areas to involve in the framework. Likewise,

it would have been hard to obtain the use of complementary theoretical areas which were needed in building the framework. The approach should therefore rather be seen as an abductive approach (Alvesson and Sköldberg, 1994) to research, as additional theories have been applied during the research process for better understanding the dynamics at the case company. By constantly going back and forth between the empirical observations and the theory, it has been possible to expand the understanding of both theory and the empirical phenomena (Dubois and Gadde, 2002). The case has to a large extent been used to refine the theory that provided the initial guidance (Ragin, 1992) into a framework for the study (presented in the next chapter). This is based on an understanding that theory cannot be fully understood without empirical observation and vice versa, and is referred to as a systematic combination between the theory and the empirical world (Dubois and Gadde, 2002).

3.6. The analytical path in the thesis

That the research has been characterised by a systematic combination between the theory and the empirical world makes it very difficult, if not impossible, to describe the analytical path exactly as it has evolved. The analytical path that can be inferred from the thesis should therefore be seen as a simplification of the real research process. Nevertheless, it is important to describe and explain which analytical steps are needed in order to arrive at answers to the research questions. The different steps are summarised in Figure 10.

As argued when describing the frequent interaction between the empirical world and theory, the development of the research framework should be seen as the first step in the analytical process. It was further argued that the framework is essential for the analysis with the final aim of answering the research questions. Therefore the research framework is also a natural first step in the analytical path as provided in the thesis.

The next step in this analytical path is the description of *how* the case company has organised for project portfolio management. Providing such a description is seen as a first step in exploring the case
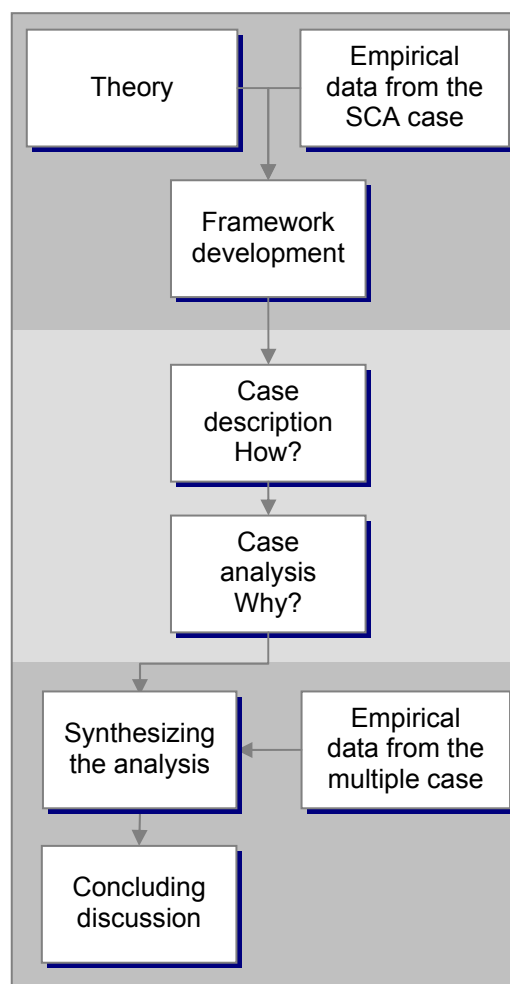
Figure 10: Schematic view of the analytical path in the thesis

(Miles and Huberman, 1994). Neither is this step of the analytical process as linear as it is described in the thesis. It has rather been developed in parallel with the development of the research framework.

In order to arrive at answering the research questions, further analysis of the empirical data is needed. The description of how the project portfolio management is organised at the case company does not provide explanations of *why* project portfolio management is organised in the certain way. Such thorough understanding of why project portfolio management is designed in that way is, however, necessary for being able to draw descriptive conclusions from the case (Miles and Huberman, 1994). These descriptive conclusions are used in the next stage of the process for elaborating on the answers to the research questions. Naturally there is no clear boundary between describing and explaining (Miles and Huberman, 1994), but this part of the analytical path is distinct from the case description part in that it makes use of existing knowledge for understanding why project portfolio management is organised in a certain way. Yet this part does to some extent also differ from the empirical part in the sense that it includes reflexion and interpretation (Alvesson and Sköldberg, 1994) of what was provided in the empirical data, in order to provide a thorough understanding of why project portfolio management is organised in the certain way.

The next step in the analytical path then takes its point of departure in the research questions, and aims at synthesising the empirical findings and elaborating on the answers to the research questions. The synthesis also uses parts of the results from the multiple case study (Dawidson et al., 2005) for relating and comparing the results from the single case study at SCA. The results of this multiple case study have to some extent also influenced the development of the research framework. This, however, is not explicitly shown in Figure 10. The final step of the analytical path is the concluding discussion where the answers to the research questions are discussed and the contributions are elaborated on.

3.7. The SCA case

In the light of the applied methodologies in the project portfolio management area, it was earlier stated that an appropriate choice of research strategy to apply in order to extend the knowledge in the area was the case study research strategy. As SCA provided a possibility to follow the process of designing a project portfolio management process case study, following this design process seemed appropriate in order to gain a sufficient understanding of the organising aspects of project portfolio management that would enable extension of the knowledge in the area.

3.7.1. Reasons why SCA AFH Tissue is appropriate for studying aspects of organising project portfolio management

The business unit for Away-From-Home (AFH) Tissue products at SCA was found to be appropriate for studying project portfolio management for diverse reasons. The most important criterion to be fulfilled when choosing a company for studying project portfolio management aspects must be that the company actually runs a portfolio of projects of such considerable proportions that the company is of the opinion that it is meaningful to manage the collection of projects as a portfolio. SCA AFH Tissue runs about 35-60 projects per year, and has the ambition of managing the projects as a portfolio. The second criterion for choosing a company must be that the company itself, at least to some extent, has the possibility to decide on projects to run. This is, for example, not always the case for sub-contracting companies or companies developing unique products on a business-to-business market. The development at SCA AFH Tissue is highly characterised by possibilities to choose among a plethora of project ideas for development. Based on these two fundamental criteria, the company was found suitable for studying organising aspects of project portfolio management.

There are, however, three other characteristics that during the study have proved to make SCA AFH Tissue even more interesting for the thesis' purpose and the research questions. The formulation of the specific research questions, even though they were motivated from a theoretical perspective, has been influenced by interaction with the empirical world, just like the development of the research framework. Therefore it is not entirely true to state that the characteristics were important for choosing the case company, as the different characteristics presumably had influenced the formulation of research questions. The three additional case characteristics have, nonetheless, been of great importance for answering the research questions formulated. The first characteristic of importance is that the projects not only directly focus on development of new products for the market, but also concern manufacturing process development and more unprejudiced technology development – all projects having the use of the same resource base. The second characteristic is that the project complexity varies from rather low in some projects to very high, involving certain parts of a complex manufacturing process. The third characteristic is that the projects vary widely in terms of duration, from some months to several years.

Beside these, so to speak, qualifying characteristics of the case company, other and more practical reasons for focusing on SCA AFH Tissue also exist. In order to gain a thorough understanding of the organising aspects of project portfolio management, which has been argued appropriate for extending the research in the area, a company with a willingness to allow close interaction with the researcher was needed. This, and a desire from the company to increase its own understanding of aspects of organising project portfolio management, were important complementary reasons why SCA AFH Tissue was chosen for the study. Another was the geographical location of the company, which permitted frequent interactions with the empirical world, but still in close contact with the university.

In order to gain a thorough understanding of project portfolio management, the reasons described above were the most important. That the case company should be clearly good at organising for project portfolio management was not seen as important when choosing the case. In gaining the thorough knowledge needed for fulfilling the purpose, it did not matter if the case company was particularly successful or not in managing the project portfolio. The most important criteria were instead, as stated earlier, that the company should be managing a portfolio of projects and should have the possibility of choosing which projects to run.

3.7.2. SCA AFH Tissue – a short description of the business area

SCA is an international paper company that produces and sells absorbent hygiene products, packaging solutions and publication papers. Products are developed for consumers, institutions, industry and the retail trade. The company is represented in all continents in the world, but the main markets are Europe and North America, while strong footholds exist in Latin America and Asia. Many of the company's products are among the most well-known on the market. In 2004 the annual sales amounted to SEK 90 billion (EUR 10 billion) and SCA had about 50,000 employees in about 50 countries (http://www.sca.com/).

SCA is divided into three business areas based on the different products: Hygiene, Packaging, and Forest products. The focal company for the study, Tissue AFH (Away-From-Home), is part of the Hygiene products area; it develops, produces and sells different types of hygiene products for business-to-business markets. These products are classified as tissue products (e.g. toilet paper, household towels, handkerchiefs, napkins) and fluff products (e.g. incontinence products, feminine hygiene products and baby diapers). For tissue products sold business-to-business, the company has established a separate R&D department in order to serve markets all over the world, often with specific products for the separate markets – implying that many product groups and specific products have to be updated and developed, and often in separate projects. The products are categorised as commodity products, and the R&D activities aim at developing both existing and new products but also the manufacturing processes, in order to make them more effective and reduce the production costs.

3.7.3. The collection of data

Even though case study strategies and qualitative research are often used interchangeably, case study research can involve either qualitative or quantitative studies, or combinations of both (Eisenhardt, 1989; Yin, 1994). The data gathered from the case study at SCA are, however, entirely qualitative, since this approach was seen as the most appropriate for providing the thorough understanding of organising issues of project portfolio management that was needed for the purpose.

In building knowledge from qualitative studies, researchers typically combine multiple data collection methods (Eisenhardt, 1989). The list of data collection methods available for case study researchers can be very long, but the more important and useful are, according to Yin (1994) and Voss et al. (2002), the six

different types found in Figure 11. In the longitudinal case study of about 2.5 years, I have been in close contact with the company personnel during regular visits at the site and five of the data collection types described by Yin (1994) and Voss et al. (2002) were found useful and have consequently been used.

Sources of evidence (data)	
• Documentation	• Direct observation
• Archival records	• Participant – observation
• Interviews	• Physical artefacts

Figure 11: Sources of evidence in case study research (Yin, 1994)

Different types of *documentation* have been used as source of data or evidence. The documentation used has the character of general information, such as information about the company and the business unit from the intranet, but also of more specific information. Examples of such specific information used are diverse types of project documentation, process documentation, strategy documentation, minutes from meetings, records from presentations made in various forums, and other internal documentation provided by the intranet. In order to get access to usable data, the members of a steering committee for the research collaboration provided guidance on where to find relevant documentation. However, this type of written data was used with care, as such written information cannot be regarded as a source of data free from bias. The written documentation may include what Yin (1994) calls reporting bias, i.e. unknown bias of the author of the document. In order to avoid such bias, no information from single sources was used; instead, each document was critically scrutinised and compared with data provided by other types of information.

To some extent, *archival records* have also been used as a data collection method in the study. The primary archival records that have been used are historical documentation of the project portfolio outcome, but also historical documentation regarding specific projects has been used in the study. Beside these sources of data, organisational charts and project budgets have been used for collecting data. According to Yin (1994) an investigator must be careful to ascertain the conditions under which the data were produced, which has been important in this study especially when the documentation provided was personal documentation from presentations in different forums. However, when documentation from such sources was used for critical purposes in the study the data were cross-checked with other types of sources. Additionally, most of the archival records used for collecting information in the study have been referred to and recommended by the steering committee at the company, whose members represent good knowledge of the different records' reliabilities.

In most case study research, the most important source of information is the *interview* (Yin, 1994), which also characterises the case study at SCA. In the study, different types of interviews have been made, from rather structured to more open interviews. The more structured interviews can be classified as semi-structured, in that a previously prepared interview guide was used as a guideline. However, the

guide was used in a way that let the respondents feel as free as possible to talk about the overall theme, and therefore the guide should be seen chiefly as a checklist to ensure that no important themes were left out. In the more open interviews, some overall themes were used as topics for the interviews and then the answers from the respondent guided the conversation. Common to all interviews was that they were of an open-ended nature; the respondents were asked both about facts and about their opinions on specific themes (Yin, 1994). All of the interviews that are classified here as semi-structured were recorded and transcribed word by word in order to make it possible to go back and analyse what the different respondents explained during the interviews. During the more open interviews I took notes which afterwards were transcribed in order to enable further analysis. The transcriptions from the interviews have not been sent back to the respondents for comments, but their results have been presented to and commented on by the members of the steering committee for the research project. The results from the analysis have, however, been presented to all respondents involved, most often at formal presentations or meetings in the case company.

The persons interviewed are a selection of managers on different levels and from different units of the organisation that were found to represent a complete view of the questions of interest. The steering committee guided me to a number of persons with important knowledge in the area. But during the study additional persons were identified, partly by the actual respondents and also by my own expanding company-internal network, as people with important knowledge in the area. In total 16 semi-structured interviews with different persons were conducted. In addition to these, over 20 formal open interviews were made, although some of them with the same person involved more than once.

Beside the data collected from interviews, the second most important sources of data have been different types of observation; what Voss et al. (2002) and Yin (1994) term *direct observation* and *participant observation* have both been used. The chief sources are observations from meetings with different forums having responsibilities for project portfolio decisions or preparations for such decisions. During a year I followed one such forum's monthly meetings focusing on project portfolio decisions. In some meetings I took a more passive role observing the discussions in the group, while in other meetings my role was more active when questioning specific reasoning. On further occasions I myself have been the one leading the meetings, which have then often focused on themes connected with how the project portfolio management is organised or comments on results from the study. This participant observation is therefore similar to group interviews, more or less structured. The meetings with the steering committee are other examples of participant observation in which I have taken an active part when presenting results from the study.

3.8. The multiple case study

The purpose of this study was to investigate how a few companies manage their project portfolios, and thus a methodology aimed at gaining a thorough understanding of companies' internal processes connected with the project portfolio management was needed. To gain such knowledge and understanding, the case research strategy was seen as the most appropriate. As we were interested in how the internal processes really were set up and why they were set up in certain ways, the case study strategy was considered a particularly good methodology (Yin, 1994). In addition, the case study research strategy is unconstrained by the rigid limits of questionnaires and models (Voss et al., 2002), an advantage which permitted a more in-depth study of how the companies manage their project portfolios.

When using multiple case studies for research, the case selection is a vital issue (Voss et al., 2002). The cases must be carefully selected so that they either predict similar results, or produce contrasting results but for predictable reasons (Yin, 1994). In this study, the first criteria guided the selection of case companies. The overall criterion when selecting the companies was that the managers at the companies themselves stated that they were managing their projects as a portfolio. This implies that the case companies can be predicted to show similar results to some extent.

For the selection of specific case companies, the most important criterion was that they had a portfolio of R&D projects and a possibility to decide by themselves on the direction for the portfolio, i.e. which project ideas to choose or prioritise. This is not always possible for sub-contracting companies where the customers' behaviour strongly influences which projects to run. Beside these criteria for choosing case companies, aspects such as the annual R&D budget (>10 million Euro) and the quantity of projects in the portfolio (>10 projects) were considered. Finally, the companies had to operate within different areas in order to avoid being industry-specific.

The number of case companies was required to be small enough to allow a manageable study and a deep understanding of each company's processes. The cases were also chosen to represent practice among a few Swedish companies' development units; hence, the number of case companies could not be too small. Due to these aspects, a study of six companies was thought to give a good trade-off between breadth and depth. The case companies are specified in the paper, due to secrecy reasons, beside what type of business they are active within. The companies were: one medical equipment company, one system supplier, one high-tech product company, one industrial company and two large manufacturing companies.

The collection of data

Three interviews, each lasting about one and a half hours, were conducted at each company in order to get a thorough understanding of the internal project portfolio management processes. Consequently, totally eighteen interviews were conducted. Based on earlier research (Cooper et al., 2004) and knowledge from the SCA case that people from different departments have different views and requirements on the project portfolio management, one executive manager, one senior marketing manager, and one senior R&D manager were selected to be interviewed at each company.

The *interviews* were primarily of a semi-structured type. A previously prepared interview guide was used as a basis; the guide was, however, used in a way that let the respondents feel free to talk about the overall theme. All interviews were recorded and after the interviews they were transcribed together with additional observations made. These data from the interviews constitute the bulk of the empirical data, but also internal *documentation* was provided from some of the companies.

As noted earlier when describing the evolution of the research studies, this multiple case study was accomplished with support from a master thesis. Due to time constraints I did not have the possibility to participate in the interviews, but I was strongly involved in and influenced the development of the interview guide. As tutor for the master thesis I also had the possibility to '*coach*' the master students before and between the different interviews. Moreover, I continuously took part in the transcriptions from the interviews during the study in order to gain as thorough a knowledge as possible about the companies' project portfolio management practices. The analysis and writing of the paper (Dawidson et al., 2005) were done in cooperation with the students.

3.9. The Ericsson case

The research collaboration with Ericsson was initiated with a part which was called Ericsson Communication Systems (ECS). The company developed and produced both systems and terminals (i.e. mobile phones) for mobile communication. The collaboration was primarily set up in collaboration with the development organisation called Ericsson Mobile Communication (EMC). When the collaboration was initiated, the second generation (GSM) for mobile communication was well established in the marketplace and initial development steps were taken in the development of the third generation for mobile communication (UMTS).

Between the first and second studies, EMC was divided into two separate companies as a result of the joint venture with Sony. The part of EMC that was responsible for completing the development of Ericsson terminals, once the technical platform was ready to be implemented, was placed in a new company called SonyEricsson. The part of EMC which, before the split, was responsible for

the development of the technical platforms was placed in a new Ericsson company, called Ericsson Mobile Platforms (EMP).

3.9.1. The first Ericsson study

The focus for the first study within the Ericsson case was complexity in the technology development, and more specifically the complexity perceived by the engineers in development projects. The purpose of the paper is to investigate what parameters constitute the perceived complexity, and the aim is to further combine these parameters into a model that can be used for measuring the perceived project complexity in terms of relative importance of variables. In the paper, a theoretical first-order model is developed, and is then verified in the study of two technology development projects.

The collection of data

For the test and verification of the first-order model, two on-going projects were analysed and the two projects were situated in two different organisations. The first project was the development of the fifth platform generation of the GSM technology (the second generation of mobile communication), which was developed in a "mature" organisation. The second project was the development of the first platform generation of the UMTS technology (the third generation of mobile phones), which was developed in a separate organisational unit.

The second project was newly established and placed in a separate organisation, which made it possible to study two projects in two organisational settings, partly different but partly also with the same characteristics. Some of the differences between the projects allowed better model-testing in terms of ambiguity. As the UMTS project was staffed with a majority of new personnel and placed within a new organisation, they were forced to assess their current situation when they were asked about their perceived complexity. Managers from the GSM project might have been affected by previous experiences, while the managers' mental models in the new organisation were not.

The two technology projects both aimed at developing new technical platforms and were divided in the same way into "technological object units", i.e. sub-projects. To get the complete picture of what the project members experienced as contributing to complexity, without asking every single project member, the nine object managers at each platform project were interviewed, as well as the two platform managers. The object managers were positioned in the "middle" of the project hierarchy and thus were seen as having the possibility to perceive not only upward and outward, but also downward on technological levels, the latter being due to their involvement in development activities. The experiences of complexity collected from these managers were therefore considered to be the overall view of complexity. The selection of object managers was similar in both of the projects.

The interviews conducted lasted for about one and a half hours each and were based on an interview guide, but they were also adapted during the discussions. In this sense, the interviews were semi-structured. The interviews were recorded and

transcribed word by word in order to make it possible to analyse in depth what every individual respondent explained. The transcribed interviews were read and analysed by each of the researchers in order to avoid misinterpretations of what the respondents really mean about complexity.

For the investigation of which parameters contribute to the perceived complexity, the interviews were the only source of empirical evidence. But for a broader understanding of the cases, other sources were also used, e.g. minutes from meetings, discussions with the steering committee and other types of internal documentation.

Results from paper 1: Complexity Perception – model development and analysis of two technical platform projects in the mobile phones industry

Authors: <u>Ola Dawidson</u>, <u>Martin Karlsson</u> & Lars Trygg[2]

The results from the paper show that underlying parameters of perceived complexity in the development of a technical platform in the mobile telecommunications industry can be presented in a model consisting basically of two types of complexities, divided into three levels. The division of complexities is based on earlier findings by Williams (1999), and the complexities are defined as *Structural uncertainty* (differentiation and dependencies) and *Uncertainty* in goals and methods. These complexity parameters can further be found on three different levels in the project environment: *the external organisation, the internal organisation*, and *the product*. This division into organisation and product is based on earlier findings by Baccarini (1996); but with support from the mapping of the empirical data in the study, the organisation was further divided into external and internal organisation aspects.

	Structural Uncertainty		Uncertainty	
	Differentiation	Dependencies	Goal	Method
External organisation				
Internal organisation				
Product				

Figure 12: Model for measuring perceived project complexity
(adapted from Baccarini, 1996 and Williams, 1999)

The results from the comparison of the two projects show that the underlying parameters of complexity come into play differently in different settings; e.g. how these parameters are perceived is highly dependent on the specific situation. The main difference between the two projects was that more respondents in the GSM project say that product complexity contributes to project complexity, compared to those saying that internal organisation does so, while in the newly established UMTS project the respondents to a greater extent say that the organisation both

---

[2] The underlinings indicate the paper's main author(s).

internally and externally contributes to the project complexity. The fundamental explanation is that the GSM organisation is mature and well known by the respondents and that the technological content evolves continually, which creates uncertainties regarding how the product is to be realised.

3.9.2. The second study within the Ericsson case

The focus for the second study at Ericsson was twofold. The first focus was on the Product and Technology Roadmapping (PTR) activities at the company, where an organisational perspective on the activities was taken. The specific aim was to analyse how the introduction of PTR had forced the organisation to adapt with respect to organisational solutions, working practices, and communication structure. The presently available theory regarding PTR was found to be fragmented in the sense that it thoroughly describes the whys of PTR, whereas how to actually implement and run such activities was found to be an area in need of more investigation.

The second focus for the study was the new situation that arose when the company was divided into Ericsson Mobile Platforms and SonyEricsson. The split had consequences for the value-chain and new product boundaries had to be established. Likely situations have earlier been found within other industries, and therefore the aim of the study was to elaborate on a framework supporting managers in their view of different factors to be taken into account when facing such situations.

The collection of data

As the focuses for the study were similar in the sense that they both aimed for a thorough understanding of the specific situation, the study inevitably raises questions as to how and why the specific situation is built up. This was the main reason why the case study research design was found to be the most appropriate (Yin, 1994).

When this second study at Ericsson was initiated, the separately established UMTS organisation had been reintegrated in the mother organisation and the technology development parts of the two projects were now part of the new company Ericsson Mobile Platforms. This company constituted the unit of analysis for this second study at Ericsson, firstly because it had newly established working procedures for PTR. Secondly, the organisation was facing a situation where new product boundaries had to be set as a consequence of rearranging the value-chain, and therefore the managers at the company ought to have knowledge about factors to take into account in deciding on such situation.

The interviewees selected consist of a complete selection on departmental level. These in turn selected personnel to whom they had delegated planning responsibility, or else who had previously been involved in planning activities. A total of 17 people were interviewed from the different departments.

To acquire the deep understanding of the dynamics involved that was required to fulfil the aims of the study, different sources of information were used. Data were gathered from different types of sources, including interviews, comments during meetings with a steering committee, and internal documentation. The main part of the study was accomplished during a three-month period when the researchers visited the company for about 12 days, during which 17 interviews were conducted. The respondents were selected primarily on the basis of discussions in a steering committee for the research project, but some of them were identified during the study, by the actual respondents, as persons with specific knowledge in the areas. All of the respondents provided important information about both the focus areas, even though some of them had more knowledge about one of the areas.

The data from the interviews constitute the main part of the empirical data. The interviews were primarily of a semi-structured type, in that a previously prepared interview guide was used as a guideline. However, the guide was used in a way that let the respondents feel as free as possible to talk about the overall theme, and therefore the guide should be seen chiefly as a checklist for the researchers to ensure that no important themes were left out.

Meetings with the steering committee were held regularly before, during and after the study in order to present the state of the study and also, more importantly, to get feedback on the empirical data that were gathered in the study. The steering committee also pointed out some new respondents to include in the study, and guided us to obtain access to relevant internal documentation. The documentation included in the study consists mainly of internal records from presentations made in different forums.

Results from paper 2: "Product & Technology Roadmapping in the mobile phone industry"

Authors: Ola Dawidson and <u>Martin Karlsson</u>[3]

The aim of this paper was to analyse how the organisation has responded to the introduction of Product & Technology Roadmapping (PTR). Our objective was to describe problems that were experienced at the case company and relate these to flaws in current theory. The main problems found from the case study concern differences in purpose of PTR, organisation of PTR within a complex organisation, and communication & synchronisation.

The results show that a vaguely defined purpose of PTR will unavoidably result in different opinions regarding how PTR is conducted. Differences within departments have proved to result in PTR work where some participants expect synchronisation to be externally managed, and some believe it to be their own task – the result being plans with vague connections to related areas outside the department. Differences in purpose between departments have shown similar results. The latter case might, however, be unavoidable due to differences in the

---

[3] The underlining indicates the paper's main author.

departments' purpose within the organisation. Informal groups have in these cases turned out to be down-prioritised, and therefore the results from the study suggest that formal groups forcing personnel to interact are more successful.

An organisation for the PTR work requires a dispersed setup in order to take care of a product complexity which in this case is too large for any individual to handle. However, the product architecture is divided in terms of technical parts of the product, which create dependencies among the functional areas that are difficult to manage. A formal "translation" between technical and functional demands then becomes necessary, early in the planning process. Since there are no formal groups today handling this translation, the personnel have to rely on informal communication channels. The lateral processes created here are, however, likely to fail since informal communication by its own nature does not involve managers who can ensure that the decisions made are implemented. The results from the study indicate that informal reference groups fail also if the planning horizons are different between the departments that are exchanging information.

To support the synchronisation in this case of complex product architecture and complex organisation, a formal communication structure would be needed. The need for a formal structure is even more emphasised by the down-prioritisation that is imposed when departments, as in this case, have differences in purpose of the PTR activity.

Results from paper 3: "Towards a framework supporting the management of product boundaries: a study of the new situation experienced by Ericsson Mobile Platforms"

Authors: <u>Ola Dawidson</u> and Martin Karlsson[4]

This paper takes its point of departure in companies within industries where the value-chains have changed as a consequence of product maturity and competition on the market. In order to support managers in their decisions regarding the position in the changed value-chain and where to place the new product boundaries, the article elaborates on a framework of important dimensions to take into consideration.

The paper gives a rich description and a problematised view of the new situation experienced by Ericsson Mobile Platforms (EMP). Beside this description, the main contribution of the paper is a proposed framework, consisting of six dimensions, guiding managers in taking more rational decisions. In order to elaborate on the framework an existing model was applied to the case.

Following the reasoning in the specific application of EMP, the distinctive dimensions in the model are useful for managers when evaluating where to position the company in the value-chain as well as where to place the product boundaries. The dimensions that constitute the model are Customer Importance, Technology

---

[4] The underlining indicates the paper's main author.

Clockspeed, Competitive Position, Capable Suppliers, and Architecture. Some of these dimensions, notably Customer Importance and Technology Clockspeed, can be interpreted more or less as they were presented in the original model, while the meaning of others is less obvious in this application and needs to be developed further.

Moreover, the empirical data revealed that the model should be extended with a sixth dimension, namely that of Strategic Knowledge. This has two aspects, the first dealing with the long-term strategic consequences of the internal knowledge level, and the second with knowledge dependence on external parties.

The study focused on an industry facing radical changes according to the value-chain design, where the company in question is confronting a set of new situations. The evolution of the mobile telecommunications industry is not a new phenomenon insofar as it has previously been apparent in other fields such as the computer industry. Nonetheless, the paper reveals that research aiming at supporting managers in companies facing new situations of this kind is sparse. The present results should therefore be seen as a first step towards a framework supporting managers in decisions on where to place product boundaries and where to position themselves in the value-chain.

3.10. The Ericsson studies' contributions to the dissertation process

The studies carried out at Ericsson, even though they do not explicitly contribute to the purpose of the thesis, have been important parts of the dissertation process. As described above, each individual paper has contributed to the general knowledge of strategically managing R&D operations. But beside these research contributions the studies have also contributed to my personal development as a researcher. Without these studies at Ericsson, the later studies at SCA and the multiple case study could not possibly have been carried out in the way they were. The contribution to the dissertation process from the studies at Ericsson can basically be divided in two areas: an increased overall knowledge in the area of R&D management, and skills of carrying out this type of collaborative research with industrial companies, together with more general research skills.

The different studies have in common that they deal with managing R&D operations and that they preferably focus on long-term, strategic aspects of managing R&D operations. As a consequence of this strategic focus, the studies deal with R&D activities above the level of managing individual R&D projects. Therefore the main contribution from the studies at Ericsson to the dissertation process is the increased overall understanding of managing R&D activities. This overall understanding, as I see it, has in many respects facilitated the research collaboration with SCA AFH Tissue. The increased understanding of managing R&D activities has also contributed to more effective and in many respects better discussions during interviews and other meetings during the study.

Also closely connected with the understanding of managing R&D activities is the increased knowledge of carrying out this type of collaborative research with industrial companies. Even though the research area of managing R&D activities is rather practical and applicable for practitioners, I learned from the studies at Ericsson that in order for such studies to become successful it is important to separate, to some extent, the deliverables to the research community and the deliverables to the company in focus. This does not mean that they should be separated from each other, but the way in which findings are presented has to be different and sometimes the deliverables to the research community use only small parts of all the knowledge learned from the research collaboration. This separation of the deliverables also has implications for the design and set-up of the studies, in which both kinds of deliverables have to be taken into account. An important question related to the discussion of carrying out this type of collaborative research is the one of ensuring quality of the data, and this is discussed in the next section.

3.11. Quality of data

When discussing the quality of data, different authors propose different areas to be used for the evaluation. Reliability and validity (external, internal, construct) are dimensions proposed by many authors (see for example Creswell, 1994; Yin, 1994). These dimensions refer primarily to two different perspectives of judging research: the measurement quality (measurement validity and reliability) and the inference quality (design validity, internal validity) (Tashakkori and Teddlie, 1998). Tashakkori and Teddlie (1998) do, however, deal with both of the two perspectives simultaneously when dealing with the trustworthiness of the research, as also Lincoln and Guba (1985) do. The most important component in establishing trustworthiness of the results and inferences from qualitative research is to establish credibility of the findings (Tashakkori and Teddlie, 1998). For determining the trustworthiness of qualitative research results, different methods can be used (Tashakkori and Teddlie, 1998) of which some have been applied in this research.

The first method suggested in order to ensure high quality of data collected in case study research is that of *Prolonged engagement* (Tashakkori and Teddlie, 1998). The authors state that it is important that investigators spend sufficient time in the field for three main reasons: to build trust, to learn the culture, and to test for misinformation in the data (either from informants or from the researchers' own interpretations). One of the main strengths of the type of collaborative research that has been used both in the Ericsson studies and in the SCA study is the possibility to build trust, to learn the culture and to test for misinterpretations. Through both of the studies at Ericsson and at SCA the companies have been visited frequently. The Ericsson studies did not allow as much interaction as the SCA study, because of the geographical distance; but the interaction must still be considered high, with between 15 and 20 days spent at the company interviewing and interacting with the personnel.

The study with SCA, however, allowed even more interaction. In this study several days have been spent during the longitudinal study. Some days were spent at the company without having any specific interviews or meetings booked, just in order to get to know the personnel, build trust and learn the culture as well as possible. This frequent interaction also allowed tests of the data gained from the study. Many of the respondents were informally contacted several times during the days spent at the company, which allowed following up and testing the data gained from the study. Regarding the multiple case study, the interviews and related company visits did not permit as much interaction as in the other studies. The companies were generally visited for two days during which the interviews were done, which did not allow building such deep trust and knowledge about the culture as in the other studies.

The next method, that of *Persistent observation*, is closely related to the first one. It, too, deals to some extent with spending sufficient time in the field, but also concerns being persistent in collecting data and thereby providing a deep knowledge about the phenomenon. This means identifying the characteristics that are most important for the phenomenon (Tashakkori and Teddlie, 1998). All interviews done in the different studies have been semi-structured and they have typically allowed the respondents to talk freely about the phenomenon studied. Follow-up questions have then been used to attain a deep understanding of the respondents' views connected with the phenomenon studied. The systematic combination (Dubois and Gadde, 2002) of knowledge gained from the cases in the studies and the knowledge from theory has further ensured a deep knowledge of characteristics important for the phenomenon.

Another method suggested by Tashakorri and Teddlie (1998) and used in collecting data for this thesis is the *Use of triangulation techniques*. According to the authors, three types of triangulation can be used: triangulation of sources, of methods and of investigators. Triangulation of the information gathered from different sources is the type that has been used most widely in all of the studies. The data collected from different types of sources have always been compared with each other when possible in order to ensure consistent empirical data. The opportunities to compare different sources of information and to capture different perspectives were the main arguments for interviewing three different respondents at each company in the multiple case study. The conclusion therefore is that no empirical data used in the different studies rely on single informants.

Asking members of the social scene to check analytical categories, conclusions, and interpretations by the investigators are what Tashakorri and Teddlie (1998) refer to as *Member checks*. They also state that this is the most important credibility check of the research. As described earlier in this chapter, all data and results from the studies at Ericsson and SCA have been presented and discussed in steering committees for the research projects. The steering committees have consisted of experienced managers at the companies, but also experienced researchers from different fields of knowledge. The results from the multiple case study were presented and discussed at a workshop with representatives from most of the case

companies. In addition to these member checks, the results from the studies also have been presented for academia on several different occasions and for different audiences, both internal and external to the university. The results have also been presented for and discussed with several persons from companies outside the specific studies. These have been both persons with great knowledge in the area and managers with more general managerial skills. The presentations and discussions were often very inspiring, gave many important and valuable insights, and have been important in increasing the trustworthiness of the research.

Referential adequacy refers to how the data are stored when collected. As described earlier in the chapter, all interviews have been taped and transcribed. The data, both the sound files and the transcribed versions, have been stored together with additional material in separate files, either in the personal computer or in folders at the office. The data have always been codified with source and date.

3.12. Transferability of the results[5]

Generalising results from case studies is not possible in the way quantitative research is generalised. Case study research is, however, for many research questions the most appropriate approach, for example when the questions need a deep understanding about the phenomenon (Yin, 1994; Voss et al., 2002). However, a discussion of how the results can be used beyond the specific case is still relevant.

When discussing generalisation from case studies it is important to note that the generalisation takes place towards theoretical propositions, not towards populations and universes (Yin, 1994). The case studies' strengths lie in their usability for developing and refining concepts and frameworks which can be generalised (Eisenhardt, 1989). References to theory developed in prior work help to set the stage for new conceptual arguments. But generalising and developing new theory from case studies is done in small steps. The research findings from the studies in this thesis is one step towards new theory in the field of organising for project portfolio management.

As the field of project portfolio management has a rather practical focus it is also interesting to discuss another aspect of the generalisation. Instead of trying to generalise the findings from case studies it can be more appropriate to discuss the transferability of the results (Lincoln and Guba, 1985). When using case study research we might need to generalise from one setting to other similar settings, or to transfer conclusions from one context (specific setting) to another, rather than from a sample to a population (Tashakkori and Teddlie, 1998). This transferability of inferences from one context to another builds on coherence between the sending and the receiving contexts. Tashakorri and Teddlie (1998), among others, state that

---

[5] The discussion of the transferability of results refers to the results answering the purpose of the thesis. Discussions on transferability and/or generalisability of the results from the Ericsson studies are found in the separate papers (see appended papers 1–3).

in order to facilitate such transferability *Thick descriptions* must be provided. The descriptions have to enable a deep understanding of the specific context, in order to make it possible for readers to determine whether or not a finding is applicable to their own context (Kennedy, 1979).

In order to facilitate such transferability, the data in this thesis are presented as thoroughly as possible. The possibilities for direct generalisation of the findings are, however, still limited to receivers with contexts similar to the one studied. But taking another point of view, general theories are not the only purpose of research; the purpose can also be to meet with theories for understanding specific situations (Brunsson, 1982).

4. A framework for analysing organising aspects of project portfolio management

This chapter aims at developing the framework for the study of organising project portfolio management. It is primarily based on earlier research in the project portfolio management area, as presented in the theoretical exposition. But as the earlier research is not seen as providing a complete picture of such a framework, it is here supplemented and extended with support from other theoretical areas. As a consequence of the methodological approach with frequent interactions between theory and the empirical world, the empirical data have also influenced the development of the framework.

4.1. Developing a framework for studying organising aspects of project portfolio management

As we have seen in the theoretical exposition, research in the project portfolio management area has expanded during recent years. No longer tending to focus only on tools and methods assisting the project portfolio management, the research now includes how the project portfolio management activities are organised in companies. But even though the project portfolio management area has extended to include also organising aspects, this part of the area must still be considered sparse and in need of elaboration.

In fulfilling the purpose of identifying aspects of importance for organising project portfolio management and trying to answer the research questions, existing research in the area has been found insufficient for structuring the empirical data. To gain the thorough understanding of how project portfolio management is carried out that is needed for answering the research questions, the existing knowledge in the area has to be supplemented. A framework which takes its point of departure in aspects emphasised as important in project portfolio management literature, therefore, has been developed with support from other areas of research. As for which areas to reinforce the existing knowledge with, they have emerged from the frequent interaction between the empirical observations and theory described in section 3.5. The framework will be used for structuring the empirical data and for analysing the case company's approach to organising project portfolio management.

4.2. Categorising the project portfolio management framework

In the theoretical exposition it was stated that project portfolio management is a dynamic decision process (Sommer, 1999), implying that it is a process in which decisions regarding the project portfolio composition are taken. Such a decision process need not be structured and formally specified (Archer and Ghasemzadeh, 1999), but such a formally specified view is beneficial for understanding how the activities really are carried out. Archer and Ghasemzadeh (1996) take yet another step when arguing that the organisation needs to formally decide on which tools or methods it wishes to use in each stage of the decision process. Consequently, the

process view is of importance for understanding how the project portfolio management is organised. This means that in order to really grasp how the project portfolio management activities are arranged, the process of how they are carried out is essential.

Following the reasoning of Archer and Ghasemzadeh (1999), that organisations need to decide on which tools and methods they wish to use in the process, it is easy to see that also the tools' and methods' use is an area important for understanding how project portfolio management is organised. Another argument for including the tools' and methods' use in the research framework is the great attention that has been paid to developing tools and methods for evaluating, choosing and prioritising among projects and project opportunities (Archer and Ghasemzadeh, 1996; Linton et al., 2000) in the project portfolio management area.

The third area that needs to be part of the framework is the organisational aspects of organising project portfolio management. This area seems quite natural to take into account as it is essentially the people involved in the project portfolio management process that are the key to success (Cooper et al., 2001b; Kendall and Rollins, 2003). For example, it concerns which managers and/or which forums should be involved in and/or held responsible for the decisions.

If we look into what constitutes related areas such as pipeline management and project management, similar areas of importance can be found. The use of tools and methods, however, is not found to be as prominent within these areas. But since much effort has been spent on tools and methods in earlier research, this is deemed appropriate here to constitute a separate area of aspects. The division between the procedural aspects and organisational aspects can be questioned. It may seem natural to take into account the people making the decisions in connection with the procedural aspects, but as the area of which people to involve is regarded as being of great importance it will be dealt with separately. The same reasoning can be made regarding the tools and methods which also are connected with the process. But for the same reason as the organisational aspects, the choice is to consider them separately.

With this overall categorisation of the framework, the following paragraphs of the chapter elaborate on what constitutes important aspects within each of the three areas of organising project portfolio management.

4.3. Procedural aspects of organising project portfolio management

In the theoretical exposition it was stated that the project portfolio management area of knowledge makes little use of knowledge from other related research areas. Consequently project portfolio management literature dealing with procedural aspects does not make use of the general process management area of knowledge. This area of knowledge commonly views a process as a standardised series of repeatable activities transforming input to output (Harrington, 1991; Bergman and Klefsjö, 1995; Rummler and Brache, 1995).

A frequent division of different types of processes in that area of knowledge is into Core processes, Support processes and Management processes (Davenport, 1993; Bergman and Klefsjö, 1995; Rummler and Brache, 1995). The core processes are the ones that earn value for the company, *"processes that make billing possible"* (Rummler and Brache, 1995). Typical among these are production processes of products and services. The Support processes are processes that support the core processes. The management processes include actions that support the operational processes, and typical examples are processes in which management makes decisions on strategic choices (Rummler and Brache, 1995). The project portfolio management process can be seen as a good example of such a management process.

Even though different authors use processes for somewhat different purposes (for a classification see Lind, 2001) the basic key constituents of processes found in almost all applications are the Customers, the Activities and the Flow (Rentzog, 1996). Translating these constituents into the project portfolio management area gives three procedural aspects important for understanding how project portfolio management is organised: Customers of the project portfolio management; Project portfolio management activities, and Sequence of the activities.

Customers of the project portfolio management process are primarily company-internal (even though external customers also may exist). The customers of the process may be different – from individuals to organisational units with different interests in the output of the project portfolio management. The setup of customers is assumed to vary among companies, and it is not only who the customers to the process are, but also what their requirements on the process are, that are important for understanding how project portfolio management is organised.

As the project portfolio management process is by definition a decision process, the main activities in the process are the decisions regarding the project portfolio composition. However, the decisions made in the process are also prepared by other activities, for example discussions in different forums or related decisions on lower levels of the portfolio. In order to really grasp how the decisions in the project portfolio management process are taken, it is essential to acquire an understanding of all types of activities in the process. Based on the process stages presented by Archer and Ghasemzadeh (1999), three different activities are defined for this framework: discussions, preparations and decisions.

The third key constituent of processes is flow. Within the procedural perspective of project portfolio management, this refers to the sequence of the different activities. Also this constituent of flow is argued to be of interest for understanding how project portfolio management is organised. The reason is that many of the activities undertaken in the process depend on or are related to activities in other forums or at other levels of aggregation in the process. This reasoning is also supported by the view of project portfolio management provided by Archer and Ghasemzadeh (1999).

4.3.1. Selecting projects and reviewing the project portfolio

From the definition of project portfolio management it can be inferred that the process involves two partly different main activities. The definition states that, in the process, ongoing projects as well as potentially new projects are revised (Cooper et al., 2001b), which means that project portfolio management is both about selecting new projects for the portfolio and about reviewing the existing portfolio composition. These two main activities can theoretically be taken care of either in the same process or by different processes, even though some authors (Archer and Ghasemzadeh, 1999) point at the importance of taking care of them in the same process. Whether or not the main activities are dealt with in separate processes is not seen as critical here. But for understanding how project portfolio management is organised, it is important to clarify how the two main activities are taken care of, no matter if they are handled in the same process or in separate processes.

Another dimension of process differentiation important for the understanding is the division of the process into sub-processes. Different parts of the project portfolio may call for input from different parts of the development organisation, and as a consequence the process has to be divided into sub-processes supporting the general portfolio process.

The periodicity of reviewing the project portfolio and selecting projects for it is argued in earlier research to be an important aspect of managing the project portfolio (Sommer, 1999; Cooper et al., 2001b; EIRMA, 2002), and must consequently be an important aspect of the research framework as well. In earlier research, only the periodicity of the portfolio reviews is discussed. But this research does not separate the review of the project portfolio from the selection of projects for the portfolio, which means that the same periodicity has to be used for both of the activities. As a consequence of separating the processes for selecting projects and reviewing the portfolio as is done here, it is possible to use different periodicities for the two main activities. The periodicity for both of the activities is of importance for understanding how project portfolio management is organised, and consequently constitutes separate aspects of the research framework.

4.3.2. Connection with other internal processes

Another important dimension in literature on process management is that of input and output (Lind, 2001). The input and output of the process are important since a process normally is seen as an activity transforming input to a desired output (Bergman and Klefsjö, 1995; Rummler and Brache, 1995). The output dimension has already been stated to be of importance when dealing with the internal customers' requirements. However, the input for the process is also an important aspect to take into consideration.

In literature dealing with project portfolio management, different inputs important for the process can be found. The relation to and cooperation with the individual projects' processes have already been described in the theoretical

exposition, and this is an example of an important input to the project portfolio management process (Sommer, 1999; Cooper et al., 2001b; EIRMA, 2002). Likewise, other internal processes can be of importance for the understanding of how the project portfolio management is organised. Examples of such internal processes are the strategy process and formal processes for collecting ideas for the development (Archer and Ghasemzadeh, 1999). Consequently, inputs from such internal processes constitute a key area of the research framework. The process perspective of the research framework is summarised in Figure 13.

<div style="border:1px solid;padding:1em;">

Procedural aspects

- Customers
    - Requirements on the processes
- Activities
    - Discussions
    - Preparations
    - Decisions
- Sequence of activities
- Selection process
    - General processes
    - Sub-processes
    - Regular updates
- Review process
    - General processes
    - Sub-processes
    - Regular updates
- Connection with company-internal processes
    - Individual project processes
    - Strategy process
    - Other internal processes

</div>

Figure 13: Summary of procedural aspects in the research framework.

4.4. The use of tools and methods in project portfolio management

Much emphasis in the project portfolio management literature has been put on the development of tools and methods (Meredith and Mantel, 1999). Which tools and methods are used for assisting the project portfolio management activities, therefore, is naturally seen as an important area for understanding how project portfolio management is organised. But to really grasp the nature of such organising it is also essential to focus on how the tools and methods are used to support the activities in the process.

Earlier research has shown that the most successful companies use more than one tool or method alone (Cooper et al., 1998). It has therefore been suggested to use diverse tools and methods to assist the project portfolio management activities. Research has also demonstrated that most companies which have implemented

project portfolio management use a combination of tools or methods aiming at different purposes in order to jointly fulfil the requirements of the process (Archer and Ghasemzadeh, 1996; EIRMA, 2002). How the different tools and methods are used together is therefore seen as providing a wider perspective than just which tools or methods are used. Consequently the combination of tools and methods constitutes a separate part of the research framework.

In order to understand how project portfolio management is organised it is also of importance to grasp why the different tools and methods are applied to the different activities. This question is closely connected with that of the procedural aspects, namely the requirements on the process. The different tools and methods are used to support the activities in fulfilling the different requirements on the process, and to understand why the tools and methods are applied a description of which requirements they aim at fulfilling is needed.

The combination of tools and methods and how they aim at fulfilling the requirements on the process are, however, not enough for understanding how project portfolio management is organised. In order to achieve such understanding it is also important to describe how the tools and methods are adapted. Examples of such adaptations are the parameters that are used in the different tools and methods, and the premises employed for dividing the project portfolio.

Yet another area important to describe in order to achieve an understanding of how the tools and methods are used is how they are applied to the different activities in the process. Here it is also important to describe which type of project portfolio management activity they are used for. The types of activities that they can be used for are the same as the different activities presented within the procedural aspects, namely discussions, preparations and decisions. A summary of the part of the research framework dealing with the use of tools and methods is found in Figure 14.

The use of tools and methods

- The combination of tools and methods
  - Requirement to be fulfilled
  - Adaptations of the tools and methods
- Sequence of application to the process
- Tools' and methods' use in the process:
  - Discussions/Preparations/ Decisions
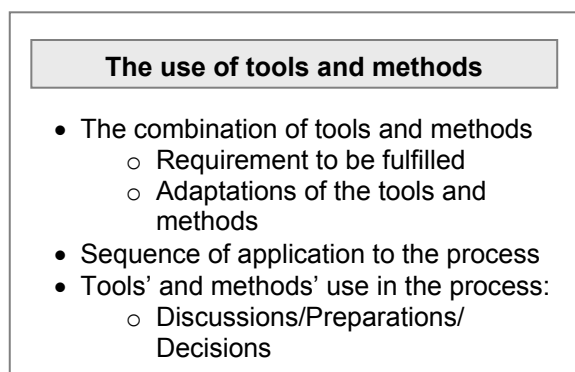
Figure 14: Summary of aspects concerning the use of tools and methods in the research framework.

4.5. Organisational aspects of organising project portfolio management

As mentioned in the theoretical exposition, previous research has made it clear that the people involved in project portfolio management are keys to success (Levine, 1999; Kendall and Rollins, 2003). Further, it is stated that different organisational units have to be involved in the decisions in order for the project portfolio management to be successful (EIRMA, 2002; Kendall and Rollins, 2003). Based on these statements, the organisational aspects constitute a crucial part of the research framework for analysing organising aspects of project portfolio management.

Since the people involved are among the keys to success in project portfolio management (Levine, 1999; Kendall and Rollins, 2003), the organisational participants in the project portfolio management activities constitute the main area within the organisational aspects of the research framework. But in order to describe what the participants involved in the activities represent, it is also important to provide an understanding of the organisational setting of the development organisation (e.g. organisational description of units connected with the projects in the portfolio). Consequently the organisational setting constitutes one area within the organisational aspects of the research framework.

Regarding the participants in the project portfolio management process, the issue is not only which the participants are, but also in which constellations they are involved. This means that, unless only isolated individuals are involved in the process, it is relevant to describe which groups of participants are connected with the process and/or which forums are involved in the process. A basis for this is also how the different participants are connected with the process, which constitutes a separate area in the framework within the organisational aspects.

The last part concerns which type of activities the different organisational participants are connected with. This aspect is seen as important since it provides an understanding of how the responsibilities for the project portfolio management are distributed. As for the two other main areas of procedural aspects and the tools' and methods' use, the different types of activities that the organisational participants can be connected with in the research framework are the discussions, preparations and decisions. The organisational aspects of organising project portfolio management are summarised in Figure 15.

```
┌─────────────────────────────────────────────┐
│  ┌───────────────────────────────────────┐  │
│  │        Organisational aspects         │  │
│  └───────────────────────────────────────┘  │
│                                              │
│   • Organisational setting                   │
│   • Participants                             │
│        ○  Individuals                        │
│        ○  Groups/Forums                      │
│   • Connection with the process             │
│   • Type of activity connected with:         │
│        ○  Discussions/Preparations/          │
│           Decisions                          │
│                                              │
└─────────────────────────────────────────────┘
```
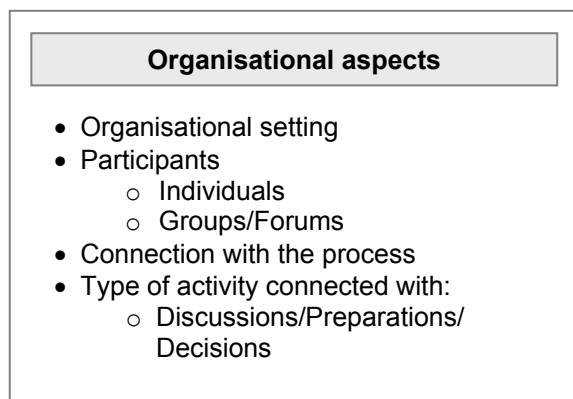
Figure 15: Summary of organisational aspects of the research framework.

4.6. Summarising the framework for organising project portfolio management

The framework described in this chapter should be seen as an attempt at structuring existing knowledge in the project portfolio management area. The framework is primarily focused at bringing up aspects important for understanding how project portfolio management is organised.

The framework will be used for structuring the description of how project portfolio management is organised at the case company in Chapter 6. In the next step of the analytical path (see section 3.6) the framework will be used for structuring the analysis of why project portfolio management is organised in a certain way (Chapter 7). This analysis aims at providing the thorough knowledge of how project portfolio management is organised that is needed for being able to elaborate on the research questions.

Even though the framework described here takes its point of departure in how the project portfolio management activities are arranged in the process, possibly also other points of departure might have been taken. But as project portfolio management normally is referred to as a decision process in which the portfolio of projects is constantly revised (Dye and Pennypacker, 1999), the process perspective was seen as appropriate to start out from. The framework is summarised in Figure 16.

Procedural aspects

- Customers
    - Requirements on the processes
- Activities
    - Discussions
    - Preparations
    - Decisions
- Sequence of activities
- Selection process
    - General processes
    - Sub-processes
    - Regular updates
- Review process
    - General processes
    - Sub-processes
    - Regular updates
- Connection with company-internal processes
    - Individual project processes
    - Strategy process
    - Other internal processes

The use of tools and methods

- The combination of tools and methods
    - Requirement to be fulfilled
    - Adaptations of the tools and methods
- Sequence of application to the process
- Tools' and methods' use in the process:
    - Discussions/Preparations/ Decisions

Organisational aspects

- Organisational setting
- Participants
    - Individuals
    - Groups/Forums
- Connection with the process
- Type of activity connected with:
    - Discussions/Preparations/ Decisions

Figure 16: Summary of the framework for the study of organising project portfolio management

5. Extended summary of the papers focusing on project portfolio management

This chapter gives a summary of the papers contributing to the thesis' topic. The papers deal with different aspects of project portfolio management, two of them with data from the SCA study and one from the multiple case study of six Swedish companies. Each summary begins with a short background to the study and some notes on how the data were collected for the specific paper. Then the main emphasis is placed on the conclusions in the different papers. For more elaborate understanding of the results, one may refer to the appended papers 4-6 in the last part of the thesis.

5.1. Results from paper 4: Requirements to be fulfilled by project portfolio management

Author: <u>Ola Dawidson</u>

Introduction

The most commonly reported reasons for project portfolio management in literature are, as elaborated on in the theoretical exposition, to facilitate the choice of 'the right projects' for the future, to operationalise the business strategy, and to handle the resource allocation. These reasons for project portfolio management are comprehensive, and are reasons addressing the company more or less as a whole. In the literature one can also find some more specific, and to some extent more internal, requirements to be fulfilled; these deal with the right balance between projects and investments, internal communication of project priorities, and providing greater objectivity in project selection (Cooper et al., 2001b).

However, these requirements are also argued to be too general, since they hide a lot of differentiated information which, in the paper, is argued to be important to consider in managing project portfolios. The requirements are quite general for the company as a whole and do not take into account how the different requirements are known by different internal units of an organisation. In order to make it possible to gain the full potential of the project portfolio management work, it is maintained in the paper that a more differentiated view – of which the distinct requirements are and how they are distributed in an organisation – is important to understand and deal with in setting up project portfolio management processes. If the requirements are not understood and integrated in the work, some important aspects may be left unfulfilled. Therefore the aim of the paper is to extend the knowledge base of driving forces that are relevant to consider in designing project portfolio management processes. Within this framework, the focus of the study was on the different requirements that are supposed to be fulfilled by the project portfolio management, but also how these requirements are distributed among different organisational units.

Setting

This paper is based on results from the longitudinal case study at SCA AFH Tissue. The company was seen as appropriate for studying requirements on project portfolio management primarily as it was believed to involve a wide set of requirements on the management of the project portfolio. The company is active in an industry where the development of manufacturing processes is at least as important as product-driven development. The case was therefore assumed to represent different requirements found in companies within industries with more narrow focus (e.g. only focusing on product development).

To acquire a deep understanding of the internal forces involved, the data were gathered from different types of sources. However, interviews with 16 respondents, representing a selection of managers on different levels and from different units of the organisation, constitute the bulk of the empirical data.

Findings of the paper used in the thesis

The paper shows that managing a project portfolio is a task involving many different requirements to be fulfilled. Further, it demonstrates that the requirements are distributed among different organisational units in the company. The view built up in the paper gives a more detailed view of the requirements on project portfolio management at the case company than what is normally expressed in the project portfolio management literature. The requirements on project portfolio management constitute an important area of the research framework, and are consequently important for understanding how project portfolio management is organised.

The main contribution of the study, therefore, is that it gives a more elaborate view of important requirements to fulfil and of how these are distributed among the different organisational units which share an interest in the project portfolio management. All of the requirements revealed in the study can be argued to be covered by the overall requirements known from project portfolio management literature. However, some of them are covered in a straightforward way while others are expressed in roughly the same terms as the ones stated in the literature. An example of a requirement expressed directly as one of the overall goals described in the theoretical exposition is that of securing a proper balance according to different dimensions, expressed by managers at the R&D unit. On the other hand, the requirement of being able to evaluate the R&D output in relation to the resources put in, as expressed by the Executive Committee (management group at the business unit level), and the closely related statement by the R&D unit about being able to justify its existence, are examples of requirements that are not clearly covered by the overall goals in the project portfolio management literature. These requirements can, though, be argued to be covered by a subset of the overall goals – namely those of value maximisation, yielding the right balance between projects and investments, and communicating project priorities within the organisation.

The specific requirement of communicating project priorities, both vertically and horizontally in the organisation, is not mentioned as more important than any of the

others in the project portfolio management literature. But this requirement is the one most widely expressed and spread among all of the organisational units revealed in this study. The results therefore indicate that this is an important requirement to consider in managing the project portfolio.

The principal literature in the field (e.g. Roussel et al., 1991; Cooper et al., 2001b; EIRMA, 2002) states that business leadership, marketing, operations and R&D have to be involved in the management of the project portfolio. This paper also shows that these organisational units express many requirements on the project portfolio management effort. But the paper also shows that requirements from other organisational units can be important to consider. Beside the ones known from literature, three other organisational units were found at the case company: the environment department, the sourcing department and the patent department. These units, though, differ from the others in that they are mostly interested in obtaining knowledge of what projects are in the pipeline. The environment department also requires that the project portfolio management effort secures resources for upcoming scrutinising projects, and the patent department also requires a ranking of how important the assistance from the department is for the projects in the portfolio.

The conclusion from the paper, therefore, is that the requirements on the project portfolio management effort as described in most well-known literature are too comprehensive. The findings show that the requirements can be more nuanced in terms of detail and of how the requirements are distributed among different organisational units. Consequently, in order to be able to benefit as much as possible from the project portfolio management effort, it is argued to be beneficial to map out the specific requirements of the different organisational units before setting up the process. This means that not only the different requirements on the project portfolio management have to be scrutinised, but also how they are distributed and known among different organisational units, in order to understand them better.

5.2. Results from paper 5: Project portfolio management at SCA, Tissue AFH – Process and tools

Author: Ola Dawidson

Introduction

To facilitate decisions on project portfolio composition in research and development environments, tools and methods are needed. For the purpose of guiding managers on evaluations and decisions regarding project portfolio composition, a couple of tools and methods exist, either as elaborated on in literature and/or as found to be used among leading companies (Stummer and Heidenberger, 2003). According to earlier studies of US companies, successful companies use a combination of tools and methods in managing their project portfolios and often the combination is made up of different types of tools and methods.

Even though the tools are extensively developed and described in literature, making good decisions on project selection and resource allocation is still a complex and demanding task, as many relevant aspects have to be taken into account simultaneously (Liberatore, 1988). The tools are not decision tools per se and they must be chosen, adapted and applied to the company's specific situation in order for the project portfolio management work to fulfil its purposes and requirements.

For real success in conducting project portfolio management work, it is important to find out what the requirements on the work are inside the organisation (Cooper et al., 2001b) before choosing, adapting and applying a set of tools. Efficient project portfolio management work calls for carefully evaluating the tools when they are chosen and adapted to fit different requirements in the organisation. The literature on R&D project portfolio management has so far focused upon either the goals of such management or the individual tools to be used in the work. However, which tools are preferable and how to use them in order to fulfil a business's requirements and goals have not been examined in the literature, although certain authors have noted these topics' importance (Cooper et al., 2001b). The aim of this paper was to elaborate on how different tools can be adapted and applied in the project portfolio management work in order to fulfil the goals and different organisational units' requirements on the work.

Setting

This paper, too, is based on data collected in the longitudinal case study at SCA AFH Tissue. As the paper aims at describing and analysing how tools for R&D project portfolio management can be adapted and applied to fulfil a set of goals and requirements, a company that was supposed to involve many different goals and requirements was found to be suitable. As SCA AFH Tissue is active in an industry where the development of manufacturing processes is at least as important as the development of new products, the set of goals and requirements was supposed to be at least as faceted as in other companies, in which the development activities are more focused on the development of new products.

During the longitudinal study at the case company, regular contacts with the company personnel have been maintained. The data were gathered from different types of sources in order to acquire the deep understanding of the internal mechanisms that was needed in order to fulfil the purpose. The different sources used for collecting the data included the interviews with 16 managers (the same as for the fourth paper, but some of the managers have been contacted more than once), participation in and discussions during several workshops, comments and discussions during meetings with a steering committee, internal documentation, and participation in several meetings with different forums responsible for decisions on the project portfolio. The documentation included in the study consists of internal records from presentations made in different forums, strategy documentation, and historical documentation of R&D portfolio outcome.

Findings of the paper used in the thesis

The paper presents the setup of project portfolio management tools that SCA AFH Tissue has chosen for managing its project portfolio. The tools' adaptation to the specific requirements and how they are used in the decision process are presented. The combination of project portfolio management tools connected with the strategy process, as presented in the paper, shows that rather simple tools can be adopted and applied to the strategy process in order to fulfil the different goals and requirements on the project portfolio management effort in this specific situation.

In line with what other authors have described, one single tool does not fulfil all the different requirements in this case either. To fulfil the specific set of requirements in this setting, not only a combination of different adaptations of the same tool will be sufficient. For real success, a combination of different tools has to be adapted and applied.

The goal of maximising the value of the project portfolio was, in this specific situation, taken care of in close cross-functional collaboration between representatives from R&D, marketing and manufacturing. However, when the study was accomplished, there were ongoing discussions in the organisation about developing a scoring model to assist the cross-functional forums' work[6].

Another conclusion from the paper is that simply choosing and adapting a set of different tools and methods for managing the project portfolio is not enough; the tools and methods must also be carefully connected in a decision-making process. In this connection with the process, the specific use of the different tools has to be defined. Using too many tools, or views from the same type of tool, would rather overanalyse the project portfolio. If using many different views as in the case of SCA, some of them have to be used for steering the project portfolio, while others must be used for follow-up and information. How many tools or views from the same type of tool are appropriate has to be situation-specific.

The tools presented in the paper, when taking a rapid glance at them, appear easy to adapt and apply. The division of the project portfolio into different sub-project portfolios[7] on several levels seems, for example, quite straightforward. However, the managers at SCA discussed different alternative divisions a lot before they agreed on the division described here. There are many possible divisions, and the one that fits a given part of the organisation does not fit another part, so the alternatives need to be carefully evaluated.

The tools described in this paper are just some of all the tools presented in existing literature. But at the same time many authors also point at the importance of keeping the project portfolio management as simple as possible, and this is

---

[6] Since this specific part of the study was ended, a scoring model has been developed to support the project portfolio decisions in the cross-functional forums. The scoring model is comprehensively described in Section 6.2.2.

[7] In the paper the sub-project portfolios are named strategic buckets.

supported by the managers at the case company. For example, many of the bubble diagrams reported on in recent literature are useless as decision tools when listening to managers involved in this study, simply because they are too complicated, involving too many parameters in the same diagram. Beside the requirements directly fulfilled by the tools presented, some of them involve more of information-sharing within the organisation, and these need to be fulfilled by the project plan coming out of the project portfolio process.

5.3. Results from paper 6: Project portfolio management – a multiple case study of six Swedish companies

Authors: Ola Dawidson, Eric Sandgren and Jonatan Sjöström[8]

Introduction

Project portfolio management is a rather complex activity that preferably is carried out with the support of different tools and methods. Since there is no single, generic tool available, companies must not only select the combination of tools for their purposes, but also decide how they can adapt them to fit their own specific operating environment. What further increases the complexity of project portfolio management is that some tools (e.g. scoring models), although designed specifically to measure the contribution towards a single goal, also provide some measurement of the other goals. The question of which tool should be dominant may then arise if they each reveal different results. The complexity of project portfolio management is further increased by the suggestion that all types of projects have to be considered in the portfolio approach. Considering the scenarios described here, it is not difficult to understand that the practical use of the tools and methods described in project portfolio management literature is both complex and demanding for companies.

Even though the tools and methods are complex to use in practice, it appears from previous research that project portfolio management approaches are frequently used. Recent studies have illustrated that project portfolio management processes are widely used among companies within different industries. Studies of US companies (Cooper et al., 1999; Center for Business Practices, 2003) and UK companies (Szwejczewski et al., 2004), show that many of the companies involved in the studies manage their projects as portfolios. In fact, all seven companies in the study by Szwejczewski et al. (2004) practised portfolio management. Also the EIRMA working-group report implies that a majority of its working-group member companies use project portfolio management approaches (EIRMA, 2002). Beside these studies, other authors have stated that project portfolio management is becoming more common in organisations today (e.g. Roussel et al., 1991; Bridges, 1999).

---

[8] The underlinings indicate the paper's main author(s).

However, the studies reported on so far have focused upon the practice primarily among US companies, though also among UK companies, while no such study among Swedish companies has so far been made or at least been reported on. This paper was undertaken as an attempt to rectify the anomaly, and thus its purpose was to examine how a number of Swedish companies have adopted the framework for project portfolio management to fit their own organisational requirements.

Setting

As described earlier, this paper reports the findings from a multiple case study at six Swedish companies. The bulk of the data was collected from semi-structured interviews with three managers at each company representing executive management, marketing and R&D. The data were also complemented with internal documentation.

The criteria for choosing specific case companies were that they should have at least ten projects in their project portfolio and their annual budgets exceed 10 million Euro. The companies that were focused upon in the study differ in annual sales and R&D budgets, and these differences were thought to give a faceted view. Companies with higher annual sales are normally larger and presumably have more complex organizations. However, since the study focuses on single R&D units within each company, the overall complexity of the rest of the organisation is thought to have a minor impact upon the findings. Furthermore, the companies chosen for the study do not rely exclusively on customer-controlled development, since this was supposed to prevent explicit control of their R&D project portfolio. The companies studied operate within different areas in order to avoid being industry-specific. The companies focused upon are: one Medical Equipment Company, one System Supplier, one High Tech Product Company, one Industrial Company, and two Large Manufacturing Companies. A common characteristic of the companies is that they are well-known companies at the forefront of their industries.

Findings of the paper used in the thesis

The results presented in the paper are somewhat surprising when compared to those from previous research; they show that the majority of the companies have not implemented any parts of the project portfolio management approach as described in principal literature. Only in some cases have parts of the approach been adapted to the company's situation. But this does not mean that the companies studied are not managing their project portfolios; in some cases they have developed their own *ad hoc* methods, which are working well for their specific needs.

Given the claim in earlier research that project portfolio management is vital for success and widely used in practice, it would be natural to believe that the companies studied here are also using the project portfolio management approach to some extent. In the studies by Cooper et al. (2001a) and Szwejczewski et al. (2004), though, it is not claimed that the case companies have adopted the entire

project portfolio management approach, but that they have implemented certain parts of it. Even more interestingly, these studies show that the best-performing companies have adopted the entire approach – meaning tools, review processes, and involvement of the suggested people in the management of the project portfolios[9].

In the paper, the project portfolio management practices in the companies were studied and analysed according to these three areas, which were seen as important parts of project portfolio management. The results show that all of the companies concerned have formal processes for evaluating and choosing projects for the portfolio. However, only three out of six companies consider the project portfolio as a factor in their decisions. Furthermore, only one of the three companies that take the entirety into account actually considers the project portfolio, while the other two concentrate only on their product portfolios. Taking only the product portfolio into account means that only new product projects are measured against one another; other types of projects are simply not considered in this product project selection. Other types of projects in these two companies are selected on an individual basis. The three companies that do not consider the entire project portfolio do have a formal selection process, but the projects are selected on the basis of different criteria, and still only on an individual basis.

Two of the companies review the project portfolio regularly. The other four companies instead concentrate on projects which are about to enter the portfolio. Once selected and entered in the portfolio, each project is handled individually in the project management process (e.g. Stage-Gate), and it is believed that this process ensures that the projects stay on track and that they are still meaningful to conduct. This is not in line with leading literature, which suggests that in order to realise the most advantageous project portfolio, companies should review them at least every third month (EIRMA, 2002; Kendall and Rollins, 2003; McDonough III and Spital, 2003). The two companies that do review their project portfolio on a regular basis conduct the review process annually, which should be compared to the recommendation in literature of reviewing the project portfolio at least every third month.

In contrast to earlier studies (Cooper et al., 1999; EIRMA, 2002; Szwejczewski et al., 2004) which have discovered that project portfolio management tools and methods are widely used, the results of this study show that only two out of six companies are using any of the project portfolio management tools supporting the project portfolio management process. Most of the managers are averse to the idea of, as they say, "using tools that make decisions for them", and are therefore not using any tools or methods at all. They seem, however, to have misunderstood the purpose of the tools, since the literature does not advocate the usage of the tools as

---

[9] For a description of how project portfolio management performance was measured, see Cooper et al., 1999.

decision-makers. In fact the tools are recommended simply as support tools for helping the managers to make more thoughtful and thereby better decisions.

The teams responsible for managing the portfolios in the studied companies consist of managers mainly from senior levels, which is consistent with the suggestions made in literature. Moreover, theory suggests that the project portfolio management should be done by cross-functional teams, which is the actual practice in most of the case companies. The fact, found in this study, that different types of decisions regarding the project portfolio composition are made at different levels in the organisation has not, however, been highlighted earlier in leading literature.
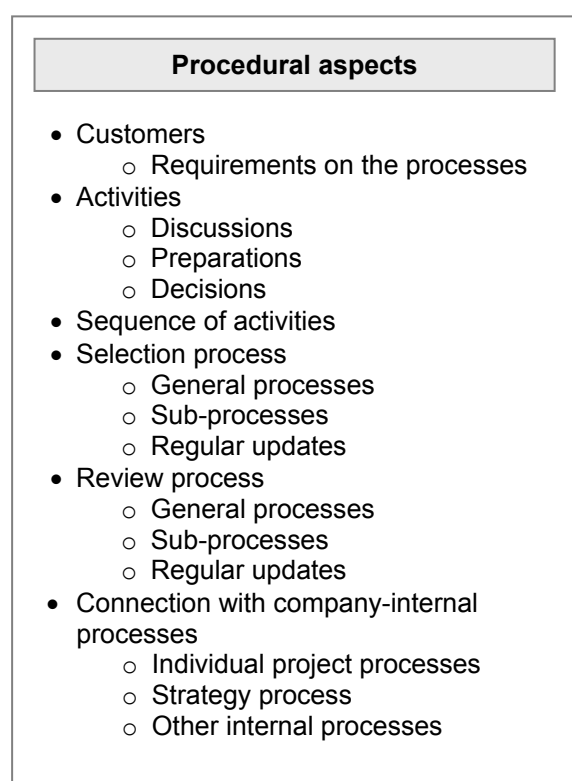
6. A description of how project portfolio management is organised at SCA AFH Tissue

The description of how project portfolio management is organised at SCA AFH Tissue was initiated when the results from papers 4 and 5 were presented in the previous chapter. The present chapter aims at completing the picture of how the project portfolio management is organised at SCA AFH Tissue, and the description follows on a general level the research framework elaborated on in Chapter 4 – i.e. procedural aspects, the use of tools and methods, and organisational aspects. Those parts of the description that have already been presented in the summary of papers are only referred to in this chapter.

6.1. Procedural aspects

According to the framework elaborated on in Chapter 4, the first overall area of aspects important for understanding how project portfolio management is organised concerns the procedural aspects. When describing the framework it was stated that, in order to get a complete picture of the project portfolio management process, the different areas summarised in Figure 17 have to be described. In describing how the case company has organised project portfolio management work, the different areas of procedural aspects are not feasible for structuring the chapter. Some of these areas are so intertwined that describing them separately from each other is not possible. They should instead be seen as a checklist of areas to be covered in the description.

Procedural aspects

- Customers
    - Requirements on the processes
- Activities
    - Discussions
    - Preparations
    - Decisions
- Sequence of activities
- Selection process
    - General processes
    - Sub-processes
    - Regular updates
- Review process
    - General processes
    - Sub-processes
    - Regular updates
- Connection with company-internal processes
    - Individual project processes
    - Strategy process
    - Other internal processes

Figure 17: Procedural aspects of the research framework

The different internal customers that share an interest in the management of the project portfolio were described in the summary of paper 4 in section 5.1. In that section the different organisational units' requirements were also presented on a general level. In Figure 18 the requirements on the project portfolio management work are recapitulated. The figure gives, though, a more detailed view of the requirements than the one that was given in the summary of paper 4. A more detailed description of the organisational setting and thus also the organisational units will follow in section 6.3.1.

	Requirements on the project portfolio management effort:

AFH Executive team:	• Ability to evaluate R&D output, related to resources put in
	• Be convinced that:
	  - the strategies are to be fulfilled
	  - the volume growth goals can be fulfilled
	  - the R&D activities are coordinated with Category needs
	• Securing resources for upcoming scrutinising activities

The R&D unit:	• Communication tool towards different organisational forums
	• Ensure that the right R&D activities are in focus
	• Ensure that their projects are coordinated with the market needs
	• Ensure that their projects support the needs of the Supply-chain
	• Ensure a proper balance with regard to:
	  - different products or groups of products
	  - market versus manufacturing versus R&D-driven needs
	  - different parts of the manufacturing process
	  - short-term versus long-term development
	• Be able to show reasons to be for the R&D department

Category:	• That the portfolio of projects supports the strategic intentions • That the projects support the goals regarding volume growth • Ensuring that all products, or groups of products, are developed over a period of time • Ensuring that enough resources are spent on R&D activities in the long-term perspective • Ability to set up a short-term launch plan for the market organisation • Ability to see upcoming potential launches from product development projects • Ability to see that enough research and early development projects are included in the project portfolio • Be convinced that the ideas dealt with in R&D are good and numerous enough for future profitability

Supply-chain:	• Knowledge about upcoming projects and their implications for the manufacturing facilities
	• Securing resources for upcoming scrutinising activities:
	  - in projects included in the R&D project portfolio
	  - additional unplanned activities

Sourcing:	• Knowledge about upcoming projects and their implications for sourcing
Environment department:	• Securing resources for assistance in upcoming scrutinising activities • Knowledge about upcoming projects in order to be able to plan for their own activities
Patent department:	• Knowledge about upcoming projects and their implications for the patent department • Prioritization list of which projects are important to support

Figure 18: Requirements on project portfolio management at SCA AFH Tissue
(a description of the organisational units is given in 6.3.1 Organisational setting)

6.1.1. The strategy and project portfolio approval process

At SCA AFH Tissue a yearly planning process is used to revise the ongoing projects within the portfolio, update the projects planned for the coming years and, based on different types of inputs, propose and decide on new projects for the portfolio. Examples of important inputs are a yearly product benchmarking process, the budget process and the strategy process – the last being perhaps the most important, although they all mutually influence each other.

The strategy process starts out from the business strategy which, by upper management levels, is broken down into the Sales, Marketing & Product strategies

and the Supply-Chain strategy (see Figure 19). These strategies are then in turn translated into more tangible consequences for the different product groups and for the different manufacturing facilities. These consequences are used as input for the process where the project portfolio is revised.

Definitions:
PLP – Product Launch Project   TDP – Technology Development Project
PDP – Product Development Project   EDP – Early Development Project
TIP – Technology Implementation Project   RP – Research Project
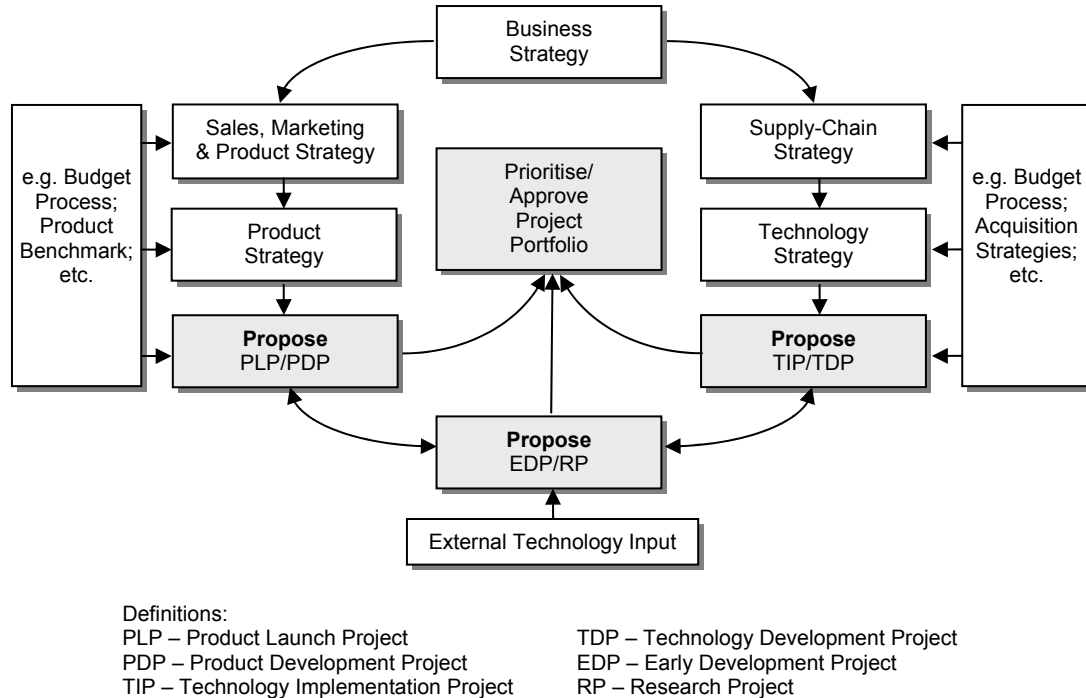
Figure 19: The strategy and project portfolio approval process[10]

6.1.2. The project portfolio selection process

The process view of the strategy and project portfolio approval process provides an overview of how the business strategy is developed, down to implications for the process of proposing and selecting individual projects. The view does not, however, go into details of how the decisions are made regarding the project portfolio. The process shown in Figure 20 describes more in detail the steps of how projects are selected and the portfolio evaluated. In the figure, the outcomes from the different steps of the process are also presented.

In the two first steps of the process, the actual project portfolio is evaluated together with implications from the strategy process. The outcomes from these steps are desirable values regarding how the available resources should be used, so-called strategic portfolio values. These strategic values are based on discussions in different management forums (see Section 6.3) and should be seen as guidelines for the resource spending, not exact values.

---

[10] The projects named technology projects at the case company are what in this thesis are regarded as manufacturing process development projects. The company's terms are used for the description in this chapter.
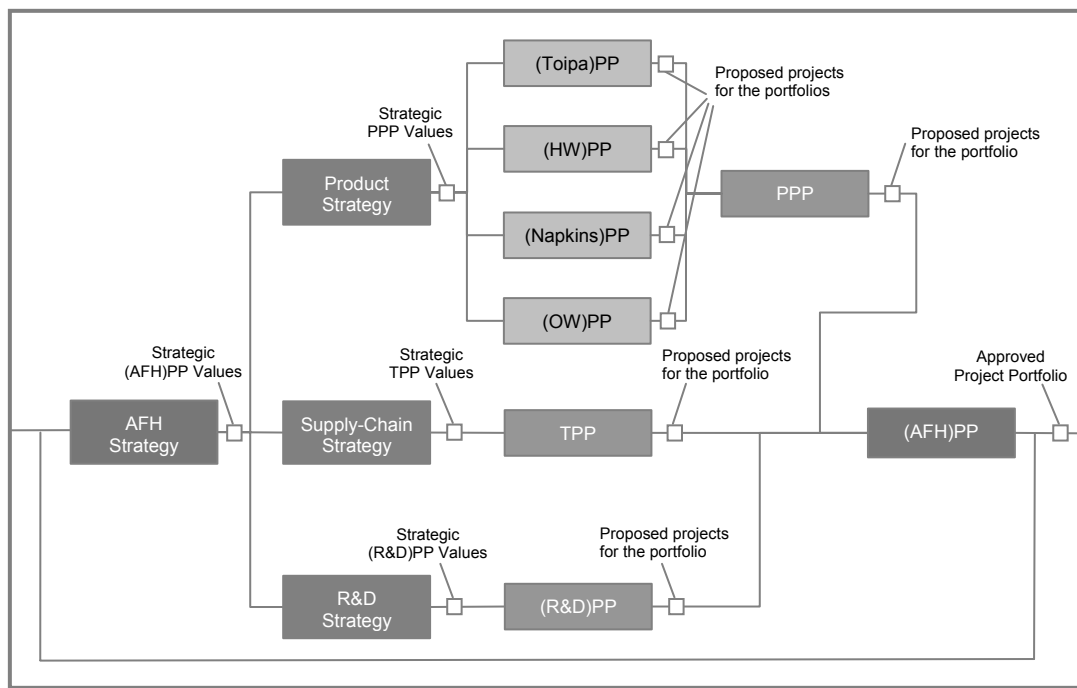
Figure 20: The project portfolio selection process[11]

The third step in the process involves evaluations, prioritisations and selections of specific projects. The AFH project portfolio involves a wide range of different types of projects and the evaluations, prioritisations and selections of projects are taken care of in separate sub-processes. The sub-processes for the technology and R&D projects are dealt with in single processes, and the proposed project portfolios are based on discussions in forums during the process. No formal process is established for these evaluations; the proposed portfolios of projects are instead based on discussions in meetings, from more formal meetings with established groups of managers to more informal forums or workshops.

For the sub-process dealing with the Product Project Portfolio (PPP) the process is further divided into four separate processes, each dealing with projects for the different product groups. The proposed projects for the portfolio are here based on discussions in different forums for the specific sub-processes. The four sub-processes are then collapsed and discussed in the next step with an aim to agree on one proposed Product Project Portfolio.

In the fourth step the three different sub-processes then converge into an overall AFH project portfolio. With the basis in the proposed product, technology and R&D projects, the overall AFH project portfolio is evaluated and approved. Also this decision of approving the project portfolio is based on discussions in a

---

[11] The technology projects at the case company are what in this thesis are termed manufacturing process development projects. A project that at the case company is termed an R&D project corresponds to a technology project in the thesis. The company's terms are used for the description in this chapter.

management forum. If the composition of projects in the portfolio does not meet the expectations, some or all of the different process steps may have to be redone. The different forums' connection with the process is examined in greater detail in section 6.3.

The three sub-processes (PPP, TPP and (R&D)PP) are driven separately according to the process view; but no matter which type of project is involved, they should all strive to deliver products for the market. Therefore, some kind of synchronisation between the sub-processes is needed. Even though the process does not show any synchronisation between the sub-processes, synchronisation does exist and it is ensured by cross-representation in the forums responsible for the different steps of the process (this is more thoroughly described in section 6.3).

6.1.3. The project portfolio review processes

In the yearly process of selecting projects for the portfolio, a general review of the ongoing projects in the portfolio constitutes the basis for the evaluation and selection of new projects. It is also in this process that the main direction for the portfolio is set. However, the project environment, both internal and external to the company, changes during a year – which also has implications for the project portfolio. In order to take care of these changes, more frequent reviews of the project portfolio are made. These reviews are primarily done at the level below the main project portfolio (i.e. PPP, TPP and (R&D)PP).

The product project part of the portfolio is the one that is reviewed most frequently. This part of the portfolio is reviewed once a month as an ordinary point for discussion at monthly formal meetings. The reviews focus not only on the project portfolio level, but also on the single projects. It actually starts out from discussions on how the individual projects perform and, based on these discussions, consequences for the other projects as well as for the project portfolio are discussed and possible actions are taken. At these monthly meetings, not only projects that actually are part of the portfolio are put up for discussion. Both projects that are planned to start in the near future and new project ideas as responses to changes in the projects' environment are brought up for discussion.

The technology part of the project portfolio is not updated in the same way as the product project part of the portfolio. The resources involved in the technology projects are also used for more rapid actions such as support for the mills, but these activities are not handled as projects, since they cannot be avoided and the alternative of not performing them simply does not exist. The updates therefore have a greater focus on these types of actions and the real portfolio updates are done more on an *ad hoc* basis in response to changes in the projects or their environment.
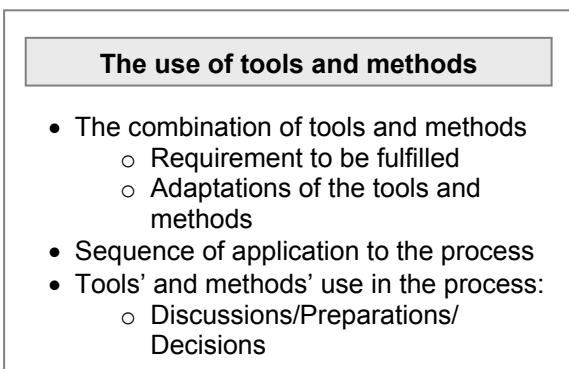
The projects in the third part of the portfolio, the R&D project portfolio ((R&D)PP), are updated in the same way as the product projects. The projects and the portfolio composition are reviewed on a monthly basis as part of formal meetings. As for the product project part of the portfolio, both the technology and

R&D project portfolio reviews bring up new project ideas for discussions, although they are not as frequent as within the product projects.

The overall project portfolio is also updated in a regular way as part of monthly formal meetings. The update of the project portfolio on this level is largely focused on following up the planned project portfolio from the yearly portfolio selection process, but also allows for changes of the project portfolio composition. The reviews do, however, have more focus on single projects than on the overall project portfolio composition.

6.2. The use of tools and methods

The second area of aspects according to the research framework concerns the tools and methods used. Three main areas were stated to be of importance for understanding how the project portfolio management is organised, and those areas are found in Figure 21. It is not feasible in this section to follow the division built up in the framework. The different areas are instead, again seen as areas which are important to cover when describing the tools and methods.

The use of tools and methods

- The combination of tools and methods
  - Requirement to be fulfilled
  - Adaptations of the tools and methods
- Sequence of application to the process
- Tools' and methods' use in the process:
  - Discussions/Preparations/ Decisions

Figure 21: Aspects concerning the use of tools and methods.

Some parts of the material presented here regarding the basis for classification of projects and the tools and methods used are also described in paper 5. But in order to make it easier to understand the entirety, the classification of projects and the tools and methods used are presented here instead of referring directly to the appended paper or presenting the areas in the executive summary of papers.

6.2.1. The project portfolio's division into sub-project portfolios

The basis for many of the tools and methods used at SCA AFH is a division of different types of project activities into so-called sub-project portfolios. The division into these sub-project portfolios on the first level is the same as the division of the project portfolio approval process, i.e. the division into a product project portfolio (PPP), a technology project portfolio (TPP) and a R&D project portfolio ((R&D)PP). Among these first-level sub-project portfolios, each project can only belong to one of them.

However, within these three sub-project portfolios the different projects are further divided in order to better follow up different aspects of the project portfolio. For the PPP, the division is naturally based on the product categories. The TPP is divided into four types of projects and the (R&D)PP is divided in three types. The divisions are found in Figure 22.
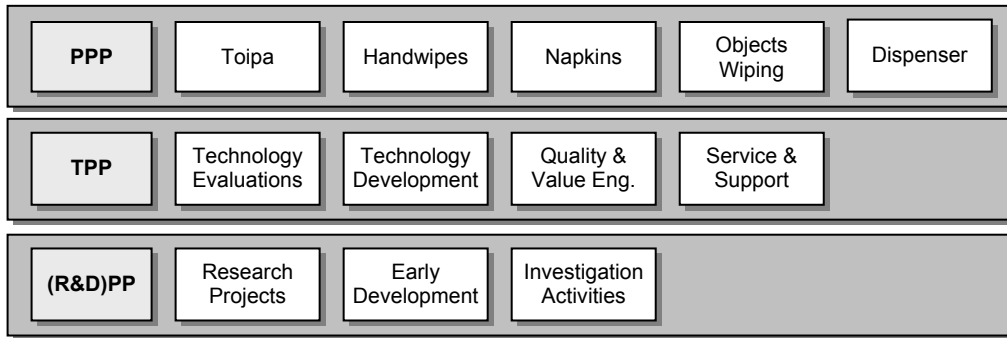
Figure 22: The first and second sub-project levels[12]

These sub-project portfolios are then divided into yet another level, with different bases for the three sub-project portfolios. The product project portfolio is divided on this third level with a basis in different product groups, within each of the product categories (Toipa, Handwipes etc.), which was the basis for the first-level division. The names of the product groups are omitted here for secrecy reasons, but a schematic view of the division can be found in Figure 23.
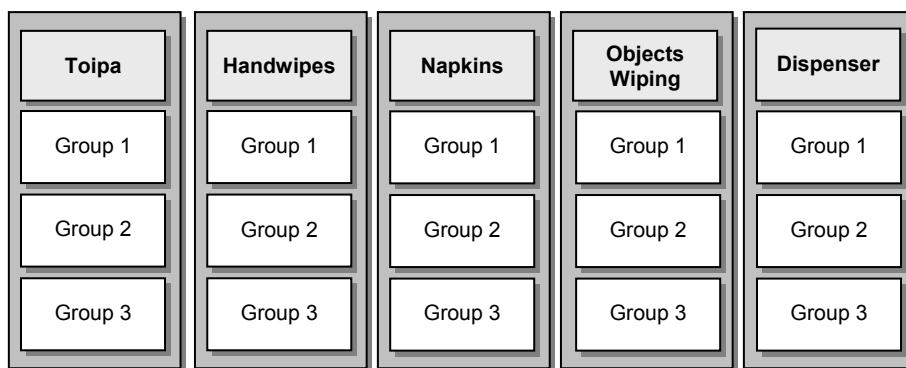
Figure 23: The Product sub-project portfolio (second and third levels)

Within the Technology project portfolio, the Technology Evaluation projects are divided into: Reconstruction Projects, Restructurings, New Investments, and Evaluations of Technologies. The other three categories of Technology projects are divided more or less according to the manufacturing process; see Figure 24.

---

[12] The technology projects at the case company are what in this thesis are termed manufacturing process development projects. A project that at the case company is termed an R&D project corresponds to a technology project in the thesis.

Technology Evaluations	Technology Development	Quality & Value Engineering	Service & Support
Reconstruction Projects	Raw material (type & treatm)	Raw material (type & treatm)	Raw material (type & treatm)
Restructurings	Support Processes	Support Processes	Support Processes
New investments	Paper Making processes	Paper Making processes	Paper Making processes
Evaluations of Technologies	Converting	Converting	Converting

Figure 24: The Technology sub-project portfolio (second and third levels)[13]

The division of the R&D project portfolio is, like the Technology project portfolio, based on the manufacturing process but from a more theoretical view; see Figure 25. Beside this division, a further category is added to each, called Product Development. This category is added to cover activities that do not fit in the categories based on the manufacturing process, such as customer behaviour studies, brand management studies etc.

Research Projects	Early Development	Investigation Activities
Chemicals	Chemicals	Chemicals
Recycled paper & fibre processes	Recycled paper & fibre processes	Recycled paper & fibre processes
Paper making processes	Paper making processes	Paper making processes
Converting	Converting	Converting
Product Development	Product Development	Product Development

Figure 25: The R&D sub-project portfolio (second and third levels)[13]

At both the second and third levels of dividing the project portfolio, specific projects are not constrained to be classified as one specific type. Instead they can be distributed among more than one project category, based on an estimated ratio between the different project categories.

---

[13] The technology projects at the case company are what in this thesis are termed manufacturing process development projects. A project that at the case company is termed an R&D project corresponds to a technology project in the thesis.
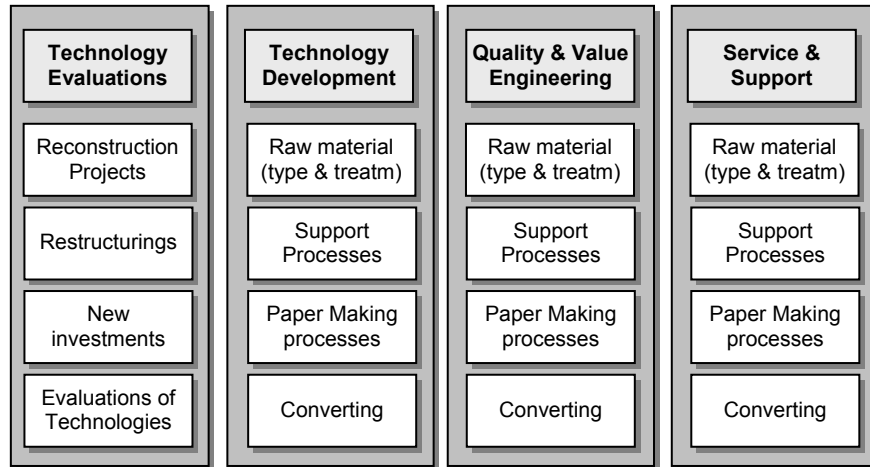
6.2.2. Tools and methods for the project portfolio management

The tools and methods that are used in the project portfolio management process are of two types: graphical charts and a scoring model. The classification of projects that was presented in the previous section is the basis for many of the graphical charts, but also other perspectives of the portfolio are used.

Graphical charts

The first overall chart shows the split of resources in use among the different sub-project portfolios and, furthermore, the split among different types of activities within each sub-project portfolio (see Figure 26). To visualise the distributions of resources also on the next level of the project portfolio, the same type of pie chart is used also here. In Figure 27 an example of these further divisions is shown. Beside the three pie charts at the right-hand side of the figure, there is also a comprehensive view of all the activities within R&D divided into the different manufacturing steps (see the pie chart in the bottom left corner of Figure 27).

Figure 26: Strategic bucket pie charts of 1st and 2nd levels
(the splits shown in the diagrams are simulated for secrecy reasons)[14]

---

14 The technology projects at the case company are what in this thesis are termed manufacturing process development projects. A project that at the case company is termed an R&D project corresponds to a technology project in the thesis.

In the same way as for the R&D project portfolio, pie charts for the other sub-project portfolios are used. For the technology project portfolio, the pie charts follow the classifications described in the previous section without any comprehensive view. However, for the product project portfolio, product managers also use a visualisation below the third level, described in Figure 27. This division is based on a classification of the different products, which however are left out of the presentation here for secrecy reasons.
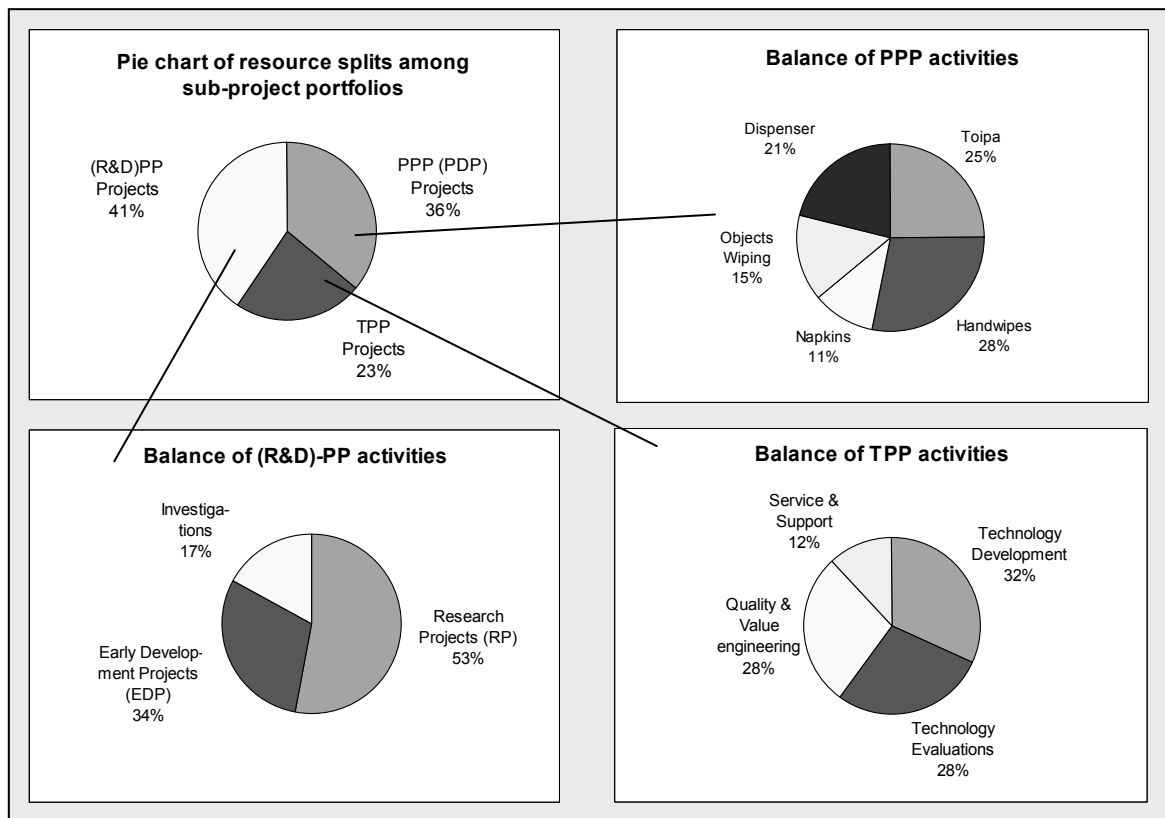

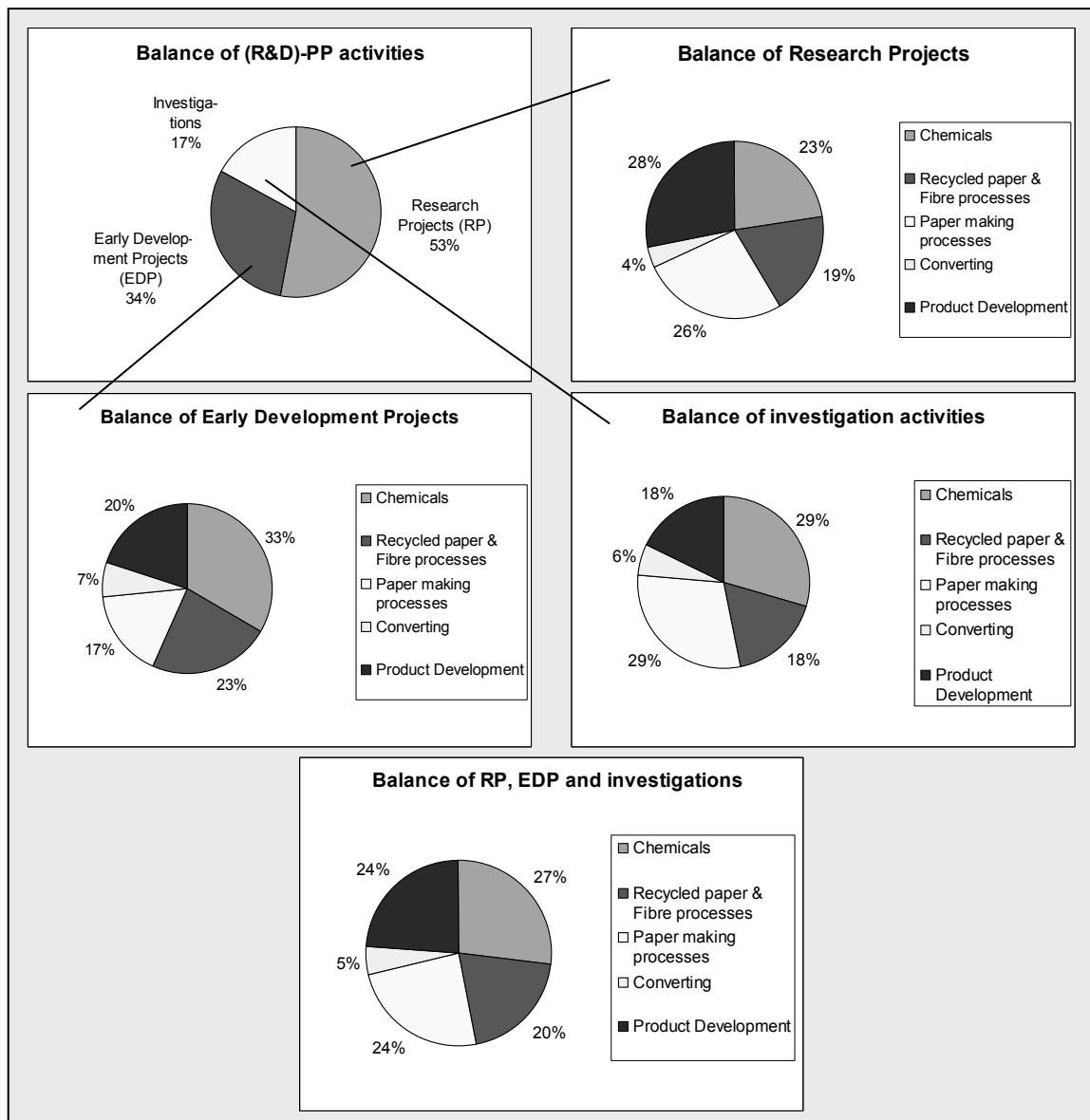*Figure 27: The R&D strategic bucket pie charts (2nd and 3rd levels)*
(the splits shown in the diagrams are simulated for secrecy reasons)[15]

---

[15] The technology projects at the case company are what in this thesis are termed manufacturing process development projects. A project that at the case company is termed an R&D project corresponds to a technology project in the thesis.

In addition to the graphical charts with a basis in the resource split on different levels of aggregation in the portfolio, some other charts are also used in managing the project portfolio. In order to get a view of the project portfolio's future distribution, the diagrams shown in Figure 28 are used, instead of classifying the different projects in terms of how long- or short-term they are.
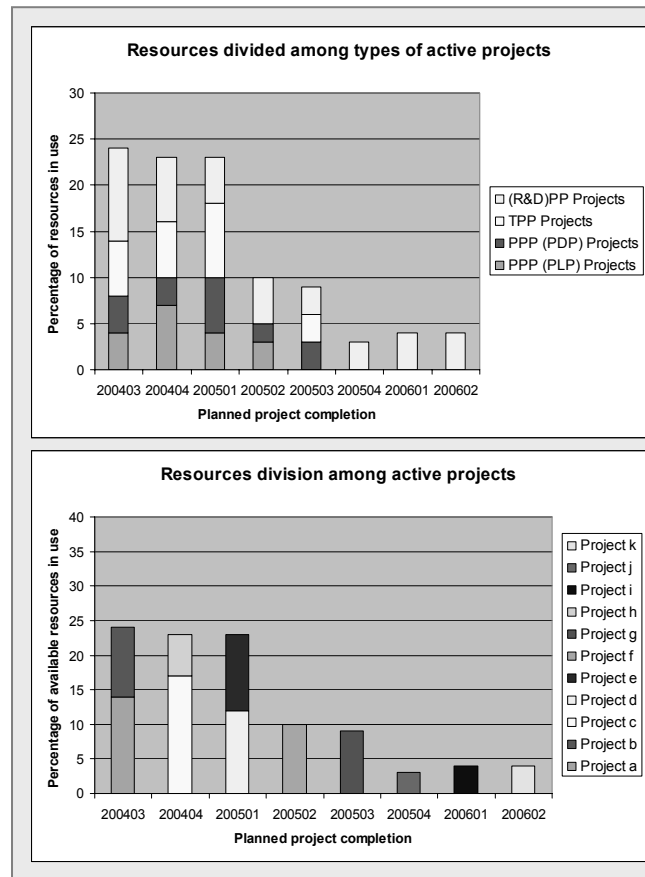
*Figure 28: Planned (both ongoing and future) projects' time distribution
(the splits shown in the diagrams are simulated for secrecy reasons)[16]*

The upper diagram shows each active project's planned completion time, and in the same way the lower diagram shows the distribution of the different sub-project portfolios. Note that the PPP sub-project portfolio is divided into the two project classes, Product Development Projects (PDP) and Product Launch Projects (PLP), in order to give a more specific view of the resources planned for product launches.

Some further charts showing different perspectives of the project portfolio are used for the project portfolio management. In Figure 29, three comprehensive perspectives of the project portfolio as a whole are presented. All of them show different trends of how the development resources are spent.

---

[16] The technology projects at the case company are what in this thesis are termed manufacturing process development projects. A project that at the case company is termed an R&D project corresponds to a technology project in the thesis.

Figure 29: Different comprehensive perspectives of the project portfolio (the splits shown in the diagrams are simulated for secrecy reasons)[17]

---

[17] The technology projects at the case company are what in this thesis are termed manufacturing process development projects. A project that at the case company is termed an R&D project corresponds to a technology project in the thesis.
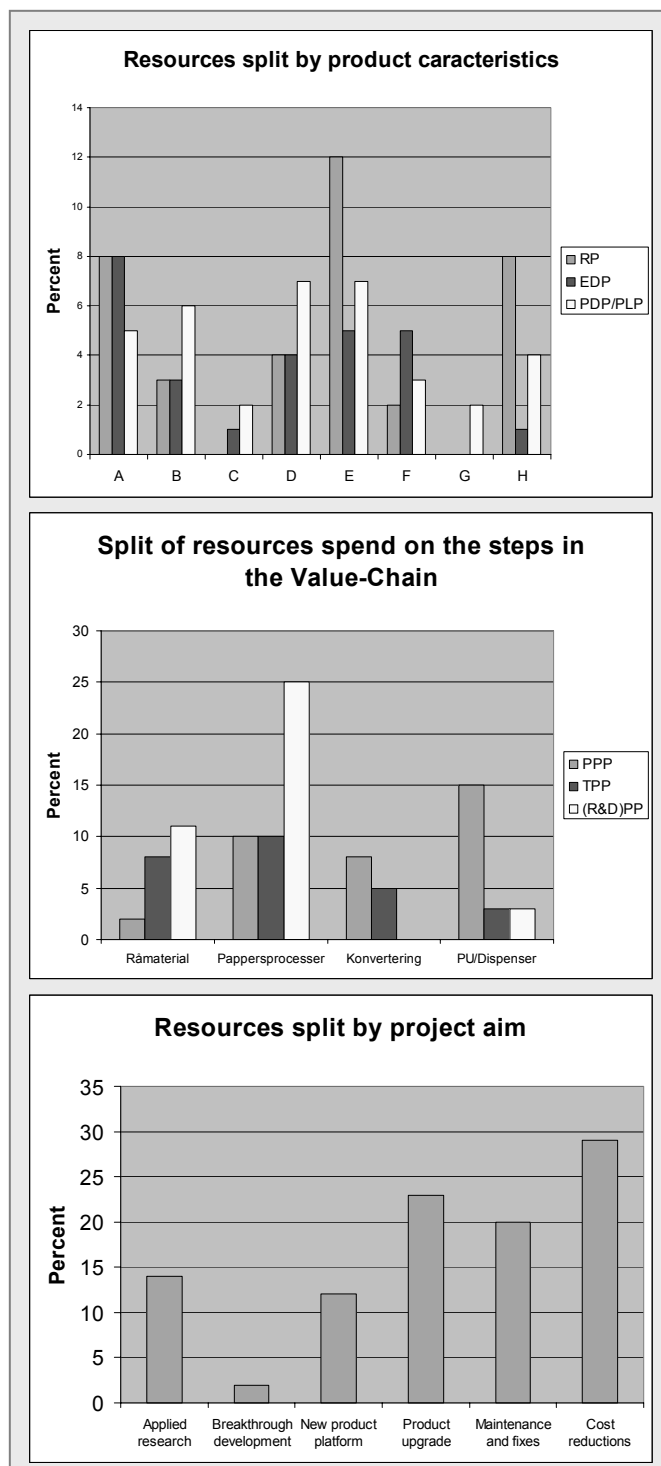
The first chart gives a view of properties that are essential for how the tissue products are perceived (for secrecy reasons the appellations are replaced with letters). The bars are divided among the different project classes, research projects, early development projects, and product development and launch projects, in order to get a more nuanced view. The diagram in the middle shows a comprehensive view of the resources spent on the steps in the value chain (Raw material; Paper making processes; Converting; PD/dispenser), and the right diagram gives a view of the project portfolio based on the aims of the different projects, split into: Applied research; Breakthrough development; New generation platform; Product upgrade; Maintenance and fixes; and Cost reductions.

The scoring model

The second type of tool or method that is used at the case company is a scoring model for evaluating new project ideas. The model is basically built up of eight areas which are important to consider in the evaluation of ideas for new projects. The eight areas (see Figure 30) are, however, built up with between one and five different sub-criteria that together constitute the complete set of points to consider. Every project idea is scored according to these in total 23 different sub-criteria and the project idea gets a score of 0, 4, 7 or 10 points on each criterion. The different values at each sub-criterion have a sharp definition of what is required for a specific score in order to make the evaluation as impartial as possible.

1. Product and Competitive advantage
2. Market Attractiveness
3. Strategic Alignment & Importance
4. Contribution
5. Project & marketing costs/simplicity
6. Development & manufacturing experience
7. Patent
8. Spill-over effect on other product groups

Figure 30: The main criteria used in the scoring model

When the different sub-criteria within one of the eight areas are evaluated and scored, an overall score for the area is agreed on (0, 4, 7 or 10). The summed score for the area is therefore not necessarily the same as the mean value of the different sub-criteria's scorings. When the values of all the eight areas are agreed on, the total value for the project idea is summarised. The different areas have, however, different weightings since they are seen as having different importance for the overall project value. The most important area, for example, is three times as important as the one with lowest importance. When the scorings have been summarised, the percentage of the maximum score is used for comparing the different ideas. How the project scorings are defined, and how the scoring model is applied and used in the project portfolio management process, is described in the next section.

6.2.3. The tools' and methods' application in the portfolio processes

The different tools and methods that have now been described are applied to the project portfolio management process in a specific sequence in order to support each other and the activities in the process. In Figure 31 the different graphical charts that are used for different purposes are presented.
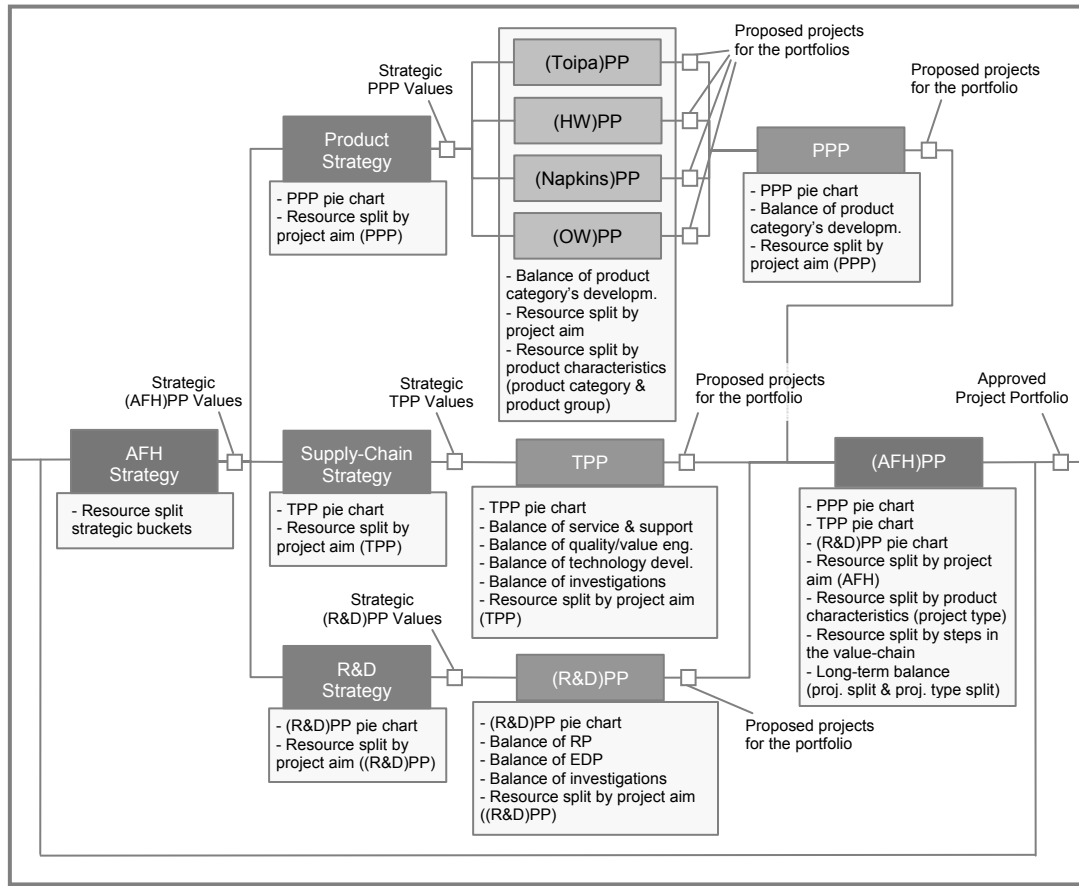
Figure 31: The graphical charts' connection with the project portfolio approval process[18]

The first step, the development of the AFH strategy into consequences for the project portfolio, uses the first-level split of the resources into sub-project portfolios, as input. The decision on strategic values is based on a qualitative discussion in a management group, and the information provided by the tool is one information input among others to the strategy discussion. Therefore the tool can be seen as information on the actual portfolio resource split, but also as a decision basis for the preferable splits which are important inputs for the next step in the process.

The next three parallel steps of the process use the split on the sub-project portfolio level in the same way as in the first step. Also used in this step is the

---

[18] The technology projects at the case company are what in this thesis are termed manufacturing process development projects. A project that at the case company is termed an R&D project corresponds to a technology project in the thesis.

resource split among projects with different project aims. The splits among different project aims refer to the split within each sub-project portfolio (not the portfolio as a whole) and the tool is used in the same way as the different charts showing the splits among the sub-project portfolios. This means input of actual values as a basis for qualitative discussions and, in the next step, decisions about preferable splits.

The outputs from the next step of the process are proposed projects for the portfolio. The four sub-processes within the PPP part use three different charts as support for their decisions on new projects: the balance of the product category's development projects; the resource split by project aim; resource split by product characteristics (both on the product category level and at the product group level). These graphical charts, however, are only used as information on historical splits in order to reflect upon how the resources should be distributed in the future. The decisions on which projects to propose for the portfolio in these four processes are also supported by using the scoring model. The model is not used as a decision tool *per se*, but instead as a method for structuring the discussions in the cross-functional management teams responsible for the decisions. The ranking values on the different criteria in the model are agreed values in the group, which are sometimes easy to agree on and sometimes not. But the discussions do not end until the group has agreed on common values. When the different project ideas are evaluated and ranked against each other, the list of ranked projects is used together with the information from the graphical charts in order to agree on a list of proposed projects for the portfolio.

The next steps (PPP, TPP, (R&D)PP) of the process use different graphical charts for supporting the decisions. All charts are here used just as support for the qualitative discussions in the different management groups, with the aim of agreeing on a list of proposed projects for the portfolio.

In the last step of the process the graphical charts, applied as described in Figure 31, are used in a somewhat different way. Here the management group holds the responsibility to follow up the project portfolio on all of the seven different balances or splits. The responsibility is not only to follow up but also, if necessary, to take corrective actions. However, the overall split of resources among the different sub-project portfolios is the main resource split to steer the portfolio against; the others are rather follow-up balances and splits which are points for discussion and eventual action.

6.3. Organisational aspects

Regarding the two parts describing procedural aspects and the use of tools and methods, it is not sufficient to structure this section strictly according to the research framework. This section starts out from the organisational setting at the case company, but then the forums and personnel involved in the portfolio decisions are presented according to the project portfolio approval process outlined in the previous sections. The different areas according to the framework should therefore, also for the organisational aspects, be seen as a checklist of areas important to cover.
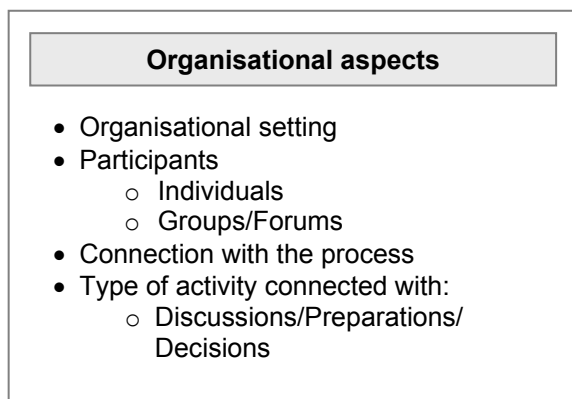
Organisational aspects

- Organisational setting
- Participants
  - o Individuals
  - o Groups/Forums
- Connection with the process
- Type of activity connected with:
  - o Discussions/Preparations/ Decisions

Figure 32: Organisational aspects in the research framework

6.3.1. Organisational setting

The three most central organisational units for the project portfolio management at SCA AFH are the R&D unit and two units called the Category and the Supply-chain. The *Category* is a central market/product organisation which is established to serve different markets all over the world. Within the Category, different product managers hold the responsibilities for different product groups and the products' long-term development. The distribution of the products on the market then goes through regional market directors at different markets based on a geographical division. The Category is the receiver of the finished projects and responsible for connecting the launches with the local market organisations.

The *Supply-chain* is a central organisational unit responsible for the manufacturing facilities. The products sold all over the world are rather low-cost products, according to product weight and volume, and therefore not profitable to transport over long distances. The production facilities (mills) are thus located regionally at the different markets. In order to synchronise the production at the different mills, the company has established the organisational unit called the Supply-chain. The main responsibilities for the unit are to initiate and coordinate efficiency works at the mills, initiate and propose investments in order to fulfil production demands, and be responsible for the overall production structure. Since a kind of strategic decision is made that the department is not going to have many resources of its own, besides resources within the manufacturing in the mills, R&D resources are often used in various inquiry projects initiated by the Supply-chain.

The *R&D* unit is organised internally according to both product areas and the different parts of the production process. The three different product areas are Toiletpaper/Napkins/HandWiping, ObjectsWiping/NonWoven, and Dispensers. These product areas have one responsible product development manager each, who

is responsible for the product developments within that area, and for contacts with the Category which are, so to speak, the contacts with the market side of the organisation. The last area is special because the dispensers are not developed inside the organisation and the dispenser development supports all the different product areas. The development manager responsible for the dispensers more or less coordinates the external development activities. The other groups in the R&D unit consist of a converting group and a process & materials group which have more technical focuses. Within the group of process & materials, different responsibilities such as papermaking, process & fibre, and non-woven material are distributed. The converting group holds the responsibility for knowledge about cutting, embossing and packaging of the tissue products.

Besides these units, three other units are relevant for the study, namely the *Sourcing* department, the *Environment* department and the *Patent* department. The Sourcing department is responsible for the purchasing of consumable supplies, which for example can be chemicals of different types, paper pulp or mother reels (manufactured paper on large reels ready to be converted into final products). The Environment department has the responsibility of following legislative processes and upcoming recommendations within the environment field, in order to understand the consequences for SCA's products as quickly as possible. The Patent department is a central unit responsible for following the evolution of patents relevant for the area. The department follows the competitors' developments in terms of new patents and looks after SCA's own patent interests. One important part of this is to assist the projects in patent inquiries, which can be in terms of both existing patents restricting the development and possibilities for new patents based on ideas found in the projects. These last three departments are not directly involved in the management of the project portfolio, but are noted here as organisational units with interest in the management of the project portfolio.

In Figure 18 also the AFH Executive team was brought up as an organisational unit with interest in the project portfolio's management. The AFH Executive team is the managerial group ultimately responsible for the Away-from-home tissue business.

6.3.2. Participants

The project portfolio approval process as described earlier is carried out with support by different forums with representatives from the different units in the organisation. Figure 33 gives an overview of how the different forums are connected with the project portfolio approval process.
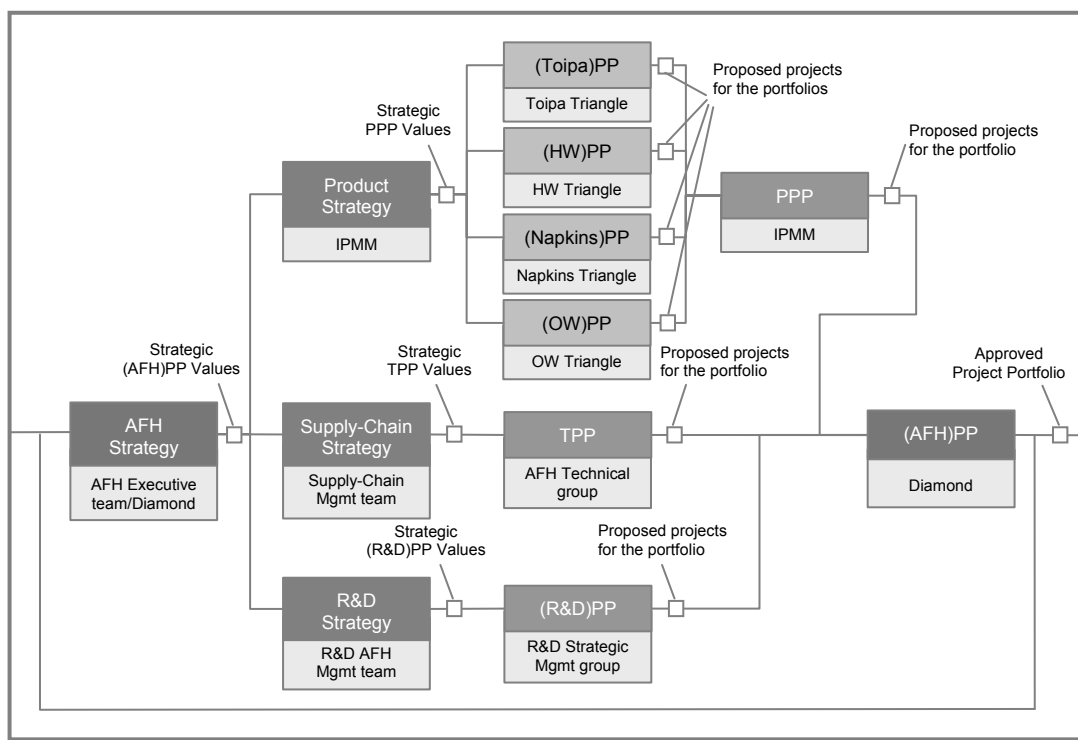
Figure 33: The project portfolio approval process with organisational forums[19]

In the first step of the process the *AFH Executive team* is involved, which as described before is a management team. The team consists of the managers from the Category, the Supply-chain and R&D. Together with the overall AFH manager, the executive team also includes the managers from marketing, human resource and finance. The *Diamond* can be seen as a more operative part of the executive team. This forum consists of three members: the managers responsible for the Category, Supply-chain and R&D.

The International Product Marketing Management team (*IPMM*) consists of the category manager and the international product managers (IPM), who represent one product group each (toilet paper, handwipes, napkins, objects wiping). This group holds the overall responsibility for the AFH tissue products' development in both a short- and a long-term perspective.

The *Product Triangles* are cross-functional forums with representatives from the Category and from R&D. The product triangles are chaired by the IPMs, and included in the group are also a product manager (from the Category) and a product development manager from the R&D unit. The Supply-chain is not represented by a separate manager, but sufficient knowledge about the manufacturing facilities is provided by the IPM who has regular contacts with the managers at the different

---

[19] The technology projects at the case company are what in this thesis are termed manufacturing process development projects. A project that at the case company is termed an R&D project corresponds to a technology project in the thesis.

mills. At the meetings with the triangles, representatives from different parts of the organisation are also frequently involved.

The *Supply-chain management team* consists of managers with different responsibilities within the Supply-chain. In addition to these managers, some administrative mangers are included in the group. This management team holds the responsibilities for the developments of the global manufacturing structure. The *AFH Technical group* consists of some of the managers who are included in the Supply-chain management team, but this group is a smaller one that can be seen as an operative group of the Supply-chain management team. The representatives of this group have close contacts with the manufacturing facilities and deep knowledge about ongoing activities in the mills.

The *R&D AFH management team* includes the head manager of the R&D unit, the group managers within R&D (see 6.3.1) and additional personnel with more administrative responsibilities. The *R&D Strategic Management group* then includes the head of the department, the group managers of the technical groups within R&D, and some experienced senior researchers in the organisation.

6.3.3. Delegating structure

As noted when the process was described, it seems that no synchronisation exists between the different sub-processes. But as many of the managers participating in the forums, in which the evaluations, prioritisations and selections of projects are made, do participate in more than one of them, synchronisation among the sub-processes is ensured.

It is not only between the different sub-processes that cross-participation among the different forums occurs. Along the different sub-processes, managers in the different forums participate in more than one forum. Typically the manager responsible for one forum is involved as a participant in the forum connected with the preceding step in the process. In the end, where the process converges, the responsible managers for the next-to-last step are participants in the forum connected with the last step of the process.

This means that the project portfolio decisions are delegated three levels down from the overall project portfolio level. The responsibility for the portfolio of projects lies ultimately with the AFH manager, and is delegated to the Diamond group as operatively responsible for the project portfolio's execution. The Diamond group has then further delegated the responsibility for the different sub-project portfolios to the next levels, which in turn have delegated it to yet another level in the organisation.

The delegation of responsibilities concerns not only the outcomes of the different steps in the project portfolio approval process, but also the periodic reviews of the project portfolio described in 6.1.3.
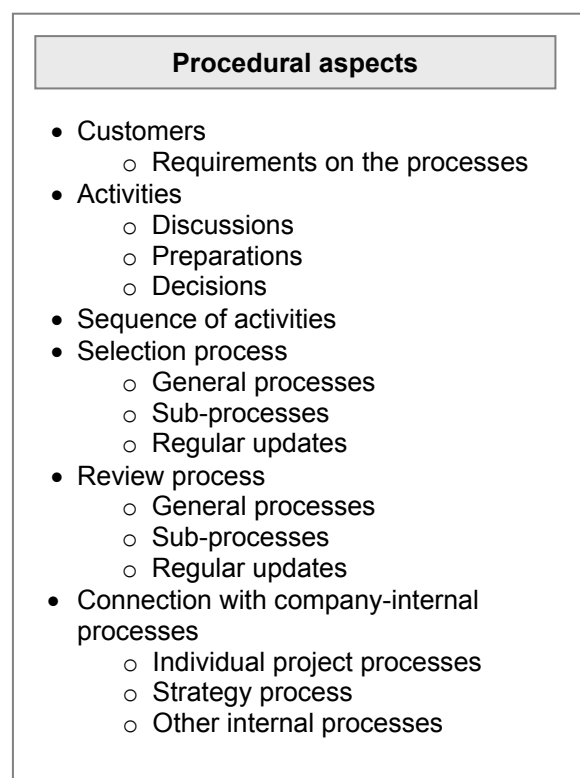
7. An analysis of SCA AFH Tissue's approach to organising project portfolio management

The previous chapter and parts of Chapter 5 have given a description of how project portfolio management is organised at SCA AFH Tissue. This chapter aims at taking the next step in the analytical path by analysing SCA AFH Tissue's approach to organising project portfolio management. The research framework is used for analysing the case company's approach and the chapter is consequently structured according to the framework. The results of the analysis are empirical findings which will be used in the next chapter when elaborating on the research questions.

7.1. Procedural aspects

According to the research framework several different procedural aspects are important for understanding project portfolio management. The framework can be used for structuring the analysis of the procedural aspects in different ways. For analysing this specific case it has been decided to start out from the three key constituents of processes: Customers, Activities, and Sequence of the activities (Rentzog, 1996). The aspects dealing with the selection process and the review process are not dealt with separately, but instead as parts of the paragraph dealing with the activities. The connection with other company-internal processes is dealt with in a separate section.

Procedural aspects

- Customers
  - Requirements on the processes
- Activities
  - Discussions
  - Preparations
  - Decisions
- Sequence of activities
- Selection process
  - General processes
  - Sub-processes
  - Regular updates
- Review process
  - General processes
  - Sub-processes
  - Regular updates
- Connection with company-internal processes
  - Individual project processes
  - Strategy process
  - Other internal processes

Figure 34: Procedural aspects in the research framework

7.1.1. Customers of the project portfolio management processes

Essential to all processes are the customers of the process and what output these customers expect from the process (Rummler and Brache, 1995; Rentzog, 1996; Lind, 2001). Project portfolio management literature in general does not deal with the question of which parties are interested in the process. Some authors in the project portfolio management area (Cooper et al., 2001b; EIRMA, 2002; Kendall and Rollins, 2003) do, however, deal with which organisational participants to involve in the process. They generally suggest that a specialist group consisting of experienced managers ought to be put together for carrying out the project portfolio management task. It may be presumed that such a specialist group should represent

the parties with an interest in the project portfolio's management. The results of the SCA AFH Tissue study show that many different parties are interested in the project portfolio's management, but not all of them are explicitly involved in the management of the project portfolio. The results also show that the different parties interested in the portfolio's management have different requirements on the project portfolio management process, from requirements regarding specific balances in the portfolio to requirements on information about upcoming projects.

The results of the study also show some relations between the organisational units with an interest in the project portfolio management and the ones actually involved in the project portfolio management work. The organisational units involved (i.e. Category, Supply-chain, R&D) are the units that share the greatest interest in the management of the portfolio (in terms of different requirements on the process) and are also the ones that are most directly influenced by the decisions in the process. The representatives from these organisational units are also the ones that possess the most crucial knowledge for the project portfolio decisions. Even though all organisational units with an interest in the project portfolio's management have information that can be of importance in the project portfolio management, it would not be feasible to involve all of them. The results show that there are more organisational units that share an interest in the project portfolio's management at the case company, than the organisational units emphasised in literature as important to involve in the project portfolio's management (Cooper et al., 2001b; EIRMA, 2002; Kendall and Rollins, 2003). But the results also show that the units emphasised in the literature as important to involve are the ones most important at the case company as well (Category, Supply-chain and R&D).

According to the results, even though it not is feasible to involve all organisational units which have an interest in the project portfolio's management, these units still are important to deal with when managing the project portfolio. Some of the requirements expressed by these internal customers differ from the requirements expressed by the units involved in the process. Therefore the requirements from all organisational units with an interest in the project portfolio's management are relevant to consider when managing the project portfolio, regardless of whether those units are explicitly involved in the project portfolio's management.

> **Summary of findings:** *Not all of the organisational units that are internal customers of the project portfolio management process are involved in the project portfolio management process. The representatives from the organisational units involved in the process are, however, the ones that possess the most crucial information for the project portfolio decisions.*

7.1.2. Activities in the project portfolio management process

The project portfolio management literature in general does not separate between the selection of projects for the portfolio and the review of the project portfolio (Archer and Ghasemzadeh, 1999; Cooper et al., 2001b). These two different parts of project portfolio management involve different types of decisions which rely to some extent on different needs of information. At the case company the selection of projects and the review of the portfolio are handled in separate processes, even though they are closely related to each other.

The basic reason why the selection of projects and the review of the project portfolio are made separately is that the project selection process is seen as a natural extension of the strategy process, which is done once a year. A review of the actual project portfolio is always an important point of departure for the selection process, but this yearly review of the project portfolio is not seen as frequent enough for all parts of the portfolio. The yearly process of selecting projects and planning the portfolio is resource-consuming, and carrying it out more often than once a year is not seen as valuable. Instead, it has been discussed at the case company whether this process should be carried out once every second year. This is one reason why the project selection process is separated from the portfolio review process at the case company. A separate process for benchmarking competitors' products that provides important input to the selection of projects for the portfolio is also carried out once a year, in connection with the strategy process. Consequently this is a contributory reason why the selection process is carried out once a year.

This division of the project selection and project portfolio review into separate processes does not, however, imply that new project ideas cannot be included during the year. If new important project ideas emerge or the market changes during the year, new projects can be evaluated and eventually be included in the project portfolio, at the expense of reprioritising other projects. But this does not mean that new project ideas are brought up for evaluation at every project portfolio review; instead such project ideas are brought up as they emerge, which is not frequent.

> ***Summary of findings:*** *The selection of projects for the portfolio and the reviews of the project portfolio are taken care of separately. The process of selecting projects for the portfolio is seen as an extension of the yearly strategy process which also includes a review of the project portfolio. This yearly review of the project portfolio, however, is not enough for all parts of it; some parts need to be reviewed more frequently.*

Project selection process

Beside the split between the process dealing with the selection of projects and the one dealing with the review of the portfolio, another notable finding is that the project selection process is divided into separate sub-processes. Authors dealing with process aspects of project portfolio management do not, in general, go into

detail of how the processes should be arranged. As noted in the theoretical exposition, Archer & Ghasemzadeh (1996) are some of the authors who, nonetheless, have made some efforts at detailing the process aspects, when developing a generic project portfolio management process. Their generic process (see Figure 8, p.27) focuses, though, on the different stages of the process and does not deal with eventual division of the process into sub-processes. One reason may be that the authors do not deal with process aspects at this level of detail, and another may be that the approach of dividing the process into sub-processes is not commonly used in practice.

> ***Summary of findings:*** *The selection process is divided into separate selection processes for the different sub-project portfolios.*

No matter why project selection processes divided into separate processes for different parts of the project portfolio are not dealt with in earlier research, for the purpose of this thesis it is still interesting to understand why the project selection process at the case company is taken care of in separate sub-processes. This involves two different questions: why the selection process is separated, and why the project portfolio is still kept as a single portfolio.

One reason why the project selection process is divided is the close connection with the business strategy process, which is divided into separate strategies for the product categories and for manufacturing. Connections with the R&D strategy also exist, even though this strategy is also developed on the basis of other inputs external to AFH Tissue unit but internal to SCA. Since the projects, and thus also the project portfolio, are one important way to operationalise the strategies (Cooper et al., 2001b; EIRMA, 2002), it is natural that also the project selection process is divided at the case company. That the business strategy is developed into separate strategies for different areas is not unique; this is rather the natural way of working with strategies (Wheelwright and Clark, 1992; Slack et al., 2001).

Regardless of whether different strategies are developed for the different sub-project portfolios, the project portfolio could have been managed in one single process. Another contributory reason why the project selection process is divided is therefore that the projects included have distinguished characteristics, and thus are better taken care of in separate processes. A project aiming at launching a product with a new package on a specific market, for example, is rather different from a large investment project in a mill or a research project aiming at analysing very specific parts of the manufacturing process. Projects with such distinctive characteristics need to be evaluated in different ways, including different types of project information. Personnel with different types of knowledge therefore have to be involved in the evaluations of the different types of projects, and consequently the different project types are more efficiently dealt with in separate sub-processes.

Even though the importance of including all types of projects in the project portfolio has been emphasised in project portfolio management literature (Bridges, 1999; Cooper et al., 2001b), it is not explicitly described to what degree the characteristics of the projects included in the same portfolio are distinguished from

each other. Literature elaborating on procedural aspects of project portfolio management does not deal with processes divided for different types of projects (Archer and Ghasemzadeh, 1999). Instead this literature seems to presume that all projects should be taken care of in the same process. Nevertheless, the results from this study show that project portfolios including projects with such distinguished characteristics can be handled in separate processes.

> **Summary of findings:** *One reason for dividing the selection process into separate processes is that different strategy development processes are connected with the different types of projects in the portfolio and the project selection process is seen as an extension of the different strategy processes. Another reason for dividing the selection process is the inclusion of projects with distinguished characteristics in the same project portfolio. As different knowledge is needed for selecting the different types of projects, they are better taken care of in separate processes.*

The second area of interest is why the project portfolio still is kept as one project portfolio. The split of the strategy and the process for project selection could have implied that the overall project portfolio was split into totally separate project portfolios for the different types of projects (product development, manufacturing process development and technology development). But as the same base of resources is used for the different types of projects, it was found more feasible to manage all of the projects as one overall project portfolio, divided into sub-project portfolios dealt with in separate sub-processes. The resources most widely used among the different types of projects are the resources based in the R&D unit. But resources from the other organisational units (Category and Supply-chain) are also used for the different types of projects. One common way of managing this type of project portfolios, including different types of projects, is through the use of strategic buckets for the allocation of resources to groups of different types of projects (Cooper et al., 2001a). However, this is done only on the level of describing the uses of different tools and methods (Cooper et al., 2001b). The consequences for how the project portfolio management is carried out for such project portfolio settings are not elaborated on. The way to manage the project portfolio at the case company has many similarities with the strategic buckets approach (Cooper et al., 2001b), the main difference being the division of the project selection process into separate processes.

Another factor that also seams to be relevant for keeping the project portfolio as one overall portfolio is the characteristics of the industry. In industries where the manufacturing processes are not as complex as the one of producing hygienic tissue products, and where the manufacturing effectiveness is not the most dominant profitability factor, it may be easier to separate the different sub-project portfolios from each other, thus constituting separate project portfolios with dedicated resources. But in industries competing with products such as hygienic tissue products, projects aiming at new products and manufacturing process development – and technology development, for that matter – are closely related and dependent on each other. Separating the sub-project portfolios into separate portfolios in this

type of industry is not feasible. The fact that the characteristics of the industry influence the composition of the project portfolio is supported by Bridges (1999) when stating that there is no single approach to project portfolio management that works in every organisation, industry or culture. That situational characteristics influence the ways to organise for project portfolio management is supported by several authors (Bridges, 1999; Levine, 1999; Meredith and Mantel, 1999; Kendall and Rollins, 2003), but few of them detail how specific characteristics influence the project portfolio management approach, which could be an area of interest for future research.

> ***Summary of findings:*** *As the same base of resources is used for all types of projects, the project portfolio is managed as one single project portfolio and not as separate portfolios for the different types of projects. Another reason is the characteristics of the industry; the different types of projects (product, manufacturing process and technology), for the particular industry at hand, are closely related to and dependent on each other, and thus better taken care of as one portfolio of projects.*

The choice of separating the project selection process while still managing all projects as one overall project portfolio, however, has additional consequences for the procedural setting. In order to keep the three sub-project portfolios as one overall project portfolio, the divided selection process has to converge again in the later stages of the process. The main aim of letting the process converge again is to integrate the different sub-project portfolios in order to avoid sub-optimisations of the resources.

Another consequence of the decision to select projects in divided processes while the projects to a large extent still depend on each other is the need for synchronisation between the sub-processes. This synchronisation is to some extent fulfilled when the process converges in the later stages, but this is found to be insufficient. Synchronisation is found to be important also between the sub-processes, during the evaluations and selections of projects in order to arrive at a good project composition, where the projects complement and reinforce each other. If for example the Supply-chain plans an installation project in a specific mill, it is necessary for the Category to take this into account when planning the product project portfolio as well. The synchronisation between the sub-processes is further analysed in the fourth part of this chapter, when dealing with the organisational aspect of project portfolio management.

> ***Summary of findings:*** *As a consequence of selecting projects in separate sub-processes, the overall selection process has to converge in later stages of the process. But the different sub-processes also have to be synchronised during the evaluation and selection of projects.*

Project portfolio review process

The project portfolio management process is, at the case company, divided in separate processes for selecting projects and reviewing the project portfolio, in contrast to what has been described in earlier research (Archer and Ghasemzadeh, 1999). Earlier in this chapter it was described that the reason for this division was that the selection of projects for the portfolio is seen as an extension of the yearly strategy processes, and that to review the project portfolio once a year was not enough for all parts of the project portfolio. But for some parts of the project portfolio, yearly reviews are indeed thought sufficient. The frequency of portfolio reviews depends upon factors such as the type of projects that are considered, the lead time of the development, and the dynamics of the industry (McDonough III and Spital, 2003). This has resulted in dividing the project portfolio review process into different processes for the different sub-project portfolios, where the projects within each sub-project portfolio are compared against each other. The basic reason for this division is the inclusion of projects with such distinctive characteristics as product development projects, manufacturing process development and technology development in the same project portfolio.

The environment facing the projects in the manufacturing process development projects does not change in the same way as the environment facing the ones in the product sub-project portfolio. The product projects face changes in both company-internal and external environments with sometimes rapid and large implications for the product sub-project portfolio. In order to be able to respond to such changes this part of the portfolio is reviewed once a month as a recurrent point at formal meetings.

The manufacturing process development projects are not influenced in the same way by changes in the external environment as the product development projects. Therefore this part of the project portfolio can be seen as more stable and easier to plan for, and consequently this part of the portfolio is not in need of as frequent reviews as the product project part. While the resources most frequently involved in the manufacturing process development projects are also used for more quick actions such as support for the mills, these activities are not handled as ordinary projects, since the alternative of avoiding them does not exist. The reviews thus focus more on these types of actions, and the real portfolio reviews are done more on an *ad hoc* basis as responses to changes in the projects or the internal organisational project environment.

The projects in the third part of the portfolio, the technology project portfolio, are typically also easier to plan for, compared to the product projects. The project environment is more stable (both internal and external to the development organisation) and it is mainly what happens in the different projects that has consequences for the project portfolio. However, even though these projects are easier to plan for, this part of the portfolio is still in need of regular reviews. Therefore this part of the portfolio is regularly reviewed as part of monthly meetings, but is not updated at all of these meetings. The updates are more

requirement-driven, i.e. the sub-project portfolio is updated when significant changes in the projects or in their environments have occurred.

The other project characteristic contributing to updating the different sub-project portfolios separately is how long the projects are (McDonough III and Spital, 2003). The projects included in the product sub-project portfolio are on average shorter than the projects in both the R&D and the technology sub-project portfolio, which calls for more frequent updates (McDonough III and Spital, 2003).

As a consequence of using the same base of resources in the all of the projects, an update of the project portfolio is required also on the general portfolio level. This review of the overall project portfolio is, however, as with the project selection process, more a matter of just following up the current status of the ongoing projects in the portfolio. This review is held once every second month, but the action decisions regarding the portfolio composition that are taken on this level primarily concern prioritisation decisions between the different sub-project portfolios. Prioritisation decisions within the sub-project portfolios are taken care of in the separate portfolio reviews.

> ***Summary of findings:*** *The distinguished project characteristics, in terms of both the project environment's dynamics and the projects' durations, are the reason why the different parts of the project portfolio are reviewed separately.*

7.1.3. Sequence of activities in project portfolio management

Compared to the project portfolio management processes dealt with in existing literature (Archer and Ghasemzadeh, 1999), the process at SCA AFH Tissue is divided differently and into more process stages. When comparing the process at the case company with the framework by Archer and Ghasemzadeh (1999) presented in Figure 8 (p.27), it can be seen that the two processes are rather different. The process at the case company includes the strategy development in the process, while this is not viewed as a part of the portfolio selection process in the proposed framework. It is, however, an important constituent in the framework of Archer and Ghasemzadeh (1999). One reason why the strategy's development is included in the process at the case company is that the projects included in the portfolio are guided by different strategies. That the projects are guided by different strategies is in turn a consequence of including projects with distinctive characteristics in the same project portfolio.

The second difference is the pre-screening stage in the framework of Archer and Ghasemzadeh (1999), which does not constitute an explicit stage in the case company's process. The project ideas that are brought up are, however, pre-screened as part of the process. The Product triangles, for example, perform a pre-screening of the project ideas before evaluating each project that is of interest for the portfolio. The same holds for the Technology and the R&D sub-processes, where the project ideas are pre-screened as part of the process even though not documented at the same level of detail as for the product projects.

Yet another difference is that of the reiteration loop back to the process if the portfolio composition is not satisfactory. In the framework of Archer and Ghasemzadeh (1999), the loop back is to the preceding stage, while in the process at the case company the loop goes back all the way to where the strategic portfolio values are decided on. This difference is due to the division of the project portfolio into separate sub-project portfolios. The strategic portfolio values constitute the basis for the whole project selection process, and new values for the different sub-project portfolios may result in rather different project prioritisations within the different sub-project portfolios.

The division into the three sub-project portfolios also influences the number of different stages in the process at the case company, compared to the framework suggested by Archer and Ghasemzadeh (1999). The division into sub-project portfolios, firstly, adds an extra stage when deciding on the splits within the different sub-project portfolios, which, if the process were not divided, would have been taken care of in the single process. At the end of the process, yet another stage in the process is added for following up the split values of the proposed project portfolio. In the sub-process for the product project portfolio, yet one more stage is added. This process is divided into yet another sub-process level, and consequently needs to be followed up for the same reasons as for the first-level division.

> ***Summary of findings:*** *Including projects with distinctive characteristics in the same portfolio has implications for the stages in the selection process. The strategies' development is included in the selection process; additional stages are needed for splitting and following up the resource splits among the sub-project portfolios; the reiteration loop back, if the portfolio composition is not satisfactory, becomes more extensive.*

7.1.4. Connection to other company-internal processes

According to the framework presented by Archer and Ghasemzadeh (1999), the strategy process is seen as an internal process connected with the project portfolio management process. At the case company, the strategy process is tightly intertwined with the project portfolio selection process, and consequently also constitutes separate stages of the three portfolio selection processes, as has already been described above.

At the case company, a formalised process for benchmarking competitors' products is closely connected with, primarily, the selection of product projects. This benchmarking process can, however, generate ideas also for projects in the other sub-project portfolios. Beside this formalised benchmarking process, less formalised processes for collecting ideas for improvement projects from the mills, ideas from the regional marketing organisations, and workshops aiming at brainstorming and discussing ideas for R&D projects also exist. In the framework of Archer and Ghasemzadeh (1999), these processes or ways of working could be seen as parts of collecting project information in the early stages of the process, but they are not covered by the framework as important company-internal processes. The importance of widening the channels for collecting ideas has earlier been

emphasised by, for example, Wheelwright and Clark (1992). Because of its importance, it is easy to argue that such internal processes should constitute an important aspect of a framework for analysing project portfolio management, which not has been emphasised earlier.

Summary of findings: *The case company has internal processes providing important input for the project selection processes: a formalised process for benchmarking competitors' products, and less formalised processes for collecting project ideas from different parts of the organisation.*

7.2. The use of tools and methods

This part of the chapter deals with different aspects of how the tools and methods are applied and used for assisting the project portfolio management activities. It is organised according to the research framework in three main sections, dealing with the combination of tools and methods, the sequence of application to the process, and the tools' and methods' use in the process.

The use of tools and methods

- The combination of tools and methods
  - Requirement to be fulfilled
  - Adaptations of the tools and methods
- Sequence of application to the process
- Tools' and methods' use in the process:
  - Discussions/Preparations/ Decisions

Figure 35: Aspects concerning the use of tools and methods.

7.2.1. The combination of tools and methods

In empirical breadth-based studies it has been found that companies successful in project portfolio management use a limited number of tools or methods assisting the portfolio management work (Cooper et al., 1998; Center for Business Practices, 2003; Szwejczewski et al., 2004). Based on such results it has been recommended to use a limited number of tools and methods assisting the project portfolio management (Cooper et al., 2001b; EIRMA, 2002). It has consequently also been recommended to focus on a few tools and methods which are most relevant for the specific situation (Cooper et al., 2001b). The very most successful companies use one to three different tools or methods (Cooper et al., 2001a).

However, within process management literature it is argued to be important also to consider the customers and the requirements on the process (Rentzog, 1996; Lind, 2001). If the project portfolio management process involves many different customers and extensive requirements, this may favour the use of more than a few tools and methods, as the latter are applied for supporting the fulfilment of the requirements on the process.

The case company uses several different tools and methods for the project portfolio management process, and the main reason for their use is to assist the project portfolio management in responding to all of the different requirements on the process. The results in paper 4 (Dawidson, 2004) show that the requirements on the process at SCA AFH Tissue are comprehensive. However, research elaborating on requirements on project portfolio management at this level of detail is sparse. The goals, which are considered to be the same as the requirements on the process, are reported on a general level (EIRMA, 2002). It is therefore hard to determine if the requirements on the process at the case company are more comprehensive than among companies in general.

Some of the requirements found at the case company, however, are not reported to be found at other companies, while others are. Some of the requirements on the process at the case company are more specifically stated, compared to the general goals of project portfolio management (e.g. several specific balance aspects of the portfolio). Both that the requirements are more extensive, and that they are more specifically stated, makes it reasonable that more tools and methods are needed to assist the project portfolio management to fulfil its requirements. There may be both different types of tools and methods and different adjustments of the same tool or method. The latter is especially the case at SCA AFH Tissue, which has applied different adjustments of the same type of graphical charts to the process.

It is, however, relevant to consider whether the ambition should be to respond to every part of the different requirements on the process. The most successful companies reported to use a few tools and methods (Cooper et al., 1998; Center for Business Practices, 2003) may also focus on the most important requirements when choosing their few tools and methods, but this is not reported in these studies. The question of whether fulfilling all the requirements on the project portfolio management is more important than focusing on a few number of tools and methods cannot be answered on the basis of the empirical data provided here, but could be of interest for future research.

A contributory reason why more tools and methods than suggested by literature (Cooper et al., 2001b; EIRMA, 2002) are used, in assisting the portfolio management at the case company, is the choice to manage the different sub-project portfolio in separate processes. In each sub-process a set of tools and methods that are specifically adjusted to fit the requirements of each sub-process are applied. The same type of tool or method is therefore to some extent applied at more than one stage of the process and its sub-processes. Consequently, the use of several different tools and methods can also be seen as a consequence of dividing the project portfolio into separate sub-project portfolios. If the different sub-project portfolios were managed as separate project portfolios, the total number of different tools and methods applied to the process would be more limited. As the reason for managing the different parts of the project portfolio in separate processes is the inclusion of projects with varying characteristics in the same portfolio, this is also a reason for the use of several tools and methods.

> ***Summary of findings:*** *The case company has applied several tools and methods to the project portfolio management process, and one reason for doing so is the extensive set of requirements on the project portfolio management at the case company. The choice to manage the different parts of the project portfolio in separate processes is another reason for applying several tools and methods to the process.*

The second area of interest regarding the tools and methods combination, according to the framework developed, is the adaptation of the tools and methods. In choosing tools and methods for assisting the project portfolio management, it is not only the choice of specific tool and method that is relevant (Cooper et al., 2001b). For specific tools and methods, several different adaptations are possible and consequently have to be evaluated (Cooper et al., 2001b). According to Meredith and Mantel (1999) the type of tool and method to use should depend on the philosophy and wishes of management, but they do not deal with how to adapt the tools and methods to the specific situation.

The primary basis for *choosing* specific tools and methods to apply to the process at the case company was the philosophy and wishes of management, as suggested by Meredith and Mantel (1999). But the specific *adaptation* of the tools and methods was not only guided by the wishes of management. Instead, the requirements on the project portfolio management process were the main guidance for *adapting* the tools and methods. As the wishes of management also influence the requirements on the process, they thus indirectly influence the adaptations of the tools and methods.

The requirements were not, however, the only aspect that influenced the adaptation of the tools and methods. The choice to divide the selection process into separate processes for the sub-project portfolios has consequences for how to adapt the tools and methods to assist the project portfolio management. In order to show different resources' splits among the sub-project portfolios, the tools and methods have to be adapted accordingly. How the project portfolio is divided into separate sub-project portfolios therefore also influences how the tools and methods must be adapted.

> ***Summary of findings:*** *The adaptation of the tools and methods is affected by the requirements on the project portfolio management, but also by how the project portfolio is divided into sub-project portfolios.*

7.2.2. Sequence of the tools' and methods' application to the process

Earlier research in the field has not provided any in-depth descriptions of how project portfolio management processes are set up (beside the attempts by Archer and Ghasemzadeh). Neither has research described how project portfolio management tools and methods are applied to the project portfolio management process. The attempts by Archer and Ghasemzadeh (1999) to generate a generic process do not go into the detail of how the tools and methods should be applied.

Their approach is to give the decision-maker at every stage the possibility to choose the tools or methods that they find most appropriate, which implies high flexibility of a computerised database. On the other hand, best-practice studies have shown that top performers of project portfolio management have an explicit, established portfolio process with applied tools and methods for the project portfolio management (Cooper et al., 1998). SCA AFH Tissue has an approach which can be seen as a mix of these two ways of applying the tools and methods to the process. The company has chosen, adapted and applied a number of predefined tools and methods to the project portfolio management process, and in that way the approach is in accordance with the best-practice studies (Cooper et al., 1998). But on the other hand, the tools and methods applied to the process are differentiated from each other in that some of them are used for supporting the strategic resource splits among the different sub-project portfolios on different levels, while others are used to, so to say, implement strategic ambitions. These tools and methods used for supporting strategic ambitions may change as consequences of the yearly strategy processes. Consequently the choice, adaptation and application of these tools and methods are more in accordance with the thoughts of Archer and Ghasemzadeh (1999).

The application of the graphical charts showing the strategic resource divisions of the overall project portfolio effort can be seen as the basic structure of tools and methods in the process and are the ones that are predefined, in accordance with the best-practice studies (Cooper et al., 1998). It starts out at the uppermost level and is then developed down into preferred resource divisions at lower levels of the project portfolio. At the first stages, graphical charts based on historical portfolio outcomes are used (see Figure 31). In later stages when the project portfolio is aggregated, the same graphical charts are used again, but now with the planned project portfolio outcome as a basis. In this way the structure of graphical charts showing the resource divisions can be compared with a work-breakdown structure. This structure of tools and methods in the process is the one that can be seen as static and will not change due to changes in the strategy. Some of the other tools and methods that are applied to the process can, however, to some extent be said to reflect areas that are and/or have been strategically focused upon during recent years (e.g. splits by project aim, splits by different steps in the value-chain, splits by product characteristics). In the future, possibly other areas can be strategically more important to focus on, and some of the tools and methods used now can consequently be exchanged. The scoring model is another tool or method that may be changed due to changes in the strategies. The model itself will probably not change, which means the different areas that constitute the model. It is instead the different areas' mutual importance that may have to be changed if the strategic priorities in the organisation change. The charts showing the different splits based on strategic considerations and the scoring model's specific weightings may be changed from year to year, and are consequently applied in accordance with the recommendations by Archer and Ghasemzadeh (1999).

> **Summary of findings:** *The case company has formally chosen, adapted and applied a set of tools and methods to the project portfolio management process. The tools and methods can be divided in two different categories: those which are static and visualise resource splits among the sub-project portfolios, and those which are more dynamic and may be changed as consequences of strategic changes.*

The scoring model is applied to the lowest level of aggregation in the product project portfolio sub-process. The model is applied to each separate sub-process for evaluating project ideas within each product group. The application of scoring models to the process of project portfolio management is yet another area which is not dealt with in detail in the literature. Authors elaborating on scoring models do not go into detail of how the results from scoring different types of projects are compared to each other (Meredith and Mantel, 1999; Cooper et al., 2001b). Cooper et al. (2001b) do elaborate on how scorings of ideas of different maturity can be dealt with, but not ratings of, for example, projects aiming at different product groups. At the case company, the ratings from the scoring models are solely used for decisions within each product sub-project portfolio. The project scoring is not compared with scorings from other product sub-project portfolios, and the reasons are threefold.

Firstly, different forums with different persons are involved when the project scorings in the different product sub-project portfolios are discussed. As people have different apprehensions of what a specific rating should be, even though anchor values are used, it is therefore not equitable to compare ratings from the different product sub-project portfolios. Secondly, the different forums are responsible for the different product areas, and the people involved could have personal advantages from success in their own area. A risk of favourable ratings of projects therefore exists, if ratings of projects from different product sub-project portfolios are compared with each other and used for prioritising among projects on a wider basis than within each product sub-project portfolio. The resource split among the different product sub-project portfolios is therefore instead set on the basis of strategic considerations at the next level of aggregation in the process. Thirdly, the scoring model's weightings among the different criteria are set by the forum using the model itself, and are not necessarily synchronised among the different sub-processes. This makes comparisons between the projects from different sub-project portfolios impossible. This aspect is also emphasised by Cooper et al. (2001b). The sub-processes for technology and R&D projects do not use the scoring model for evaluating project ideas. In these processes the idea evaluations are taken care of in discussions at managerial forums.

> **Summary of findings:** *The scoring model is applied to the lowest sub-process level for evaluating product projects. The ratings from the model are only used for comparing project ideas within each product category.*

7.2.3. The tools' and methods' use in the process

According to the framework for structuring the project portfolio management process of Archer and Ghasemzadeh (1999), the combination of tools and methods is all applied at one stage of the process. How the different tools and methods are used in relation to each other in such process set-ups is perhaps not interesting to study, which may be a reason why the use of tools and methods in combination is not elaborated on in earlier literature. Yet if the process is split up not only in different stages but also in different sub-processes, the question of how the tools and methods are used along the process becomes interesting. It is interesting partly since the activities along the process are related to and depend on each other, as do the tools and methods.

Some of the graphical charts are applied at more than one stage of the process and used for different purposes (see Figure 31, p.92). Some of the divisions represented by these graphical charts are decisive and provide input for the next stage in the process. The pie charts showing resource divisions connected with the first two stages are one such example. The output from the second stage, the strategic values, then sets the frame for the third stage where the actual project selection is made. In the second stage it is also decided on the preferable resource split by project aim in the three sub-project portfolios. These preferable splits are then used in the next stage, but here only as one type of information among others, supporting the decisions on projects for the portfolio. In the later stages when the process converges, the same graphical charts are used again, but now for following up the outcomes of the planned project portfolio.

The different graphical charts are therefore used essentially in three different ways: either as a basis for the decisions on preferable resource splits in the portfolio as in the first stages, or as providing portfolio information to support the decisions on projects for the portfolio, or for following up and deciding on the project portfolio composition.

> ***Summary of findings:*** *The graphical charts are used at the case company in three ways: as a basis for the decisions on preferable resource splits, or as providing portfolio information to support decisions, or for following up the project portfolio composition of proposed projects.*

An additional implication of these different ways of using the graphical chart is the use of different types of project information throughout the process. This is also an area not elaborated upon in earlier research, presumably also due to the common perception that all tools and methods are used at the same stage of the process. In such situations it may not be relevant to take into account other values than the proposed portfolio data. But in the process setting where the preferable resource splits are decided on before the actual project selection is made, as at the case company, it has been found feasible to use different types of project data throughout the process.

In the first stages where the decisions on preferable resource splits are made, the graphical charts are based on historical project data as a basis for the discussions.

The graphical charts that are used in the PPP, TPP and (R&D)PP stages (see Figure 31, p.92) are used with two different types of information. Firstly, as in the first stages, they are based on historical data – and secondly with actual project portfolio outcome, i.e. the portfolio outcome based on the inclusion of new projects proposed for the portfolio. The same holds also for the four sub-processes within the PPP process. In the last stages of the process where the proposed project portfolio is evaluated and approved, it is essentially graphical charts based on the data from the proposed project portfolio that are used as support, even though historical charts sometimes are recalled as support.

		Type of use		
		Decisive	Decision support	Follow up
Type of information	Historical project data			
	Proposed project data			

Figure 36: Classification of the graphical charts' use in the project selection process

These different types of information used in the graphical charts can then be combined with how they are used in the process. This results in a matrix like the one shown in Figure 36. From the matrix it can be concluded that the graphical charts are applied to the process in four different ways.

> ***Summary of findings:*** *The graphical charts applied to the project portfolio management process are used in four different ways according to the matrix in Figure 36. The matrix is composed of the three different types of use and two different types of project portfolio data.*

The scoring model's use in the process

The other type of tool or method that is used in the project portfolio management process, the scoring model, is applied to the product project sub-processes. The ratings of the projects in this type of model, according to Meredith and Mantel (1999), can be done in two different ways. The rating may either be carried out by one person who is responsible for the evaluation and selection, or it may be performed by a committee charged with the responsibility. The authors state further that if a committee handles the task, the individual rankings can be developed anonymously and the set of anonymous rankings can then be examined by the committee itself for consensus. At the case company, the scoring model is used in a somewhat different way. The model, even before the ratings are set, is used as a basis for discussion. The different areas covered by the model are each a basis for discussions where consensus in the group is reached and no anonymous ratings are used. This way of using the scoring model has proven to give a more common view of the project ideas among the participants in the forum. The participants normally do not have such a common view of the project ideas before starting the discussions. This strength of using scoring models is also supported by the findings of Cooper et al. (2001b).

The outcomes from scoring models can be used in various ways, from decision tools *per se* to inputs for qualitative discussions (Cooper et al., 2001b). At the case company, the output from the project scorings are used as an input of information, into a qualitative discussion on which projects to include in the portfolio. An example of other input of information used in these discussions is project portfolio data provided by the graphical charts.

> ***Summary of findings:*** *The scoring model is used as a basis for discussion in management forums and in a way where consensus is reached on each parameter constituting the model. The outcomes from the models are used as one input among others, for a qualitative discussion on which projects to choose.*

7.3. Organisational aspects

According to the research framework, three different organisational aspects are important for understanding how project portfolio management is organised. This part of the chapter is structured according to these three areas, which are the organisational setting, the participants and the responsibility distribution.
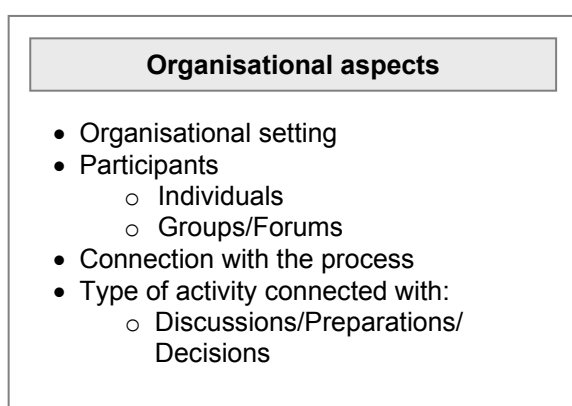
Organisational aspects

• Organisational setting
• Participants
    ○ Individuals
    ○ Groups/Forums
• Connection with the process
• Type of activity connected with:
    ○ Discussions/Preparations/
       Decisions

Figure 37: Organisational aspects in the research framework

7.3.1. Organisational setting

In the theoretical exposition and in Chapter 4 when elaborating on the research framework, it has been observed that literature focusing on organisational aspects of project portfolio management is sparse. The organisational setting of the development organisation was stated, when developing the research framework, to be important for understanding how the project portfolio management is organised. The organisational setting of the development organisation is, however, more relevant for understanding where the different participants involved in the project portfolio management organisationally belong. Which participants are involved in the project portfolio management is dealt with separately in the next section.

One notable finding regarding the development organisation's relation to the project portfolio management has been made in the case study. To ensure balances in the project portfolio is commonly seen as one of the aims of project portfolio management (Cooper et al., 2001b; EIRMA, 2002), and consequently authors deal with different types of balance aspects in the portfolio (Cooper et al., 2001b). The overall balance among the different sub-project portfolios at the case company is one example of such balances dealt with in literature. A possible interpretation is that this division into different sub-project portfolios is based on the organisational setting of the development, but that interpretation would be wrong.

The division of the project portfolio into product development projects, manufacturing process development projects and technology development projects is based on the fact that the projects have distinctive characteristics, and that different strategies are developed for the different types of development (as has been described in section 7.1.2). Even though similarities with the organisational setting of development organisation exist, the organisational structure should not be seen as the basis for dividing the projects into sub-project portfolios. The project portfolio management process, the sub-processes and the tools and methods used are desired to be stable over a considerable time period, and consequently also to be resistant to organisational changes. Therefore the division of the project portfolio was desired to be based upon more stable characteristics than the organisational structure of the development organisation.

> ***Summary of findings:*** *The division of the project portfolio into sub-project portfolios is based on the projects' distinctive characteristics and different strategies, and not on the organisational setting of the development organisation.*

7.3.2. Participants

Project portfolio management literature in general suggests that the project portfolio management activity should be carried out by a group of experienced managers with relevant knowledge about the projects and their environment (Kendall and Rollins, 2003). The relevant kinds of knowledge that are normally involved in the decisions are R&D, marketing and senior management (EIRMA, 2002). These findings from earlier research, however, consider the management of the overall project portfolio and not situations where the project portfolio management processes are separated. On the overall level of such separated project portfolios, the same functions are supposed to be present, but whether all functions are involved also in the separate sub-project portfolio processes is not clear.

The divided project portfolio management process at SCA AFH Tissue includes, on the overall portfolio level, all of the functions emphasised in the literature as important to involve (Cooper et al., 2001b; EIRMA, 2002). The Category, the R&D unit, and senior managers with large industrial experience are involved in the project portfolio's management. The Category, which is the product organisation, should here be seen as representing marketing. But at the case company, representatives from manufacturing are also represented in the project portfolio management process, which is not explicitly emphasised in literature (Cooper et al., 2001b; EIRMA, 2002). As all types of projects using the same base of resources should be part of the project portfolio, including manufacturing process development, it would be natural to include representatives from this function. One reason why the manufacturing function is seen as important to involve at the case company may be the characteristics of the industry. Efficient manufacturing is a very important factor for being successful at the marketplace, and thus important to involve in the management of the project portfolio. Another reason could be that the literature on project portfolio management generally focuses on either product projects or R&D projects, and does often not include manufacturing process

development-focused projects in the portfolios. Thus, manufacturing personnel are not considered as important to involve as R&D, marketing and senior management.

Not all of the different organisational units with requirements on the project portfolio's management are represented in the groups or forums responsible for the management of the portfolio. The Environment department, the Sourcing department and the Patent department are not represented in the portfolio management process. Their requirements on the project portfolio management process differ, however, from the requirements of the functions directly involved in the process, in that they are more interested in the planned project portfolio, which does not imply that they need to be involved in the actual management of the project portfolio.

> **Summary of findings:** *Beside the functions generally considered important to involve (R&D, marketing and senior management), representatives from manufacturing are considered equally important to involve in the management of the project portfolio at the case company. Not all of the organisational units expressing requirements on the project portfolio management process are involved in the management of the project portfolio.*

If the focus is instead put on the different sub-project portfolios' management, the three functions are not all directly involved in each of the sub-processes. The technology project portfolio sub-process does not include representatives from R&D or from the Category in the process. Likewise the R&D project portfolio sub-process does not involve representatives who organisationally belong to the Supply-chain and Category. But in order to increase the integration between the market side (Category) and R&D, the product development managers are involved in both the product sub-project portfolio process and the R&D sub-project portfolio process. The product development managers thus facilitate the integration of market perspectives into the R&D project portfolios' management, which is seen as an important area for the success of R&D activities in general (Cooper and Kleinschmidt, 1987). The product development managers are responsible for the development of the different product categories, and belong organisationally to the R&D unit. The product development managers also facilitate the necessary integration of R&D knowledge into the product sub-project portfolio processes. This integration on the sub-project portfolio process levels is critical, as the projects undertaken within R&D must be possible to translate into successful products in the marketplace. Likewise, it is important to get input into R&D regarding which early development projects (or research projects) need to be undertaken to support the market priorities. Hence, a deep knowledge of each other's development priorities is needed and is also seen as crucial at the sub-project portfolio process level.

> **Summary of findings:** *Not all of the functions important to involve in managing the project portfolio are involved in each of the sub-processes. But cross-representation is necessary to facilitate the integration between the sub-processes.*

7.3.3. Responsibility distribution

For project portfolios which are managed as one overall project portfolio by one single management group, the responsibility distribution is not important to consider, as all decisions are made by the same group of managers. But for project portfolios which are managed in separate processes, like the one at the case company, the responsibilities for the different sub-processes have to be defined. In section 6.3.3 the responsibilities' distribution for the different sub-project portfolios and subsequent sub-processes were described. Delegating the responsibilities in this way is therefore a consequence of dividing the process into different sub-processes.

Section 6.3.3 also describes the cross-participation in the different forums along the sub-processes. There are basically two different reasons for this overlap of representation along the processes. Firstly, the managers involved, in the stage before the one that they are actually responsible for, also provide important input to the discussions and decisions in the preceding stages. Secondly, it is an important way to sell the decisions which basically are prioritisations among different areas. Such decisions are sometimes hard to get full commitment or acceptance for, if the managers themselves not are involved in the decisions.

> **Summary of findings:** *The responsibility for the overall project portfolio is delegated to managers at subsequent organisational levels.*

8. Aspects of importance for organising project portfolio management

This chapter aims at answering the research questions by synthesising the empirical findings from the analysis in Chapter 7, but also by relating the empirical findings to existing theory. The chapter is structured according to the three research questions, and at the end of each section a short summary of the conclusions for the research question in focus is given.

8.1. Implications for organising the management of project portfolios including different types of projects

After the first research question was presented in Chapter 2, it was stated that the ambition of identifying implications for organising the management of project portfolios including different types of projects is not to bring up a complete set of implications. Instead it was stressed that the ambition is to identify implications of importance for organising such project portfolio management.

Studies of project portfolio management generally focus on portfolios including projects which are rather homogeneous, i.e. similar project characteristics in terms of the aim of the project (Elonen and Artto, 2003). Even though seldom explicitly described, the impression is that the project portfolios deal either with new product projects or with R&D projects (EIRMA, 2002). This was also supported by the findings from the multiple case study (Dawidson et al., 2005). Even though projects in such portfolios can differ to a large extent in terms such as project time, technological novelty, project risk or possibilities for future rewards, to mention just a few, they will still be considered homogeneous in comparison to project portfolios where, for example, R&D projects as well as new product projects – or more different types of projects – are included in the same portfolio.

In the theoretical exposition, three areas of aspects important for organising project portfolio management were recognised: procedural aspects, aspects regarding the use of tools and methods, and organisational aspects. These three areas were also the ones that constitute the main areas in the research framework. The inclusion of distinctive types of projects in the same project portfolio is supposed to have implications for these areas, which consequently will be analysed here. The section is therefore structured according to the three main areas of aspects important for organising project portfolio management.

8.1.1. Implications for the procedural aspects

According to the theoretical exposition, aspects commonly emphasised as important in project portfolio management literature are how the project portfolio decision process is arranged (Archer and Ghasemzadeh, 1999), how the project portfolio review process is arranged (Cooper et al., 2001b), and how frequently the portfolio is updated (Sommer, 1999; EIRMA, 2002; McDonough III and Spital, 2003).

It is generally agreed in literature that project portfolio management processes should be formal and should handle all types of projects in their entirety (Bridges, 1999; Cooper et al., 2001b). Beside this general advice on the formality of the process, very few authors elaborate on how the process should be arranged. Archer and Ghasemzadeh (1999) have made some effort to specify a framework of generic stages of the project portfolio management process, but these authors do not consider the heterogeneity of the projects included in the portfolio.

If projects with distinctive characteristics are included in the same portfolio, Cooper et al. (2001b) suggest using the approach of strategic buckets. They suggest this approach as a project portfolio method where resources are allocated to different parts or strategic buckets of the portfolio, which means allocating resources to different types of projects in the portfolio. However, they do not consider whether the projects in the different strategic buckets need to be managed in different ways and, thereby, provide implications for how the project portfolio decision process should be arranged.

At the case company, the different types of projects included in the portfolio go under different strategies which have implications for the project selection process. Projects are generally seen as an important way to operationalise the strategies (Cooper et al., 2001b) and to allow different strategies to influence the different types of projects in the portfolio. The case company has divided its project portfolio into sub-project portfolios, in accordance with the recommendations of strategic buckets by Cooper et al. (2001b). But the case company has taken one step further by dividing the project selection process into separate sub-processes for the different sub-project portfolios.

To divide the project portfolio into separate sub-project portfolios in accordance with the suggestion by Cooper et al. (2001b) was, at the case company, not found to be sufficient for handling projects under different strategies. Projects with different characteristics, as at the case company, also need to be evaluated in different ways, including different types of in-depth project information. This knowledge cannot possibly be provided by individuals – even within each sub-project portfolio – as the different sub-project portfolios include projects with such characteristics as development of different groups of products, and different parts of a complex manufacturing process. To include managers representing such different knowledge in one and the same decision process is seen, at the case company, as neither manageable nor efficient.

The suggestion of using the strategic bucket approach (Cooper et al., 2001b) by allocating resources to different groups of projects is not enough for project portfolios including such different projects as product, manufacturing process and technology development projects. Not only different strategies need to be taken care of, but also different types of project information, and thus also managers with different knowledge must be involved in the selection of projects for the portfolio.

But the division of the process into separate sub-processes for the sub-project portfolios should only be seen as one way of dealing with different projects in the same project portfolio. Other ways could also prove feasible; although they must have in common that the project selection process allows taking into account different strategies, different ways of evaluating projects, and involvement of managers representing different areas of knowledge.

> **Conclusion:** *The process of selecting projects for the portfolio must allow taking into account different strategies, different ways of evaluating projects, and involvement of managers representing different areas of knowledge.*

The division of the selection process into separate sub-processes, as at the case company, has further implications in that the overall selection process has to converge again in later stages. Through converging the process in the later stages, the projects can still be kept as one single project portfolio. The findings from the study also show that such synchronisation in the end of the process is not sufficient. The process must also allow synchronisation between the different sub-processes.

The second activity important in project portfolio management is the regular review of the project portfolio. Generally the processes of selecting projects for the portfolio and reviewing the project portfolio are conducted as a joint process (Archer and Ghasemzadeh, 1999; Cooper et al., 2001b). The appropriate frequency of the regular updates of the project portfolio depends upon factors such as the type of projects that are considered in the portfolio, the lead time of the development, and the dynamics of the industry (McDonough III and Spital, 2003). Including different types of projects in the same portfolio therefore yields implications for how to manage different frequencies of the portfolio updates for the different projects included.

The projects included in the project portfolio at the case company differ from each other in diverse respects. The mean lead times of the different types of projects vary widely. Technology development projects and manufacturing process development projects are on average longer than product development projects. The dynamics of the project environment for the different projects is another characteristic that distinguishes the projects from each other. The project environment for a product project changes, on average, faster than does the environment for both a technology and a manufacturing project. These differences in project characteristics have the consequence that the product sub-project portfolio needs to be updated more frequently than both the technology and the manufacturing sub-project portfolios, which is in accordance with the reasoning by McDonough III and Spital (2003). This need of updating the different sub-project portfolios has, in turn, consequences for how to arrange the process.

The selection process is done on a yearly basis at the case company, as an extension of a yearly strategy process. In the yearly selection process a review of the project portfolio is included, but this update is not appropriate for all the sub-project portfolios. To handle these different needs of updating the sub-project

portfolios, the case company has chosen also to split the process for reviewing the project portfolio into separate sub-processes for the sub-project portfolios.

As a consequence of updating the different sub-project portfolios with different frequencies, the portfolio review process must also be separated from the project selection process. The reason is that the selection of projects for the portfolio is still done once a year, as an extension of the yearly strategy process.

Since earlier literature seems to handle projects with rather similar project characteristics in the project portfolios (EIRMA, 2002; Elonen and Artto, 2003), it overlooks the issue of how to take care of portfolios including different types of projects in need of different frequencies of updates. To allow for such differences in updating the different types of projects in the portfolio, the case company updates the different projects in separate sub-processes. Another possible solution could be to set the frequencies of the reviews on the basis of the types of projects that need to be updated most frequently. But this has the consequence of reviewing parts of the portfolio more frequently than needed. Other ways of dealing with these differences in need of updating different parts of the portfolio could also be feasible, but common to them must be that they are flexible in taking care of different needs of updating for the different types of projects.

> **Conclusion:** *The process for reviewing the project portfolio must be arranged in a way that allows for taking care of the different projects' needs of being updated with different frequencies.*

As both the selection of projects for the portfolio and the reviews of the project portfolio are handled separately and are divided in the same way, it would have been possible to run both of them as one sub-process for each sub-project portfolio. But as the same base of resources is used for all projects in the overall portfolio, the selection process has been run once a year for all of the three sub-project portfolios. As the sub-project portfolios need to be reviewed with different frequencies but all of them more than once a year, the company has chosen to separate the processes for selecting projects for the sub-project portfolios and for reviewing them. This cannot be seen as a direct implication of including different types of projects in the portfolio, but is a result of dividing the project selection and portfolio review processes into sub-processes. In order to keep the overall project portfolio as one single portfolio of projects, the selection sub-processes and the portfolio review sub-processes are followed up on the overall project portfolio level. This enables reprioritising of resources also between the different sub-project portfolios.

8.1.2. Implications for the use of tools and methods

In the theoretical exposition it was noted that little attention has been paid to how project portfolio management tools and methods are used to support the project portfolio management activities. The types of tools and methods favoured are company-specific and dependent on the goals that management wishes to focus on (Bridges, 1999; Meredith and Mantel, 1999). Aspects influencing the use of tools and methods in such specific situations have not been examined so far.

In terms of understanding how project portfolio management is organised, though, it was stated when elaborating on the research framework that three different aspects are relevant to the use of tools and methods: their choice, adaptation and application to the activities (while not explicitly stated thus in the final research framework). As these three aspects are essential for understanding the use of tools and methods in project portfolio management, it is these aspects that have implications for including different types of projects in the same project portfolio.

At the case company, the divisions of the project selection process and the portfolio review process have influenced the choice, adaptation and application of tools and methods showing resource splits among the sub-project portfolios. Graphical charts have been chosen to show these splits, and their adaptation has been delimited accordingly. The charts are applied both in the initial stages of the process, for providing information on preferable splits, and in the later stages for following up the resource splits of the planned project portfolio.

The choice, adaptation and application of graphical charts have their basis in dividing the selection process into sub-processes. As stated above, this division is just one way of dealing with different projects in the same project portfolio. If the process is arranged in other ways, the inclusion of different types of projects in the same project portfolio need not have the same effects on the use of graphical charts. But if the resource splits among the different types of projects in the portfolio are relevant to consider, which they almost always ought to be (Cooper and Edgett, 2003), the implications for the use of graphical charts are relevant also in other ways of arranging the processes. The inclusion of different types of projects in the portfolio therefore implies that some type of tool or method showing resource splits must be used.

> **Conclusion:** *Tools or methods showing the resource distribution among the different types of projects in the portfolio must be chosen, adapted and applied in order to assist the project portfolio management.*

Beside the graphical charts showing resource splits, other tools and methods are used in the processes. As a consequence of including different types of projects in the same project portfolio, different parts of the portfolio need different information as a basis for decisions. To provide such information, different types of tools and methods are used in the different sub-processes, some of them being adaptations of the same tool or method, while others are only used for assisting particular activities. One such example is the scoring model, which is only used for evaluations of the different product projects.

The use of different tools and methods is not only a consequence of the fact that different projects need different information for the evaluation. It is also a result of including different managers in the different activities, as the philosophy and wishes of management influence the choice of tools and methods (Meredith and Mantel, 1999) and the different managers involved have different apprehensions of which tools and methods to use.

The literature lacks a discussion of the use of different tools and methods for different types of projects in the same portfolio. But to respond to the different types of projects' requirements regarding information for portfolio decisions, the project portfolio management must allow for the use of different types of tools and methods. The involvement of different managers in the different activities further calls for allowing the use of different tools and methods.

> **Conclusion:** *The project portfolio management must allow for using different tools and methods for decisions concerning the different types of projects, in order to provide relevant portfolio information and to fit with the philosophy and wishes of the managers involved in the different activities.*

8.1.3. Implications for the organisational aspects

The last area of implications of including different types of projects in the same project portfolio concerns the organisational aspects of organising project portfolio management. Even though the knowledge of such aspects is, as stated earlier, not extensively developed, some authors have made important contributions regarding aspects relevant to consider. It has been stated that which organisational participants are involved, and which organisational units they represent, in the project portfolio management activities is critical for the latter's success (Levine, 1999; EIRMA, 2002; Kendall and Rollins, 2003). How the organisational participants are involved in the project portfolio management activities (Cooper et al., 2001b) and how they are connected to the different activities in the process (EIRMA, 2002; Center for Business Practices, 2003; Kendall and Rollins, 2003) are also areas emphasised as important for the project portfolio management. These areas are found relevant when elaborating on implications for the organisational aspects of including different types of projects in the same project portfolio.

Commonly stated as important to involve in project portfolio management are representatives from sales, marketing and R&D (EIRMA, 2002; Kendall and Rollins, 2003). However, project portfolio management literature does not emphasise the involvement of manufacturing knowledge in the project portfolio's management. Still, at the case company this knowledge is as important as the other functions (marketing, R&D, senior management). This may be a consequence of including manufacturing process development projects in the portfolio, but also a reflection of the case company's specific industry, where manufacturing efficiency is among the most important factors for success. But as the importance of including manufacturing early in all development activities is commonly emphasised in product development management literature (Clark and Fujimoto, 1991; Wheelwright and Clark, 1992), it must be important to involve manufacturing knowledge in project portfolio management as well.

Nonetheless, an implication of including different types of projects in the same project portfolio is that representatives with relevant knowledge for the different types of projects have to be involved in the project portfolio management. The knowledge to include may comprise more different knowledge areas than those which, in project portfolio management literature, are ,commonly stated as

important to involve, i.e. sales, marketing and R&D (EIRMA, 2002; Kendall and Rollins, 2003). The case company also includes for example, managers with manufacturing process knowledge.

> ***Conclusion:*** *Managers representing all areas of knowledge relevant for the distinct types of projects included must be involved in managing the different parts of the project portfolio.*

Regarding the areas of how the organisational participants are involved in the project portfolio management activities and how they are connected to them, the findings do not show any implications of the inclusion of different types of projects in the same portfolio.

But the findings from the case company show that the division of the project portfolio management processes, as a consequence of including different types of projects in the same project portfolio, has implications for how the organisational participants can be involved in the different activities. The separation of the processes facilitates the involvement of managers with specific knowledge relevant for the management of the different sub-project portfolios. Moreover, the distribution of decisions to different activities, as a consequence of dividing the project portfolio management processes, results in necessary cross-representation for facilitating the integration between the sub-processes. Another result of dividing the project portfolio management processes is that it facilitates the possibilities of distributing the responsibilities for different parts of the project portfolio. These, however, are implications of dividing the project portfolio management processes into sub-processes, and not direct implications of including different types of projects in the same portfolio. Therefore the inference must be that the inclusion of different types of projects in the same project portfolio does not have any direct implications for how the organisational participants are involved in the project portfolio management activities or how they are connected to the activities.

> ***Conclusion:*** *The inclusion of different types of projects in the same project portfolio does not have any major implications for how to involve and connect the organisational participants to the project portfolio management activities.*

8.1.4. Summary of conclusions

The conclusions concerning implications for the procedural aspects of including different types of projects in the same portfolio were that the selection process must allow attention to different strategies and different ways of evaluating projects, but also allow an involvement of managers representing different areas of knowledge. It was further found that the process for reviewing the project portfolio has to allow updating the different projects with different frequencies.

As for the use of tools or methods, it was found that tools or methods showing the resource distribution among the different types of projects in the portfolio must be used to assist the project portfolio management. The project portfolio management must also allow the use of different tools and methods for decisions concerning the different types of projects.

Concerning the implications for the organisational aspects, the conclusion was that managers representing all areas of knowledge relevant to the distinct types of projects should be involved in the management of the project portfolio. But concerning how to involve and connect the organisational participants with the project portfolio management activities, no implications were identified.

8.2. Implications for using tools and methods in combination

Related to the presentation of the second research question in Chapter 2, it was stated that the ambition of identifying implications for using combinations of tools and methods in project portfolio management is not to bring up all implications possible, but to identify implications of importance for organising project portfolio management.

In research on best practices for project portfolio management, it has been found that the most successful[20] companies use 2-3 tools or methods for the assistance of project portfolio management (Cooper et al., 1998; Center for Business Practices, 2003). The basic reason for not using more than a few tools or methods is to avoid the trap of information overload (Cooper et al., 2001a). Even though it is tempting to use more than a few tools or methods, it is recommended to focus on the most important. On the other hand, the requirements on the project portfolio management must also be fulfilled, which calls for support by the use of tools and methods. Therefore, the more extensive the requirements are, the more powerful are the arguments for using further tools or methods for assisting the project portfolio management. Yet the need to avoid the trap of providing too much information for the project portfolio decisions is still relevant.

This demand of applying several tools and methods in combination, to support the project portfolio management activities in fulfilling its requirements, has implications for how the tools and methods can be used. The implications concern three different aspects of using tools and methods: their choice, adaptation and application to the project portfolio management activities. This section is structured according to these three aspects.

8.2.1. Implications for the choice of tools and methods

If the main argument for not using more than a few different tools and methods assisting the project portfolio management is to avoid providing too much information for the decisions, it is relevant to consider also whether the decisions are distributed or not. This is not done by authors who assert the importance of using only a few tools or methods (Cooper et al., 2001a). It is generally held that portfolio decisions are made by a group of experienced managers at specific project portfolio meetings. If more than a few different tools or methods are applied to

---

[20] For a description of how success of project portfolio management was measured, see for example Cooper et al., 1998.

such meetings, it is easy to understand that such use may provide information overload.

The case company uses a set of tools and methods for the project portfolio management. However, these tools and methods are used for assisting different project portfolio management activities along the processes, and each activity involving different managers is therefore supported by a limited number of tools and methods. The basic reason for using several tools and methods assisting the project portfolio management activities is to enable fulfilment of the extensive requirements on the process.

Therefore, if the project portfolio management decisions are made at different activities along the processes and if different groups of managers are involved in the different activities, the use of more than a few tools and methods can instead be beneficial or even necessary, in contrast to recommendations in earlier research (Cooper et al., 2001a). The recommendations in these studies are primarily based on results from breadth-based studies where the most successful companies use just a limited number of tools and methods. These studies do not consider whether all of the tools and methods are used for assisting one single project portfolio management activity, or whether the decisions are distributed among different activities using different tools and methods as aids. The empirical findings from this study have shown that more than a few different tools and methods must be used in order to fulfil the extensive requirements on the process. Not all of the tools and methods are used for assisting any particular activity; they are distributed over several activities in the project portfolio management.

> **Conclusion:** *It is the number of tools and methods used for supporting each project portfolio management activity that is relevant for avoiding provision of too much information, not the total number of tools and methods used.*

8.2.2. Implications for the adaptation of tools and methods

When dealing with the implications for the choice of tools and methods, their adaptations were closely related. The authors suggesting a limited use of tools and methods for the project portfolio management do not clearly state whether different adaptations of the same tool or method are equated with using different tools or methods (Cooper et al., 2001a). Each adaptation of a specific tool or method ought to be considered a separate one if we compare the tools and methods used at the case company. Here, several pie charts are used for displaying different resource splits in the project portfolio. Thus, based on the empirical findings from the SCA study it is found relevant to consider also the adaptations of tools and methods when deciding on the number of tools and methods to be used. Different adaptations of the same tool or method can provide too much information for specific project portfolio management activities even though just one type of tool or method is used. No other implications for using combinations of tools and methods have been identified concerning the adaptations of tools and methods.

> ***Conclusion:*** *The number of different adaptations of the same tool or method is as relevant to consider for avoiding provision of too much information as is the number of different tools and methods.*

8.2.3. Implications for the application of tools and methods

If several different tools and methods are used to assist the project portfolio management at different stages and for different activities, their application to the process becomes important. This is an area not dealt with in earlier research, as the project portfolio management literature in general does not consider how the process should be arranged. Archer and Ghasemzadeh (1996), who are some of the authors studying how project portfolio management processes are arranged, do not, however, consider how tools and methods can be applied to the process. In their model, they only suggest that managers choose methodologies to assist the decisions in the process. They do not consider the implications of using them in combination.

The empirical findings from the case company, though, do show that some tools and methods applied at different stages of the project selection process can be related to each other and are consequently important to take into account. Some of the graphical charts applied to the project selection process at the case company are related to each other, and some of them are used at more than one stage of the process. To avoid contradictions in the use of the different graphical charts, they are applied to the activities and used for supporting the decisions in three ways: as a basis for the decisions on preferable resource splits, or by providing portfolio information as support for decisions, or for following up the project portfolio composition of proposed projects. Such different ways of using the graphical charts for assisting different activities have so far not been described in project portfolio management literature. Neither does the literature describe the use of different types of project portfolio data for the activities. At the case company, two types of project portfolio data are used: historical and current data. The historical data are primarily used for the graphical charts applied to activities at the beginning of the project selection process, while the current data are used in the process itself.

This way of using the different tools and methods for the different activities along the process is also a way of prioritising their use. It gives a prioritisation of which resource splits are mandatory and which are used for input of information to the decisions. For example, in the second stage of the project selection process, the resource splits among the different sub-project portfolios are mandatory, while the resource splits by project aim are used for providing portfolio information. Thereby more than a few different tools and methods can be used for supporting the same project portfolio management activity, without entailing information overload.

However, not all of the tools and methods that are applied to the project selection process at the case company are related to each other. Some of them, for example the scoring model and graphical charts showing resources splits among product characteristics for the specific product groups, are used without any direct relation to other tools or methods.

These findings from the case company must be seen as rather explorative, since literature dealing with specifically how the tools and methods are used for assisting the project portfolio management is sparse. The different types of use identified in this study could therefore be seen as an early classification. Even though the findings are not seen as specific for this situation, more studies on different types of use of tools and methods are needed.

Conclusion: Tools and methods visualising resource splits can be used either as a basis for the decisions on preferable splits, or as providing portfolio information to support decisions, or for following up the project portfolio composition of proposed projects. Further, these tools and methods can be used with two different types of data, historical and current project portfolio data.

According to the framework presented by Archer and Ghasemzadeh (1999), tools and methods (methodologies in the framework) are chosen and applied to the project portfolio management process as part of the framework (see Figure 8, p.27). The authors do not elaborate on how the different tools and methods can be applied, but the empirical findings from the case study at SCA add such knowledge.

At the case company, the graphical charts can be divided into two categories according to how they are applied to the process. Some charts are static and visualise resource splits in the project portfolio, while others are more dynamic since the tools and methods may be changed as consequences of strategic changes. The static charts visualise aspects of the resource splits in the project portfolio and these charts are not changed because they are not influenced by strategic changes in the organisation. Such tools and methods can be seen as the basic structure of tools and methods assisting the project portfolio management. These tools and methods are not among the methodologies that are chosen in the framework of Archer and Ghasemzadeh (1999), as they already are part of a basic structure showing resource allocations among the different types of projects.

The other group of tools and methods is applied to the process as reflections of prevailing strategies in the organisation. Senior management may use specific tools or methods to effectuate and implement strategic choices in the project portfolio management work. The project portfolio management is commonly argued to be one of the more important ways to operationalise the business strategies (Cooper et al., 2001b; McGrath, 2001). Consequently such application of specific tools to the process is an effective approach in operationalising business strategies. This application of tools and methods to the process is therefore closer to the interpretation of tools and methods by Archer and Ghasemzadeh (1999), where methodologies are chosen for the different stages in the process.

Conclusion: Project portfolio management tools and methods can be applied to the process in two different ways: either static, aiming at constituting the basic structure of showing resource splits among different types of projects, or dynamic, aiming to show strategic intentions and the changes that may result.

8.2.4. Summary of conclusions

With reference to the second research question, it has been concluded that it is the number of both different tools and methods and different adaptations of the same tool or method which are used for supporting each project portfolio management activity, and not the total number of tools and methods used, that is relevant for avoiding the provision of too much information.

It has further been concluded that tools and methods visualising resource splits can be used either as a basis for the decisions on preferable splits, or as providing portfolio information to support decisions, or for following up the project portfolio composition of proposed projects. It was also concluded that tools and methods can be used with both historical and current project portfolio data. The last conclusion was that project portfolio management tools and methods can be applied to the process in two different ways, as either static or dynamic.

8.3. The procedural and organisational settings' effects on the choice, adaptation and application of tools and methods

Also regarding the third research question, the use of tools and methods in project portfolio management involves the three different aspects: their choice, adaptation and application. It is therefore how the procedural and organisational settings affect these three aspects that is the focus of this question. The aspects of the procedural and organisational settings brought up in the research framework are the ones that also are relevant to consider regarding their effect on the use of tools and methods. Two different ways of structuring this section therefore emerge: according to the procedural and organisational aspects, or to the aspects of using the tools and methods. The second alternative is the one chosen.

Literature on project portfolio management during decades of research has had a strong focus on developing tools and methods for assisting project portfolio decisions (Archer and Ghasemzadeh, 1996). Some authors, however, have also noted the importance of an organisation that develops and supports an environment for project portfolio management (Levine, 1999). It has also been stated that it is the philosophy and wishes of management that influence which specific tool or method to use (Meredith and Mantel, 1999). This also means that the use of tools and methods is influenced by the aspect of which organisational participants are involved in the project portfolio management. Nonetheless, there is no description of influence on the different aspects of using tools and methods for assisting the project portfolio management activities – the choice, adaptation and/or application of the tools and methods.

Bridges (1999) adds to this knowledge by arguing that which tools and methods to use depends on which industry the company is active within, the strategic directions of the organisation, its guiding principles, capacity, constraints and complexity. Even though this clarifies the issue of which tools and methods to use, existing literature does not explicitly analyse how the procedural and organisational settings influence the use of project portfolio management tools and methods.

8.3.1. The procedural and organisational settings' effect on the choice of tools and methods

The empirical findings from the case study at SCA show that the case company uses several tools and methods for the project portfolio management. It was also found that one of the main reasons for using several tools and methods was the extensive set of requirements on the project portfolio management. This supports to some extent the statement by Meredith and Mantel (1999) that the tools and methods to choose for assisting the project portfolio management rely on the philosophy and wishes of the managers involved. The extensive set of requirements at the case company is primarily stated by managers involved in the process. But it is also shaped by managers from organisational units not involved in the process, who have an interest in the project portfolio's management. Further, the requirements on the process are not stated in terms of which tools or methods to use, but rather in terms of aspects to consider concerning the project portfolio composition.

The empirical findings show that the requirements on the project portfolio management restrict the choice to tools and methods that have the possibility to fulfil the different requirements. Given these restrictions, it is then the philosophy and wishes of management that guide the choice of specific tool or method. For example, bubble diagrams are not used for assisting the project portfolio management at the case company because many managers involved think they employ too many different parameters in the same diagram. Therefore other types of diagrams were chosen instead. The empirical findings from the multiple case study (Dawidson et al., 2005) also support the statement by Meredith and Mantel (1999) that it is the management that chooses the tools and methods to use.

The empirical findings from the SCA study further show that the choice to manage the different parts of the project portfolio in separate processes is another reason for specifically using several tools and methods. Some of the tools and methods, namely several of the pie charts presented in section 6.2.2 are used for supporting the activities with information concerning different perspectives on resource splits among the different sub-project portfolios.

As the underlying reason for dividing the project selection process into separate sub-process is the inclusion of different types of projects in the same portfolio, this is a contributing aspect influencing the choice of tools and methods. This aspect does not, however, influence the specific choice of tool or method. Instead it restricts the choice, in the same way as the requirements do, but now to tools and methods that visualise portfolio balances (see section 2.3.3 for examples). The final choice of specific tool or method then depends on the philosophy and wishes of the managers involved in the activities (Meredith and Mantel, 1999).

The choice by management to divide the project portfolio into sub-project portfolios and related sub-processes can be seen as a guiding principle (Bridges, 1999) used in the organisation. Thus the finding found here, that the choice of tools and methods is influenced by how the process is arranged, specifies the statement by Bridges (1999) that the guiding principles influence the choice of tools and methods.

> ***Conclusion:*** *Both the requirements on the project portfolio management, and how the project selection process is arranged, affect the choice of tools and methods by restricting the choice to specific types of tools and methods. The choice of specific tool or method is affected by the philosophy and wishes of the managers involved in the activities.*

8.3.2. The procedural and organisational settings' effect on the adaptation of tools and methods

In the last section it was shown that authors dealing with the use of tools and methods (Bridges, 1999; Meredith and Mantel, 1999) do not distinguish between the choice of tools and methods and how they are adapted for use (i.e. which parameters to employ in the tools and methods).

The empirical findings from the SCA study have shown that the adaptations of the tools and methods are also affected by the requirements on the project portfolio management. For example, the specific portfolio balances shown by many of the tools and methods used (see Figure 26-29, p. 87-90) are affected by requirements concerning specific balances to fulfil with the project portfolio management. As argued above, it may be the wishes of managers involved in the project portfolio management that influence the adaptations of the tools by stating the requirements on the process. But since managers other than those directly involved in the process also place requirements on the process, the empirical findings show that the requirements give a better view of what affects the adaptations of the tools and methods. The requirements on the project portfolio management are generally not considered in project portfolio management literature; instead the focus is put on the overall goals of project portfolio management, i.e. ensuring strategic alignment, maximising value, achieving a balanced portfolio (Cooper et al., 2001b).

The empirical findings also show that how the project portfolio management process is arranged, in terms of the division into sub-processes, affects the adaptation of the tools and methods. For supporting the project portfolio management among the different sub-processes, portfolio information concerning balances among the different sub-project portfolios is needed. Therefore, some of the tools and methods have to be specifically adapted to provide this information for the relevant activities. How the process is arranged, though, affects only the tools and methods which earlier were classified as static, constituting the basic structure for the project portfolio resources splits (see 8.2.3) that are affected.

> ***Conclusion:*** *The requirements on the project portfolio management affect how the tools and methods have to be adapted. How the project portfolio management process is arranged in terms of division into sub-processes affects the adaptations of the tools and methods classified above as static.*

8.3.3. The procedural and organisational settings' effect on the application of tools and methods

As for the separation of the choice and adaptation of tools and methods for the project portfolio management, earlier research has not separately examined how procedural and organisational aspects affect the application of tools and methods to the process. The focus has only been on what influences the choice of tools and methods (Bridges, 1999; Meredith and Mantel, 1999).

The empirical findings have shown that how the project portfolio process is arranged affects the possibilities of applying tools and methods to assist the activities. At the case company, the graphical charts are applied to the process and used in three ways: as a basis for the decisions on preferable resource splits, or as providing portfolio information to support decisions, or for following up the project portfolio composition of proposed projects. These different applications of graphical charts along the process are basically an effect of the choice to divide the process into separate processes for the different sub-project portfolios. Based on the division of the process, the graphical charts are needed to support and effectuate the decisions on the resource splits throughout the process. How the project portfolio process is arranged in terms of its division into sub-processes is therefore found to affect how the graphical charts must be applied to assist the project portfolio management.

In project portfolio management literature as a whole, the application of tools and methods to the project portfolio management is not deemed an issue of importance, since all tools and methods are considered to be used as part of one meeting that involves a group of relevant managers (EIRMA, 2002). But if the project portfolio process is divided and the decisions are distributed to different activities throughout the different sub-processes, the way of arranging the process becomes crucial, because tools or methods displaying balances of resource distributions have to be applied to specific activities in the process.

The empirical findings also show that the organisational participants who are involved in the project portfolio management activities affect how the tools and methods are applied. The scoring model, for example, is applied to the activities at the lowest process level for the product sub-project portfolios, but not to any other activities even though this should be feasible. The reason for applying the scoring model to these activities was the wishes of the organisational participants involved in these activities, while managers involved in other activities do not make use of scoring models. In the same way, some of the diagrams showing specific aspects of

balances are applied to the activities due to the wishes of the managers involved. Hence, the findings show that which organisational participants are involved in the project portfolio management affects the application of the tools and methods to the process.

> ***Conclusion:*** *How the portfolio management activities are arranged in sub-processes affects the application of the tools and methods in the process. The philosophy and wishes of the managers involved in the different activities also affect how the tools and methods are applied to the process.*

8.3.4. Summary of conclusions

The conclusions from this third research question are that the requirements on the project portfolio management, and how the project selection process is arranged, affect the choice of tools and methods by restricting the choice to specific types of tools and methods. The choice of specific tool or method within these restrictions is then affected by the philosophy and wishes of the managers involved in the activities.

A further conclusion is that how the tools and methods have to be adapted is also affected by the requirements on the process. Likewise, the adaptation of the tools and methods earlier classified as static is affected by the division of the project portfolio process into sub-processes. The last conclusion stated that the application of tools and methods in the process is affected by both how the activities are arranged in sub-processes and the philosophy and wishes of the managers involved in the different activities.

9. Concluding discussion

This chapter discusses the conclusions from the thesis work. The first section elaborates on how the conclusions contribute to increased knowledge concerning aspects of importance for organising project portfolio management. This part also elaborates on areas interesting for future research. In the end of this first part the contributions from papers 1–3 are highlighted as well.

In the second section, managerial implications based on the conclusions from the thesis work are discussed. The managerial implications are not strictly limited to these conclusions, but also add some practical thoughts on how to organise for project portfolio management that have been learned during the research studies.

9.1. Contributions and suggestions for future research

In the chapter describing the research methodology, it was argued that when using the case study research strategy it might be better to speak of the transferability of the results than of their generalisability. Such transferability is best described as generalising from the actual setting to other similar settings, or transferring conclusions from one context to another (Tashakkori and Teddlie, 1998). In enabling such transferability, the case company's approach to project portfolio management has been described thoroughly and analysed according to the research framework. This description and analysis are attempts at providing such thorough understanding of how project portfolio management is organised at the case company, which allows the reader to translate the findings to similar settings.

9.1.1. Aspects of importance for organising project portfolio management

So far the project portfolio management literature has focused largely on developing tools and methods for project portfolio management (Archer and Ghasemzadeh, 1996; Cooper et al., 2001b; EIRMA, 2002). During recent years the research has developed to include aspects of how to organise for project portfolio management, but even though different aspects have been elaborated on, no more complete framework of aspects important for organising project portfolio management has emerged. Thus the main present contribution, concerning the purpose of identifying aspects of importance for organising project portfolio management, is the development of the research framework. The framework does not add any new major areas to the existing knowledge of project portfolio management, but based on existing project portfolio management literature and interactions with the empirical world, three areas of important aspects for organising project portfolio management have been identified. These three areas are procedural aspects, aspects of using tools and methods, and organisational aspects.

The procedural aspects generally relate to the main processes of selecting projects for the portfolio and reviewing the portfolio. The processes are detailed in terms of how, and in what sequence, the different project portfolio management

activities are arranged and the sequence of them. Moreover, the procedural aspects concern the customers and their requirements on the processes, as well as connections with other company-internal processes. The second area, that of the tools' and methods' use, deals with the combination of tools and methods chosen, which parameters are employed for adapting them, and how they are applied to the activities. How the tools and methods are used in the process, i.e. for discussions, preparations or decision, as well as which requirements they aim at fulfilling, are also examined. Regarding the organisational aspects, the organisational setting of the development organisation constitutes the basis, as it provides important information on which participants, i.e. individuals, groups or forums, are connected with the different activities in the processes.

As mentioned above, the aspects of importance gathered in the research framework are not new for the project portfolio management literature, but the diverse aspects included are more detailed in the framework than what is normally found in literature. The main contribution from developing the research framework, therefore, is the classification and specification of the aspects important for organising project portfolio management.

Even though the research framework has been developed with insights from interaction with the empirical world, it has a strong basis in the project portfolio management literature. The single case study has provided most of the insights from the empirical world into the development of the framework, but it has also been supplemented with empirical data from the multiple case study. Since the framework has its foundation in existing project portfolio management literature, and since the primary development of new knowledge is based on the related theoretical area of general process management (see for example Rentzhog, 1996 and Lind, 2001), the framework ought not to be seen as valid only for this particular case, but should also be useful elsewhere. However, this research framework is not a final one including every relevant aspect of organising project portfolio management; it takes a step forward in the process of reaching a more complete understanding of aspects important for organising project portfolio management. Consequently an area suggested for future research is the further development of a framework for organising project portfolio management.

The research questions that were answered in Chapter 8, by synthesising the empirical findings from the study at the single case company, should be viewed as some aspects of organising project portfolio management that have been specifically highlighted. The contributions from these three questions are therefore dealt with in the following three subsections.

9.1.2. Implications for organising the management of project portfolios including different types of projects

Project portfolio management should include all types of projects undertaken with the use of the same resource base (Bridges, 1999). However, studies of project portfolio management generally focus on portfolios where the projects included have rather similar characteristics in terms of project aims (Elonen and Artto,

2003). Even though the project characteristics to some extent always differ from each other in portfolios, the literature on project portfolio management generally does take this into account when organising for the project portfolio management activities.

Project portfolios focused upon in this thesis include projects with distinctive characteristics: product development projects, manufacturing process development and technology development projects. The main conclusion from the study is that including projects with such different aims in one portfolio has implications for how the project portfolio management can be organised. It means that the arrangement of the process of selecting projects for the portfolio must allow taking into account different strategies and ways of evaluating projects, but also allow an involvement of managers representing different areas of knowledge. The process of reviewing the project portfolio has to allow updating of the different projects with different frequencies. The inclusion of different types of projects also has implications for the use of tools or methods. It was concluded that tools or methods showing the resource distribution among the different types of projects in the portfolio must be used to assist the project portfolio management. The project portfolio management must also allow using different tools and methods for decisions concerning the different types of projects. The last area of implications concerns the organisational aspects, where it was concluded that managers representing all areas of knowledge relevant for the distinct types of projects have to be involved in the management of the project portfolio. For the inclusion of manufacturing process development projects, this implies that managers with thorough knowledge of manufacturing should also be included, which is generally not considered important (EIRMA, 2002; Kendall and Rollins, 2003).

Earlier research has suggested a strategic bucket approach for allocating resources to different types of projects in the portfolio (Cooper et al., 2001b), but without considering any changes of the portfolio process. This approach fails in its ability to take into account the implications that have been identified here, since even rather homogeneous projects generally are considered in the project portfolios (Elonen and Artto, 2003). Therefore the increased knowledge provided here, about the implications of including distinctive project types in the same project portfolio, can be seen as significant contributions to the research.

The case company mainly focused upon in this thesis has taken one step beyond the strategic bucket approach (Cooper et al., 2001b). It has chosen to separate the two main activities of selecting projects for the portfolio and reviewing the project portfolio, enabling the different types of projects to be managed in different ways. The company has also separated the selection and review processes into separate processes for the different types of projects. This way of taking care of different projects in the same portfolio should, however, be regarded as only one feasible means of facilitating for the different types of projects to be managed differently. Other ways of arranging the project portfolio management process may also be feasible. To look for such ways of organising project portfolio management is an area where future research would be beneficial.

9.1.3. Implications for using tools and methods in combination with each other

The second area of contributions provided in the thesis concerns the use of tools and methods in combination. This is an area rather unexplored by earlier research. Much focus has been put on developing tools and methods for project portfolio management (Archer and Ghasemzadeh, 1999), but most often them have been developed in isolation from each other (Cooper et al., 2001b). Some studies have examined the use of tools and methods in project portfolio management, but often on a general level through questions such as how many tools and methods are applied and which types of tools or methods are most popular (Cooper et al., 1999; Center for Business Practices, 2003). Thorough knowledge of how tools and methods can be chosen, adapted and applied to support project portfolio management is missing.

Literature focusing on project portfolio management has emphasised the importance of focusing on a few tools or methods assisting the project portfolio management (Cooper et al., 2001b; EIRMA, 2002). This research, however, has not provided any more detailed knowledge of how the project portfolio management is organised in companies. The conclusion from the study at SCA is that it is the number of both different tools and methods and different adaptations of the same tool or method which are used for supporting each project portfolio management activity, not the total number of tools and methods used, that is relevant for avoiding the provision of too much information. The earlier research (Cooper et al., 2001b; EIRMA, 2002) fails to provide this more detailed knowledge of how different tools and methods can be used.

The other area of conclusions, which deals with how the tools and methods are used and applied to the activities, must be seen as even more explorative within the project portfolio management literature. One conclusion is that the tools and methods can be used in basically three different ways: for decisions on preferable splits, or as providing portfolio information to support decisions, or for following up the project portfolio composition of proposed projects. It was further concluded that they can be used with both historical and current project portfolio data. Such different types of use of project portfolio management tools and methods are not dealt with in existing project portfolio management literature. Neither is the last conclusion, namely that the tools and methods can be applied to the process in two different ways: either as static, constituting a basic structure for visualising balances of resource allocations, or as dynamic, which may change more frequently as consequences of changes in management's strategic intentions.

This second area of conclusions concerning the use and application of tools and methods in the project portfolio management process, must be seen in the light of how SCA has organised its project portfolio management. At the case company, the project portfolio management process is divided in separate processes for the different sub-project portfolios, where the decisions regarding the portfolio composition are distributed in the processes. If instead all project portfolio decisions are taken at one single portfolio meeting with a specific group of

managers, the contribution is not as relevant as in settings like the one described here. But if the project portfolio decisions are distributed in different stages, the increased knowledge provided here makes an illuminating contribution.

9.1.4. The procedural and organisational settings' effects on the choice, adaptation and application of tools and methods

The third research question focuses on how the procedural and organisational aspects of organising project portfolio management affect the use of tools and methods. Earlier research has stated that the tools and methods should fit with the philosophy and wishes of managers involved (Meredith and Mantel, 1999), which is supported by the conclusions in this thesis. But the conclusions reached here show that the requirements on the project portfolio management, and how the project selection process is arranged, also affect the choice of tools and methods by restricting the choice to specific types of tools and methods. In agreement with Meredith and Mantel (1999), the choice of specific tool or method within the restrictions stated by the requirements is affected by the philosophy and wishes of the managers involved in the activities. However, since these managers are also involved in stating the requirements, they indirectly also influence the restrictions on choice of the tools and methods. But if managers other than those actually involved in the project portfolio management are able to shape the requirements on it, the philosophy and wishes of managers involved should be seen as just a part of what influences the choice of tools and methods.

Adding to this discussion is the conclusion that the procedural and organisational aspects affect the adaptation of the tools and methods. It has been found that the requirements on the project portfolio management also influence these adaptations. However, the adaptation of the tools and methods is generally not considered a separate aspect of choosing tools and methods. A further conclusion concerning such adaptations is that the tools and methods which earlier were classified as static are affected by how the project portfolio processes are arranged. Within the last area of conclusions, it was stated that both how the activities are arranged and the philosophy and wishes of the managers involved in the activities affect how the tools and methods are applied to the project portfolio management activities.

The main contribution from this research question is the increased knowledge of areas affecting the use of tools and methods. It seems that the requirements on the project portfolio management are what matter, together with the philosophy and wishes of management. The aspects brought up by Bridges (1999) – that which tools and methods to use depends on which industry the company is active within, the strategic directions of the organisation, its guiding principles, capacity, constraints and complexity –will be covered by the requirements on the project portfolio management. The requirements are stated by organisational participants relevant for the project portfolio management, and should therefore correspond to those aspects.

Another area of contributions concerns the separation of how the tools and methods are used into the aspects of choice, adaptation and application. The conclusions from this thesis have shown that such a distinction is beneficial for understanding what influences the use of tools and methods.

As has been noted, the knowledge provided here is to some extent situation-specific, since it deals with a distributed approach to project portfolio management. A point made in the research methodology was that general theories are not the only purpose of research; it can also provide understanding of specific situations (Brunsson, 1982). Nevertheless, as the area of which people are involved and how they are organised for the project portfolio management is critical (Levine, 1999), the aspects dealt with by this third research question should be of interest for further research. Therefore, studies with a similar focus in other settings would be valuable for increasing the knowledge in the area.

A related area that has emerged as interesting for future research concerns the procedural aspects of organising project portfolio management. In implementing project portfolio management, Cooper et al. (2001b) suggest initially establishing a formal process for the work. Such formal processes, however, are not frequently reported in project portfolio management literature. To increase the knowledge of how project portfolio management is organised, more in-depth studies analysing such formal processes would be helpful. These studies could also be important steps in supplementing the research framework developed in the thesis.

9.1.5. Contributions from papers 1–3

The three papers whose results were presented as part of the chapter dealing with the methodological considerations have also contributed to increasing the knowledge in the area of strategic management of technology. However, they have not added knowledge in the field of organising project portfolio management, which can be seen as a specific segment within that area.

The results from paper 1 contribute to knowledge about the sources of perceived complexity in the development of two technical platform projects. The results show that the complexities can be defined as *Structural uncertainty*, i.e. differentiation and dependencies, and *Uncertainty* in goals and methods. These complexity parameters can be found on three different levels in the project environment: *the external organisation*, *the internal organisation*, and *the product*. Comparison of the two projects has shown that the underlying parameters of complexity come into play differently in different settings; e.g. how these parameters are perceived is highly dependent on the specific situation.

The second paper identifies three main problem areas in introducing product and technology roadmapping (PTR). These concern differences in purpose of PTR, organisation of the PTR work within a complex development organisation, and communication and synchronisation. The results show that a vaguely defined purpose of PTR will unavoidably result in different opinions regarding how PTR is conducted. Concerning the organisation for the PTR work, it was found that a

dispersed set-up is required for dealing with the complex product. To support the work with PTR concerning both a complex product architecture and complex organisation, a formal communication structure was found to be needed.

The third paper gives a rich description and a problematised view of the new situation experienced by Ericsson Mobile Platforms (EMP), which resulted from a changed value-chain as a consequence of product maturity and competition on the market. Beside this description, the main contribution of the paper is a proposed framework, consisting of six dimensions, guiding managers in taking more rational decisions on product boundaries. The dimensions that constitute the framework are Customer Importance, Technology Clockspeed, Competitive Position, Capable Suppliers, Architecture, and Strategic knowledge. The results from the paper should be seen as a first step towards a framework supporting managers in decisions on where to place product boundaries and where to position themselves in the value-chain.

9.2. Managerial implications

The project portfolio management area is by its nature rather practically oriented, which characterises also the contributions from this thesis. The contributions presented should therefore not be very hard to apply in practical project portfolio management work. Nevertheless, in this section some more managerial implications will be discussed, based not only on the specific theoretical suggestions made in the thesis but also on existing literature and additional knowledge acquired during the studies.

Project portfolio management has gained an increasing interest during recent years (EIRMA, 2002; Center for Business Practices, 2003). This is not surprising in the light of aims such as aligning development activities with strategic intentions and maximising the value of development efforts. To facilitate the management of project portfolios, much emphasis has been laid on developing tools and methods for assisting the work. This strong focus on the tools and methods for managing project portfolios may have led to an impression that using some carefully chosen tools and methods is enough for managing project portfolios. However, the thesis has shown that being successful in project portfolio management involves more considerations than just applying project portfolio management tools and methods. Both procedural and organisational aspects need to be taken into account at the same time as tools and methods are carefully chosen.

9.2.1. Let the requirements guide the project portfolio management

The overall aims, which are to achieve strategic alignment, a balanced project portfolio and a maximum return on investments, are important to take into account when organising for project portfolio management. The results in this thesis have shown, however, that the requirements to fulfil with project portfolio management may be more elaborate than those overall goals. In order to benefit as much as possible from the project portfolio management effort, it is important to make an inventory of the requirements to fulfil. It is also important to note that more

organisational units than the ones directly involved in the project portfolio management can provide important requirements on the project portfolio management. Consequently, such organisational units must also be involved in making an inventory of the requirements to fulfil.

9.2.2. Tools and methods

Among the many different tools and methods described in research and used among practitioners, project portfolio management literature suggests limiting the use of tools and methods to a few key ones. The main argument for limiting the number of tools and methods is to avoid information overload (Cooper et al., 2001b). These recommendations, however, are based on the assumption that all decisions are made by the same group of managers. Due to the results in this thesis, it is advisable not to overemphasise using a limited number of tools and methods, and it is important to consider the possibilities of fulfilling the requirements on the process. This is not to say that numerous tools and methods should be applied to the process. But if the project portfolio decisions are distributed among different activities along the process, it must be possible to allow more tools and methods than if all decisions are made on one occasion and by one managerial group.

9.2.3. Procedural aspects

Project portfolio management consists basically of two different activities which generally are regarded as parts of the same process. These activities are the selection of projects for the project portfolio and recurrent reviews of the project portfolio composition. The results in this thesis have shown that it can be beneficial to take care of these two different activities in separate processes, so as to be able to respond to different projects' characteristics in the project portfolio.

If the same base of resources is used for projects with distinct characteristics (e.g. product development, manufacturing process development, technology development) and the projects are managed as one project portfolio, the conclusions in this thesis have shown that it can also be feasible to separate the processes for the different types of projects. At the case company, the separation of the processes was basically a response to the different projects' managerial needs. Irrespective of whether the project portfolio management process is divided into separate processes or not, the results have shown that if projects with distinct characteristics are included in the same portfolio, the processes must be arranged in ways that allow taking into account different strategies, different ways of evaluating projects, and different demands concerning frequencies of updating the portfolio.

9.2.4. Organisational aspects

Related to the recommendations regarding the procedural aspects for portfolios including projects with distinct characteristics, it has been found crucial to allow managers with different knowledge to be involved in managing the different types of projects in the portfolio. For example, marketing knowledge relevant to product

projects for specific markets is usually distinct from in-depth knowledge about specific parts of a complex manufacturing process. Such diverse knowledge is needed for managing different parts of a portfolio including projects with distinct characteristics.

In literature on project portfolio management it is often noted that organisational units important to involve in the project portfolio management normally are marketing, R&D and senior management. The results in this thesis, however, have shown that other organisational units can also be well worth involving. It is basically the different types of projects included in the project portfolio and the characteristics of the business that determine which organisational units should play a role. At the case company, managers from the manufacturing function are as indispensable as the other units suggested by the literature.

An area not dealt with in this thesis is the way of collecting and distributing the project portfolio information. In order to succeed with the project portfolio management, an efficient manner of collecting and distributing the related information is essential. During recent years, several companies have presented software tools for facilitating the collection of project information. It is perhaps hard to say that such software tools are a must, but some kind of aid for managing the information is needed in order to deal properly with all the intricacies of project portfolio management.

10. References

Alvesson, M. and Sköldberg, K. (1994). *Tolkning och reflektion - Vetenskapsfilosofi och kvalitativ metod*. Lund, Studentlitteratur.

Archer, N. P. and Ghasemzadeh, F. (1996). Project Portfolio Selection Techniques: A Review and a Suggested Integration Approach. *Innovation Research Working Group Working Paper No. 46*. McMaster University.

Archer, N. P. and Ghasemzadeh, F. (1999). An Integrated Framework for Project Portfolio Selection. *International Journal of Project Management* 17(4): 207-216.

Baccarini, D. (1996). The concept of project complexity - a review. *International Journal of Project Management* 14(4): 201-204.

Bergman, B. and Klefsjö, B. (1995). *Kvalitet från behov till användning*. Lund, Studentlitteratur.

Blichfeldt, B. S. and Eskerod, P. (2005). Project Portfolios - There's more to it than what management enacts. In proceedings of *12th International Product Development Management Conference*, Copenhagen, European Institute for Advanced Studies in Management, EIASM.

Braunstein, D. M. and Salsamendi, M. C. (1994). R&D Planning at ARCO Chemical. *Research Technology Management* (September-October).

Bridges, D. N. (1999). Project Portfolio Management: Ideas and Practices. In *Project Portfolio Management*. L. D. Dye and J. S. Pennypacker. West Chester, Center for Business Practices: 45-54.

Brown, S. L. and Eisenhardt, K. M. (1995). Product development: Past research, present findings, and future directions. *Academy of Management Review* 20(2): 343.

Brunsson, N. (1982). *Företagsekonomi - sanning eller moral? Om det normativa i företagsekonomisk idéutveckling*. Lund, Studentlitteratur.

Castellion, G. (2005). A New Product's Development Strategy: Formulation and Implementation. In *The PDMA Handbook of New Product Development*. K. B. Kahn. Hoboken, New Jersey, John Wiley & Sons Inc.: 29-45.

Center for Business Practices (2003). Project Portfolio Management - A benchmark of current business practices. Havertown, Center for Business Practices - Capturing, Organizing, and Transferring Management Knowledge: 108.

Chiesa, V. (2001). *R&D Strategy and Organisation - Managing Technical Change in Dynamic Contexts*. London, Imperial College Press.

Clark, K. B. and Fujimoto, T. (1991). *Product Development Performance - Strategy, Organization and Management in the World Auto Industry*. Boston, Harvard Business School Press.

Cooper, R. G. (2001). *Winning at new products - accelerating the process from idea to launch*. Cambridge, Massachusetts, Perseus Publishing.

Cooper, R. G. and Edgett, S. J. (2003). Overcoming the crunch in resources for new product development. *Research Technology Management* 46(3): 48-58.

Cooper, R. G., Edgett, S. J. and Kleinschmidt, E. J. (1997). Portfolio management in new product development: Lessons from the leaders - II. *Research Technology Management* 40(6): 43-52.

Cooper, R. G., Edgett, S. J. and Kleinschmidt, E. J. (1998). Best practices for managing R&D portfolios. *Research Technology Management* 41(4): 20-33.

Cooper, R. G., Edgett, S. J. and Kleinschmidt, E. J. (1999). New product portfolio management: practices and performance. *Journal of Product Innovation Management* 16(4): 333.

Cooper, R. G., Edgett, S. J. and Kleinschmidt, E. J. (2001a). Portfolio management for new product development: Results of an industry practices study. *R&D Management* 31(4): 361-380.

Cooper, R. G., Edgett, S. J. and Kleinschmidt, E. J. (2001b). *Portfolio Management for New Products*. Cambridge MA, Perseus Publishing.

Cooper, R. G., Edgett, S. J. and Kleinschmidt, E. J. (2004). Benchmarking best NPD practices-II. *Research Technology Management* 47(3): 50-59.

Cooper, R. G. and Kleinschmidt (1987). Success Factors in Product Innovation. *Industrial Marketing Management* 16(3): 215.

Creswell, J. W. (1994). *Research Design - Qualitative & Quantitative Approaches*. California, Sage Publications, Inc.

Czarniawska-Joerges, B. (1996). Organizational structure: Organizing, process of. In *International Encyclopedia of Business and Management*. M. Warner. Cornwall, England, Routledge.

Davenport, T. H. (1993). *Process Innovation - Reengineering Work through Information Technology*. Boston, Harvard Business School Press.

Dawidson, O. (2004). Requirements to be fulfilled by project portfolio management. In proceedings of *11th International Product Development Management Conference*, Dublin, European Institute for Advanced Studies in Management, EIASM.

Dawidson, O. (2005). Project Portfolio Management at SCA, Tissue AFH - Process and Tools. In proceedings of *12th International Product Development Management Conference*, Copenhagen, European Institute for Advanced Studies in Management, EIASM.

Dawidson, O. and Karlsson, M. (2005). Towards a framework supporting the management of product boundaries: a study of the new situation experienced by Ericsson Mobile Platforms. *International Journal of Mobile Communication* 3(3): 49-65.

Dawidson, O., Karlsson, M. and Trygg, L. (2004). Complexity Perception - Model Development and Analysis of Two Technical Platform Projects in the Mobile Phones Industry. *International Journal of Information Technology and Decision Making* 3(3): 493-512.

Dawidson, O., Sandgren, E. and Sjöström, J. (2005). Project Portfolio Management - a multiple case study of six Swedish companies. In proceedings of *12th International Product Development Management Conference*, Copenhagen, European Institute for Advanced Studies in Management, EIASM.

De Maio, A., Verganti, R. and Corso, M. (1994). A multi-project management framework for new product development. *European Journal of Operational Research* 78: 178-191.

Dubois, A. and Gadde, L.-E. (2002). Systematic Combining: an abductive approach to case research. *Journal of Business Research* 55: 553-560.

Dye, L. D. and Pennypacker, J. S. (1999). An Introduction to Project Portfolio Management. In *Project Portfolio Management*. L. D. Dye and J. S. Pennypacker. West Chester, Center for Business Practices.

EIRMA (2002). Project Portfolio Management - WG59 Report. Paris, EIRMA Working Group Reports.

Eisenhardt, K. M. (1989). Building Theories from Case Study Research. *Academy of Management Review* 14(4): 532-550.

Elonen, S. and Artto, K. A. (2003). Problems in managing internal development projects in multi-project environments. *International Journal of Project Management* 21(6): 395.

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

Graves, S. B., Ringuest, J. L. and Case, R. H. (2000). Formulating optimal R&D portfolios. *Research Technology Management* 43(3): 47-51.

REFERENCES

Griffin, A. (1997). Drivers of NPD Success the 1997 PDMA Report. Chicago, IL.

Harrington, H. J. (1991). *Business Process Improvement*. New York, McGraw-Hill, Inc.

Hayes, R., Pisano, G., Upton, D. and Wheelwright, S. C. (2005). *Operations, Strategy, and Technology - Pursuing the Competitive Edge*. Hoboken, NJ, John Wiley & Sons Inc.

Henriksen, A. D. and Traynor, A. J. (1999). A Practical R&D Project-Selection Scoring Tool. *IEEE Transactions on Engineering Management* 46(2): 158-170.

http://www.pdma.org/library/glossary.html (2005-09-21).

http://www.sca.com/ (2005-11-08).

Karlsson, M. (2004). Organizing Technology Planning - A contingent approach. Department of Operations Management and Work Organization. Göteborg, Chalmers University of Technology: 118.

Karlsson, M. and Dawidson, O. (2003). Product & Technology Roadmapping in the Mobile Phones Industry. In proceedings of *Management of Research and Development in the New Millenium*, Department of Management Studies, Indian Institute of Technology, New Delhi, India.

Kendall, G. and Rollins, S. C. (2003). *Advanced Project Portfolio Management and the PMO: Multiplying ROI at Warp Speed*. Florida, J. Ross Publishing, Inc.

Kennedy, M. M. (1979). Generalizing from Single Case Studies. *Evaluation Quarterly* 3(4): 661-678.

Levine, H. A. (1999). Project Portfolio Management: A Song Without Words? In *Project Portfolio Management*. L. D. Dye and J. S. Pennypacker. West Chester, Center for Business Practices: 39-44.

Liberatore, M. J. (1988). A Decision Support System Linking Research and Development Project Selection with Business Strategy. *Project Management Journal* 19(5): 14-20.

Lincoln, Y. S. and Guba, E. G. (1985). *Naturalistic inquiry*. Beverly Hills, Sage.

Lind, M. (2001). Från System till Process - Kriterier för processbestämning vid verksamhetsanalys. Linköping studies in Information Science. Linköping, Linköpings universitet.

Linton, J. D., Walsh, S. T., Kirchhoff, B. A., Morabito, J. and Merges, M. (2000). Selection of R&D Projects in a Portfolio. In proceedings of *The 2000 IEEE*, Engineering Management Society.

Lundqvist, M. A. (1996). Organizing Product Development - Formalizing the informal in interdependent knowledge work. Dep. of Operations Management and Work Organization. Göteborg, Chalmers University of Technology.

Lycett, M., Rassau, A. and Danson, J. (2004). Programme management: a critical review. *International Journal of Project Management* 22: 289-299.

Makins, M. (1995). *Collins English Dictionary and Thesaurus*. Glasgow, HarperCollins Publishers.

Martino, J. P. (1995). *Research and Development Project Selection*. New York, John Wiley & Sons.

McCutcheon, D. M. and Meredith, J. R. (1993). Conducting Case Study Research in Operations Management. *Journal of Operations Management* (11): 239-256.

McDonough III, E. F. and Spital, F. C. (2003). Managing project portfolios. *Research Technology Management* 46(3): 40-46.

McGrath, M. E. (2001). *Product Strategy for High-Technology Companies - Accelerating Your Business to Web Speed*. New York, McGraw-Hill.

McGrath, M. E. (2004). *Next Generation Product Development - How to Increase Productivity, Cut Costs, and Reduce Cycle Times*. New York, McGraw Hill.

Meredith, J. R. and Mantel, S. J. J. (1999). Project Selection. In *Project Portfolio Management*. L. D. Dye and J. S. Pennypacker. West Chester, PA, Center for Business Practices: 135-167.

Miles, M. B. and Huberman, A. M. (1994). *Qualitative Data Analysis*. California, Sage Publications.

Nelson, B., Gill, B. and Spring, S. (1999). Building on the Stage/Gate: An Enterprise-wide Architecture for New Product Development. In *Project Portfolio Management*. L. D. Dye and J. S. Pennypacker. West Chester, Center for Business Practices: 87-94.

Nobelius, D. (2002). Managing R&D Processes - Focusing on Technology Development, Product Development, and their Interplay. Department of Operations Management and Work Organization. Göteborg, Chalmers University of Technology: 91.

Nobelius, D. (2003). An ambidextrous organisation in practice: strategic actions in Ericsson's management of 'Bluetooth'. *International Journal of Mobile Communication* 1(1-2): 57-90.

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

Poh, K. L., Ang, B. W. and Bai, F. (2001). A comparative analysis of R&D project evaluation methods. *R&D Management* 31: 63-75.

Power, D. (1986). Linking R&D to corporate strategy. *Management Review* 75(12): 28-33.

Project Management Institute (2004). A guide to the project management body of knowledge: PMBOK Guide. Newtown Square, Pa, Project Management Institute.

Ragin, C. C. (1992). "Casing" and the process of social inquiry. In *What is a case? Exploring the foundations of social inquiry*. C. C. Ragin and H. S. Becker. Cambridge, Cambridge University press.

Rentzog, O. (1996). Core Process Management. Department of Mechanical Engineering. Linköping, Linköping University. Tek.Lic.

Rosenau, M. D. J., Griffin, A., Castellion, G. A. and Anschuetz, N. F. (1996). *The PDMA Handbook of New Product Development*. New York, John Wiley & Sons.

Roussel, P. A., Saad, K. N. and Erickson, T. J. (1991). *Third Generation R&D - Managing the Link to Corporate Strategy*. Boston, Massachusetts, Harvard Business School Press.

Rummler, G. A. and Brache, A. P. (1995). *Improving Performance - How to Manage the White Space on the Organization Chart*. San Francisco, California, Jossey-Bass.

Sharpe, P. and Keelin, T. (1998). How SmithKline Beecham Makes Better Resource-Allocation Decisions. *Harvard Business Review* (March-April).

Slack, N., Chambers, S. and Johnston, R. (2001). *Operations Management*. Harlow, England, Prentice Hall.

Smith, P. G. and Reinertsen, D. G. (1998). *Developing Products in Half the Time - New Rules, New Tools*. New York, John Wiley & Sons, Inc.

Sommer, R. J. (1999). Portfolio Management for Projects: A New Paradigm. In *Project Portfolio Management*. L. D. Dye and J. S. Pennypacker. West Chester, Center for Business Practices: 55-59.

Spradlin, C. T. and Kutoloski, D. M. (1999). Action-Oriented Portfolio Management. In *Project Portfolio Management*. L. D. Dye and J. S. Pennypacker. West Chester, Center for Business Practices: 261-270.

Stummer, C. and Heidenberger, K. (2003). Interactive R&D portfolio analysis with project interdependencies and time profiles of multiple objectives. *IEEE Transactions on Engineering Management* 50(2): 175-183.

Szwejczewski, M., Mitchell, R. and Lemke, F. (2004). An investigation into the use of Portfolio Management among UK organisations. In proceedings of *11th International Product Development Management Conference*, Dublin, European Institute for Advanced Studies in Management, EIASM.

Tashakkori, A. and Teddlie, C. (1998). *Mixed Methodology*. Thousand Oaks, California, SAGE publications.

Turner, J. R. (1999). *The handbook of project-based management*. London, The McGraw-Hill Publishing Company.

Wheelwright, S. C. and Clark, K. B. (1992). *Revolutionizing Product Development - Quantum Leaps in Speed, Efficiency, and Quality*. New York, The Free Press.

Williams, T. M. (1999). The need for new paradigms for complex projects. *International Journal of Project Management* 17(5): 269-273.

Voss, C., Tsikriktsis, N. and Frohlich, M. (2002). Case research in operations management. *International Journal of Operations and Production Management* 22(2): 195-219.

Yin, R. K. (1994). *Case Study Research - Design and methods*. Thousand Oaks, California, SAGE publications.

Paper 1:

**Complexity Perception – Model Development and
Analysis of Two Technical Platform Projects
in the Mobile Phones Industry**

Ola Dawidson

Martin Karlsson

Lars Trygg

Paper 2:

Product & Technology Roadmapping in the Mobile Phones Industry

In the proceedings of *Management of Research and Development in the New Millenium Conference, Department of Management Studies, Indian Institute of Technology, New Delhi, India, 2003.*

Martin Karlsson

Ola Dawidson

Paper 3:

Towards a framework supporting the management of product boundaries: a study of the new situation experienced by Ericsson Mobile Platforms

Ola Dawidson

Martin Karlsson

Paper 4:

Requirements to be fulfilled by
project portfolio management

An earlier version of this paper was printed in the proceedings of
*The 11th International Product Development Management
conference (EIASM), Dublin, Ireland, 2004.*

Ola Dawidson

Paper 5:

Project Portfolio Management at SCA, Tissue AFH – Process and Tools

In proceedings of
The 12th International Product Development Management conference (EIASM), Copenhagen, Denmark, 2005.

Ola Dawidson

Paper 6:

**Project Portfolio Management
– a multiple case study of six Swedish companies**

In proceedings of
*The 12th International Product Development Management
conference (EIASM), Copenhagen, Denmark, 2005.*

Ola Dawidson

Eric Sandgren

Jonatan Sjöström