Learning for the next Project - Bearers and barriers in knowledge transfer within an organisation

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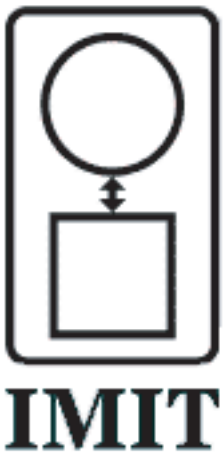

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CONTENTS

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Learning for the next project
Bearers and barriers in knowledge transfer within an organisation

by

Charlotte Björkegren

Licentiatavhandling

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Abstract

This study concerns knowledge transfer within an organisation. More specifically this encompasses knowledge transfer between projects and the organisation in which the projects are performed. The study has been conducted at STORA Corporation, a large Swedish industrial organisation within the pulp and paper industry, where two major investment projects at two different mills, divisions, and countries have been carried out. Through visits to the mills and by conducting interviews with participants from the projects a thematically structured story illuminating events related to knowledge transfer has emerged.

The thesis concludes that different types of knowledge are developed within a project: process- and product-related knowledge, project-organising knowledge and technical knowledge, meaning that even though the end product differs between two following projects, experiences and knowledge from previous projects can be utilised in projects with similar procedures. Since there is no natural transfer mechanism between projects, because of their temporary nature, knowledge transfer becomes problematic. Through the concepts of knowledge bearers and knowledge barriers, this problem is addressed.

The study actualises the importance of having a dual approach to project management, i.e. to not only focus on the traditional dimensions of time, cost and quality, but also take into consideration what the experience gained in one project can mean for the efficiency of the next project. From the view of the company as a whole, therefore, the metaphor of projects as learning experiments is introduced emphasising the explorative character of projects, i.e. gaining knowledge that can be exploited in the next.

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- CHAPTER ONE -

Introducing the Problem

The aim of this chapter is to introduce the problem of the study. The chapter begins with a description of the empirical context, i.e. the pulp and paper industry and large-scale production organisations.

Empirical context

> 'On Tuesday, March 7, 1995, at 09:30 a.m., the first inauguration shovel digs into the ground and just a few hours later three big excavators are thundering on to the site. This is the beginning of the largest investment project in the history of the STORA Corporation – the KM8 project in Sweden. Almost 18 months later, more exactly on November 20, 1996 just after 08:00 a.m., the new machine at the mill in Skoghall produces the first board. Before this, on December 11, 1995, the board of the STORA Corporation takes a decision to invest in yet another major project – the PM2 project – this time on the other side of the Atlantic. On May 1, 1996, groundwork begins and almost two years later, in April 1998, a new paper machine starts up at the mill in Port Hawkesbury in Canada. Thus, another large investment project in the history of STORA Corporation has been accomplished.'

During a time interval of nearly four years, that is, from autumn 1994 through spring 1998, two major investment projects were imple-

mented within STORA Corporation (further on STORA[1]), a large Swedish industrial organisation within the pulp and paper industry. Looking back over time one investment project of comparable size has during the last 20 years been carried out roughly every second year and in June 1998, when I visited the company for the first time, the board of STORA had just taken a decision to investigate (yet) another investment project, in Vera Cruz, on the East Coast of Brazil. The two investment projects illustrated above, i.e. the KM8 project at the mill in Skoghall and the PM2 project at the mill in Port Hawkesbury, are thus neither the first nor the last ones to come within STORA.

Even if some of the earlier projects will be mentioned in the following chapters, the empirical focus will be on the KM8 and the PM2 projects. The aim of both projects was to build a new product line, within an already existing mill, and the projects were to a large extent not concurrent. There were therefore strong possibilities for the later project (PM2) to learn[2] from experiences gained in the earlier project (KM8), i.e. for knowledge to be transferred from the KM8 to the PM2 project. Thus the KM8 and the PM2 projects cannot only be seen as investments in new product lines, but can also be seen as springs of knowledge.

Technical 'conservatism' and concentration tendencies

When compared with e.g. the computer industry the pulp and paper industry is often described as a less dynamic industry, where few radical technological innovations have taken place since the first paper machine was produced in the year of 1796. The new paper machines that are being designed today are still based on concepts that were developed already around the 1850s (Laestadius 1997). The innovations taking place within the pulp and paper industry can be described as incremental with a dominant design (see e.g. Abernathy & Utterback 1978; Tushman & Rosenkopf 1992) being developed and settled

[1] When referring to STORA Corporation, STORA is used. When referring to a part of the corporation, e.g. Stora Skoghall, the division of Stora Paper Board, or Stora Corporate Research, Stora is used.

[2] In this thesis learning will be seen as the process where knowledge is being transferred and utilised.

about 150 years ago. Laestadius (1996a) illuminates this very well when he argues that a technical 'conservatism' permeates the pulp and paper industry.

On the industry level in Sweden there has been a strong concentration tendency and the manufacturing competencies have been concentrated within fewer companies. Out of 82 manufacturers in 1957 only 26 were left in 1982 and toward the end of the 1980s three large actors dominated the industry in Sweden: STORA[3], MoDo[4], and SCA. In the beginning of the 1990s there were only two large actors: STORA and SCA[5]. Other important, but smaller, companies were ASSI-Domän, Korsnäs, MoDo, Munkedal, Munksjö, Rottneros, and Södra Skogsägarna (Melander 1997; Sölvell et al. 1991). The domestic mergers during the postwar era were followed toward the end of the 1980s by international take-overs; in the period 1987 to 1990 Swedish companies acquired 26 pulp and paper companies in Western Europe (Melander 1997). Also during the last decade, there have been a number of mergers and acquisitions within Europe, the latest concerning STORA itself through its merger with the Finnish pulp and paper company ENSO.

A further industrial tendency is that the manufacturing companies within the pulp and paper industry, to an increasing extent concentrate on their core operations (Laestadius 1996a) and sell off segments that are not invalued in the manufacturing of pulp and paper. However, while the large manufacturing companies are concentrating on making their production more efficient in order to enjoy the advantages of large-scale production as well as diversifying their proficiencies by packaging it in different products, the suppliers of mechanical equipment, like e.g. Kvaerner and Valmet, are concentrating on developing complete systems in order to enlarge their product range. This means that a supplier for mechanical equipment is now able to deliver a complete paper or board machine. In as much as the manufacturing companies concentrate on their core operations, the involved consult-

[3] Here also including Billerud, which was acquired in 1984, and Papyrus, which was acquired in 1986.
[4] Here also including Holmen and Iggesund, which both were acquired in 1988.
[5] In the beginning of the 1990s a large stock holding in MoDo was bought by SCA and during 1999 MoDo and SCA merged their fine-paper divisions to form a 50/50 company.

ant companies (e.g. Jaakko Pöyry, Ångpanne Föreningen) have during the last decades been given an increased importance. Laestadius (1996a) writes that when Ortviken (a SCA mill) in 1984 built a new product line very few consultants were involved. Today no mill has the resources to manage this.

Short-term running competencies and large-scale production

A manufacturing company within the pulp and paper industry often consists of different production units, i.e. mills, which can be more or less independent. On a mill level the organisations, not only within STORA but also in other manufacturing companies within the industrial sector in Sweden, are becoming leaner: the mills concentrate their capacity exclusively on their core operations, i.e. on producing e.g. cardboard or magazine paper and doing it more efficiently. While Research and development has to a large extent been centralised to the board level, the knowledge that is mainly developed on a mill level is operating knowledge, that which is referred to as short-term 'running competence' by Laestadius (1996a; 1996b).

The operating knowledge could be described as technical knowledge about *how* to run the complex system (the product line) in an efficient way so as to increase the capacity of the cardboard/paper machine. It can also be described as *learning-by-doing* or *routinisation of knowledge*, to use Nelson's and Winter's (1982) term. Since no paper machines are exactly the same the knowledge of how to run a machine is unique at the paper-machine level.[6]

> *The knowledge necessary to run a paper machine, although based on well known and internationally available technology, is unique at the paper machine-level. Every paper machine is a complex compromise between old and new subsystems connected according to locally developed traditions and modified over the years.*
>
> Laestadius 1996b: 11

[6] See Perby (1995) for an engaging description of the operators' knowledge at the mill in Iggesund, where she makes an analogy between the knowledge of a process operator and the knowledge of a craftsman.

Although based on well-established concepts, every paper machine is still, as argued in the quotation above, a unique compromise between the old knowledge and the new that has been developed and modified over the years. On the one hand the utilisation of operating knowledge leads to incremental modifications of the existing systems, i.e. improvements in prevailing technology (see also Melander 1997). On the other hand the machines' lifetime expectancy is more than 50 years, which means that the machines that no longer serve the market they were originally intended for are often reconstructed to produce other products for other markets[7].

The mills' focus on the production of their existing products has meant that technical developments on a long run have been outdistanced. Earlier, when the mills had both construction and engineering departments on site, it was possible to work with long-term technical development. However, as the mills' organisation has become leaner these departments have been closed down, to the advantage of the consultant companies. According to Laestadius (1996a) this means that the long-term 'development competence'[8] is eroded.

Investing in a new product-line

Investments in new product lines are very important for the survival of the investing company: an investment can either bring forth an increased capacity for an already existing product or create capacity for a new product. While the decision to invest in a new product line is taken by the board of STORA Corporation, the mill that is later going to run and maintain the machine is seen as the 'owner' of the investment project. To be the 'owner' of the project means that it is the mill itself that is responsible for managing and organising the construction

[7] This was for example the case of Skoghall's cardboard machine number 7 (KM7) which was rebuilt from a folding box board machine into a machine for liquid packaging board to serve a new market, mainly due to a declining market for folding box board.

[8] With long-term 'developmental competence' Laestadius (1996a: 12) means competence which 'makes the paper mill a strong user or a *competent purchaser* which puts high pressure on the equipment manufacturers to improve equipment and provide new technical solutions, thus moving the technology frontier forward'.

of the new machine, a machine they later are going to be responsible for running.

However, since these investments do not belong to the mill's normal activities – which is to run the existing product lines – the people in the mills are neither used to manage, nor prepared to manage, large investment projects. Further, since a paper machine has a long life span and since it is such a capital-intensive investment, investment in new product lines occur very seldom within each particular mill. However, even if complex investment projects occur very seldom within a particular mill, small reengineering and improvement projects are continuously taking place, meaning that even if the normal activities are organised in line organisations, projects as a form for organising work is nothing new for the mills. What is new when comparing the reengineering or improvement projects is the size, the complexity, and the number of actors involved in executing the project.

This leads to an important discussion concerning the composition of the project organisation. As STORA makes its living from manufacturing pulp and paper as efficiently as possible, it could be argued that it is of importance that the persons who later are going to run the new product line also are involved in the project. This due to the importance of transferring *operational knowledge* between the project and the permanent organisation, i.e. the line organisation in which the projects are performed (see Figure 1 below). It could, however, also be argued that since an investment in a new machine occurs so rarely within a specific mill earlier experiences of these kinds of projects are of importance. This because of the importance of transferring *project knowledge* from one project organisation to another within the corporation (Figure 1).

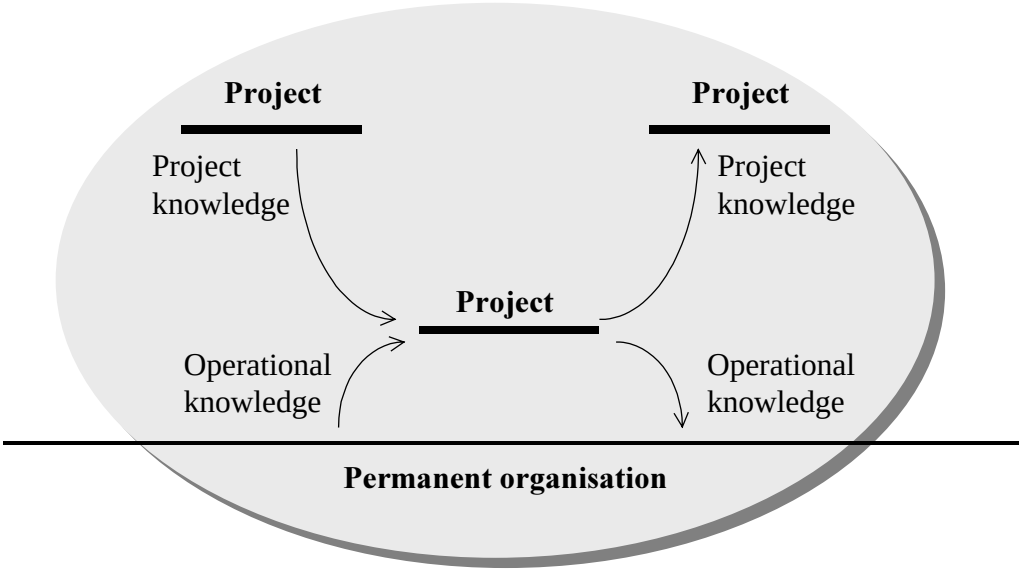

Figure 1: A rough illustration of knowledge transfer between projects and the organisation in which the projects are performed.

One way to get around the problem of the mills lacking experience in the managing and organising of major investment projects, could thus be to take advantage of experience made in earlier projects elsewhere in the Corporation. This demands, however, an awareness of the importance of *knowledge management* both on a Corporate as well as on a mill level. In the light of the discussion above about the growth of the manufacturing companies, their concentration on their core operations, and the large but few investments within each particular mill, this can, be problematic. On a mill level it might therefore be more efficient, as well as natural, to concentrate its resources on learning to run the new machine by transferring operational knowledge from the project organisation to the mill's line organisation than to transfer experience to the next project. There is thus a tension between transferring knowledge from project to project and transferring knowledge from project to the mill's line organisation.

The strategic dimension of knowledge management

From a strategic perspective in particular, knowledge and learning in organisations have received increasing attention during the last decade. The interest in knowledge and learning is however not something

new. Adam Smith in his time acknowledged that man's ability to learn - his increase in dexterity - had an impact on productivity. In this century, economists have further elaborated on the concepts of learning-by-doing and experience (Arrow 1962; Yelle 1979; Nelson & Winter 1982). The more recent focus has nevertheless been within the field of organisational science (Argyris & Schön 1978; Hedberg 1981; Fiol & Lyles 1985; Senge 1990), hence also from a managerial and a strategic perspective (Drucker 1993; Nonaka & Takeuchi 1995; Moingeon & Edmondson 1996; Sanchez & Heene 1996). Here, learning, or rather knowledge, is often seen as a strategic asset and a source for competitive advantage.

Knowledge as a source for competitive advantage

> *In the classical economics, the sources of wealth are land, labor and capital. For most of this century, large-scale, highly efficient manufacturing facilities have brought prosperity to firms and their shareholders. Now, another engine of wealth is at work. It takes many forms: technology, innovation, science, know-how, creativity, information. In a word, it is knowledge.*
>
> Badaracco 1991: 1

As argued in the introduction to this section the interest in knowledge and learning is not something new. The strategic dimension of knowledge has, however, during the last decade received increasing attention. The survival of a firm is thus not only dependent on the traditional economic resources land, labour, and capital but as argued and illustrated in the quotation above it is also a matter of knowledge (see also Drucker 1993).

Theories of perfectly competitive markets, relative prices, and Pareto optimal resource allocation, related to neoclassical economics and the structure-conduct-performance school of industrial organisation, have after the postindustrial era been supplemented with more dynamic theories, e.g. 'the behavioural theory of the firm' (March & Simon 1958; Cyert & March 1963) and 'the evolutionary theory of the firm' (Nelson & Winter 1982), in order to explain competitive advantage.[9] The reason for this effort was the earlier theories' ignorance of a firm's internal processes of development, beyond the mere production

[9] For an overview of this development see Tell (1997).

function, and the inability to cope with the 'dynamic' nature of competition.

More recently there has been an emergence of a 'knowledge-based theory of the firm' (Kogut & Zander 1992; Nonaka & Takeuchi 1995; Grant 1996b; Foss & Foss 1999)[10] and a 'resource-based theory of the firm' (Wernerfelt 1984), to explain competitive advantage. According to Foss and Foss (1999), Penrose's (1959) book '*The theory of the growth of the firm*' is generally known as the origin of this approach. Even if Penrose herself does not use the concept of the resource-based theory of the firm, her book has, through her discussions about the firm as a bundle of knowledge assets or as a collection of productive resources, come to be seen as a primary source of inspiration by many authors adopting this perspective.[11]

Penrose's contribution lies, however, not only in her discussion of the firm's productive resources. An important issue acknowledged in her book is the managerial aspect of competitive advantage, i.e. how experience gives rise to knowledge, which, when applied in different areas within the firm, is the main reason for the growth of the firm and therefore also for the survival of the firm:

> *…the growing experience of management, its knowledge of the other resources of the firm and of the potential for using them in different ways, creates incentives for further expansions as the firm searches for ways of using the service of its own resources more profitably.*
>
> Penrose 1995: xii

Although Penrose (ibid.) does not concentrate on the strategic importance of knowledge explicitly, she does so implicitly through her discussion about the firm's value-adding processes that contribute to the growth of the firm. According to Penrose (ibid.) continuous growth has to do with the gradual accumulation of the firm's knowledge and she argues that the increase of knowledge shows itself in two ways: '*changes in knowledge acquired and changes in the ability to use knowledge*' (p. 53). That is, as a firm's knowledge becomes routinised (see also

[10] Other authors like e.g. Prahalad and Hamel (1990) or Hamel (1994) name this the 'competence-based theory of the firm'.
[11] See Foss & Foss 1998 and Foss 1998 for a further discussion.

Nelson & Winter 1982) it is able to release resources and allocate them to other activities that leads to the growth of the firm.

Exploitation and exploration of organisational knowledge

The knowledge-based theory of the firm explicitly focuses knowledge as the most important source for competitive advantage. It is nevertheless not knowledge *per se* that is important (Nonaka & Takeuchi 1995; Grant 1996a), but rather the usability of the organisation's knowledge, i.e. what Penrose (1959) would have called the productive use of the firm's resources, and the organisation's possibility to create, recreate, and absorb new knowledge (Cohen & Levinthal 1990). The productive use of a firm's resources may create occasions for knowledge synergies through the ability to transfer skill or expertise from one part of the organisation to another and to share activities among the business units (Porter 1987). The emphasis here is, however, not just on the *management of knowledge*, i.e. the utilisation of existing knowledge within the organisation, but also on the *management for knowledge*, i.e. the creation of new knowledge.

Another way of describing the utilisation of the firm's existing knowledge and the creation of new knowledge is provided by March (1991) and Weick & Westley (1996) who uses the concepts of *exploitation* and *exploration* and their relation to the short-term versus the long-term competitive advantage of a firm. Exploitation can be seen as the utilisation and development of the firm's knowledge base. In a large-scale production organisation, as in the case of STORA Corporation, exploitation can be described as the development of operating knowledge, i.e. running experience, and the incremental modifications of the existing systems that lead to a more efficient utilisation of the existing paper machines (Laestadius 1996b). Exploration can be seen as the creation of new knowledge, e.g. through research and development. Whereas exploitation in the short run, as argued by March (1991) below, means decreasing costs by doing what we already know better and more efficiently, the exploration of new knowledge in the short run most often involves increased costs:

> *Adaptive systems [organisations] that engage in exploration to the exclusion of exploitation are likely to find that they suffer the cost of experimentation*

> *without gaining many of its benefits. […] Conversely, systems that engage in exploitation to the exclusion of exploration are likely to find themselves trapped in suboptimal stable equilibrium.*
>
> March 1991: 71

As proposed in the quotation above a balance between the reuse of existing knowledge and the creation of new knowledge is needed in order to survive in the long run (see also Weick & Westley 1996). Among companies there is however a tendency to overlook failures, to ignore the long-term and the larger picture, i.e. what Levinthal and March (1993) call 'learning myopia'.

Project management and knowledge transfer

The Project, as a way of organising work, is a countermeasure that has emerged to cope with the dynamics of competition. This is particularly the case in large industrial corporations (Anderson & Larsson 1998; Ekstedt et al. 1998), where flexibility is not an inherent part of the bureaucratic organisations. The profitability of industrial organisations lies in their large-scale production and their worked-up routines, i.e. the exploitation of the firm's knowledge base, which at the same time nevertheless can be inert in the face changes. Here projects may be seen as the solution at times when companies have to take impressive actions. This was for example the case of the KM8 project, where the board of STORA in order to retain its market shares decided to increase its capacity in liquid-packaging board through investing in a new product line at the mill in Skoghall. This also applied in the case of the PM2 project, where the board of STORA hoped to get into a new market segment for super-calendered paper in North America ahead of its competitors by investing in a new product line at the mill in Port Hawkesbury.

There are many additional reasons why projects have become such a popular way of organising, reasons which one could claim go hand in hand with the increased interest in knowledge management and organisational learning. Project researchers, such as Kreiner (1992) and Partington (1996), mention the organisation's need for continuous renewal and innovation. Packendorff (1993) argues that projects can lead to change, innovation, and organisational learning and Engwall

(1995) states that projects are efficient in an environment characterised by uncertainty. Since knowledge is seen, by foremost authors belonging to the somewhat differentiated knowledge-based theory of the firm, as a strategic asset and a primary source for competitive advantage, the possibility to gain from earlier project experiences, i.e. to make productive use of the firm's resources, becomes central. Not solely to save time and money, but to avoid 'reinventing the wheel' in every new project.

As individuals, each having different experience and skills, come together to solve a common task during a limited time period, projects could be seen as local arenas (Sahlin-Andersson 1989; Söderlund 1998) for knowledge creation. Here new knowledge concerning technical matters and project organising are integrated and shared, and routines for organising the project are developed over time. In this study it will be argued that projects can not only be seen as a vehicle for reaching external presettled targets, as is proposed in the traditional theory on project management (see Chapter Two). Projects can also be seen as occasions for organisational learning, where knowledge and experience gained in one project can be transferred and utilised in the next. This is an important supposition in line with March et al. (1991), who argue that organisations learn from experience that could lead to future improved performance. I shall return to this in Chapter two. As argued by Penrose (1959) it is the utilisation and the productive employment of experiences that makes a firm grow. The question is, then, how this could be applied in a project context, i.e. how experiences gained in one project could be transferred to the next. My argument here is not that all knowledge created and experiences gained within a project should be transferred, but that knowledge can be transferred between projects.

One problem in transferring knowledge between projects is that no specific project organisation has an 'organisational memory' (Nelson & Winter 1982; Fiol & Lyles 1985; Huber 1991). While organisations as judicial entities are seen as 'going concerns', the project concept means that the project organisation is terminated after its completion. A specific project organisation has therefore no history and no future, but is a so-called 'temporary organisation' (Packendorff 1993; Packendorff 1995; Lundin & Söderholm 1995; Kreiner 1995). In comparison with bureaucratic organisations that have the support of

both structure and routines which are knowledge absorbing, i.e. where new knowledge is absorbed into the organisation and over time becomes common practise, project organisations *per se* do not support any natural knowledge-transfer mechanism between the projects within an organisation. There is thus a tension between a long-term focus within the bureaucratic organisation and a short-term focus within the project with its temporary nature.

Problem discussion and the purpose of the thesis

Knowledge transfer between projects has received little attention from both academics and practitioners. Project researchers such as Partington (1996), in line with Packendorff (1995), call for studies:

> *Learning in projects should be studied not only within projects, but also between projects; the learning in one project influences the learning in the next one, even through the projects and the respective roles of the individuals are different.*
>
> Packendorff 1995: 330

The transfer of knowledge between projects does however, as argued above, seem to be problematic (Engwall 1998a); if we for example look at construction companies the same kind of problems occur in nearly every new project (Andersson 1998; Ekstedt et al. 1998). This problem could also be found in software-development companies where similar kinds of problems are repeated in every new project (Tjäder 1998). Why is this so? What happens with knowledge gained and experiences won during a project after its completion? Since the project participants are either absorbed into the organisation in which the project has been performed (here line organisation) or assigned to new projects within the organisation when a project is completed, Ayas (1996) argues that project knowledge is diffused throughout the organisation. But does this mean that the knowledge will be transferred to and utilised in later projects? What happens in divisionalised organisations and/or in projects where a large share of the project participants is hired externally?

The phenomenon of knowledge transfer has been examined in a large-scale industrial organisation – STORA Corporation. There, two large and strategically important investment projects, the KM8 and the PM2, have been carried out within the same company, but within different divisions, mills, and countries. While neither the mill in Skoghall nor the mill in Port Hawkesbury had any recent experience of organising and managing major investment projects, the KM8 and the PM2 project were of similar character and to a large extent non-concurrent. There were, that is, possibilities for knowledge transfer between the projects. This brings us to the purpose of this thesis:

The general purpose of this thesis is to create an understanding of knowledge transfer within an organisation. More specifically this means to describe and conceptualise knowledge transfer between projects and the organisation in which the projects are performed.

The thesis aims at creating a conceptual framework for the studied phenomenon, both with regard to the knowledge developed within a project and the impediments and enablers for the transfer of this knowledge on an individual as well as a structural level. The study also aims to discuss the strategic implications of knowledge transfer between projects for the organisation's short-term versus long-term competitive advantage. My ambition with this is to contribute to the research area that seeks to develop the knowledge covering organising projects within organisations.

The purpose of the thesis can be broken down to coincide with the following research questions. First, how can knowledge be conceptualised within a project context? Second, how can the process of knowledge transfer between projects be hindered? Third, how can the process of knowledge transfer between projects be facilitated? Fourth, what are the consequences of knowledge transfer between projects for the organisation's short-term versus long-term competitive advantage?

The concepts created in this study are on an overall level which means that the concepts are neither directly operational or precise. More studies will thus be needed on each of the concepts.

Outline of the thesis

The aim of the following chapter – *Project Management and Knowledge Transfer* – is to give the reader a fuller theoretical description of project management and knowledge transfer than what was presented in this chapter (Figure 2). The third chapter – *The Empirical work* – is a methodological discussion of the conducted study.

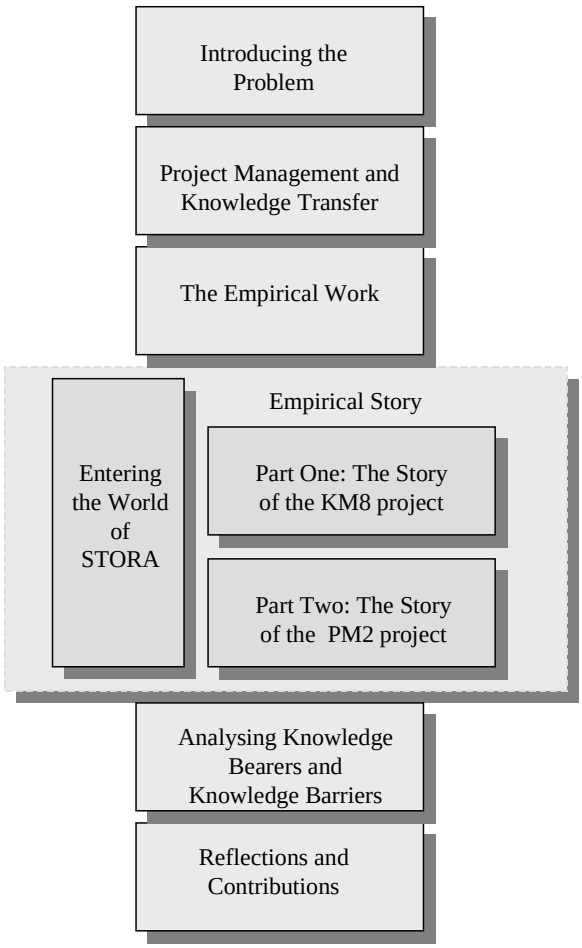

Figure 2: Outline of the thesis.

Chapters Four, Five, and Six make up the empirical part of the thesis. Chapter Four – *Entering the World of STORA* – gives an introduction to the case company, STORA Corporation, and to the two projects that constitute the empirical focus of the study (the KM8 and the PM2 projects). Chapters Five and Six – *Empirical Story – Part One: The Story of the KM8 project* and *Empirical Story – Part Two: The story of the PM2*

project – are descriptions of important events in the KM8 and the PM2 projects regarding knowledge transfer within an organisation.

Chapter Seven – *Analysing Knowledge Bearers and Knowledge Barriers* – consists of a conceptual framework for knowledge transfer between projects and the organisation in which the projects are performed. This includes a discussion about different types of knowledge developed within a project and a discussion about bearers and barriers in the process of knowledge transfer.

Chapter Eight – *Reflections and Contributions* – is a discussion about the strategic implications of knowledge transfer between projects for the organisation's short-term versus long-term competitive advantage. The discussion ends with future research and managerial implications, where a dual approach to project management is proposed.

- CHAPTER TWO -

Project Management and Knowledge Transfer

In the previous chapter the problem of this study was put in an empirical as well as in a theoretical context. In this chapter further theoretical considerations will be made regarding both project management and knowledge transfer. The chapter ends with an introduction of the concepts knowledge bearers and knowledge barriers.

Different views on project management

As argued by many project researchers, projects have become a common way to approach a task in today's organisations (see, e.g. Engwall 1998a; Lundin 1998). Lundin (ibid.) argues that way back in history all operations were organised in project form, and gives the building of the Egyptian Pyramids and the Viking tours as examples. Later on operations became organised, companies were formed and e.g. the trips to East Indies became the base for the East Indies Company. During the industrial revolution the need for stabilisation and large-scale production grew, which meant that the industrial organisations, as a form of organising operations, acquired an outstanding role in the economy. As argued by Engwall (1995) it was thus not until the 1950s that project management was acknowledged; the

breakthrough came primarily through the United States Navy's Polaris program. That which during the cold war began as a way of organising research and development within the US military service, is today considered to be the normal way of carrying out certain types of work within industry in general. [12]

In this section two different but complementary views regarding project management will be discussed: a traditional view, belonging to the dominant, normative view of project management; and an alternative view, acknowledging the importance of knowledge management. Since the projects that are in focus of this thesis are organised within line organisations, the project will be seen as a complement to the normal operations of the industrial organisation. With complement is here meant a way of organising activities, such as investments in new product lines that cannot be handled by the line organisation.

Projects from a traditional point of view

According to the dominant, normative view of project management, planning and forecasting are both possible and desirable (Lundin & Söderholm 1995; Engwall 1995). A proper plan is fundamental if the project is to be managed successfully. A review of the recent content in '*The International Journal of Project Management*' and '*The Project Management Journal*', made by Partington (1996), showed that nearly half of the articles discuss tools and techniques for project planning. Engwall (1995) implies that the literature, belonging to the traditional view on project management, is mainly for 'practical' orientation and is full of checklists to help different users manage the project successfully (see e.g. Cleland 1990; Lock 1996).

T*ime*, *cost*, and *quality* (see e.g. Lock 1996) are seen as the most important dimensions in project management and the project work is divided into three different phases: *planning*, *control*, and *evaluation*. In order to manage the project in a rational way different techniques for project planning have been developed. The different planning techniques help the project manager control the project, i.e. keep the project on time, manage the costs arising during the project, and make sure that the work progresses. After the project task is executed the

[12] For a historical overview see Engwall (1995).

project is evaluated according to actual plan, i.e. according to planned time, cost, and quality, in order to measure goal fulfillment.

Examples of some of the planning methods are Gantt schedule, PERT, CPM, and WBS[13]. Successful projects have applied these methods and even if there is no proven evidence that the success of the Polaris program was based on the use of PERT, Lundin (1998) argues that this success meant that structural projects came to be even more applied. This in turn helped to spread the belief in the different planning methods.

The underlying philosophy in WBS, which is one of the most common project-planning methods, is to break the project down into work packages, where each package is a performance-control element (see e.g. Cleland 1990). The manager for each package is responsible for a specific objective (e.g. electricity or instrumentation within a paper-machine project). As argued by Cleland (1990: 287) '*The work-breakdown structure is a means for dividing a project into easily managed increments helping to ensure the completeness, compatibility and continuity of all work that is required for successful completion of the project.*' This means that it is not only a tool for scheduling the project but it also gives a picture of activities and resources that have to be allocated in order to accomplish the project. Planning is, according to this view, important not only for scheduling the project activities but also to obtain the right resources for the performance of the project task. Gaddis (1959) implies that the project organisation shall consist of specialists representing the disciplines needed to bring the project to a successful completion.

The focus of the traditional view on project management is on the individual project, the individual project task, and on the individual project manager, i.e. an internal focus on the project per se (Figure 3) where '*the project manager plays a prominent role. The project task and project work constitute the centre from which the world around is considered*' (Engwall 1995: 41). In this way the project is decontextualised from the activi-

[13] Gantt schedule is a graphical method for placing the different project activities in time. PERT (program evaluation and review technique) and CPM (critical-path method) are both methods for network planning. WBS stands for work breakdown structure and is a method for the structuring of a project. For an overview, see Engwall (1995: 53-62).

ties of the normal operations (see e.g. Kreiner 1995) and when the operations are being considered this is always from the view of the project manager. In comparison with the bureaucratic manager within the industrial organisation who manages the whole organisation, the project manager manages the project task only. The projects within an organisation are thus managed from a portfolio perspective, with no structure bridging the projects, i.e. where every project is seen as a separate entity.

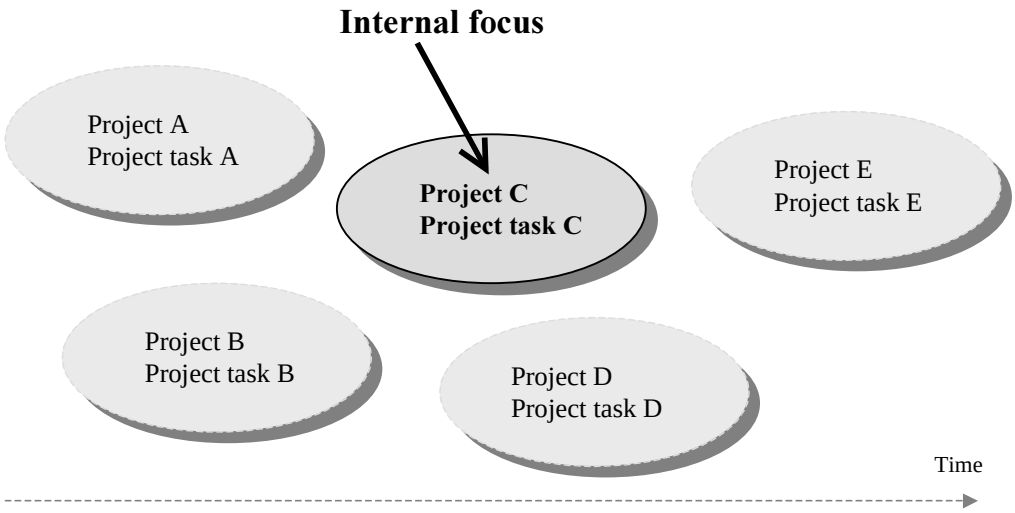

Figure 3: An illustration of the internal focus on the project according to the traditional view of project management.

Partington (1996), in line with Engwall (1998b) and Lundin (1998), claims that there is a widespread belief in the generic principles of project management, where a project is seen as '*a given, plannable, and unique task, limited in time, complex in its implementation, and subject to evaluation*' (Packendorff 1995: 320). This traditional view of project management has now been questioned (Engwall 1995; Christensen & Kreiner 1997; Blomberg 1998) and Packendorff (1993; 1995) argues that a project should not be seen elusively as a vehicle reaching external predetermined objectives, it could also be seen as an objective in itself. In this way Packendorff (ibid.) makes a distinction between 'projects as plans' and 'projects as temporary organisations'. The former implies a focus on plan, control, and evaluation (that which has here been emphasised as the traditional view), the latter a focus on expectation, action and learning.

Projects from the view of knowledge management

From an epistemological point of view, knowledge has often been seen as justified 'true'[14] belief. Although a controversial statement in its own right, most scientific disciplines support empirical investigations and experiments as a way to create new knowledge. Through scientific experiments new knowledge is created and experiences are gained not only from the experiment itself, but also from dialogues with colleagues and through the diffusion of scientific findings in different forums, e.g. journals or conferences. In the following discussion experiments will be used not in the traditional sense, but rather as a metaphor emphasising knowledge creation, i.e. focusing on gaining new knowledge and experience in organisational activities.

Leonard-Barton (1992) stresses the importance of experimentation and knowledge integration in organisations as a way of creating new knowledge. As in the discussion above about an experiment as a way of gaining new knowledge, a project can metaphorically be seen as an experiment[15], i.e. as an occasion for knowledge creation, taking in consideration the knowledge created in the process of executing the project. During a project the participants, through their engagement in a learning process, gain new experience and knowledge that could be 'useful' also for other parts in the organisation. This means that a project can be seen as *a learning experiment for the company* as a whole.

To see projects as learning experiments for the company means that projects are not seen as separate entities within the organisation that can be managed from a portfolio perspective, but rather that the knowledge created within one project can be utilised also in later projects (Figure 4). That is, the possibility of gaining from knowledge

[14] I have put quotes around *true* since some disciplines of a more interpretative character do not think that there exists one universal truth, rather that the observers construct both truths and facts. Knowledge is here seen as personal belief (see also Nonaka 1994). At the same time, however, some things are perceived as truths and facts because of intersubjectivity, i.e. that the knowledge is subjectively shared among people (see Berger & Luckmann 1966). One example of this is that successful projects depend on the use of planning methods.

[15] See e.g. March & Olsen (1975) and Herriott et al. (1985) for a discussion of experimental learning. While organisations and the people within them learn from experience at the same time, experience might be a bad teacher if it is not sufficiently rich (Levinthal & March 1993).

synergies created between concurrent, sequential or to some extent overlapping, projects must be acknowledged. This view is however not a substitute but relevant only as a complement to the traditional view of project management, where knowledge goes by as an unacknowledged by-product to task fulfilment.

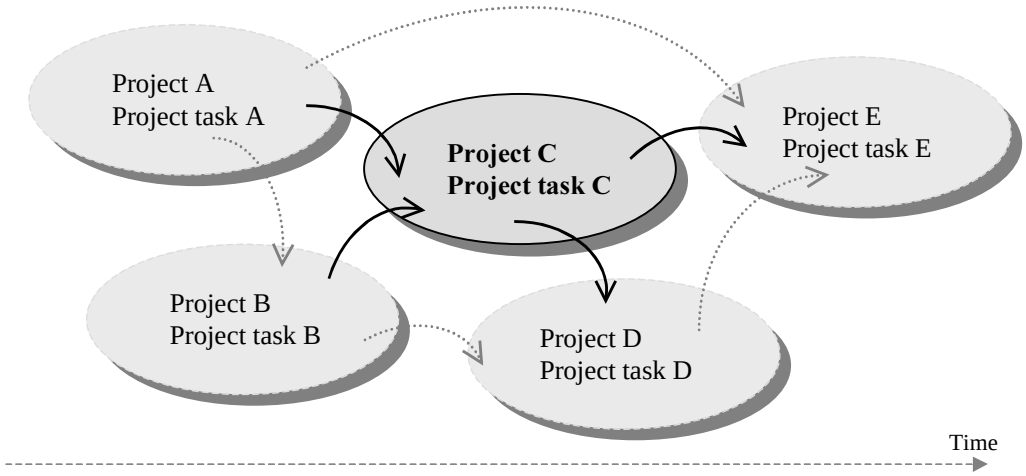

Figure 4: An illustration of knowledge transfer between projects.

The metaphor of projects as learning experiments for the company embraces an awareness of the importance of both exploration and exploitation of knowledge in organisations. To see an individual project as an experiment means that new knowledge is created, i.e. explored, in the project. To see projects as learning experiments for the company as a whole means a possibility for synergies or, in other words, to gain from experience made in earlier projects, i.e. knowledge exploitation made possible through knowledge transfer. Thus it is not just the management *of* knowledge, but also the management *for* knowledge, that is of importance.

Project, as a form of organising work, can be one way to explore new knowledge, project related as well as operational (see Chapter One). In other words, to offer an occasion for the organisation to learn and to gain from knowledge synergies through the transfer of knowledge between projects and the organisation in which the projects are performed. In this way management for knowledge would imply the creation of new knowledge, both operational as well as project related, during the project. Management of knowledge would imply a reuse of

the organisation's project experience through the process of knowledge transfer between projects.

As mentioned in the introduction of the thesis knowledge transfer between projects can be problematic. The question is how we can learn from the experience of others by listening to their stories or by reading project reports written by people who have taken part in an event that we have only heard of. Can a complex investment project be described to someone who has no experience of these kinds of projects?

A reflection on knowledge

Knowledge *per se* is a multifaceted and complex phenomenon, with a long history within philosophy. An in-depth discussion of what is or what is not knowledge lies however beyond the scope of this thesis. The discussion has therefore been narrowed down to focus on those dimensions of knowledge that are vital for an understanding of the complexity of knowledge transfer.

> *A man has no ears for that to which experience has given him no access.*
>
> Friedrich Nietzsche

If this quotation is drawn to its extreme it can be argued that we cannot learn about things at all where we have no previous experience. It could, however, also be interpreted to mean that it is more difficult to gain knowledge about things of which we have no previous experience than to gain knowledge about that which we already have some previous experience. That is, what we perceive depends not only on immediate sensory data, but also on our previous experience, some beyond our immediate awareness and accessibility.

Different knowledge dimensions

As an afterthought to his career as a scientist Polanyi began his philosophical journey illuminating the nature of knowledge. Reflecting upon the peculiarity that not all knowledge can be explicit or shared by everyone, he developed a theory about personal knowledge (see

Polanyi 1958). Building on Ryle's (1949) concept of knowing *how* and knowing *that*, he expounds the concepts of *tacit* and *explicit* knowledge, or rather tacit and explicit knowing[16] to show the ongoing activity of the phenomenon and the presumption of a knowing subject. Polanyi (1966) exemplifies the two *dimensions*, tacit and explicit, using Ryle's concepts expressed as *practical* and *theoretical* knowledge to argue that the one is never present without the other. '*This is particularly clear in the art of diagnosing, which intimately combines skilful testing with expert observation*' (Polanyi, 1966: 7). Both practical (skillful testing) as well as theoretical knowledge (expert observations) are needed to understand what disease the patient is suffering from.

Polanyi's (1966) dimensions of tacit and explicit knowledge, which here are seen roughly as practical and theoretical knowledge, can thus be seen as two different sides of a coin, where neither side can exist without the other[17]. Seeing tacit and explicit knowledge as two unseparable dimensions of knowing implies that we can always know more than we can tell, i.e. there will always be some knowledge that we cannot formulate explicitly. At the same time there is always some knowledge that we can express, i.e. that can be formulated explicitly.

To give an example of tacit and explicit knowledge from the pulp and paper industry, an experienced maintenance person within a paper mill can just by looking at a specific spot on the finished paper tell what is wrong with the paper-making process. If we ask the person how he knows this, he would most probably not be able to explain. Thus, the person knows how to run the machine, but can only with great difficulty tell us why he or she does it in a specific way.

Another philosopher who ought to be mentioned in a discussion about different dimensions of knowledge is Popper. Popper (1972) takes a somewhat contradictory stance to Polanyi's theory about personal knowledge, arguing that *objective knowledge*, i.e. scientific knowledge, is independent of a person's beliefs.

[16] Also Blackler (1995) argues for the use of knowing instead of knowledge, arguing that knowledge makes us think about abstraction, progress, permanency, and materialism. This remark is acknowledged throughout this thesis but to circumvent confusion the word knowledge is used.

[17] This is just an analogy, meaning that tacit and explicit knowledge are necessarily conditions for each other.

> *Knowledge in the objective sense is* knowledge without a knower*: it is* knowledge without a knowing subject.
>
> Popper 1972:109

Through making knowledge impersonal, Popper (ibid.) disconnects knowledge as a product from the process in which it was created. The source of objective knowledge is thus worthless since the books in the libraries contain knowledge irrespective of who has written them (e.g. a human being or a computer) and if they are read or not. Examples of objective knowledge include theories published in journals and books, discussions about such theories, etc. *Subjective knowledge* on the other hand is metaphysical knowledge, i.e. knowledge that consists of dispositions and expectations which have no scientific value at all (Popper ibid.). This is knowledge that belongs to the world of subjects. The difference between subjective and objective knowledge is that subjective knowledge belongs to a knowing subject whereas objective is independent of a knowing subject.

Different views on knowledge transfer

In this section two different views on knowledge transfer will be discussed. These are inspired by Reddy's (1986) conduit and tool-maker metaphor on communication.

Knowledge transfer as knowledge copying

Literally the concept of knowledge transfer would very well suit Reddy's (1986) conduit metaphor, where '*thoughts can be 'inserted'*' in words and where there is '*a space 'inside' [the words that are communicated] wherein the meaning can reside*' (p. 288). According to this metaphor knowledge transfer can be described as a mechanical process where a stock or a body of knowledge is transferred from sender to receiver (Figure 5) as with bits of data over a telephone line.

From this view all knowledge is explicit, i.e. it can be codified and expressed in words. Knowledge transfer can be described as mental telepathy or as *knowledge copying*, i.e. where knowledge is being copied from the sender's head to the receiver's. Since the receiver does not take an active part in this transfer and since there is only one way to

interpret the transferred knowledge, everyone could receive the same knowledge (see the discussion about objective knowledge above).

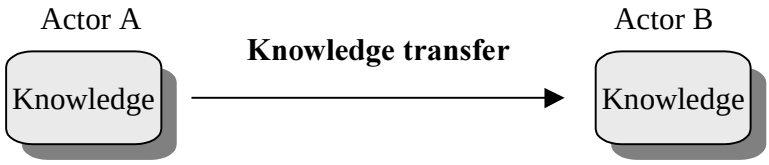

Figure 5: Knowledge transfer as knowledge copying.

This view of knowledge transfer implies that all knowledge developed in one project could be transferred to the next. This can be related to Popper's (1972) discussion about objective, i.e. knowledge that is independent of anybody's belief. This view on knowledge transfer has similarities with a behavioural perspective discussed by Björkegren & Rapp (1998).

However, since the meaning of knowledge is ambiguous, since we cannot receive anyone else's thoughts directly into our mind when using language, and since all knowledge cannot be told (Polanyi 1966), it will in this thesis be argued that also knowledge transfer is dependent on the involved actors' interpretation of what is being transferred (see also Langefors 1993). This implies that even if explicit knowledge is transferred, the interpretation of this knowledge will always depend on the receiving individual's previous experience. It can, however, be argued that people with similar previous experience can interpret knowledge in a similar way.

Knowledge transfer as a process of translation, reconstruction, and utilisation

Another way of describing knowledge transfer is through Reddy's (1986) metaphor of the toolmaker's paradigm. Rather than being viewed as knowledge copying, knowledge transfer is here to be understood as an interactive process of knowledge translation and reconstruction which is dependent upon the actors' previous experience (Figure 6).

The toolmaker's paradigm implies that when people communicate with each other, they are isolated in slightly different environments

and there is no way for people to visit each other's environment, or even exchange samples of what they construct. The only things that we can exchange, according to Reddy (ibid.) are '*odd looking blueprints scratched on special sheets of paper that appear from a slot in the hub and can be deposited in another slot – and nothing more*' (p. 292). The process of knowledge transfer is thus a process of knowledge translation and reconstruction dependent on the participating actors' (here actor A and B) previous experience.

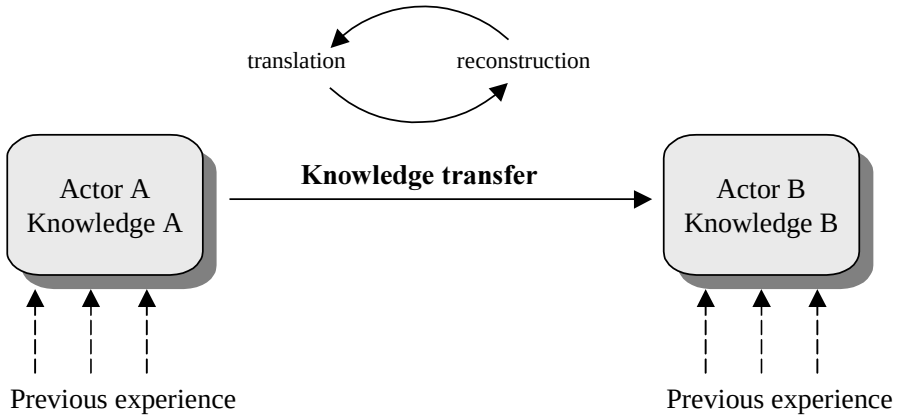

Figure 6: Knowledge transfer as a process of translation and reconstruction.

Illustrated in the figure is an interactive process between two interacting actors, where actor A transfers knowledge A to actor B. Actor B translates and recreates the knowledge that actor A has transferred according to his or her previous experience. Knowledge transfer as emphasised here does thus not mean that members within an organisation should or could have the same knowledge (see also Grant 1996b) but that knowledge is always translated and reconstructed by the participants depending upon their previous experience.

In a discussion of knowledge transfer Polanyi's (1966) question about whether the tacit dimension of knowledge means that we cannot transfer our knowledge at all is particularly relevant. The answer he gives to this question is that we can transfer our knowledge. However, since everything cannot be expressed in words, we have to rely on the actor's ability to catch the meaning of what we are trying to demonstrate, i.e. the actor's ability to translate and recreate the knowledge in the light of his previous experience. Even if we are able to learn from

others' experiences by listening to stories or reading project reports it will never be the same as to experience something itself and to take part in the activities. However as argued by Orr (1990) and in line with Polanyi (1958), 'rich stories' as well as 'illustrative examples' may facilitate the transfer of knowledge and experience, since this is a way to put knowledge within a context.

Organisational knowledge

Until now the concept of knowledge transfer has mainly been discussed from an individual perspective. It is, however, not only individuals who can hold knowledge but also organisations, e.g. in the form of organisational routines or organisational memory (Nelson & Winter 1982; Fiol & Lyle 1985; Huber 1991).

Nonaka and Takeuchi (1995; see also Hedlund & Nonaka 1991; Hedlund 1994; Nonaka 1994) illustrate one example of organisational knowledge as created through a process where individuals' tacit knowledge is made explicit and shared throughout the organisation and where explicit knowledge over time becomes routinised and tacit. Through what Nonaka and Takeuchi (ibid.) call *socialisation*, individuals come to share tacit knowledge. In order to share tacit knowledge face-to-face contacts and some kind of shared experience is considered to be important. Converting tacit knowledge into explicit knowledge is what Nonaka & Takeuchi (ibid.) call *externalisation*. Also here face-to-face contacts and some kind of shared frames of reference are important. Externalisation is further facilitated by the use of metaphors or analogies where knowledge is shared, created, and re-created. *Combination* is when explicit knowledge is shared; *internalisation* is learning by doing. Internalisation has similarities with Nelson's and Winter's (1982) concept of routinisation, where routines can be explained as organisationally shared tacit knowledge. In order for knowledge to become organisationally shared it is important that the procedures are repeated again and again.

To take an example from the pulp and paper industry, running a paper machine to a large extent builds on internalised knowledge. Thus a newly recruited employee has to work as an apprentice together with experienced people during a period of time before he or she has learned enough to be able to work alone. Learning to manage and

organise projects thus implies that in order for the project-related knowledge to be internalised the project procedures have to be repeated again and again and again. Since an investment in a new product line occurs very seldom within a specific mill that, and hence the task is not repeated for many years to come, this might be problematic.

Arguing that learning is a situated activity that takes place through participation in everyday life (see for example Brown & Duguid 1991; Chaklin & Lave 1993; Lave & Wenger 1991) means that learning to run a paper machine takes place through the participation in the everyday working life in a pulp and paper company. The same applies to learning to manage and organise a project. According to Brown and Duguid (1998) this means that it might be difficult to get knowledge to circulate throughout the organisation, since the decontextualisation of knowledge to make it mobile may also mean that it loses its original value. Instead it is important to present knowledge in its authentic context, i.e. a setting that would normally involve this knowledge, since it is the embedding circumstances that efficiently provide the essential parts of its structure and meaning. Brown and Duguid (1998) argue that knowledge can more easily be transmitted within than between groups of people who share a common language, working culture, etc.

Projects and knowledge transfer

From a traditional view of project management projects are seen as unique actions that are clearly separable from the normal activities in the organisation. From a knowledge-management view it is, however, argued that, in order not to reinvent the wheel in every new project, previous project experience can be exploited and utilised in later projects, meaning that few projects actually are a completely unique activity.

Project task, procedure, and group

On the basis of project task, i.e. what is to be carried out, and project procedure, Packendorff (1993) makes a distinction between *unique* and *repetitive* projects (Figure 7). To see projects as completely unique

means that both project task and project procedure are unique and hence that there are no routines in the organisation for how to organise projects or, in other words, that the previous experience of the organisation is of no use.

> *When stressing the extra ordinary character of a project it is implied that it cannot follow any regular program, the project is something beyond the ordinarily which needs to be pursued in an unprogrammed way.*
>
> Sahlin-Anderson 1998: 103

Seeing projects as repetitive, i.e. that the project task is unique whereas the procedure is standardised, means that there already exists routines for how the projects should be handled (c.f. Sahlin-Andersson 1989) e.g. through the use of a project handbook. Where both task and procedure are standardised, i.e. repititive, Packendorff (ibid.) argues that it is a question of *large-scale production*.

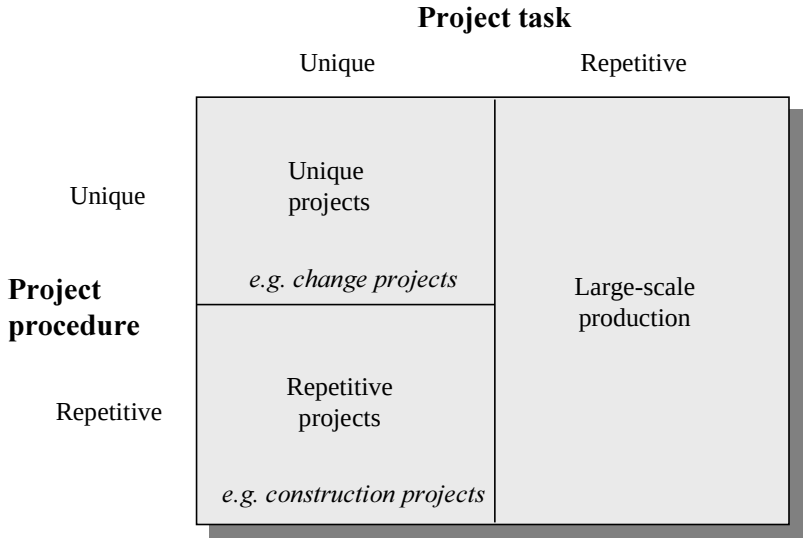

Figure 7: Unique and repetitive projects.
(Adopted from Packendorff 1993: 24)

In major projects, as in the case of the 'Stockholm Globe Arena', many different actors and organisations with different previous experience are involved; such as construction companies, architectural firms, Stockholm stad, etc. (Sahlin-Andersson 1989). When many different actors are involved in the same project, in this case the building of a new sport arena, it can be seen as unique or repetitive

depending on the perspective taken. Whereas the 'owner' of the project (Stockholm stad) launched the project as an extraordinarily event, mainly because of its spherical architecture, some of the actors involved did not perceive it as something unique at all but used their existing procedure to manage the project. The large building companies emphasised for example the ordinarily character of the project arguing that since the task was so large and complex, the project so unique and spectacular, and the time pressure so extreme it necessitated the project to be handled as ordinarily as possible. That is, the same project can be seen as unique or repetitive depending on who's perspective is taken. From the construction companies' perspective the Stockholm Globe Arena was seen as repetitive, whereas from Stockholm stad's viewpoint it was seen as a completely unique.

Another way of illustrating unique and repetitive projects is through the use of the concepts project task and *project group*. In Figure 8 four different situations are illustrated: (A) where the same group of people (or at least almost the same) performs a similar project task; (B) where the same group of people performs a unique project task; (C) where different groups perform different project tasks; and (D) where different groups in different parts of the organisation perform similar project tasks.

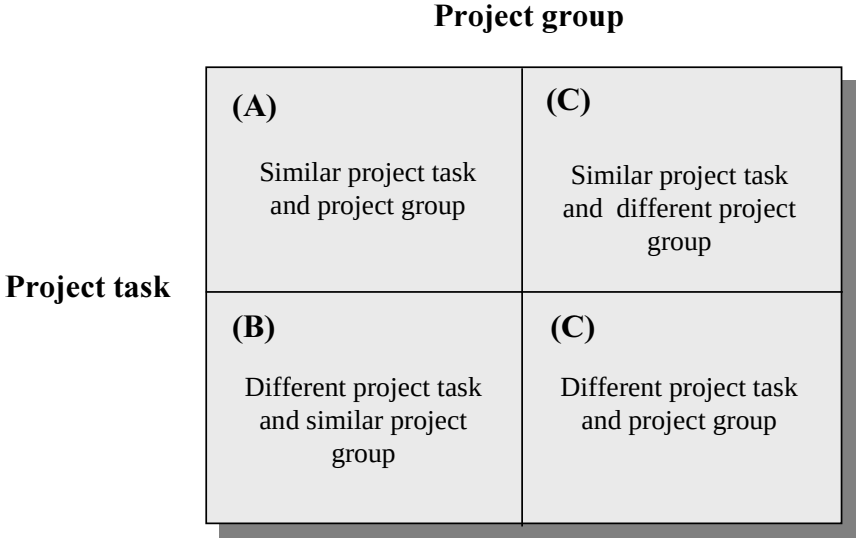

Figure 8: Different types of projects.

Incentives and possibilities for knowledge transfer

Ekstedt et al. (1998) argue that learning between projects is complicated. With r*epetitive project*, such as e.g. construction projects, is meant that every new project is handled in the same way as the projects always are handled within the organisation; since project is perceived as repetitive it is argued that there are few incentives for learning from previous projects. Also in the case of *unique projects* there are few incentives for knowledge transfer: since a unique project is a unique action that will not be repeated again within the organisation. That is, there are few incentives to store knowledge and experiences gained in the projects for later use.

In the first two situations (A) and (B), described in Figure 8 above, modest incentives are given to learn from previous experiences. In the case of similar project task and project group (A) the project will be given a routine-like treatment, which means that there are neither incentives nor room for individual reflections. Instead, the participants know what to do, and as argued by Ekstedt et al. (ibid.), the same mistakes are often repeated in every new project. Also in the case of different project task and similar (B) (or different (C)) project group the incentive for learning between projects is modest. Since the projects are seen as so unique the project-specific knowledge is considered to be difficult to use in the future. The conditions for individual learning is, however, particularly good in unique projects (see also Packendorff 1993) since a unique task demands a search for relevant knowledge.

In the case of similar task and different group (D) it can, however, be argued that there are possibilities to transfer experiences from one project organisation to another. Inasmuch as a similar project task already has been executed within the organisation experience and knowledge about project procedures could be exploited in the following project. However, as argued in the introduction of this thesis, knowledge transfer between projects can be problematic.

When individuals learn e.g. to run a paper machine some of the knowledge becomes routinised and internalised, i.e. it becomes tacit. This knowledge is very difficult to express in words since it most often is unconscious. When e.g. learning how to swim we are not con-

sciously aware of how our muscles cooperate in order to fullfil the task or how fast we have to move our legs in relation to our arms in order not to sink. When we direct our awareness toward the swimming activity, we are at the same time directing our awareness away from how our muscles cooperate (cf. Polanyi 1966). The knowledge about how our muscles cooperate, if we do not focus our awareness on this, remains tacit. This means that if we want to teach somebody else to swim it is easier to demonstrate how we move our body than to try to express this knowledge through language. However, since this tacit knowledge is internalised we can also use it the next time we are swimming.

If we apply this reasoning to the discussion of knowledge transfer between projects this means that, if the project organisation focuses its attention exclusively on the time, cost, and quality dimensions when the members of the project organisation are executing the project, this will be what they are able to talk about after the project. At the same time the experience gained during the project will remain in the body of the project organisation, i.e. it will stay tacit. This means that if it is not the same people that are going to execute the next project this knowledge will not be transferred to that project.

Empirical glasses – knowledge bearers and knowledge barriers

In this chapter I have tried to illustrate the complexity of the studied phenomenon by presenting different theories and different angles on project management and knowledge transfer. What has been discussed thus far can be summarised in the following four points.

First, inasmuch as the traditional, normative, view of project management exclusively focuses on a single project and its objective and not on how knowledge and experience developed in one project can be transferred and utilised in later projects, a complementary view has been presented. In this view projects are seen as learning experiments for the company as a whole, meaning that knowledge developed in one project can be 'useful' also for following projects. Second, knowledge can be described as having different dimensions, e.g. tacit and explicit, knowledge. Third, two different models of knowledge trans-

fer between actors have been presented: one where knowledge transfer is seen as knowledge copying and one where knowledge transfer is seen as an interactive process of knowledge translation and reconstruction depending upon the participating actors' previous experience.

Finally, depending on the perspective taken the same project can be seen as both unique and repetitive. This means that in a large project involving many different actors some may see the project as unique whereas others may see it as repetitive. Seeing projects as completely unique means that there are little incentives for knowledge transfer. If the project on the other hand is seen as repetitive and another project group within the organisation has performed a similar project task it could be argued there are possibility of gaining from previous experience. As illustrated in this chapter, as well as in Chapter One, knowledge transfer between projects raises a number of problems.

In Chapter One four different questions were raised. First, how can knowledge be conceptualised within a project context? Second, how can the process of knowledge transfer between projects be hindered? Third, how can the process of knowledge transfer between projects be facilitated? Fourth, what are the consequences of knowledge transfer between projects for the organisation's short-term versus long-term competitive advantage? In order to answer the first question, the concepts of project knowledge and operational knowledge, presented in Chapter One, will further be elaborated on. In order to answer the second and the third question, two different concepts will be developed in this thesis, namely knowledge bearers and knowledge barriers (Figure 9) and in order to answer the fourth question the concepts of exploitation and exploration has been introduced.

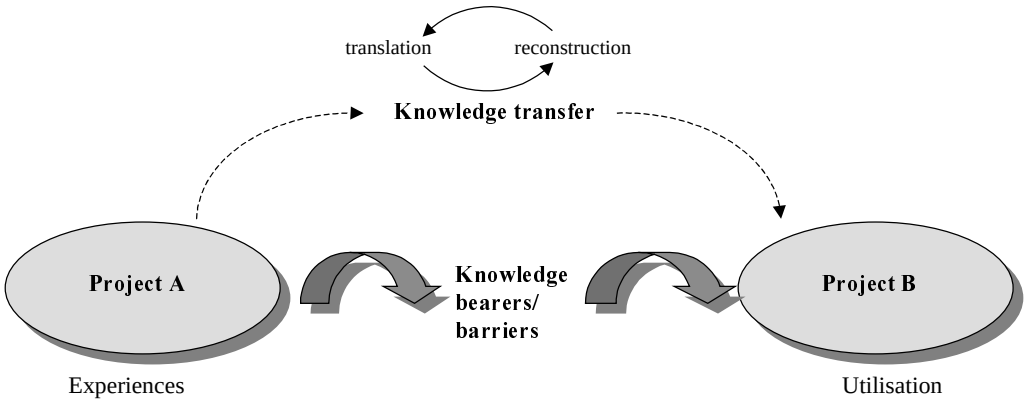

Figure 9: An illustration of the process of knowledge transfer between projects.

The figure illustrates the process of knowledge transfer between projects is viewed in this study, i.e. where experiences made in one, subject to bearers and barriers, project are translated and reconstructed before being utilised in the next project. Through the introducing of the concepts knowledge bearers and knowledge barriers it is possible to also illustrate how knowledge transfer can be facilitated and how it can be hindered.

- CHAPTER THREE -

The Empirical Work

The aim of this chapter is to describe how the study was conducted and the different choices that were made during the study.

A qualitative study

As argued by Merriam (1994) the nature of the problem, the questions that are being raised, and the result that the researcher wants to reach decide how to approach a problem. I would not propose that there is only one way to approach the problem of knowledge transfer within an organisation. However, since the purpose of this study is to *create an understanding* of knowledge transfer within an organisation and since the problem is of a *complex nature*, which means that it is empirically difficult to 'grasp' a *qualitative study* has been made. But, what do I mean by a qualitative study and how a qualitative study is conducted? These are two of the questions that will be discussed in the following section. First, however the choice of case will be described.

The case of STORA

The reason why I got engaged with STORA was more or less a coincidence. The company had just gone through a period with two major investment projects, the KM8 and the PM2, and was just about to start up a third. The management was therefore interested in a study

of learning between projects, which matched with my research interest. Thanks to their interest in such a study access was given me to the company and I was during the autumn of 1998 able to spend three weeks in Port Hawkesbury, in the Canadian province Nova Scotia, to make interviews with participants in the PM2 project. It also meant that I, during the autumn and winter of 1999, was able to spend time in Skoghall, in the Swedish province of Värmland, and carry out interviews with participants in the KM8 project. The people present at the mills offered to help me to get in touch with the people who no longer were working there.

A qualitative expedition

When I began this study little research had been done on learning and project organising. To be able to create an understanding of the phenomenon a rich description was needed. In order to create this rich description a *qualitative expedition* was made at STORA Corporation. I call it an expedition since I was not the only researcher walking in the hallways but *a team of social researchers* was visiting STORA and talking to participants of the KM8 and the PM2 project. The team represented a collaboration effort between Linköping University and The Royal Institute of Technology and consisted of senior researchers, master's students, plus myself. The expedition did thus not just result in this licentiate thesis, but also in two master's theses: '*Learning in Projects*' (Anell & Vien 1999) and '*STORA Project Procurements within the Forest Industry*' (Modin & Samelius 1999).

A study made in retrospect

Inasmuch as both projects already were completed when I was doing my field study the case study can, to use Czarniawska's (1997) terms, be described as a story edited from the standpoint of today. The empirical stories, in Chapter Five and Six, are thus not 'tales from the field' (Van Maanen 1988), i.e. field reports from participating observations, but are rather 'tales of the field', i.e. my construction of the stories of the projects told by the participants.

To make a study in retrospect has meant that I started my empirical research trying to retrospectively get an overarching view of the two

investment projects carried out within STORA Corporation. This in order to figure out important events, to find key persons involved in the projects, and to talk with them. During the first interviews I focused mainly on the mill's own project organisation. To study the knowledge transfer between projects and the organisation in which the projects are performed meant, however, that other individuals as well as organisations, external to the mill's project organisation, came into sight. Some examples of this are people from other parts of the corporation, such as Stora Purchasing and Transport, Stora Corporate Research, and other Stora mills. Other examples are external actors and companies, such as consultant firms and supplier organisations. Even if there were other project organisations involved in the project the unit of analysis in the study comprises the two investment projects and the interaction between them from the two mills' and the Corporation's perspective.

Interviews as dialogues

In total 49 persons were interviewed (Table 1). Out of these, 41 were STORA employees and 8 were consultants. The choice of persons, who have been interviewed, were not made from the start of the study, but has evolved throughout the interviews and as I have created more understanding of the phenomenon. One restriction however was that some of the participants in the two projects were no longer working for STORA, which meant that it was difficult to get in touch with them. Some of the project participants in Port Hawkesbury had, for example, gone back to their home mill in e.g. Germany and others, especially the external participants, had left for a new project in another pulp and paper company. Some of these were, however, able to come to Skoghall, Port Hawkesbury, or Stockholm for an interview.

As illustrated in Table 1 in both projects participants from the project-management level, from the project's steering group, as well as members within the project matrix were interviewed. I also interviewed some people from the line organisation, people from Stora Corporate Research and from Stora Purchasing and Transport. Some of these persons have been interviewed more than once. In total 6 of the people who were interviewed had participated in both projects. Of these 2 were members of the mills' project organisations, two were

consultants, one was a member of Stora Corporate Research, and one was a member of Stora Purchasing and Transport.

Table 1: Interviews in the KM8 and the PM2 projects.

	KM8 project	PM2 project
Project managers (including subproject managers	6	4
Project steering group	5	5
Others (training manager, project coordinator...)	4	5
Project matrix	3	3
Line organisation	1	1
Stora Corporate Research	1	2
Stora Purchasing & Transport	1	1
Consultants	4	3

Since the studied phenomenon was not well investigated when I started this study, I did not know from the start where the study was going to end. The interviews can thus be described as rather unstructured, or as dialogues[18], and the character of the interviews changed during the study. Structured interviews or inquiries would therefore not have been possible nor useful (see also Merriam 1994). The purpose of the earlier interviews was, as argued above, to get an overarching view of the projects, but also to formulate new questions. The later interviews focused more on the actual phenomenon.

The interviews, which were all taped, lasted between 40 minutes and two hours and immediately after each interview I made notes of my thoughts and impressions. The reason for taping the interviews was mainly that I wanted to use quotations from the interviews in order to create a richer description and to give a more living story. Another

[18] See 'the active interview' by Holstein and Gubrium (1995).

reason was that I wanted to be able to actively listen to what people were telling me instead of focusing my attention on taking notes. This also made it possible for me to listen to the interviews more than once. The interviews were transcribed to 95 percent on paper, which resulted in more than 400 pages of interview material.

From the interview material, together with 'mind maps' that I let the people who had participated in both projects make, a story from the field was constructed (Chapters Five and Six). Other material, such as annual reports, project descriptions, and videotapes of project work in progress (secondary data) has also been used. This material constitutes a more 'functional' description of STORA Corporation and the projects (Chapter Four). The story as well as the more functional description is in this thesis to be seen as a platform for the analysis, in which a conceptual framework for the studied phenomenon is constructed.

An empirical and theoretical journey

Above, the methodological discussion has almost exclusively been focused on the empirical part of the thesis. Methodology is, however, not only about empirical choices but also about theoretical.

The theoretical as well as the empirical journey can be described as an iterative process between land, here symbolising different theories, and ocean, here symbolising the empirical case study. If we look at the research process in this way my expedition began on land in the theoretical field of organisational learning (see Rapp & Björkegren 1998 and Björkegren & Rapp 1999). During the autumn of 1998, when I for the first time had travelled on the ocean the focus changed and I became more and more interested in knowledge processes within organisations. Coming back to land again I started to read articles and books within the theoretical field of 'the resource-based theory of the firm' and 'the knowledge-based theory of the firm'. Later on in this process I got more interested in the philosophical question of knowledge. The same can be said about the different theories on project management, where my process has led me more into an alternative view of project management, i.e. the acknowledgement of learning as an important dimension.

Inasmuch as I started my journey on land, I was thus not entering the research field unprejudiced applying a Glaser and Strauss (1967) approach. Since we always carry in our backpack of life expectations and preconceived meanings (see e.g. Asplund 1970 or Ödman 1979), I do not believe that it is possible to enter the research field unprejudiced, i.e. in a *tabula rasa* sense. This, on the other hand, does not mean that I was entering the field with a theoretical model or a theory that I wanted to test. Instead I was entering the field with a problem that I wanted to create an understanding of and with some hunches to where I was going.

Analysing the case

Doing a quantitative study means that there are established methods and rules to follow in order to fulfil what is regarded as the scientific demands. Doing a qualitative study, however, is somewhat more difficult to describe. This is not because of a lack of existing methods, e.g. grounded theory (Glaser & Strauss 1967), case studies (Eisenhart 1989; Merriam 1994; Yin 1994), or ethnography (see e.g. Van Maanen 1988), but because these are often more difficult to express in words. Instead authors have used metaphors to describe the analysis, e.g. like solving a mystery or a puzzle Asplund (see 1970).

To know more than we can tell

> *…to search for the solution of a problem is an absurdity; for either you know what you are looking for, and there is no problem; or you do not know what you are looking for, and then you cannot expect to find anything.*
>
> Plato 'Meno' (in Polanyi 1966:22)

Plato's arguments, in the quotation above, that all knowledge is already known can be seen as a contradiction to Polanyi's (1966) argument that problems certainly exist and that common to all scientific research is that it emanates from a problem. Polanyi (ibid.) further claims that to see a problem is to see something that is hidden, i.e. to have a hunch or clue about something. Polanyi (ibid.) continues by proposing if problems exist and discoveries can be made to solve them, '*we can know more than we can tell*' (p. 4). This means that we can

have a hunch that there is something to be solved, a hunch that cannot be told. Asplund (1970) also makes this point when he argues that searching for new knowledge is like solving a mystery or a puzzle. To solve a mystery or a puzzle means that we from the beginning neither know where to start or where we are going.

Solving a puzzle

I would describe the work with the analysis in this thesis as *an evolving puzzle-solving process* and as an ongoing dialogue between the empirical and the theoretical parts that took place during the whole study (see also Ödman 1979; Alvesson & Sköldberg 1994). More specifically this means that I have been holding interviews, reading research articles and books, writing the different chapters in the thesis, typing the interviews, rewriting the chapters, etc., in an iterative process. Since I from the beginning only had a hunch of where I was going the whole study has, as argued above, been evolving throughout.

The thesis has thus not been written in the same sequence as was the research. Being aware of that it is almost impossible to solve a puzzle with more than 10,000 pieces starting from the upper left corner and moving down toward the right corner, most people just start somewhere, it does not matter where, and work their way from there. Or, they start building around many separate parts until the different parts can finally be put together. The in this thesis developed *conceptual framework* for the studied phenomenon, both regarding knowledge developed in a project as well as the concepts of *knowledge bearers* and *knowledge barriers* for the transfer of this knowledge, was thus not developed through a theoretical investigation. Instead they were created through a dialogue between the empirical and theoretical parts that was constructed and reconstructed throughout the whole study.

To use the metaphor mystery- or puzzle-solving here does not imply that there only exists one 'true' solution to the problem. Since the researcher takes an active part in the research process (see Nordenstam 1993; Alveson & Sköldberg 1994), there is not one single way to illuminate a problem, but several. Some of these will be more meaningful than others, meaning that while some solutions give the

reader an 'of course!' [19] feeling, others leave the reader with a 'really?!'. I therefore agree with Asplund (1970) when he argues that the objective of a researcher is to produce a solution that gives an 'of course!' feeling. I am thus not claiming that my way is the best way to create an understanding of the problem of knowledge transfer. Hopefully it is a meaningful one. My wish is therefore that the readers will share this journey with me all the way from the mere hunches, puzzle solving, and conceptualisation to the last chapter of this thesis and finally, close the book with an 'of course!' feeling.

Conceptualisation – a result with flexibility

The purpose of this thesis is to describe and conceptualise knowledge transfer between projects and the organisation in which the projects are performed in an effort to create an understanding of knowledge transfer within an organisation. By creating a conceptual framework for the studied phenomenon contributions could be made to understand the phenomenon also in other organisations outside of the context of this study. This is facilitated by the rich descriptions, but also because of the flexibility of the concepts (see also Brunsson 1982). What I am arguing is thus that the *concepts* developed in this study could be useful to create understanding for the problem of knowledge transfer within an organisation also within companies other than STORA Corporation and the pulp and paper industry. But why conceptualisation?

> *Gedanken ohne Inhalt sind leer, Anschauungen ohne Begriffe sind blind.*
>
> Kant

As argued by Kant above '*Thoughts without content are empty. Views without concepts are blind*', which could be interpreted as meaning that the things we see and pay attention to are the things that we have concepts for. Creating new concepts and thereby new ways of seeing things could thus give us a new understanding of the world we live in (see Asplund 1970, Brunsson 1982) and thereby the tools to create conditions for actions.

[19] My translation of Asplund's (1970) expression 'Aj fan!'

- CHAPTER FOUR -

Entering the World of STORA[20]

The aim of this chapter is to give the reader a brief overview of STORA Corporation. The chapter starts with a historical tour of the company, from its start up in the 13th century to the larger structural changes during the 1980s and 1990s. Then follows a description of how STORA was organised during the time period covering the KM8 and the PM2 projects. Finally the background of the projects, the project organisation, as well as the different project phases are presented.

The corporation, the divisions, and the mills

A historical detour

STORA Corporation, one of the largest pulp and paper companies in the world, started its operations within the mining industry during the second part of the 13th century in Falun, in the Swedish province of Dalarna. It took many hundred years before the at that time Stora Kopparbergs Bergslag got involved in the pulp and paper industry; it was not until the turn of this century that the first paper mill was raised in Kvarnsveden, in Sweden. In the year of 1978, i.e. almost 700

[20] All figures and data are in this chapter based on material from STORA Corporation.

years after the start, Stora Kopparberg[21] became exclusively a pulp and paper company.

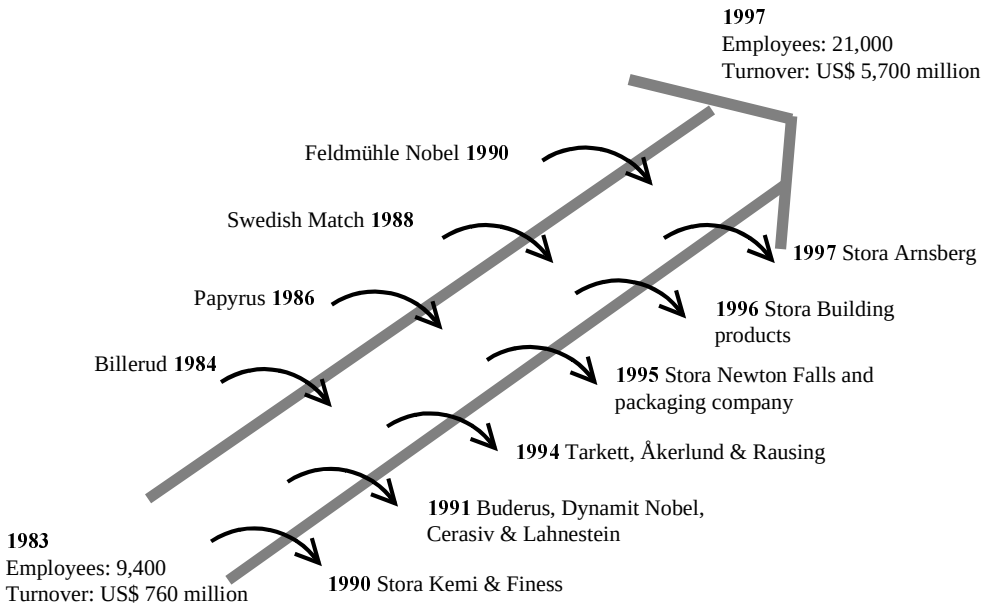

Figure 10: Larger structural changes within STORA corporation.

During the 1980s and the 1990s STORA went through some larger structural changes (Figure 10). A period covering four larger acquisitions was followed by a focus on operations to sell off those parts that were not necessary for its core business. In 1984 the Swedish forest company Billerud was acquired, in 1986 Swedish Papyrus, in 1988 Swedish Match, and in 1990 the German pulp and paper company Feldmühle Nobel was acquired. According to Sölvell et al. (1991) the acquisition of Feldmühle Nobel was at the time the largest foreign acquisition ever made by a Swedish firm. In the same year as Feldmühle Nobel was acquired, matches, lighters, and shaving products were sold off through Stora Kemi & Finess. Buderus, Dynamit Nobel, and Cerasiv & Lahnstein were sold off in 1991, Tarkett and Åkerlund & Rausing in 1994, Stora Newton Falls & Packaging Company in 1995, Stora Building products in 1996, and Stora Arnsberg in 1997.

[21] In 1984 the company changed its name to STORA. The copper sign was however, also after the change, a part of STORA's logotype through a circle and a cross, which is a stylisation of the Greek letters for pi and sigma. For the alchemists the sign stood for copper and the planet of Venus. ♀

From 1983 to 1997 STORA grew from 9,400 employees with a turnover of US$ 760 million (5,700 MSEK) to 21,000 employees with a turnover of US$ 5,700 million (45,000 MSEK). During the end of 1998 the decision was taken to merge with ENSO, a large Finnish pulp and paper corporation – but this is yet another story.

A divisionalised corporation

The STORA corporation is organised around four business (product) areas (Figure 11): *base products*, *graphic papers*, *board & packaging papers*, and *financial operations*. The business areas in their turn are organised within eight divisions: *Stora Power*, *Stora Forest & Timber*, *Stora Cell*, *Stora Publication paper*, *Stora Fine Paper*, *Stora Merchant*, *Stora Paper Board*, and *Stora Financial Service*. Besides the eight divisions STORA has three common group functions: *Stora Purchasing and Transport*, *Stora Corporate Research*, and *Stora Houses*. [22]

The head office of the common group functions, Stora Purchasing and Transport as well as Stora Corporate Research, is situated in Falun. Research offices are also to be found in Säffle[23] and in Viersen[24]. The services of the group functions are common to all mills within STORA. Each mill pays a monthly corporate fee to Stora Purchasing and Transport as well as to Stora Corporate Research. When a mill needs, for example, the service of lab tests from Stora Corporate Research only variable expenses, such as travel and subsistence, are paid.

Organisationally the two studied investment projects were carried out within two different mills and divisions within STORA Corporation (Figure 11). The investment in a new board machine – the KM8 project – was carried out at the mill in Skoghall, within the division of Stora Paperboard, and the investment in a new paper machine – the PM2 project – was carried out at the mill in Port Hawkesbury, within the division of Stora Publication Paper.

[22] This is how STORA Corporation was organised during 1994 and 1998.
[23] The research office of Billerud was situated in Säffle before the company was acquired by STORA.
[24] The research office of Feldmühle Nobel was situated in Viersen before the company was acquired by STORA.

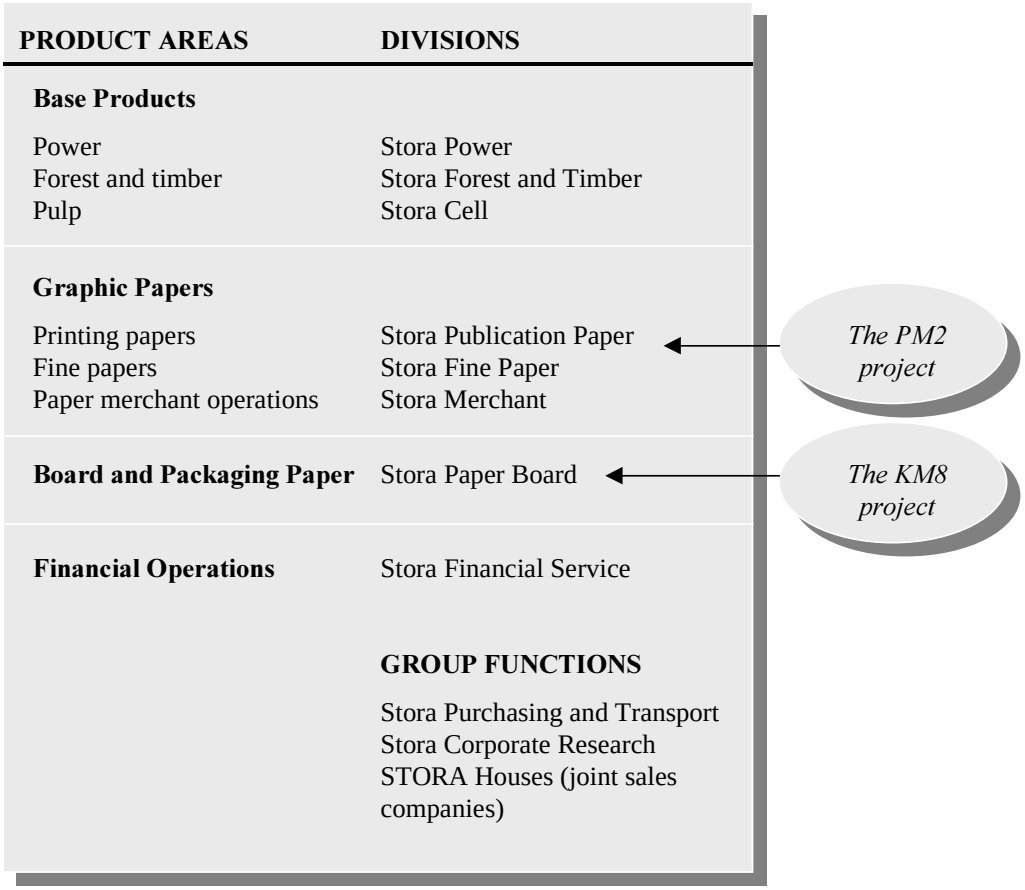

Figure 11: Product areas and divisions within STORA Corporation.

Stora Paperboard (KM8)

The division of Stora Paperboard, with its head office in Skoghall, has a total turnover of US$ 1,200 million (9,260 MSEK) and 4,314 employees. The market department is localised on a divisional level and answers for the advertising and sales for all the products within the division. Seven different production units, i.e. mills, belong to the division. Five of these are in Sweden (Stora Fors, Stora Skoghall, Stora Gruvön, Stora Mölndal, and Stora Hammarby), one is in Germany (Stora Baienfurt), and one in England (Stora Newton Kyme). Within the mills different grades of board are produced (Table 2):

Table 2: Mills and products within Stora Paperboard.

Mill:	**Product:**
Fors, Mölndal, Baienfurt, Newton Kymne	*Cartonboard*
Skoghall	*Paperboard*[25]
Gruvön	*SC, fluting and kraft*
Hammarby	*Folding cartonboard*
Mölndal	*Coated and uncoated fine paper*

Stora Publication Paper (PM2)

The division of Stora Publication Paper, with head office in Düsseldorf, has a total turnover of US$ 2,100 million (16,440 MSEK) and 6,157 employees. Also here the marketing department for Publication Paper is located on a divisional level. Of the nine mills that belong to the division, two are in Sweden (Stora Kvarnsveden and Stora Hylte). Four of the mills are situated in Germany (Stora Kabel, Stora Reisholz, Stora Flensburg and Stora Hillegossen), one in France (Stora Corbehem), one in Belgium (Stora Langebrygge), and one in Canada (Stora Port Hawkesbury). Within the mills different grades of publication paper are produced (Table 3):

Table 3: Mills and products within Stora Publication Paper.

Mill:	**Product:**
Kvarnsveden, Langebrygge, Port Hawkesbury, Reisholz	*SC paper*[26]
Corbehem, Kabel	*LWC paper*[27]
Kvarnsveden, Hylte, Langebrygge, Port Hawkesbury	*Newsprint*
Flensburg, Hillegossen	*Speciality paper*

[25] Paperboard is a thick, heavy-weight, multiple-type of paper, coated or uncoated, where the outer layers are produced from bleached or unbleached sulphate (craft) pulp, and the middle layer(s) produced from CTMP (chemi-termomechanical pulp).

[26] SC stands for Super Calendered, which is an uncoated paper produced from mechanical pulp, sulphate (kraft) pulp, and filler (china clay) which is treated mechanically between hard and soft rolls to achieve a glossy printing surface. Used primarily for periodicals and advertising materials.

[27] LWC stands for Light-Weight Coated a clay-coated paper produced from mechanical pulp and sulphate (kraft) pulp. Used for periodicals and advertising materials, where four-colour printing quality demands are high, e.g. catalogues for IKEA.

Independent mills

The mills are to a large extent independent profit centres and some of the mills are incorporated companies. They create their own profit & loss statement and make their own plans for the future, which of course must be adapted to STORA's overall strategy as well as to the market analyses, made at a divisional level.

The idea for an investment in a new product line can originate from the divisions, i.e. from the market department (as in the case of the PM2 project), as well as from the mills themselves (as in the case of the KM8 project), or a combination of both. Different competing investment alternatives can thus circulate during the same period of time. However, since the board of STORA is responsible for financing the investments, they are also the ones who decide if a particular mill will get an investment or not. While the board is responsible for financing the investment, the mill is responsible for conducting the approved project, as well as for the return on capital employed:

> *It is always the mill, or in other words the mill manager, who is ultimately responsible for all investments made at a mill. In this case, it is the mill that must bear the capital cost of the investment, and therefore is also fully responsible for the project. At the same time, it is the marketing organisation which must ensure that the product is marketable (saleable).*
>
> Member of the steering group in the KM8 project

Since investments in new product lines within the pulp and paper industry are capital intensive (between US$ 350 and US$500 million) with long lifetime expectancy (50 years), investments in new paper machines are rare at a mill level. During the last 20 years STORA has invested in approximately one new machine every second year. Three of these have been within the same mill, the other investments have been within different mills (Table 4):

Table 4: Investments in new product lines during the last 20 years.

New product lines		
Year	**Mill**	**Product**
1979	Hylte	Newspaper (PM3)
1980	Kabel	LWC (PM5)
1983	Hylte	TMP line
1986	Hillegossen	Self-copy paper (PM2)
1986	Nymölla	Coating machine
1988	Kvarnsveden	Newspaper + TMP (PM11)
1988	Nymölla	Fine paper (PM2)
1989	Hylte	Newspaper + Recycling plant (PM5)
1990	Corbehem	Coated magazine paper (LWC) + TMP (PM5)
1997	Skoghall	Liquid packaging board + CTMP (KM8)
1998	Port Hawkesbury	Magazine paper (SC) + TMP (PM2)

Instead of making an investment in a new machine old machines are reconstructed to serve the production of a new product. Some of these have been within the same mills (Table 5).

Table 5: Reconstruction projects during the last 20 years.

Larger reconstructions		
Year	**Mill**	**Reconstruction activity**
1981	Skoghall (KM7)	New forming section, TMP to CTMP
1983	Kvarnsveden (PM8)	In principal a new PM for SC paper
1984	Skoghall	Sulphate line
1988	Kabel (PM4)	Paper machine
1992	Reisholz (PM1)	Capacity
1993	Reisholz (PM2)	Paper machine
1993	Kabel (PM3)	Coating to on-line
1993	Kvarnsveden (PM10)	Quality, new windings, and rolling
1995	Baienfurt (KM1)	New forming section
1995	Kabel (PM4)	New forming section
1996	Kabel (PM5)	New forming section and calenders
1996	Nymölla (PM1)	Capacity
1996	Skutskär	Pulpmill
1998	Hylte (PM3)	New forming section, TMP & DIP
1999	Fors (KM3)	Coating, new pope, and rolling
1999	Grycksbo (PM10)	Capacity

Organising major investment projects

The background of the KM8 project

Up until 1981 production from the mill in Skoghall consisted of four separate products. MG paper[28] on PM3 (read paper machine number three), fluff pulp[29] on PM4, sack paper[30] on PM5, and folding-box board[31] on KM7. Due to the poor market situation for folding-box board at that time, it was decided to modify KM7 for the production of liquid-packaging board. It is worth noting that KM7 was designed and built for an annual production of 115,000 tons of folding-box board, but by the end of the 80s was producing 230,000 tons of liquid-packaging board. In 1986 PM4 was taken out of service and replaced by the rebuilt PM1 (which continued producing dried fluff pulp until 1995). The steadily increasing world market for liquid-packaging board combined with a declining market for sack paper resulted in plans for a second board machine. With a limited production capacity, STORA faced the risk of losing market shares, hence a feasibility study for KM8 was started in 1990.

KM8 would not only increase production capacity but would also allow the mill to manufacture a range of packaging board with a more diversified grammage, or basis weight, than KM7 alone could produce. The total pulp production in the mill was of course a vital ingredient in the calculation, and an increased board production could only be achieved by radical changes in the rest of the mill. These changes would mean that even though machine number 1, 3, and 5 must close down, Skoghall would also need to invest, among other things, in a new and larger bleaching plant.

Some figures… The result of the KM8 project today is a board machine with a length of 298 metre, a width of 8.30, having a

[28] MG paper is used for e.g. paper bags and wrapping paper.
[29] Fluff pulp is used as absorbing materials in e.g. napkins.
[30] Sackpaper for the production of sacks is made out of sulphite pulp with high strength.
[31] Folding boxboard is principally used for packaging of dried, moisture-containing products like food, paper cups, cigarettes, and other consumer products. The board is also used within the graphic industries for catalogue covers, postcards, folders, etc.

construction speed of 800 metre per minute (48 km/h) and a production capacity of 320,000 tons of board per year. If we look at the description of the KM8 project, it is a question of a US$ 400 million (3,200 MSEK) investment in a new board machine. Included in the project is not just the board machine but also supporting facilities, such as a new pulp plant for CTMP[32], the interface with the existing mill (which in the project is called site & media), and a finishing section where the product acquires its final quality. With the new machine the mill's whole grammage register ranges from 120 to 425 g/m²; KM8 produces board in the lower weight range between 120 and 300 g/m².

The background of the PM2 project

The decision to establish a pulp mill in Port Hawkesbury, on Cape Breton Island, in the Canadian province of Nova Scotia, was taken in 1957. Five years later the mill began to produce bleached sulphite-market pulp. Almost ten years later the mill was expanded to include a newsprint line (PM1) and a groundwood[33] pulpmill. In the beginning of the 1990s storm clouds began to gather regarding the future of the mill; there were even discussions about closing down the mill. The market for sulphite pulp was unprofitable and to only have a 20-year-old single-line mill for newsprint to compete with the new generation of paper machines was hardly possible. The background of the PM2 project is thus a decline in some of the existing products and the possibility of a new market in North America – a market for SC-A+ paper.

Some figures… The result of the PM2 project today is a paper machine with a length of 146 metre, a height of 25 metre, a width of 10.15 metre, with a production capacity of 350,000 tons per year and a construction speed of 1,800 metre per minute (108 km/h). The total cost of the investment was US$ 550 million. The investment includes not only a new paper machine, but also supporting facilities, such as a new pulp plant for TMP[34], the interface with the existing mill, and a

[32] CTMP stands for chemi-thermomechanical pulp that is produced by refining chemically impregnated, preheated, woodchips.
[33] Groundwood is a mechanical pulp produced by grinding wood.
[34] TMP stands for termomechanical pulp.

finishing section where the product acquires its final quality. The PM2 project was an attempt to enter a completely new market by offering a special quality between two others: SC (Super Calendered) and LWC (Light-weight coated paper). The grade that was going to be produced on the new paper machine SC-A+ could be used in magazines, catalogues, flyers, and inserts. SC-A+ approachest the same quality as those at the low end of the LWC paper, with the difference that it is cheaper to produce. Instead of coating the paper, the surface is polished using super calenders.

Project organisation

The project organisations for both KM8 and PM2 were in the form of a matrix organisation (Figure 12). Due to the complex nature of these projects they were divided into a number of smaller areas, each having its own project manager. The projects at Skoghall and Port Hawkesbury were very similar in the way in which they were broken down into areas. The TMP/CTMP plants, the paper machines, and the finishing departments were in each case separate areas. Also, both projects were dependent upon considerable changes and additions to the existing mill, both process- and service-related, also treated as separate areas within the main project. These areas formed then the vertical divisions in the matrix, and the area project manager was ultimately responsible for all activities taking place in the area.

Horizontally, the project matrix was divided into functions or disciplines, for example, process, maintenance, instrumentation, electricity, construction, commissioning, etc, each with its own manager. These were then responsible for their respective discipline in each of the areas concerned.

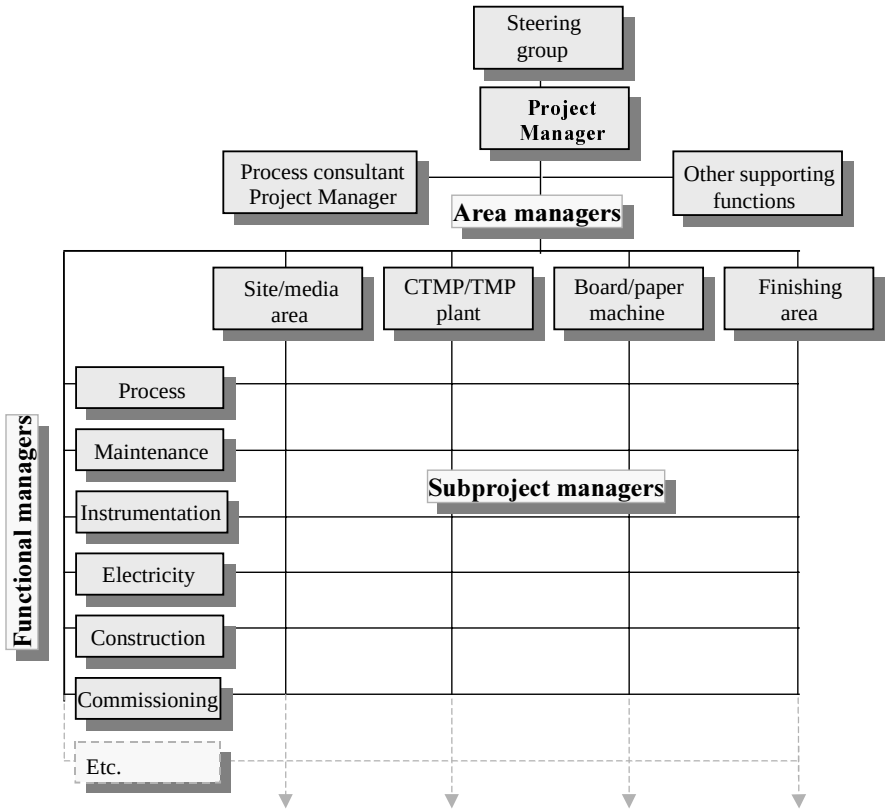

Figure 12: Rough outline of the project matrix.
(Adopted from Anell & Vien 1999).

In both projects there were four different categories of managers with different roles. In charge of the project organisations was the *project manager*. Below him there were *area managers*, five in the KM8 project (here the paper machine was divided into two areas) and four in the PM2 project, and *functional managers*. The area managers were each responsible for one area of the manufacturing process (e.g. Site & media, CTMP, board machine, etc.) and were mainly dealing with administrative issues, like revision and approval of the drawings from the process consultants, purchasing, and coordination of the work within the responsible area. The functional managers were responsible for the coordination between the existing mill and the project took at the same time care of the ordinary activities within the existing mill. Both the area managers and the functional managers reported to the project manager on a weekly basis. The fourth category of managers, the *subproject managers*, was responsible for technical competencies. These managers were responsible for specific functions in one or

more areas of the projects. On this level all the engineering was done in cooperation with both suppliers and process consultants.

In both project organisations the project manager reported monthly to the project's steering group. These reports consisted of a description of project progress, i.e. how the project was progressing in relation to the planned outcome. The project's steering group can be seen as the board of the project, responsible for the outcome of the project.

Project phases

The work within the KM8 and the PM2 projects were divided into six project phases: prestudy (feasibility study), preengineering (pre-project), engineering, construction, commissioning, and start up (Figure 13). In order to speed up the project some of the project phases were to some extent overlapping. As shown in the figure below also the two projects were overlapping. The PM2 project in Port Hawkesbury was thus starting up before the KM8 project in Skoghall was completed.

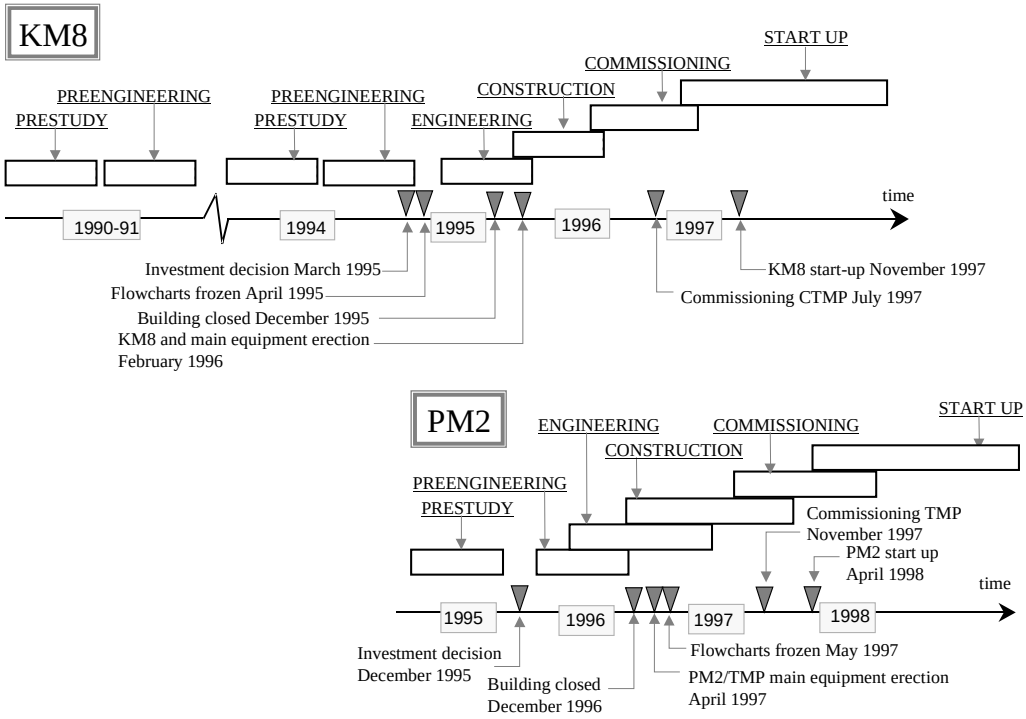

Figure 13: Rough outline of the KM8 and the PM2 projects.
(Adopted from Modin & Samelius 1999)

In the first project phase a *prestudy* was conducted. This included an analysis of the product that was going to be manufactured (liquid-packaging board/SC-A+ paper), expected output, and a market investigation of which market to serve. Suppliers, process consultants, etc. were not involved during this phase; a team of employees at each mill carried out the work by themselves. In this phase people from the management level within the mill in collaboration with people from the divisional board formed the steering group and started searching for a project manager.

The target of the *preengineering* phase (or preproject) was roughly to settle the framework for the new product line that was going to be constructed, i.e. layout, process, time, and budget. In this phase the process consultant for the whole project was chosen. The process consultant was responsible for designing and engineering the production process, which includes the design of the paper machine, pulp mill, and supplementary equipment. This phase also involved negotiation with competing suppliers. The manning of the project organisation was to a large extent made during this phase. In the KM8 project the preengineering phase ended with the decision from the board of STORA to go along with the project. In the PM2 project the preengineering phase can be said to have been started with this decision.

During the *engineering* phase final negotiations with main suppliers and civil constructors were conducted and the major contracts were signed. Procurement of the civil construction was during this phase completed, including excavation and erection of the main buildings, although the size of the board/paper machine at this stage was not yet decided. Shortly after this the civil work was started up with preparation of the site and erection of the building. During this phase the detailed engineering of the process design, the board/paper machine and pulp plant, as well as of the detailed layout of the plant was performed together with the process consultants. The contractors for the installation of pipes, electrical equipment, and instrumentation were chosen.

The *construction* phase started with civil work and continued with the assembly of the board/paper machine, down to fitting the pipes, electrical circuits, instrumentation, etc. During this phase the construction manager was in charge of the project, which meant that he was

responsible for the coordination between the machine and equipment suppliers, subcontractors, and the project organisation. At the peak of the construction phase there were about 1,200 construction workers on site in Skoghall and 2,200 in Port Hawkesbury. Finally, the training of maintenance personnel and operators was mainly carried out during this phase.

During the *commissioning* phase all the equipment assembled during the construction phase were tested. A systematic testing of all systems, including piping, wiring, and instrumentation was carried out in order to find flaws that may occur. The commissioning phase was, both in Skoghall and Port Hawkesbury, led by the personnel from the process consultant. Personnel who knew the systems, i.e. equipment suppliers and people from the project organisation, did the testing. Personnel from the existing mill who were going to operate the machine in the future were also engaged during this phase.

In the final phase, the *start-up* phase, the equipment was put into production. During this phase the facilities were handed over by the project organisation and the suppliers to the future production organisation.

Different organisations involved

Some 20 years ago most mills had their own research and engineering departments so that a mill to a large extent could carry out a major investment project on its own. No single supplier could at that time supply a whole product line; this knowledge had then, to a large extent, to be within the mill. When an investment project was going to be conducted the mill usually knew what kind of machine they wanted and sometimes even made the design (both process and layout) themselves. As described in the introduction of the thesis the suppliers are now becoming both fewer and larger; the suppliers have taken over both design and construction and can today supply not just parts of the paper machine but can supply a whole paper machine.

Since, along with this development, there were not enough resources within the mill a number of external companies were engaged in the project (Figure 14).

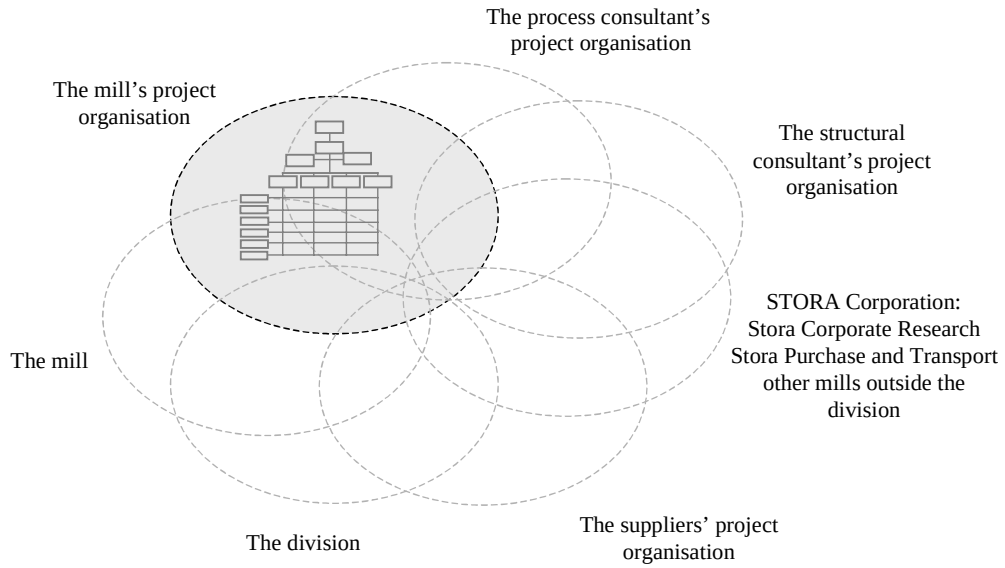

Figure 14: Different organisations involved in the projects

As illustrated in Figure 14, there were many different organisations involved in the projects and some of the external companies were the same in both the KM8 and the PM2. Nevertheless when the project organisation is refereed to in the following chapters it is the project organisation of the paper mill, emphasised in figure 14, that is in focus.

Summary

During the last decades STORA Corporation has grown extensively through mergers and acquisitions. Different pulp and paper companies, both Swedish and foreign, have been acquired and segments that are not involved in pulp and paper operations have been sold off. During the time period covering the two projects the Corporation was organised around different product groups, which in their turn were organised to fit different divisions. Each division consisted of a number of production units, i.e. mills. The mills are independent profit centres and even if the board is responsible for financing an approved investment, the mill is responsible for conducting the project. Since new investments are capital intensive with long lifetime expectancy, investments in new product lines are rare at mill level. This means that STORA during the last 20 years has made one new

investment every second year and that very few of these are within the same mill.

The two studied projects, the KM8 and the PM2 projects, were to some extent overlapping in time. Further, the projects were carried out within two different divisions, countries, and mills, and neither the mill in Skoghall nor the mill in Port Hawkesbury had any recent project experience with regards to managing and organising major investment projects. On a technical level the two investments differ. Whereas the KM8 project was an investment in a new board machine with supporting facilities such as a new CTMP plant, the PM2 project was an investment in a new SC-A+ paper machine with supporting facilities such as a new TMP plant. On a general level there are, however, similarities. Both project organisations were organised in a matrix structure and the project progress was divided into six overlapping phases. Further, many external actors, such as consultant and supplier organisation, were involved during the different project phases and some of these actors were the same in both projects.

- CHAPTER FIVE -

Part One: The Story of the KM8 Project

In this chapter the first part of the empirical story will be told. The story is thematically structured with some hopefully illuminative detours. The ambition with this story is not to exhaust a description of the KM8 project but to describe different events related to events in the following empirical story in order to shed light on the phenomenon of knowledge transfer within an organisation.

A preproject revived

For a long time the idea of investing in a new board machine had circulated within what was then the Billerud sphere. In the mid-1970s there were, for example, far reaching plans for a new machine for the production of everything from 'white top liner' to 'liquid-packaging board' at the mill in Gruvön, and in Säffle (Billerud's head office) they had even started advertising for a project manager. '*A KM8 project, but in Gruvön*', as one of the participants of the KM8 project expresses it. At the end of the 70s, when Uddeholm (including the mill in Skoghall, which was burdened with debt) was acquired by Billerud, there was no money available for such an investment. At the end of the 80s, when

the idea of investing in a new board machine was brought up again, it was at the mill in Skoghall.

> *…as there had been such a powerful development of liquid packaging at Skoghall and as things had gone so well at KM7, everyone probably thought that it was a good idea to continue with liquid-packaging board and to locate the new machine at Skoghall.*
>
> Member of the project's steering group, my translation

For almost one year, i.e. from 1990 through 1991, preengineering was conducted by the project team at the mill in Skoghall together with participants from the process consultant firm Jaakko Pöyry. Before the preengineering phase the possibility of reconstructing the old sack-paper machine (PM5) from 1967 for a production of liquid-packaging board was investigated by a small prestudy group of Skoghall employees. The conclusion was that a reconstruction of the old sack paper machine would be almost as expensive as building a completely new machine. Furthermore, the width of the PM5 machine was only 6.5 meters, which would give a limited production capacity. Instead a project team started to consider the investment in a new machine with a 8.1 meter width. This prestudy was the beginning of the first KM8 preproject[35].

Before the final report was written by the project team after the preproject in 1990/1991 the STORA board took the decision not to invest in a new liquid-packaging machine. One reason for taking such a decision was that STORA had just acquired the German pulp and paper company Feldmühle Nobel and therefore had no funds for a new investment. Another reason was the environmental discussions of recycling, which meant that everything should go back to the producer. Skoghall started therefore to conduct some tests together with their customer Tetra Pak. A third reason was that the pulp and paper industry was entering an economic recession and that STORA therefore did not dare to make such a major financial investment. A final reason might have been bad memories from the time of the last investment (KM7) at the mill in Skoghall. This investment was made during a time of regression and this together with large technical

[35] Preproject and preengineering will be used synonymously.

problems as well as problems with organising the project led to the fall of what was then the Uddeholm Corporation.

When the decision to '*put the KM8 project on ice*' was taken by the board of STORA, negotiations with suppliers had progressed to the point where the project team would have been ready to start purchasing after an official announcement. After the board's decision the project team had to visit all the suppliers again in order to tell them that the project had been abandoned. The enthusiasm was low but the team worked one more month to close the books and to document and file all the decisions made during this first preproject.

During the winter of 1993/1994 the Stora Paper Board division wanted the mill in Skoghall to again do a prestudy in order to explore the possibilities of reconstructing the PM5 machine for the production of liquid-packaging board. The result of the study was that such an investment would mean no possibilities for expansion, no coating, and would be relatively expensive. In the summer of 1994 the KM8 project was therefore revived and a new preengineering phase started up during the autumn of 1994. With support from the new president of Stora Paper Board the investment proposal was presented again to the board of STORA and this time the decision was affirmative.

Some of the project participants in the second preengineering phase argue that they benefited greatly from the earlier one, i.e. the preproject of 1990/1991, mainly through the written contracts with suppliers but also through the test-runs that had been made. Some also argue that the documents from 1990/1991 made it easier to become familiar with the project. Some claim that it was just a matter of reviving the old documents, others that much had changed. That they had had little use of the first preproject was mainly because little had been documented and many questions had still not been answered when the project closed. Another argument is that it was difficult to take over other people's work (a new project team was formed for the later preengineering phase). Further suggestions were that the fact that a preengineering phase had already been completed was not exclusively beneficial when some people thought that it was just a matter of reusing the old plans.

> *When I started as a new participant in October 1994 I felt that we had very little help from the preproject in 1990/1991, which shouldn't have been the case when you consider its extent [more than 20 million SEK[36]].*
>
> Project participant, my translation

> *I feel it took too long to agree on the layout. […] Considering the short time left [from the start up of the preproject] before [the board decision] the 2 March, it would have been more beneficial if the base documents from 90/91 had been updated much earlier.*
>
> Project participant, my translation

Some of the participants argue that the second preengineering phase was performed somewhat superficially. During the first preengineering phase in 1990/1991 the project team was in contact with different internal as well as external mills in STORA Corporation; both operators and maintenance personnel visited these mills. During the second preengineering phase no contact was made at all. However, even if the participants do not agree concerning how much use they had of the first preengineering phase, they still argue that the point of departure for the second preproject was the first preproject, albeit with some minor changes.

So, what did change? When the KM8 project was restarted in the autumn of 1994, the preengineering phase was initially based on the concept arrived at during 1991. In other words, a new board machine with a sheet width of 8.1 meters would be installed in a new machine hall, and the stock preparation and CTMP plants would be installed in the existing PM5 mill albeit the 25-year-old PM5 was removed (and later sold). In the original layout, the plan was to have the control rooms and offices for the new departments situated in a central, glass-roofed area between KM7 and KM8. This meant that KM8 would be designed as a left-hand machine and that the drive side would be on the north side of the building. It is here that some differences of opinion arise as to how much help the second project group had from the results of the first preengineering phase.

On a technical basis very little was changed and the 1991 specification for the process and the equipment required little modification.

[36] US$ 3.3 million with an average exchange rate during 1990/1990 SEK/US$=6.

However, the layout question quickly became the most important item for discussion; it was eventually decided to completely change the original concept. The main reason for this was that the original concept did not allow for future expansion of the CTMP production. Therefore, a new decision was taken to build a separate building for the CTMP plant, together with its own control room. This meant that the idea of centralised control rooms was no longer an issue, and that KM8 could be built with the drive side to the south. This solution would present fewer design problems from an engineering point of view and would at the same time give added space with the possibility of more natural light.

Also the mill's new project organisation was somewhat different from the prior. Much had changed during the almost four years that had passed and some of the participants from the first preproject now had other duties or had left the mill. The project manager of the first preproject, who is seen as the father of the reconstruction of the KM7 machine, had, after the KM8 project was put on ice, started to work for the market department of Stora Paper Board. At the level below him only one of the area managers, who had participated in the first preengineering phase also participated in the second. The steering group was also different. The first project's steering group's members included, for example, the manager of the mill in Kvarnsveden. Kvarnsveden had conducted the latest investment project (PM11) within the Swedish part of STORA Corporation - an investment in a new paper machine – prior to the KM8 project in Skoghall. During the start up of the second preengineering phase the project manager for the PM11 project in Kvarnsveden was being proposed as project manager for the KM8 project as well. This was, however, not possible. The person who instead became project manager came from Gruvön. During the first preproject phase in 1990/1991 he had worked at the mill in Skoghall as engineering and maintenance manager and had been a member of the project steering group. Shortly after the first preproject was discontinued, he became technical director at the mill in Gruvön.

One project in a lifetime

At a mill level an investment such as the KM8 project in Skoghall occurs very seldom. The last investment of this size at the mill in

Skoghall was the KM7 project in 1975 and prior to this was the PM5 project in 1967. The KM8 project was launched as '*a new wave*', which not only stands for a focus on the production of one product exclusively at the mill in Skoghall, i.e. on liquid-packaging board, but also of a new concept at the mill: clean, bright, and silent. The project participants talk about the KM8 project with pride and see the project as '*a historical event*' and as something unique that happens '*once in a lifetime*':

> *I've never been part of such a large project before and will never be part of one like this again.*
>
> Project participant, my translation

A project of this size, in terms of both invested time and money, is thus not an integral part of the mill's normal activities but is seen as something extraordinary. At the mill there are no rules for how to manage large investments and the mill's project handbook was found to be helpful only for small and medium-size projects. A new handbook was instead developed throughout the project. Without experience of organising and managing large investment projects there were no adequate systems on site for e.g. document control; when the project started up there was no document-control system at all. After awhile a simple document-control system was purchased from Mandator, a local computer consultant. This system provided good control over the incoming documents; outgoing correspondence was more difficult to manage, especially that which went via fax from various locations on site. During the project the drawing-number system at the mill was changed and halfway through the project the system for spare parts[37] was also changed. When this proved to require much more work a somewhat chaotic situation arose and the system was changed back again. '*Nobody seemed to know how much work was going to be involved and how many people would be needed*', as one of the project participants expressed it. Routines for how to manage different administrative and organisational demands of the project were to a large extent insufficient or completely lacking when the project first started. One of the project participants within the area of document control expresses it in this manner:

[37] A system for spare parts is needed in order to know which items are in the warehouse and which have to be bought.

> *I have the feeling that nobody really knew how much work had been put into managing and distributing all of the project documentation and drawings. It was just taken for granted that it would work.*
>
> Project participant, my translation

The project organisation, which was composed by the newly recruited project manager together with people from the top management level within the mill in Skoghall, included people from the mill itself, from a sister mill (Gruvön), and from various firms of consultants. Out of the five area managers only two were from within the mill itself. One area manager was from Gruvön and two were consultants; both consultants were well known at the mill. The project secretary and the purchasing manager were recruited from Gruvön. The project manager who had worked together with them during his years at Gruvön brought these three people into the project. The only ones in the project team who had any experience from a project of this magnitude were one of the externally hired area managers, the manager of training, and the purchasing manager. The manager of training had in the 80s participated in a project in Braviken (MoDo); the purchasing manager had from 1964 to 1984 participated as a purchasing manager for all large projects within what was then the Billerud Corporation. When Billerud's head office in Säffle closed down because of the merger with STORA, he moved to Gruvön, where he was the purchasing manager for both Gruvön and Skoghall until Skoghall employed their own purchasing manager in 1990.

Some of the consultants participating in the KM8 project argue that the customer had insufficient competence, which should not have been the case within such a large organisation as STORA Corporation. '*One problem is that it is not so easy to release competent personnel at STORA, which probably should be done*', as one of the consultants argued. Another of the consultants argue that '*you cannot maintain the experience at the mill when these investments occur so seldom*'. Therefore, within the project matrix, consultants complemented the participants from Skoghall. Since Skoghall has a lean organisation and these kinds of investment projects occur very seldom, there were few qualified people to choose among, i.e. who had a relative broad competence. '*It is not so that we have 250 electricians on site*', one participant noted. On site you have highly skillful people for managing the mill's normal activities, i.e. to operate and maintain the machine, but, as argued by one of the

consultants, '*at the mill you have very skillful construction people, but these might not be skillful administrators.*'

> *There are a limited number of people in such a lean organisation as Skoghall. So there aren't that many to choose from who have a relatively wide experience. I'm thinking of the electrician who runs back and forth between the instruments and ventilation. You just don't have 5-10 ventilation experts who've been on projects before. We don't have them.*
>
> Project participant, my translation

Looking at the level above the project manager, i.e. the project's steering group, at least some of the members had experience from larger projects. The steering group consisted thus not only of people from the top management level at the mill in Skoghall, but from the Stora Paper Board division as well as from Stora Corporate Research. Also Stora Purchasing and Transport was involved within the project. The CEO of STORA had demanded that the director of Stora Purchasing and Transport should be involved in all the major negotiations with suppliers in the KM8 project.

> *…why Helgesson [the at that time CEO] wanted to bring in the president of Stora Purchasing and Transport, I don't know, but it was probably that he [the president of Stora Purchasing and Transport] has, of course, much more experience. He has been at STORA a long time. He has handled the major negotiations there and it was his experience they wanted to use.*
>
> Project participant, my translation

The president of Stora Purchasing and Transport was thus involved in the negotiations for the board machine as well as the CTMP plant and another person from Stora Purchasing and Transport specialised in electrical equipment was engaged in these negotiations. A newly recruited person from the same department was involved more peripherally. This was the first time that any mill within STORA had worked so closely together with Stora Purchasing and Transport in a project of this magnitude:

> *I think that this became a bit of a model for purchasing, because as I see it they themselves [Stora Purchasing and Transport] thought it was going very well. A problem within a group is to get people to work together, you're so far away from each other. Here is the best organisation, they are in the same*

> *place so to say, so that they can keep each other informed on a daily basis. Because the important information is the spontaneous information you get by putting your head out the door.*
>
> Project participant, my translation

The operators and the maintenance personnel were also involved in the project, mainly in the form of reference groups. On the basis of their experience from running the KM7 machine, their mandate was to provide input to the project participants when needed. Some of the area managers used the reference group more than others and some argue that when the reference groups finally came with their suggestions, it was often too late.

The role of the consultants

Many of the project participants relate to how it was like in the old days when a mill could manage a project like this completely on its own and when Skoghall had a large engineering office as well as hoisting cranes and excavators on site. But things have changed and today the consultants and the suppliers have come to play a large role in the project. Even if the mill still wants to accomplish as much as possible on its own, they have neither resources nor experience to do this. Nor can they afford to maintain a large engineering office on site.

The competition among the large consultancy companies within the pulp and paper industry in the Nordic countries is limited. Jaakko Pöyry, the process consultants engaged in the KM8 project, was thus not only engaged during the first preproject in 1990/1991 but also when the KM7 machine was engineered and constructed. '*Jaakko Pöyry participates continually [in these kinds of investment projects] and that is why we need them*', as one of the project participants expressed it. While the consultants are indispensable, how they are viewed is somewhat differentiated. That there is today hardly any competition on the consultancy side is seen as negative by the participants from the mill.

> *As far as JP [Jaakko Pöyry] is concerned, the fact is that there are not so many companies that can handle projects of this size in such a short time. The customer, that is the paper mill, does not have many alternatives to choose from. I know that Halden PM5[Norske Skog] got their project*

> *support from CTS, but almost all other paper-mill projects, are managed by JP. Before, there was Celpap, but they unfortunately went bankrupt. So if you're going to complain about JP, you should realise that they are the only ones who can do this.*
>
> Project participant, my translation

According to one of the consultants, '*the consultants are seen as a resource reinforcement since they travel to various places and the mills might not always be able to keep up with what's going on*'. The opinion of many of the project participants was that the consultants were very skilled and well-organised, and that they had a lot of experience. As mentioned earlier, when the project started, there was no experience close at hand of how to control all the documents and how many resources would be needed. During the project many documents such as minutes, instructions, and drawings had to be circulated among the different actors within the project, i.e. project team, consultants, and suppliers. For example, the number of drawings that were circulated during the different project phases exceeded 60,000. Here Jaakko Pöyry became an important resource for establishing a system, since they had a lot of experience from earlier projects. One of the participants describes in simple terms the qualified person within Jaakko Pöyry with whom he came to work very closely as follows:

> *He's been involved in many projects, he knows how it should be done. He has extremely broad experience.*
>
> Project participant, my translation

At the same time as many participants are highly positive about the process-consultant firm, others are more negative and argue that '*JP has got lots of stuff from other projects that they are bringing out here, such as drawings and process schedules that have been used in previous projects and are now being reused*'. Since this kind of work is what Jaakko Pöyry is engaged in all the time, the problems that occurred during the project surprised the participants from the mill's project organisation. The problem area was mainly piping, but to some extent also instrumentation. Electricity, which is usually a problem, was running unusually smoothly; some of the participants argue that this was because the electricity manager within the project organisation in Skoghall had

succeeded in bringing a number of skillful people into that part of the project.

The problem with the piping as experienced by Jaakko Pöyry was that the customer – Skoghall – was constantly postponing the purchase of different parts of the equipment: the mill could not decide what kind of machine they wanted. In one of the project reports written by a project participant after the project had been completed, the following is illustrative:

> *The lack of well-planned, definitive, specifications was frustrating in my area! An example is the roller dimensions: JP's suggested specification stated max Ø1500 which we changed to Ø1800 to give us a margin, which just before purchase was increased to Ø2100, and after purchase we saw we needed Ø2250.*
>
> Project participant, my translation

Since every change implied new flows, new pumps, new pipes, new electrical motors, new bridge-signal cabins, etc. this meant that the process engineers had to make new balances again and again. According to the consultants this was because the customer had no experience of this kind of projects and that they did not understand how to determine the limit when, for example, the flow schedule had to be frozen.

> *– Have you not drawn the pipes yet? This should have been done by now! [Skoghall]*
> *– No, you haven't yet decided what flows you want! [Jaakko Pöyry],*
>
> Process consultant, my translation

Another reason that is mentioned by one of the process consultants is that the process has become more complex with more piping and more instrumentation. The customer, i.e. Skoghall, experiences the problem differently. According to the project participants the piping problem was due to inexperienced management within Jaakko Pöyry. During the time of the KM8 project Jaakko Pöyry was engaged as process consultants within two other large pulp and paper projects, which meant that there were not enough engineers and constructors with experience available. Another problem, as experienced by the customer, was that Jaakko Pöyry worked 'by area' instead of 'by

process'. This means that Jaakko Pöyry divided the building into squares with one constructor responsible for each square. That the constructors did not coordinate their work at Jaakko Pöyry's office in Helsingfors implied that when the project team got the drawings, the pipes did not always match, and in turn a lot more work and increased expense.

> *At JP you work in a way where you divide the building into squares and then you have different people in charge of different squares and different construction personnel in different partial squares. This can perhaps lead to coordination problems. Once we had received all the drawings, we put them side by side and then you could see that in one square the pipe goes to the right of the pillar and the cable trays to the left, but on the next one, they don't match.*
>
> Project participant, my translation

Another problem was that drawings were often delayed. A further was that the building, accommodating the equipment, was too small. Even if this problem is not acute it means that the work of the maintenance people is more difficult since there is little space on the drive side of the machine. Also in this case the participants find it difficult to understand how Jaakko Pöyry, with all their experience, could misjudge the size of the building, arguing that this must be a common problem in almost every project of this kind. At the same time, however, they recognize that Jaakko Pöyry does not have the maintenance experience that the mill has.

> *Talking about JP and their way of running projects … What's holding things up in the project work is partly this thing about space. It's hard to determine the right volume for the building, but since this problem always arises and new things are being introduced, it's very unfortunate that the building is too small. Then there is maintenance, being able to dismantle and remove parts. The construction workers at JP don't always think of this. They are interested in the piping and mechanical side of the project. They are very good at this, too, but they don't have experience of the maintenance side. They sit in their offices in Helsinki and draw up one paper mill after another and very few of them go and visit paper mills to see how things are. Above all, they don't go back one, two and ten years afterward to see how it works in operation.*
>
> Project participant, my translation

Many different departments within Jaakko Pöyry were involved in the project but, as is mentioned earlier, not all the participants thought that Jaakko Pöyry did a poor job. Two people from the process-consultant firm about whom many of the participants talk with appreciation were the commissioning manager and the manger of electricity and instrumentation. These were seen as very experienced and did a very skillful job when commissioning all the parts within the project on the basis of Jaakko Pöyry's work model for commissioning. The only problem mentioned by almost all the participants was that they should have started two months earlier. It was not until the commissioning manager presented her time schedules that the participants could see that there was some structure in the project and that different actors involved in the KM8 project, i.e. both the project organisations and the supplier and consultant organisation involved, had a common time schedule to follow.

Faster and faster

One of the most important factors, according to the participants, is when the machine equipment can be delivered.

> *What determines the time perspective for a project like this, i.e. the total time plan, is the delivery date of the paper machine or the main machinery. If the paper-machine supplier can deliver within 18 months from the date the contract is signed, paper should be produced within 18 months. In my opinion, we've gone too far. We must start analysing what we are doing. How much capital is lost because of borrowing money a bit longer and how much money is lost because we don't have time to engineer properly?*
>
> Project consultant, my translation

The time dimension is important and already from the start up of the project everybody is focused on the final event, i.e. the day when the machine will start producing liquid-packaging board. This point of time is essential since it is not until the machine has started to produce board that it can provide returns on the invested capital. After the start up of the new machine there is, however, at least a two-year period necessary for the operators and maintenance personnel to learn how to run the machine.

From the date of the board decision to go ahead with the project until the start-up phase of the new machine the project took 22 months, not including the preengineering phase, which took three months. Three months is considered to be an extremely short time and most of the participants agree that this was possible because '*they had something ready to go*.'

Considering the cost, the work during the preproject does not even account for one percent of the total investment cost. Even if many of the participants feel that the first preengineering phase meant that they had a platform to start from, they still feel that the second preengineering phase was too short. '*You don't have time to think during the project*', as one of the participants expresses it. '*You have so many things to do that you don't have time to find out what is happening in another area manager's domain*', says another. Time is also considered to be an important reason why the participants did not get any feedback from the project: '*Since the start-up phase [of the new machine] is so long you don't have time for evaluations.*'

KM7 but better

The KM8 project was, as other investments in new product lines, very capital intensive. History has shown that a wrong investment of this size can lead to the fall of a whole company.

> *If you build a mill like this, you have depreciation for 20 years or more. It is so capital-intensive that, if you make a mistake now and the company is not sufficiently big, it will go bankrupt. There are examples of this. A great amount of money is required.*
>
> Member of the project's steering group, my translation

The latest board machine that was built within STORA before the KM8 project was the KM7 machine in Skoghall. When the machine was started up in June 1977, the machine could not produce any folding-box board. The machine was 'bleeding' money and one year later Billerud took over the forest segment of Uddeholm (including the mill in Skoghall). The prospects for the machine were so bad that there where discussions about storing the machine 'in mothballs'. The machine had many technical problems, one of the most serious was in

the forming section. The problems were, however, not only technical. Not enough resources for the preengineering phase, a badly organised project, as well as insufficient time to conduct the project were also experienced as problematic. A further problem was that Uddeholm had no previous experience of the production of folding-box board. Since KM7 was Uddeholm's largest individual investment, it became a symbol for the company's misinvestment.[38]

> *It is doubtful that it was just the manchesterformers that were wrong, there were probably other weaknesses in the project. But it shows that if a project is not run properly, it can ruin a complete company. KM7 is a good example of this. So it is, of course, very important to proceed in a thorough manner and that you do not embrace a technology that you are not familiar with. You have to remember that KM7 has been a big success using the present concept.*
>
> Project participant, my translation

After 1978, when Billerud took over KM7, the machine was reconstructed a number of times and in 1987 the mill in Skoghall produced liquid-packaging board and nothing else. Even if the KM7 machine finally was turned into a success, there was still great apprehension about going for new technology at the time of the KM8 project. '*You should build something new, but you had to be sure that the technology was going to work*', as one of the participants expresses it.

> *We shouldn't mess about here. We should construct in a modern way, of course, but we were not allowed to start using unproven technology. We should know that when we press the button, the machine would start.*
>
> Project participant, my translation

Many of the participants mention the risk of using new technology, even if they described this as a way of developing the pulp and paper industry. '*It is better to let others make the mistakes*', or '*it is better to be number two or three*', are common comments from the project participants. Since the KM7 machine had run very well after its reconstruction in 1981, the KM8 project was build following the same concept. The KM8 machine is described as '*15 years of development at Skoghall and on the KM7*'. KM8 was thus technically only slightly innovative; most

[38] See also Hesselstedt & Lunnemar (1991).

parts are based on proven technology. For example, the wet end is a copy of the KM7's wet end. The pope reel was newly developed but had been delivered to another mill (Frövi) before the KM8 project. The coater was newly developed but this part, too, had been delivered to another mill (Iggesund). The different parts of the forming section had earlier been delivered separately, but as a complete unit this was the first time.

> *As things had gone so successfully for KM7, it was quite natural that this [concept] should form the basis for KM8 as well. KM8 was actually an extension of the products that we had had earlier.*
>
> Project participant, my translation

Contacts with other mills

During the first preproject the project participants had some exchange with other mills. This exchange concerned mainly technical matters. The various delegations of maintenance personnel or operators were sent to look at different machines, processes, and systems for maintenance. There was, as mentioned above, some exchange with the mill in Kvarnsveden and during the first preengineering phase one of the members of the steering group was from Kvarnsveden. The man who would later manage the training of the operators and the maintenance personnel came from Braviken (MoDo), where he had managed training for a paper-machine project that was taken into operation in the summer of 1985. Apart from Kvarnsveden and Braviken contacts were also made with the mill in Iggesund and in Fors, where new machines had been built during recent years. Some operators also visited some mills in Finland.

While both Fors and Iggesund produce board, Kvarnsveden and Braviken produce paper. From a maintenance point of view however it does not matter if it is a paper machine or a board machine. The reason why the maintenance personnel visited Kvarnsveden was the recent installation of a machine from Valmet and for visiting Braviken was the newly installed machine from Voith. During the second preengineering phase exchange with other mills was almost nonexistent. One reason that is mentioned is that '*there was no time*', another

that '*this has already been done*'. A further reason is that the mill in Skoghall '*saw themselves as leaders in the field of board*'.

The mill that lies closest to Skoghall, both concerning products and geographically, is Gruvön. The contacts between Skoghall and Gruvön are however, as noted by the participants, insignificant; the two mills are, even if they do belong to the same division, seen as two completely separate entities.

> *We have surprisingly little contact with Gruvön, I think the reasons are historical. Before Billerud acquired this [the mill in Skoghall] Skoghall and Gruvön were major competitors. It was said, but I don't know whether it is true or false, that when no more smoke comes out of here [in Skoghall] cake will be served there.*
>
> Project participant, my translation

If we move backward in the history of STORA, the mills in Skoghall and in Gruvön were up untill the time when Billerud acquired Uddeholm major competitors. In the beginning some cooperative efforts were made by the mills, e.g. through a common purchasing manager, but nothing came of this. Since that attempt there has not been any natural exchange of personnel or experience between the two mills. Another reason that is mentioned is that the products are different. Whereas Skoghall today produces liquid-packaging board, Gruvön produces packaging paper. Liquid-packaging board is seen as a more complex and higher-class product than packaging paper, which is used, for example, in cigarette packets.

> *Exchanging information between Gruvön and Skoghall, we're bad at that. We always have been, even after we merged in 1978 when one bought up the other. It has never been put right.*
>
> Project participant, my translation

> *We have little contact with Gruvön. I think it needs one more generation. There are still people from the old school who were around when there was competition here [between Gruvan and Skoghall]. Hopefully it will get better. At least you can talk to people these days. But we don't have too*

> *much use of each other's experience, not that I know of anyway. There was one of the guys who were a part of the project organisation who came from Gruvön, so hopefully he can make a contribution there [at the mill in Gruvön].*
>
> Project participant, my translation

At the same time as the exchange with Gruvön is minimal, it has been stated by the project participants that there is little exchange of experience and personnel within STORA in general. Two reasons that are mentioned are that '*we don't know what the other's abilities are*' and '*we feel we can manage things best by ourselves*'. Thus there are sometimes more contacts with other mills outside STORA than within, for example, personal connections between individuals at some mills. As argued by one of the participants '*it is more exiting to visit a mill that belongs to another pulp and paper company than one that belongs to STORA Corporation.*'

A small industry

The pulp and paper industry is described by the participants as a small industry where people know each other and where there is an open exchange of information about, for example, suppliers among the paper mills, competitors or not.

> *It's a matter of moving in a rather small circle, it's surprising actually. The same people you come across almost everywhere.*
>
> Project participant, my translation

The erection personnel for the KM8 project were recruited directly from a project at a non-Stora mill in Aylesford, England, where they had worked on a similar type of project. The project manager within the process-engineering company (Jaakko Pöyry) had worked with these people before and knew that they were competent. With Bloco, the structural consultant, Skoghall had no previously experience. However, the project manager had experience of dealing with them at Gruvön, and knew that they were capable of doing a good job.

The openness within the industry means that there are no problems in visiting other mills, even if they belong to competitors. Of course

there are some details that are kept secret, but a lot of the information is disseminated anyway, through the trade press or through consultants for example.

> *We have a very open attitude here in the Nordic countries, when it comes to factory visits and such things. Things appear in the trade press, for example Pulp & Paper, and if anything new appears, it'll be in there. Not construction details and suchlike but general information is freely open. There are no closed units like there are in many other branches.*
>
> Project participant, my translation

As mentioned in the section above, there are very few engineering companies within the pulp and paper industry. The same applies in fact for the whole industry. There are, for example, only three paper-machine suppliers: Valmet, Voith, and Beloit, and only two suppliers of machinery for thermomechanical pulp: Andritz and Sunds. Since the mills do not compete on technical matters – and in order to be stronger *vis à vis* the very few but large suppliers – mills sometimes cooperate. This cooperation takes place even among mills that belong to other corporations.

> *Technical matters are largely a concern of the suppliers, so we can collaborate. Then we are strong toward the suppliers. But to release a lot of information about the process, no we don't do that. We try to be strong toward the suppliers so that they produce good stuff at the right prices. In this way we help each other. There are no secrets.*
>
> Project participant, my translation

The exchange between different mills is often based on personal contacts, e.g. with a mill where someone worked earlier or with someone whom you have met at a conference. It is a small industry with a limited group of people and '*if you go to conferences around the world, it's the same people you meet*', as one of the participants expressed it. You do not only meet each other at conferences and supplier meetings but also on various courses and at seminars arranged by different Swedish and international associations, e.g. STFI (Swedish Forest Industry Technical Research) or SPCI (Swedish Association for Paper and Cellulose Engineering).

Writing a final report

At the end of the project the project manager asked all the area managers, the functional managers as well as the subproject managers, to write a final report. '*It was a general order*', as one of the participants expressed it. No formal model was given, but the project manager wanted the project participants' view of how the project had run. The reports were sent to the project manager. Few of the participants have read any of the others' reports, with the exception of the project purchasing manager, who gave his report to everyone who had participated within the project. The report was the last thing he did before he retired.

> *What I have missed somewhat in this project is that the report I sent to the project manager did not go any further. It's probably just as well considering what I wrote, but it would be good if we five [area managers] had received copies of the others' reports and exchanged experiences. This would be a way of sharing experience and hearing the others' views on the same thing. I have my own view on this and someone else may have a different view of things.*
>
> Project participant, my translation

Very few people know what happened to the reports after they were given to the project manager and the project manager himself has not written a final report about the project. At the end of the project he became mill manager and there was no time to write a report. When the KM8 project was completed, there were no formal routines within the mill in Skoghall for how a project should be finalized. Today, the mill is trying to create some routines for this. '*You lose a lot of knowledge otherwise*' as is argued by one of the managers within the mill. Thus each project manager at the mill now has to write a report on at least one of his or her major projects and give feedback to the people who participated in the project.

Many of the participants argue that it would be of importance to make the reports from the KM8 project available to other sectors within STORA Corporation. No efforts in this direction have yet been made.

> *I think it would be in STORA's interest to collect them [the reports], so that they can be used on the next project. It is actually the collective experience of this project.*
>
> Project participant, my translation

To not share the reports from the KM8 project means that experiences might be lost. '*You forget what you have experienced*', as one of the participants expressed it. '*A lot of experience was gained in this project that could be useful for the next project within STORA and some of this experience has been written down in these reports*', argues another participant. One example of this is the expressed want of an internal course on project management for the people who are going to be some kind of manager on the project. Since the people from the mill do not have experience of this kind of project they feel that they lack a lot of vital knowledge in this area. Further examples are more time to check the drawings from the process consultant, since these were quite often wrong, and more involvement from the people on the shop floor, i.e. maintenance personnel and operators, which could be a way to alleviating the problems inherent in a small building. A too small building, especially on the driving side, makes the work of the maintenance personnel very difficult. To start training the maintenance personnel and start working according to the commissioning schedule earlier in the project are other recommendations mentioned in the reports, etc. Some of the participants also discuss the importance of writing a diary during the whole project. '*A diary becomes a sort of experience bank*', as one of the participants put it:

> *It takes a bit of time to write, but it is an experience bank. When I read about what happened two years ago, I remember things. 'Right, that's what happened and it didn't work out.' I would never have remembered this if I hadn't had my diary notes. So the diary I had for KM8, I read through it before making my final report and I got most of my points of view into the final report. In concentrated form it [final report] is an attempt to record what we should try to do better next time.*
>
> Project participant, my translation

On the 'anniversary' of the completion of the project there was a formal following up in terms of time and money. During one afternoon the project manager talked about how the project had run

compared to the plan and how much they had run over budget. Despite this follow-up, the participants lacked a technical, as well as a project-administrative, discussion and feedback on how they were handling their part of the project. While the project team was not given any follow-up, except on economic questions, others did. After the project one of the participants was invited to Valmet to discuss how they had conducted their part in the project.

> *It's not too late yet. It' still so new, people remember it.*
>
> Project participant, my translation

Next project

> *It's the same procedure in all projects, the same procedure and the same experience.*
>
> Project consultant, my translation

When the KM8 project in Skoghall was in the middle of mounting, i.e. in the middle of the construction phase, another STORA project – the PM2 project – was starting up at the mill in Port Hawkesbury in Canada. There was an expressed interest at the mill in Skoghall to send people to the PM2 project and the participants, even those who were not asked to travel felt that they would have had valuable experience to take to the next project. Just how they could contribute some have however difficulties to explain. While some argue that they during the project have learned new routines, e.g. for document control, for delivery follow-up, etc. others mention that they have learned new ways of viewing things. While some have difficulties in pointing out anything specific others of the participants have difficulties putting their experience into words, except that which they have written in their final reports. The consultants involved in the KM8 project argue that the different investment projects are all very similar.

> *Sure they're unique, but there are extremely many similarities in the projects as well.*
>
> Project consultant, my translation

Because of the possibility of supplying project skills and experience to a mill that makes a new investment, similar to the KM8 project, only

every 15 or 20 years some of the participants discuss the possibility to have project team within STORA Corporation that could travel between the mills. The project team would have nothing to do with the technology, it should instead manage the procurements, know how to manage projects, how to make time schedules, etc. At the same time some people at management level argue that the project participants are also needed at the mill after the project has been conducted since these are the ones who best know the machine. Looking at management level of the project organisation, there are however very few people who stayed on after the project was terminated. Three people from the mill went to participate in the PM2 project in Canada, one went back to Gruvön, and one went to another project in Portugal. Out of five area managers only one remained at the mill. Soon after the termination the consultants and all the suppliers also left. '*The project quietly fell asleep*', is how one of the participants who remained at the mill expresses it.

Summary

Part one of the empirical story consists of a description of different events in the KM8 project, from the start up of the first preproject in 1990 to the start up of the new product line in 1996. As argued by many of the participants from the mill's project organisation investments in new product lines occur very seldom within a mill. This is not a part of the mill's normal activities, but is seen as an extraordinary event that happens once in a lifetime. Within the mill there was no experience about organising and managing large investment projects and the mill's project handbook was found to be helpful only for smaller and medium-sized projects. When the project started up again for the second time administrative routines, e.g. for document control, were completely missing. Further there was no experience to indicate how much resources would be needed for different administrative and organisation activities and it was taken for granted that this part of the project would take care of itself.

The pulp and paper industry is seen as an open industry and during the first preproject period contacts regarding technical matters were made with other mills which had during the last decade made new investments, both inside and outside of STORA Corporation. Operators as well as maintenance personnel took part in these visits.

During the second preproject period no contacts were made. One reason was that the mill in Skoghall itself had the most recently built board machine (KM7) within the Corporation and the new machine would be based on the same concept.

The project organisation consisted to a large extent of people from the mill. However, since the resources are limited within the mill participants were recruited from various firms of consultants as well as from a sister mill within the same division. The engaged project manager, who had during the years when the KM8 project was put on ice worked at a sister mill, brought some people from this mill to the project. The CEO of STORA had demanded that the director of Stora Purchasing and transport should be involved in the negotiations and in the end three people from this department were supporting this part of the project. Stora Corporate Research was also involved.

Consultants were not only a part of the mill's project organisation. Jaakko Pöyry, a large process-consultant firm which during recent years had participated in almost every pulp and paper project in the Nordic countries, had during the whole project a matrix organisation complementing the mill's own. Some of the project participants argue that the consultants are needed because of their experience. At the same time others argue that the consultants did not bring anything new to the project but reused knowledge from earlier projects. There were also a number of problems within the KM8 project which, according to the project participants, were related to Jaakko Pöyry's share of work. Most problematic was piping and instrumentation, which meant increased costs. People from Jaakko Pöyry argue however that the problem had to do with the inexperience of the customer, which in such a large organisation as STORA Corporation should not have been the case. Many of the project participants and the involved consultants argue that there is little exchange of people and experience within the Corporation, that they do not know each other, and that they prefer to solve their problems on their own. Another problem was that the building was too small, which made the work of the maintenance personnel more difficult. Further, the commissioning started too late and the maintenance personnel did not get enough training in the project.

Things that did go well in the project were the commissioning and the training of the operators. Further, the project started up on time and held almost to its budget. The time, including the start-up date of the new product line, is seen as essential since it is not until the paper is being produced on the new product line that it can begin to give returns on invested capital. After the project was completed there was no time for evaluation and the mill concentrated its resources on learning how to run the new product line. The project participants were nevertheless asked by the project manager to write in a final report how they thought that the project had run. No efforts to put the reports together have been made and only a few of the participants have read the others' reports. One year after the start up of the new product line a formal follow-up of time and cost was made by the project manager. At the time when the KM8 project there was no formal system for project closure within the mill, which meant that there were no routines for recording and sharing project experience.

In the middle of the construction phase, another STORA project – the PM2 project – started up at the mill in Port Hawkesbury in Canada. Some of the actors in the KM8 project, both participants from the mill's project organisation and consultant and supplier organisations, participated in the PM2 project. Also participants who did not attend argue that they could have contributed with their gained experience. Except for that which is written down in the final reports, some find it, however, difficult to put their experience in words. Another problem is that the project participants are needed on site after a project is executed in order to shorten the learning curve for the new machine.

- CHAPTER SIX -

Part Two: The Story of the PM2 Project

In this chapter part two of the empirical story will be told. Analogous to Chapter Five the ambition has not been to exhaust a description of the project but through the thematically structured story illuminate events related to knowledge transfer.

A secret prestudy

In the middle of the 1990s an international engineering company conducted a study of possible locations for a future paper machine for super-calendered paper (SC paper). The study was ordered by a Finnish pulp and paper company. When the division of Stora Publication Paper heard about the result of the study an internal group was formed in the summer of 1995 to discretely investigate the possibility of locating a future SC machine at the Stora mill in Port Hawkesbury on the Canadian East Coast. In recent years the mill in Port Hawkesbury had examined different types of investment projects:

> *We conducted a number of studies over the years for a new pulp mill or a newsprint mill or a de-inking plant and more recently we had looked at newsprint. Then the direction came, basically from the man who was the president at that time of Stora Feldmühle, Düsseldorf [i.e. the board of*

> *Stora Publication Paper], that we should look at SC. So, very quickly the study group was formed and very quietly and confidentially we worked on this project for, I think it was, about three or four weeks. We did nothing but this.*
>
> Member of the secret prestudy group

The members of the secret group were employed within the division of Stora Publication Paper, to which the mill in Port Hawkesbury at that time belonged. Four of the members came from the top-management level at the mill in Port Hawkesbury and four came from the board of Stora Publication Paper. The prestudy was to be treated discretely until an announcement about the investment was made by the board of STORA. The reasons for this were that competitors were contemplating a similar project and that there was only room for one new SC machine on the North American market.

> *Our mandate was to do this [prestudy] in complete secrecy because there were at least two, if not three machines that were very close to being announced. Our strategy internally was that if an announcement was made, then we would back out of the project, therefore secrecy was essential. We were asked to put together a preproject, but it was a pale imitation of a preproject in the normal sense as we could not speak with suppliers, with other SC mills, and were not allowed to hire an engineering company to help us.*
>
> Member of the secret prestudy group

If any of the competitors had made an announcement before STORA, as one of the members of the group explains, '*there would have probably been no opportunities for an investment in an SC machine within the same market area for another five or six years*'. There was thus no time to lose: on December 8, 1995 the project was presented to the board of STORA and on December 11, 1995, the decision to invest in a new product line for SC paper was announced.

The decision to invest in a new SC-A+ paper machine was based exclusively on the prestudy made by the secret group. Thus it was not until after the announcement that a small project team started to look at the design of the new plant and to recruit people to the mill's project organisation. The target of the project was the very low end of the coated market, the lightweight coated paper (LWC) since this is a

bigger market than the normal SC market. The product that was going to be produced was SC-A+, which was going to close the gap between the high end of the SC market and the lower end of the LWC market. SC-A+ is a high-grade magazine and catalogue paper.

During the internal prestudy, the group did not have any contact with either suppliers or engineering companies. The total cost of the investment project was thus estimated by the internal group at US$ 470 million (CAD 650 million). After the feasibility study, including Jakko Pöyry in the spring of 1996, the budget was revised to US$ 550 million (CAD 750 million).

Once in a generation

There is unanimity among the project participants that such a large project as the PM2 project comes '*once in a generation*'. The most recent project of comparable size at the mill in Port Hawkesbury was in the early 1970s, when PM1, the newsprint machine, was constructed. Few people at the mill, at least on the management level, who took part during the PM1 project are still on site.

> *We don't do 750 million [CAD] dollar projects on a yearly basis. Not at each mill anyway.*
>
> Project participant

Inasmuch as the latest investment project took place more than 20 years ago, the mill had little experience in managing and organising large investment projects. Because the mill has a lean organisation and the production of PM1 was going to run as usual during the entire project, there was no reserve of people who could participate in the project. From the start up of the project there were thus only a few project participants on site. One of the area managers from the mill itself together with the project manager, who was recruited from the division of Stora Publication Paper (a former member of the secret prestudy group) as well as another area manager, also from Stora Publication Paper, were the first ones on site. The project manager, who before the PM2 project began was the technical vice president of Stora Publication Paper, was asked to join the group mainly because he had more than 10 years earlier participated in an LWC project in a

mill outside Düsseldorf (PM5 in Kabel in the year of 1980). During the spring of 1996 two more area managers were engaged, one was recruited from a competitor's mill in Norway and the other one was a consultant. As time went by, more people became engaged in the project.

> *We felt that we could run this project and run the existing mill at the same time. What we didn't realise was the great deal of resources that it takes to run a project like this and we found that we were taking many people out of the organisation, from operations, to be on the project and operations suffered in efficiency, in speed. A number of factors suffered as a result of taking people away and putting them on the project. So it was a heavy weight to carry the project at the same time as running the mill. A great number of the people in the project were from other areas of STORA. There were also a number of consultants of course and engineers in the project.*
>
> Member of the project's steering group

At the beginning of the project there was a lack of routines and the participants themselves had to invent new routines. From the beginning there were, for example, no routines for how to manage the steadily increasing flow of documentation and drawings. There was no formal way of handling incoming documents or mail and people were copying and sending these out to whomever they thought would need them. This meant that information was sometimes sent to people who did not need it and people who did need the information did not always get it. Other routines that were missing in the project for a long time were a drawing-number system[39] and a system for maintenance supply. Further, there were no routines for how to receive and store goods. '*There are a lot of things that you must remember to do in the project. If you do them too later, it will cost a lot of money.*' One of the project participants who joined the project later on argues that:

> *It seems that at the beginning the feeling at the mill was that they thought they could manage more than they could. The reason for this was that they had no experience of large projects. Running a project costing 750 million Canadian dollars is totally different from running a project costing two or three million. In the steering group there were guys with experience from*

[39] A drawing-number system is used to identify when the latest drawing comes in and where the drawings come from, e.g. from the process consultants or for the suppliers.

> *large projects in Europe and those were the ones we had to have. But the mill as such didn't see this.*
>
> Project participant, my translation

The department of Stora Purchasing and Transport was engaged directly after the board of STORA had taken their decision; during the entire project one person from Stora Purchasing and Transport was a member of the project team. During the larger procurements, i.e. paper machine, TMP, and electricity, he was supported by the president of Stora Purchasing and Transport and an expert in electrical procurements from the same department in the negotiations with the suppliers. These three persons also participated in the KM8 project, although the person who during the PM2 project was the manager for purchasing and cost control only had a marginal role in the KM8 project inasmuch as he during this time was newly employed.

In the project's steering group there were people from the top-management level at the mill in Port Hawkesbury and from the division of Stora Publication Paper. The president of Stora Corporate Research and the president of Stora Purchasing and Transport were also members. Because of organisational changes within STORA Corporation, this group changed somewhat during the project: some new people joined the group, others left.

Operators and maintenance personnel participated very little in the project considering their operation and maintenance experience and that they are the ones who are to operate and maintain the machine when the project is finished. The participants from the Nordic countries argue that this was a serious oversight. One of the participants means that the poor preengineering was because the people with experience of operations and maintenance did not participate in the mill's project organisation. Others argue that the mill would have been more maintenance- and operation-friendly if the personnel from the shop floor had been involved. One reason why they were not was that the PM1 was not seen as being comparable to the new machine that was going to be built. The PM1 produces newsprint, seen by the people from the mill as a simpler process than the production of SC-A+.

Working groups

In December 1995, after the announcement introducing the project, a kickoff was arranged in Düsseldorf at the head office of Stora Publication Paper. During this phase of the project there were still very few people engaged in the project.

'*We took an open approach after the secrecy had lifted*', as one of the participant expresses it; during the spring of 1996 people were engaged in the project both internally and externally. The mill in Port Hawkesbury had no experience of producing SC-A+, but the knowledge of producing SC paper existed within other mills in the division. Therefore, the working groups, with members from different mills within the division of Stora Publication Paper and from Stora Corporate Research, were formed and assigned to the project. These working groups were engaged in different technical matters of the new product line that was going to be built. Thus there was a working group for the paper machine, the finishing, pulping, calenders, etc.

Since most of the participants within the working groups as well as the suppliers came from Sweden, Finland and Germany most meetings took place at Arlanda Airport in Stockholm, Sweden, not in Canada. During this phase of the project, i.e. from January through May/June 1996, not only suppliers but also different competitors were engaged.

> *…we had monthly meetings. Normally they were held at Arlanda, at the airport. We had five, six meetings there, one every month, starting in January, until June. Then in the end we determined the form of the project. We even had the competing firms coming in to give us a presentation and we made comments and suggestions and criticised some things and then I involved a couple of key members in the working group.*
>
> Project participant

The instructions that were given to the working groups were that they should give technical advice to the project steering group. '*It was quite important that it was advice*', was the impression held by a participant in one of the working groups. When the working groups had written their reports to the steering group they were in principal detached from the project. However, some of the participants joined the project again later to participate in the commissioning and the start-up phase.

The work of the different working groups implied some changes from the project concept originally made by the secret prestudy group, changes which meant increased costs. In June 1996 the board of STORA approved the increased costs; the project would cost another CAD 80 million. According to the original plan the existing ground wood pulp would be used as furnish[40] for the new paper machine and a new TMP pulp would be built for the existing newsprint machine. The study carried out by the pulp working group showed, however, that it was better to use TMP for the production of SC-A+ paper.

> *The work group's mandate was to find what would be the best furnish for SC. That was our first mandate. Then the second mandate was to determine what the process would look like, and the third was to then start looking at the suppliers [...] So it took us two months of deliberating and studying competitors and determining that TMP was actually the best furnish for SC. So that changed the whole ball game, we were now building a TMP for the SC product and not for PM1.*
>
> Project participant

> *The pulp working group made different tests and analyses and their conclusion was that instead of using TMP for the newsprint, it should be used for SC paper. The tests by Stora Corporate Research showed that this was a better approach. This information, of course, greatly changed the project particularly with respect to costs. Now we needed a much more complex TMP plant. Including bleaching capability. The additional cost was in the order of 50 million (Canadian) dollars. That was the first major change that took place within the framework of already approved money.*
>
> Member of the steering group

The people from the mill were positive about the working groups. These groups efforts not only led to the development of new knowledge around the process of making SC-A+ paper, but also helped to create an openness between the mills that participated in these groups. The working groups helped '*to decrease the barriers that might exist between the mills*', as one of the members of the project's steering board expressed it. Many people from different mills as well as from Stora

[40] Furnish means the material in a pulp stock mixture such as the various pulps, dyes, additives and other chemicals blended together in the stock preparation area of the paper mill and fed to the wet end of the paper machine to make the paper or paperboard.

Corporate Research were thus engaged during this period. One of the participants noted however that their knowledge was not always used.

A one-mill division

In October/November 1996, i.e. almost one year after the project was announced, it was decided that the mill in Port Hawkesbury no longer would belong to the division of Stora Publication Paper. Instead Port Hawkesbury was going to constitute a one-mill division - the Stora North America division - with its head office in Stamford Connecticut instead of in Düsseldorf. After this decision the project manager of the PM2 project retired.

> *…suddenly when the project had already started, a completely new company was formed, called Stora North America, based down in New York, and reporting directly to the group president. This meant that suddenly Port Hawkesbury was completely external to [the division of] Stora Publication as well. Fortunately we had started the working group already. But this was another door that almost closed. And then it's the case that each company and division has to show a profit and earnings. There is a certain competition and so we can't help each other too much.*
>
> Project participant, my translation

The project manager who had worked for Stora Publication Paper for many years thought '*he would take retirement in his old division*', as one of the members of the project's steering group understood it. Before the project was to end, however, the mill in Port Hawkesbury would again belong to the division of Stora Publication Paper.

After the unexpected early retirement of the project manager, for a short period of time one of the managers within the mill took over the project management role. However, inasmuch as he was also responsible for managing the normal operations within the mill, the situation was precarious. About the same time as Port Hawkesbury became a one-mill division the project manager of Jaakko Pöyry's project organisation engaged in the KM8 project had been recruited by Stora Purchasing and Transport. After a while he was assigned to the PM2 project as an assistant project manager and in February 1997 he became the new project manager.

Contacts with Skoghall

Within STORA Corporation the KM8 project was the most recent investment project before the PM2 project. In the winter of 1996/1997, i.e. after the first project manager had retired and after the person who was later going to be the new project manager had come over to Port Hawkesbury, the first contacts were made with people from the mill in Skoghall. During the spring and the summer of 1997 the new project manager brought over nine people from the KM8 project as reinforcements for the PM2-project organisation. These were not only participants from the mill's own project organisation, but also participants from the process consultant's project organisation in the KM8 project.

The new project manager began by introducing weekly meetings with the area managers and the functional managers. This was also a routine at Skoghall. Before the new project manager was assigned to the project the meetings within the project organisation were monthly, when the process consultant Jaakko Pöyry came over to Port Hawkesbury. He also started a weekly bulletin called '*A new direction*', which went to all the construction workers to inform them about what was happening on the project. In Skoghall the weekly bulletin was put on bulletin boards. In Port Hawkesbury they were handed out to all the construction workers every Friday as they entered the gates.

Since there was no coordination between the KM8 and the PM2 project from the start, '*they did not benefit from being number two*', as one of the participants puts it. Even if the participants in the PM2 project today argue that they should have gained from the experience made in the KM8 project, they then thought that it was a different product and a different manufacturing process, that there was therefore little to gain from this project.

> *From talking to the new project manager, Skoghall had the same experience as we had. We didn't learn from that experience because we weren't aware of it. But the comments have been made very clearly, that you know that you should have benefited from the Skoghall experience. We made exactly the same mistakes as they did.*
>
> Project participant

> *It is almost frightening that so many mistakes are repeated despite everything. Simple things in the projection phase, details, I know, but they are basics in projects. Maintenance-friendliness and things like that. Maintenance workers have very little room to work in, and due to the confined spaces on the drive side it is extremely difficult to change the electric motors.*
>
> Project participant, my translation

Many of the problems that the KM8 project had faced also confronted the PM2 project. The problem with the piping, i.e. that pipes did not always match, was also a major problem in the PM2 project. '*You had a pipe coming down here and it met the floor, but the other pipe was over here somewhere*', is described by one of the participants. Even here the drawings from Jaakko Pöyry were late in coming and after a while one of the participants from the KM8 project came over together with some of the members in the steering group to '*talk seriously*' with the process consultant. Another problem that was even larger in the PM2 project than in the KM8 project was the size of the building. The building was so small that it was a problem to get everything inside the building; some equipment had to be stood on end in order to get them in.

The people who came over from the KM8 project argue that the technology is completely different in the two projects. Then again '*project management is more about leading people than being competent in technology*', as one of the participants expresses it. The project organisation in PM2 could in any case have gained from experience made in the KM8 project. One of the nine people who came over to Port Hawkesbury was during the KM8 project in charge of document control. After having seen that neither experience of nor routines for document control existed within the project organisation he wrote the following in a report:

> *… Another area which I feel is somewhat under-dimensioned at present, is the document-management department. It is easy to underestimate the amount of drawings and other documents which will be produced during a project of this magnitude, and I am not convinced that SPH [Stora Port Hawkesbury] is geared up to cope.*
>
> *I expect the number of incoming drawings to increase enormously over the next few months, and the demand on the copying department will also increase. They are going to require more copying and folding capacity and*

> *more archive space. Also as the number of interested parties increases, the need for tighter distribution routines will arise.*
>
> Project participant

The report was circulated to some of the participants in the project's steering group and to the management level of the project organisation. Still, for the PM2 project no structure for document control was established and during the autumn of 1998, when I visited the mill, people were still working to sort it out. At this time they were still working on the drawing-number system, which had been changed halfway through the project because the existing system did not work. Another thing needing attention was the system for spare parts. This part of the project did not start until the people from Skoghall arrived and saw that progress had to be speeded up. When I asked one of the people who worked with spare parts what he learned during the project, he told me that it was to '*appropriately identify and set up spare parts*'. This he learned from one of the participants from the KM8 project.

> *The problem was that there was no knowledge transfer between the two projects [KM8 & PM2]. You could take advantage of the size. Take the experience from one project and transfer it to another. Port Hawkesbury had not even been in touch with Skoghall before the project started.*
>
> Project participant, my translation

Even though the project organisation in Port Hawkesbury was very late in contacting participants from the KM8 project, some people from other companies that had participated in the KM8 project visited Canada earlier. One example is Bloco, the structural consultant. Before Bloco made a bid on Port Hawkesbury they travelled to the mill in Skoghall to talk to the people there about the KM8 project and the same person who was project manager for Bloco in the KM8 project was also project manager in the PM2 project. Also some of the erection and installation personnel travelled to visit the mill in Skoghall.

Internal and external openness

There is a broad openness among the mills within the pulp and paper industry and sometimes the openness is perceived as even greater outside than inside STORA. However, as expressed by one of the participants, '*the openness is what you make it*'. The network that you have is thus related to personal contacts.

> *Your network is limited to the Stora company [mill] that you work for plus colleagues at other pulp and paper companies that work with the same product or product mix, since they have similar kinds of problems.*
>
> Project participant

During the autumn of 1996, i.e. almost six months after the announcement of the investment, a person from the mill in Halden (Norske Skog) was engaged as area manager in the project. The people from the mill in Port Hawkesbury did not know him personally, but some people from Kvarnsveden did. Both Kvarnsveden and Halden have SC machines and had at that time a good deal of exchange. Thus people in Kvarnsveden recommended this person. They knew that he was skillful and that he had participated in the three most recent SC projects at Norske Skog. Later he engaged a person he knew from another external mill, OPM Kymene, to work together with him on the project.

During the project, the mill in Port Hawkesbury worked together with some of its competitors. Some of the reasons why you choose to cooperate with a competitor are: '*the mills often have similar kinds of problems*' and '*it is for the good of the industry*'. Since the mill in Port Hawkesbury did not have any experience of training, the person who was going to be responsible for this went to visit different mills, such as Halden. After having attended a conference and seeing a presentation by the training manager from a mill in Texas, he also went to visit this mill to gain from their experience about training. Finally a training consultant who had experience from the pulp and paper industry was hired.

There is thus cooperation within as well as outside STORA. Within STORA attempts have been made to create some formal networks. However, since Port Hawkesbury is so far away from the other mills

in Europe, they have not participated. Both in Germany and in Sweden so-called purchasing days are arranged, when all the purchasing managers and engineering managers meet for two days. There are also maintenance days when all the maintenance managers get together. All these meetings are arranged within respective division. Further, people meet at conferences, seminars, courses, supplier visits, and in different kinds of associations, e.g. CPPA (Canadian Pulp and Paper Association).

New technology

Many of the participants mention the importance of using proven technology. Thus they do not see the new SC-A+ machine as a radical innovation, but rather as '*an accumulation of the collected experience within the industry*'. Since these investments are so capital intensive you dare not use too much new technology:

> *You can't take too many risks, because it is a very capital-intensive industry, with generally low rates of return. You can't afford to do too much experimentation and expect to earn a satisfactory rate of return.*
>
> Project participant

Despite this, some parts of the machine are based more on unproven than on proven technology. One example of this is the two calenders in the paper machine. The calenders are located at the dry end of the paper machine and consist of two sets of horizontal rolls, vertically stacked one upon the other. The paper sheet, which includes an additive of clay, is passed through the calender at high speed and under high pressure in order to obtain the gloss and printing performance required for the SC-A+ quality. To acquire the best calenders a working group was formed with participants from mills in Sweden and in Germany, together with representatives from Stora Corporate Research. The mills had experience of making SC paper but not of SC-A+ since at that time this was something completely new. It was thus in this area that the biggest technological developments took place.

> *The area with the biggest change was calender technology and I still think it was an important step to move forward in that area, because there was a fundamental weakness in all calender technology and it hadn't progressed*

> *that far over the years. It would have been wrong to have the newest machine in the world, but the last of the conventional supercalenders. Also there were technical limitations on calender technology, which made that part of the project very capital intensive. Conventional supercalenders were speed limited and therefore would have required three and possibly four calenders in the future using old technology, whereas with the new technology only two would be required.*
>
> Member of the project's steering group

In the area of the calenders there were only two different suppliers to choose between. One of them had a better design, but since the other appeared to be the leader at that time, this company was chosen. One-half year after the project was terminated the supercalenders are still not working sufficiently well. Some of the participants argue that the wrong supplier was chosen. Others argue that it was the right choice since otherwise there might today only have been one supplier for calendered paper, which would have been detrimental for the industry as a whole.

A fast-track project without a preproject

The project in Canada was experienced by many of the participants as '*a fast-track project without a preproject*'. The decision made by the board of STORA to invest in a new SC-A+ machine was thus based entirely on the internal material that had been put together by the secret study group.

> *I think that when STORA made a decision to invest in this mill, it was done very quickly. Other projects in Canada were going to start at the same time. So STORA said we had better make the decision right away or somebody else will announce their plan first. Because the decision was made this way, they didn't have much time to do the detailed preconstruction and preengineering studies that are usually a part of a project.*
>
> Project participant

Even if time was a limited resource, few of the participants think that it would have been better with more time, since more time might have led to not having the project at all. However, since there was no preengineering phase before the decision, as is usual in such cases,

much would change during the first months of the project, i.e. during the time when the working groups performed their studies.

The project phases in the PM2 project were to a large extent overlapping. The first construction people were employed on July 23, 1996, and on December 19 the building was being closed in, i.e. walls and roof were erected. If we look at the KM8 project, the project team was ready to start purchasing the equipment right after the decision. In the PM2 project the contracts with the larger suppliers were not signed until the beginning of the autumn of 1996. It is when the contract is written with the supplier of the main machine that the clock starts ticking and after this date, September 1, 1996, the project took 18 months to complete. One criticism is that there was no real preengineering phase in the project, not even after the decision of the board. '*There was a lot of time between December 8 and September 1, when the main machine was purchased*', is the argument of one of the members.

Time is mentioned as a key issue in this project, both positively and negatively. The participants are proud of having participated in such a fast-track project, but at the same time this led to problems. Since there was no real preproject phase after the decision, it was still not clear what kind of machine and what kind of supporting facilities they required. The building was thus constructed before they knew exactly what was going to go inside.

> *…unfortunately it is typical for a project like this that it is very difficult at the beginning to get a clear conception of what will go into the building. But it is seldom the case that items that have been around from the beginning are not needed. In Canada you can see a perfect example of what saving money on the volume of the building means: there is no room, the building is too small.*
>
> Project consultant, my translation

The building was thus constructed before the preengineering was done and before the equipment was bought. The building size became a problem, there were also problems with piping, IT, document control, training, and the purchasing of spare parts. '*IT was a problem since it was completely forgotten in the project*', one of the participants stated. The mill had started up a working group for IT six months prior to the project, but this group was completely forgotten in the project and therefore not integrated with the project work. Training was also a

problem since the training of the maintenance personnel started too late. It was difficult to relieve them of their normal duties since there was no one who could replace them on the PM1.

When the new project manager came over to the PM2 project in Canada, he brought the commissioning manager and the manger of electrical and instrumentation from the KM8 project to the PM2 project and put the commissioning team on top of the project organisation much earlier than in the KM8 project. This meant that it was the commissioning plan that determined what should be done next in the project. Within the project many different time schedules had been circulating. The construction team had one, the machine supplier and the erection people had another, and the project team a third. These were not always synchronized. However, when the commissioning started, this was the only valid time schedule and everybody had to follow it. That the commissioning plan was made by process and not by area speeded up the project, according to the project participants.

'Getting your thoughts on paper'

After the termination of the project organisation no formal winding-up meeting or feedback has been offered to the project participants. Some of the suppliers engaged in the project have however had some meetings with some of the project participants in the mills project organisation in order to get feedback from the participants concerning their role in the project. These discussions where not documents, '*they are stored in peoples heads*', as one of the managers expresses it. Neither has there been time over to write any project reports or testament. Since the calenders still do not work properly and since the work with the spare parts as well as the drawing numbering system is not completed, the personnel are still busy trying to fix these problems. The mill in Port Hawkesbury is now in a long period in which people who are operating and maintaining the machine are still learning how to run it. '*We are learning all the time*', as one of the participants who is now working at the mill summed it up.

So, what about the project reports from the KM8 project? The only people who have seen the reports from the KM8 project are the

people who participated in the mill's project organisation. These people mean that the reports have been a '*support for memory*' and if there were any problems in the PM2 project, you could go back to the reports to look up who was responsible for this part of the KM8 project in order to get in touch with this person.

In the KM8 project there were no formal requirements for writing final reports and some of the participants would find it hard to write down their experience from the project, especially concerning technical matters.

> *It may be just by chance that you see, for example, that a certain cistern is wrongly dimensioned, which means that it will overflow, or you know by experience that you should focus on certain things where problems have arisen previously.*
>
> Project participant, my translation

> *You can't just tell someone about this kind of thing. It requires a bit of experience to talk about it. I believe more in sending someone. If you look at what competitors have done, the main competitor in Finland has a project group that has traveled around putting up factory after factory. They get better and better […] you can see it from the very start. But all the participants in the project should not come from the project group. It's so complicated today that the project group should consist of pure project people who know piping and a bit about cables and such. Then there should be guys who know the product and know what is to be manufactured.*
>
> Project participant, my translation

The only way for the next project to gain from previous experience would thus be to send people. People who have participated in a project, consultants as well as STORA personnel, should also participate in the coming project. But, as is argued by some of the managers, '*what we can't send right now is our people, we need them*'. However, after the project was completed many of the participants have left the mill and have returned to their own mill or to another project. Some of the installation personnel as well as the commissioning manager left for another project in France and some personnel from STORA have after this project in Port Hawkesbury been engaged by a subsequent STORA project in Brazil. The manager for purchasing and cost

control is one of these. '*The experience I gained in Port Hawkesbury will automatically be used on the next project*'.

Next project

Some of the participants in both the KM8 and the PM2 projects argue that the projects are very similar and that there are some factors that are common to both projects. For example, routines for project meetings, documentation, spare parts, systems for filing drawings and other documents, how to make time schedules, training the operators and maintenance personnel, purchasing, etc.

> *…it's the whole planning setup and the various steps. Carrying out the time plan, checklists, and everything you have to think about. What I mean is that you should have a time plan, you should have an organisation, you should have certain routines for meetings, you should record the minutes, you should file the facts, you should make a budget. This may sound obvious, but it damn well isn't. What is general is the methodology around the project. What is unique is where you construct, what limiting conditions you have for the project.*
>
> Project participant, my translation

What is unique to the project is, for example, where you build. As argued by one of the participants '*we had no idea that installation took such a long time in Canada*'. Other items that are unique, at least if you consider the KM8 and the PM2 projects, are product related, i.e. the technical experience. However, if the technology is different from a maintenance point of view, this does not matter; from an operational point of view it does.

Summary

The second part of the empirical story consists of a description of different events in the PM2 project, from prestudy in 1995 to the start up of a new product line. The start up of the PM2 project is a secret internal prestudy performed by a small group of participants from the mill in Port Hawkesbury and from the division of Stora Publication Paper. During the prestudy no contacts were made with other Stora mills (or non-Stora mills) that had performed a similar investment

project, with suppliers, or with engineering companies. The decision to invest in a new product line for SC-A+ paper was thus based on the material of the internal prestudy group exclusively.

The project participants from the mills agree that investments like those for the PM2 project come once in a generation and only a few of the people who took part in the mill's latest investment project of comparable size are still on site. The people from the mill have therefore limited experience of managing and organising large investment projects and some thought that they could both manage to run the project as well as the existing product line (PM1). There was a lack of routines in the project, e.g. for document control, control of spare parts, and a system for numbering the drawings.

The project organisation consisted to a large extent of people external to the mill and only one of the area managers came from the mill itself. The others, including the project manager, came from the division of Stora Publication Paper or were hired externally. Also the department of Stora Purchasing and Transport and Stora Corporate Research were involved in the project. The same three people who had been involved in the KM8 project were also engaged for this project. Operators and maintenance personnel participated very little in the project; this was seen by the participants from the Nordic countries as a serious oversight. They argue that the new product line would have been more operator- and maintenance-friendly if they had participated with their running experience. However, the participants from the mill did not see the experience of running the existing newspaper machine as comparable with running a SC-A+ line.

The mill had no knowledge of producing SC-A+ paper, but long experience in producing paper existed within different parts of the division. Working groups with members from different mills within the division were therefore formed to work with different technical matters. These groups were to give advice to the project's steering group and when the working groups had written their reports most of the members were detached from the project. The working groups were seen as very positive by the people in the mill: their activities not only brought new knowledge to the mill but also helped to create an openness within the division.

One year after the announcement of the new investment project, STORA was reorganised and it was decided that Port Hawkesbury would no longer be a part of the division of Stora Publication Paper but would constitute an one-mill division. After this decision the project manager retired and for a while the project organisation had no project manager. Some months later the manager for Jaakko Pöyry's project organisation in KM8 was engaged as the new manager for the mill's project organisation within PM2. Prior to this no contacts had been signed by participants from the mill's project organisation in the KM8 project, which during this time had managed and organised STORA's latest investment project. The new project manager brought over nine participants from the KM8 project, both from the mill's project organisation and from Jaakko Pöyry's project organisation. The new project manager also brought with him routines for project meetings and delivering information to the people on site.

One reason that the contacts with the mill in Skoghall were taken so late was that they were producing a different product. Another reason was that the people in Port Hawkesbury were not aware of the experience gained in Skoghall. Contacts were thus taken with mills with the same product or with the same product mix as Port Hawkesbury. Many of the problems within the PM2 project were similar to the problems in the KM8 project: a too small building, starting the maintenance training too late, problems with the pipings. Other functions that were problematic were the calenders and the electricity. That which went well in the project were the working groups and the commissioning.

There was no formal winding-up of the project. When the line organisation took over the product line from the project organisation all the resources were focused on the mill's learning curve, i.e. learning to run the new product line. No formal reports have been written and since the calenders are still problematic and there are still things that need to be organised, things which were not fully attended to during the project, there has been no time for a project evaluation. Some of the participants even feel that it is difficult to talk about their experience, especially about technical matters.

- CHAPTER SEVEN -

Analysing knowledge bearers and knowledge barriers

The aim of this chapter is to develop a conceptual framework for knowledge developed within a project and the bearers and barriers for the transfer of this knowledge on an individual as well as a structural level. The chapter starts with a general discussion about possibilities for knowledge transfer.

Possibilities for knowledge transfer

In traditional project theory each project is a unique event. This is also the case with the KM8 and the PM2 projects, inasmuch as they are unique at their location, both geographically and timely. In comparison to each other they do as such further display various differences. While the objective of both projects was to construct a new machine with supporting facilities, the KM8 project involved a cardboard machine with a CTMP pulp and the PM2 project a SC-A+ machine with a TMP pulp. Another difference was that whereas the knowledge about the product being produced and of how to run the product line existed to a large extent within the mill in Skoghall, there was no previous experience of end-product technology nor operational knowledge about making SC-A+ paper in Port Hawkesbury. Thus, the

level of technological developments that occurred at the mills throughout project differed.

However, the projects also portray a variety of similarities. First, although the technology was different, the objectives of both projects were in general terms to construct a new product line with basically the same scope in terms of time, money, and complexity. Second, they were similarly organised, i.e. were divided into six overlapping project phases and organised in a matrix of process areas versus functional areas. Third, both projects involved a large amount of actors external to the mill, where some actually were the same in both projects. Fourth, neither of the mills had any recent experience of organising and managing major investment projects. Finally, some of the problems that arose in the KM8 project roughly also arose in the PM2 project. These similarities raises the supposition that there existed possibilities for the project organisation in PM2 to learn from experience made during KM8.

Transferring knowledge about what?

In discussing knowledge transfer between projects and what knowledge can be 'useful' to transfer, the distinction was made in Chapter One between two different types of knowledge developed in a project: *operational knowledge* and *project knowledge*. Operational knowledge is *product- and process-related knowledge*, i.e. knowledge that is related to the product that is going to be produced (e.g. a SC-A+ paper) and knowledge that is related to the process of running the new product line.

Knowledge related to the project can further be divided into *project-organising knowledge* and *technical knowledge*. Project-organising knowledge is experience about how for example procurements, incoming drawings, training, etc. can be organised, i.e. different types of project-administrative routines that emerge and develop during a project and that can be useful in a following project. Technical knowledge is experience about technical matters that are not directly related to a specific product or process, i.e. related neither to the technology of the specific paper to be produced nor to operations and maintenance of the new machine but rather to technical solutions during the projects.

This is e.g. knowledge about the piping problem and about the size of the building (Figure 15).

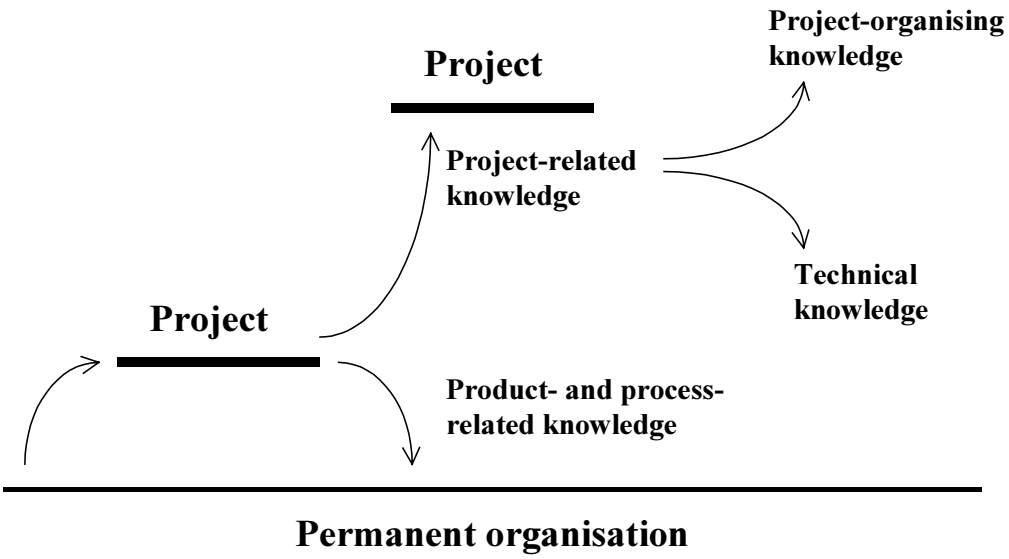

Figure 15: Knowledge developed in a project.

Product- and process-related knowledge can as illustrated in the studied case differ between two following projects. The knowledge developed around e.g. using TMP as furnish for the production of SC-A+ paper or the technology developed around the calenders might not be useful for a following investment project. This knowledge can however be useful for the company as a whole: other mills within the division and also producing SC paper are able to learn from the technological advancement made in this project.

On the basis of the examples illustrated in the following sections *project-organising knowledge*, *technical knowledge*, and *product- and process-related knowledge* will be discussed. Thereafter, in a section of how they are transferred and how they are hindered, follows a discussion about bearers and barriers for the transfer of the different knowledge types developed in a project.

Project-organising knowledge

As indicated at a number of places both in Chapter Five and Chapter Six the participants had problems with some specific activities during

the projects, problems which to a large extent are of organisational nature. These were of such character that the experience in one project could have contributed to limiting or even eliminating the problem in the next one. Although if an attempt to transfer knowledge intended or unintended did occur the nature of knowledge (e.g. tacit and explicit) makes transfer more problematic than merely being given the possibility.

(A) Spare parts. In the case of routines for spare parts the participants in the KM8 project developed a system based on one already being in use at the mill. When this system proved to be insufficient they tried to change it after halfway through the project. When this only lead to confusion, the system was changed back again. When some of the participants from the KM8 project came over to the PM2 project and observed that there was no system for spare parts at all, they started to work on this and together with people from the mill created routines for handling this activity. Facilitating this transfer was the employment of the same people who managed the procedures in the prior project, and their socialisation with participants in the later project. A prerequisite for this transfer is the previous experience of the situation of sparer parts in the KM8 project.

(B) Project procurements. In the case of procurements, the same people from Stora Purchasing and Transport who were involved in the KM8 project were also involved in the PM2 project. Routines for procurements developed in the KM8 project could thus be utilised and further developed in the PM2 project. This again gives an example of how knowledge can be used by enlisting the people who were involved in the previous project. That the same support function, whether external or internal, is involved in the next project does however, as discussed in the analysis, not necessarily mean that the same individuals are involved.

(C) Project meetings. In the KM8 project, routines for meetings were developed together with the involved process consultants. In the PM2 project there were few meetings among the people in the project organisation before the new project manager was assigned to the project. When appointed as project manager he introduced routines for regular project meetings, similar to the ones developed in the KM8

project. In this way experience gained from the previous project was put to use.

(D) Commissioning plan. In both projects the same person from the process-consultant firm managed the commissioning. She based her work on the firm's (Jaakko Pöyry) plan for commissioning. The experience made during the KM8 project was that the commissioning should start much earlier. Since the process consultants were working 'by area' instead of 'by process' it was felt that the work was progressing too slowly. When three of the individuals who had worked with the commissioning in the KM8 project were recruited to participate in the PM2 project, this knowledge could be transferred. Hence the commissioning plan started up much earlier in the PM2 project.

(E) Drawing-numbering system. The process consultant developed the drawing-numbering system in the KM8 project. In the PM2 project this job was not laid out on the process consultant and the drawings became a problem because of the deficient numbering system for handling drawings being sent from consultants and suppliers.

(F) Training of maintenance and operators. With regard to the training of maintenance and operating personnel in the KM8 project, a man with experience from another investment project in another pulp and paper company organised and managed this assignment. This part of the project went well with the exception that the training of the maintenance personnel started out too late. In the PM2 project experience was gained from another Canadian investment project in another pulp and paper company and the training was finally managed by a hired consultant. Also here the training of the maintenance personnel started too late. The participants in the mill's project organisation in Port Hawkesbury was, until the new project manager was appointed to the PM2 project, not aware of that they had made the same experience, i.e. that the training of maintenance had started up too late, as the participants from the mill's project organisation in Skoghall. Since the mills do not belong to the same division, hence do not use the same technology or work with the same product mix they were not natural partners. Few contacts had been made between the

mills before the start up of the projects and during the project none were made between the manager of this procedure.

(G) Routines for document control. As for the routines for document control the participants from the mills' project organisation within KM8 and within PM2 had no previous experience of this. In the KM8 project routines for document control were developed by one of the participants in KM8's project organisation who was going to be responsible for this duty together with a participant from the process consultant's project organisation who had experience of document control in earlier investment projects. When the person responsible for document control in the KM8 project went over to participate in the PM2 project, he saw that the routines and resources were not sufficient for this part of the project. He therefore wrote a memo to be given to some of the participants in the PM2's project organisation. Although experience was transferred from the KM8 to the PM2 project little happened.

Technical knowledge

(H) In both KM8 and PM2 two similar problems occurred that are of technical character. The first was **the building-size problem** and the second **the piping problem**. Both arose in KM8 and then again in PM2. Some of the participants argue that the involved process consultants should have known better. However, it is not the process consultants but the people from the mill who, in the case of the building, size have the running and maintenance experience. It is they who know how much space is required in order to maintain the product line. One reason why the knowledge of the building-size problem was not transferred between the projects was that PM2's project organisation initially was not aware that the same problem had occurred in the KM8 project. When participants from KM8 were engaged in PM2 these problems had already progressed too far. Since Skoghall and Port Hawkesbury do not belong to the same division, the participants from Port Hawkesbury's project organisation did not acknowledge that they could gain any experience from a non-LWC or SC project. Although the same process-consultant firm was engaged this did not automatically mean that the same individuals were engaged (see below).

Product- and process-related knowledge

(I) Regarding product- and process-related knowledge there was an awareness of the importance of gaining knowledge from outside, both through collaboration with other mills and from consultants and from suppliers. In the case of the KM8 project, operators and maintenance personnel visited both Stora and non-Stora mills. In the case of the PM2 project different working groups were formed with participants from the division so as to gain from knowledge developed at other mills. In an investment project, the focus is, from a mill perspective, on the product line that is going to be built and the technology that will be used in the process of papermaking. It is an occasion for the mill to raise its own technological level. After the project is completed the focus was therefore on getting down as quickly as possible along the learning curve to increase returns on the capital invested. On the mill's management level it is argued that neither time nor resources allow for the transfer of experience to a following project.

Knowledge types and the bearers and barriers for knowledge transfer

The typological differentiation of knowledge, where *project-related knowledge* is distinguished from *product- and process-related knowledge*, opens for a view of a project as more than solely a unique event. Further, it loosens the equation of the project with the technology of the end product. That is, takes into consideration the irrelevance of mixing-up project experiences with technological incompatibility.

Through the distinction between different knowledge types (Table 6), knowledge developed in a project is exposed and its usefulness for the mill itself, for investment projects yet to come, and for the company as a whole are emphasised. It does however not suffice to recognise different knowledge types for an understanding of knowledge transfer. It is also crucial to understand how this can be transferred.

Table 6: Knowledge types developed in a project.

Knowledge types developed in a project:		**Useful knowledge for:** The mill	Next project	The Corporation
Project-related knowledge	Project-organising knowledge	Routines for e.g. maintenance supply, training of maintenance and operators...	Routines for e.g.: document control, spare parts, procurements, meetings, training of maintenance and operators, times scheduling...	
	Technical knowledge		Knowledge related to pipings and the size of the building...	
Product- and process-related knowledge		Knowledge of how to maintain and operate the new machine...	Useful only if the following product-line is similar to the one that already being constructed...	Knowledge about different technical solutions, e.g. for example using TMF as furnish for SC-A+ paper...

The discussion about different impediments and enablers for transferring knowledge between projects and the organisation in which the projects are performed can be subsumed under the headlines of *knowledge bearers*, (A) – (D), (I), and *knowledge barriers*, (E) – (I). Here knowledge bearers are individuals and routines, and knowledge barriers are cognitive closure, the limits of language and no previous experience, organisational structure and time.

Knowledge bearers

Individuals as knowledge bearers

As argued by Lundin and Söderholm (1998) there are no carriers of organisational knowledge and know-how within a projectified society, but all knowledge will be personal knowledge. This is also in line with Packendorff's (1993) argument that only individuals can learn between projects. If the individuals are the bearers of knowledge developed in a project this means that in order to transfer experience from one project to another the people thus have either to interact or take part in both (see e.g. Nonaka & Takeuchi 1995; Grant 1996; Hamel 1994).

That some of the participants find it difficult, however, to put what they have learned in the project into concise words, exemplifies that some parts of the knowledge gained within a project is tacit (see Polanyi 1958; Polanyi 1966). One way to transfer knowledge between projects (both tacit and explicit) is thus to let people who have participated in one project also participate in the next. This is also in line with Saari's (1997) argument that the great ship-building skill that the Vikings came of their learning from experience. When a Viking succeeded in coming back from an adventurous trip he had to build a new ship based on the experiences that he had had and the knowledge that he had gained during his voyage:

> *Vikings developed their ships to such a level of excellence that modern ship-building reached the same level only in this century. Viking ships were very fast and could sail over oceans. The achievements of the Vikings were based on learning from experience, without any theoretical understanding of the phenomena in question. Every time a Viking succeeded in coming back from a voyage, his obligation was to build a better ship where all the lessons of the last trip was taken into account.*
>
> Saari 1997: 223

Inasmuch as the PM2 project was carried out after the KM8 project, there were possibilities for these involved in the later project to learn from experience made in the earlier. Until halfway through the project, when Port Hawkesbury became a one-mill division and the first project manager retired after having devoted his whole working life to the division of Stora Publication Paper, there had been little knowledge transfer between the projects. This event lead to the board of STORA engaging the project manager for Jaakko Pöyry's project organisation in the KM8 project and arranging for him to come over to the PM2 project as the new project manager. It was thus not until the new project manager went to Canada that the first contacts were made with participants from the mill's project organisation in Skoghall.

If individuals are bearers of project-related knowledge it can then be said that since the second project manager brought with him nine people from KM8 to PM2, participants from the mill's project organisation as well as consultants, knowledge was transferred between the projects. Some of the project participants who came over from the

KM8 project to the PM2 project argue, however, that they came too late; some of the problems had already gone too far (e.g. the building problem and the piping problem). Some other problems were, however possible to do something about, e.g. maintenance supply.

Those who have worked on both projects claim that when they joined the second project they had a much better overview and knew how things were going. The people in the PM2's project organisation, who worked together with the people from the KM8 project, also witness that those who came over were very experienced and that they, the PM2 people, were able to learn from the KM8 project. Those who had come over had a completely different overview of the project than was possible for people who participated in a project of this size for the first time.

Since the mills had neither sufficient resources nor knowledge to manage a project of this size on their own, several different actors were involved in the projects. These were not only from within STORA Corporation, but also contracted externally. Viewing projects as learning 'experiments' means here that the bearers of STORA's project knowledge can be found both internally and externally.

Internal bearers

Before the new project manager brought over people to PM2, Stora Purchasing and Transport was one of those already engaged in the project. Inasmuch as the same people participated in both projects they were able to bring in and develop their purchasing experience within the projects. In the PM2 project they played an even greater role than in the KM8, since one of the participants who in the KM8 project can be seen as an apprentice was a full member of the PM2's project organisation. Also the president of STORA Corporate Research was a member of the steering group of both projects. These steering groups had, however, solely a conferring role, i.e. had contact with the project manager but was not involved in the daily work of the project. However, when the first project manager retired the members of the steering group in PM2 were, because of their contact net, able to quickly find a new project manager with experience of managing large investment projects.

During the first phases of the PM2 project people from other mills in Europe participated in what was called working groups, within which different technical solutions for a production of SC-A+ paper were discussed. Since the mill itself had no knowledge relevant for making SC-A+ paper, the working groups brought both product- and process-related knowledge into the project. Further, since the mill in Port Hawkesbury is geographically so far away from STORA's other mills within the division of Stora Publication Paper, the working groups also meant an increase in mills contact surface with these mill's. When the groups had completed their work and the participants returned to their normal duties at their home mills, the product- and process-related knowledge created in the working groups could then be spread throughout the division (see also Ayas 1996).

External bearers

Within the two projects some of the employees of the external organisations participated in both projects. After the completion of the PM2 project in Canada some of these people left to participate together in another pulp and paper project in France, for another European Company.

Both projects relied for example heavily on a large consultant firm, Jaakko Pöyry, which had experience from participation in many large investment projects within the pulp and paper industry during the last decades. Also on a management level within the project organisation external participants were involved, which means that the project team consisted of a relatively high rate of external participants. Both the people in the KM8 project who were working closely with some of the consultants and the people in the PM2 project who were working together with the consultants argue that these were experienced. One of the participants in the KM8 project argues that he learned how to organise the document-control system from one of the consultants who had done this type of work earlier.

Responsibility of project owner

If all knowledge is personal knowledge (Polanyi 1958; 1966), this implies that even if the consultant companies are said to transfer project experience from one pulp and paper project to another, the

consultant firm in itself might not be bearer of STORA's project experience. Even if the same consultant firm would participate in all of STORA's projects, these might not necessarily involve the same people. Because of differences between the end task, different departments at Jaakko Pöyry were involved. As for the process consultants, only three of these were engaged in both projects and one of these was the recruited project manager. That the other two were engaged for the PM2 project was a result of the new project manager having worked together with them during the KM8 project. If experiences made in one project in STORA Corporation, e.g. that the building was too small or problematic piping, are not transferred and socialised (see Hedlund 1994; Nonaka & Takeuchi 1995) within Jaakko Pöyry's organisation, STORA will not be able to rely on any experience being transferred from one project to the next project within the Corporation. If the knowledge is not socialised within the organisation, the knowledge bearers become 'elusive' individuals (see Hedlund ibid.) in the sense that, if the same individuals are not engaged in all of STORA's investment projects (as e.g. in the commissioning phase), knowledge will not be transferred, leaving the way free for fortuitous transfer. Problems that have occurred in one project could thus as argued above also occur in the next project. Thus it can be argued that of own interest STORA Corporation as owner of the project should confront the other participants with a request that they investigate within their own organisation what was the case.

Depending on what kind of end product the mill is going to produce different suppliers were engaged. Even if some of the supplier companies were the same in both projects, the divisions or sections involved within these companies were different. If suppliers are viewed as bearers of new technological developments, it means that the suppliers will play an important role in the projects. It does not, however, mean that they can be seen as bearers of STORA's project knowledge, but rather as bearers of the pulp and paper industry's product- and process-related knowledge.

To sum up, it is important to be aware that not only STORA employees but also consultants and suppliers can be bearers of STORA's project-related knowledge. However, if this knowledge is not consciously socialised within the companies the knowledge will be the property of elusive individuals. This means in turn that if the individu-

als are seen as knowledge bearers, if the same people are not engaged within the next project, and if the knowledge has therefore not been socialised within the organisation, this knowledge will not be transferred as a resource to be utilised in the next project.

Routines as knowledge bearers

Within every project routines are developed over time, i.e. knowledge of how to do certain things within the project. To avoid having to build up project-organising knowledge from scratch in every new project, the knowledge transfer between projects is emphasised. Nelson and Winter (1982: 77) write that '*verbal instruction by itself – the information in the how-to-do-it book – provides only a starting point at best for the acquisition of a skill*'. Knowledge possible to articulate is thus not always enough. However, Nelson and Winter (1982) argue that routines are to a large extent tacit, as is the case where previous experience is required. One way to transfer these routines is thus to engage people with experience from previous projects in the new project.

Some of the routines that were developed in the KM8 project, e.g. routines for document control, time scheduling, project meetings, commissioning, etc., were brought to the KM8 project by the consultants. Other routines such as drawing numbering and maintenance supply were developed by the project participants as the project emerged. When the new project manager was attached to the PM2 project he was able to bring some of the routines from the KM8 projects to the PM2 project, e.g. routines for project meetings. Other were transferred through those participant from the KM8 project who came over to work in the PM2 project, e.g. with maintenance supply and for commissioning. Transferring routines is thus a way to make use of earlier project experiences, but also to bring some kind of structure to the project:

> *…formalised project procedures, that is everything from the simple task of handling mail and documents to the process for approval of how the project is managed […] The project grows so rapidly in terms of people coming into the project that all those things need to be formalised and documented ahead of time. This is not something that you can learn as you go, it moves too fast and brings too many people into the project.*
>
> Project participant in the PM2 project

Since Stora Purchasing and Transport's participation in both projects involved the same people they could bring routines for purchasing from the KM8 project to the PM2 project. And, since they are also going to participate in STORA's next project, in Brazil, the possibility for a transfer of routines to this project exists as well.

After the PM2 project many of the participants argue that much could have been formalised and the routines transferred between the projects. No such attempts have however been made. This could have made the fast-track project work more smoothly. To sum up, Nelson and Winter (1982) discuss about the importance of sending experienced people from experienced plants so as to participate in new plants can provide '*the basic matrix of routine in the new plant*' (p. 120), which is exemplified by the new project manager in the PM2 project and those he recruited from the KM8 project.

Knowledge barriers

'Cognitive closure'[41]

As argued by Sahlin-Andersson (1989; 1998), how the project is comprehended by the participants will affect their actions. If a project is seen as something unique, i.e. something beyond the usual, there are no routines indicating how the project should be handled. If, on the contrary, previous experience or routines influence the organising of the project, this is a way to express the ordinary character and the repetitiveness of the procedures.

In this respect there is a discrepancy between the board's and the mills' perspective of the two investment projects. The view of such a project as a historic and unique event that occurs '*once in a lifetime*' is dominant among members from both mills, Skoghall and Port Hawkesbury. This view *from below* differs considerably from that of the board members; they see projects as recurrent investments in new capacity that occur approximately once every second year. A task carried out once in a lifetime means that few people from the mill

[41] This expression is not an attempt to engage with cognitive psychology, but merely a notion of how a prejudiced understanding can limit the conception of a matter.

have any personal experience of major investment projects. This also means that people who have participated in one project do not expect to participate in the mill's next project in perhaps another 10, 15, or even 20 years. Since the mills are independent profit centres that to a large extent carry out their activities on their own, the participants from the mill's project organisation do not expect to participate in another project at another mill within the Corporation.

If a task is carried out once every second year, instead of once in a lifetime, the picture will change and the KM8 project is a strategic action in the same way as the PM2 project and others yet to come are. This view *from above* could be argued to indicating a repetitive procedure and thereby stress the similarities between the projects even if the investment projects were about different end products. Thus the same people from Stora Purchasing and Transport in both projects managed project procurement. This seems to contradict the participants from the mills' project organisation where they stress the extraordinarily character of the projects, implying that there was at the mills no previous experience of, nor existing routines for, how a project of this magnitude should be handled. When the project handbook at the mill in Skoghall proved to be insufficient for a project of this size a new handbook was developed throughout the project.

The views of the project members also differ widely from the views of the consultants and the suppliers, for whom this kind of project belongs to their normal activities. That the consultants and the suppliers were seen by the project members from the mills as being very experienced, even to the extent of being accused of reusing old stuff, can be seen as an expression of the ordinarily character of the task from their perspective. The KM8 and PM2 projects represented for them just another investment project in a pulp and paper company.

If we relate how the project was viewed by the different actors involved in the project to the discussion about project task and project procedure, discussed in Chapter Two, it can be argued that a project's uniqueness or repetitiveness will depend on the perspective taken (c.f Engwall 1998b), i.e. the same project can be seen as both unique and repetitive. While the projects in this case were seen as repetitive by the process consultants, suppliers, and board members, they were seen as unique from the perspective of the mills (Figure 16). When projects

are regarded to be repetitive there are as argued by Ekstedt et al. (1998), few incentives for knowledge transfer. In as much as the process consultant Jaakko Pöyry base much of their work on existing project procedures e.g. the commissioning adopted the same work procedure in the KM8 as in the PM2 project.

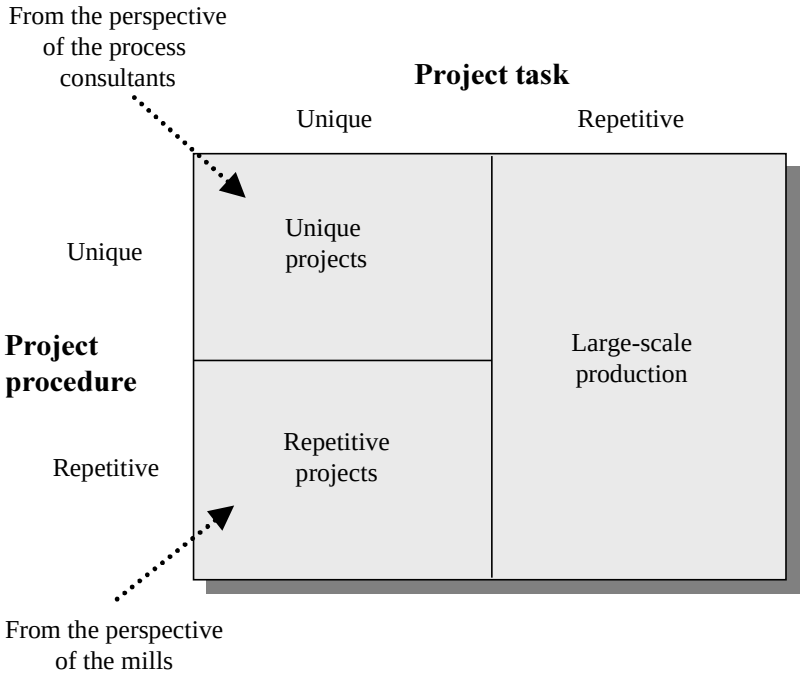

Figure 16: Unique and repetitive projects depending on the perspective taken.

If projects are seen as completely unique, from the mill's perspective, there are few incentives for knowledge transfer. If neither the task nor the procedure will be repeated again within the mill for a very long time it makes no sense to store project-related knowledge for the future. From a board perspective it can, however, be argued that because of the similarities between the procedures within the projects and because of the lack of previous experience on a mill level, project related knowledge developed in one project can be useful also in projects to come.

If we relate this to the discussion about project task and project group (Chapter Two), the mills' project organisations differed to a large extent and during the initial phases only a few people were the same (e.g. the people involved from Stora Purchasing and Transport and

the president of Stora Corporate Research) in both projects. Since the projects from a mill perspective involved both different project groups and different project task (Figure 17) there was no impetus for knowledge transfer between the projects. The participants in the mills' project organisation did not initially acknowledge the similarities of procedure between the projects; their focus was on the product that was to be produced on the new product lines, i.e. liquid-packaging board and SC-A+ paper.

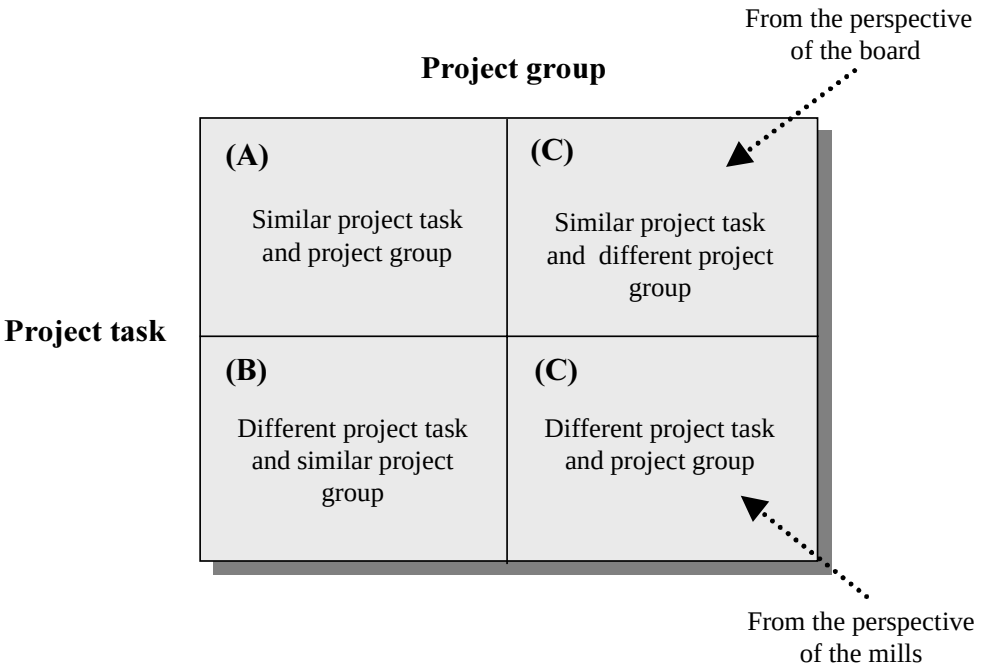

Figure 17: Project task and project group.

Also from a board-room perspective the projects are managed and organised by different project groups, i.e. by different mills and involving different consultants and suppliers. However, depending on the chosen time frame (see also Engwall 1998b) investments in new product lines are recurrent events. Although technology, or end-product, and product group differ among these, project procedures, that is project- organising knowledge, are recurrent. Since very few of the participants in these groups had any experience of this type of task and the procedures can be argued to display a repetitive character, there were possibilities to transfer knowledge from one project organisation to another within the Corporation.

However, if no kind of overarching structure that provides some kind of continuity, stability, and farsightedness are created (Blomberg 1998), there is a danger that much is invented again, also that mistakes are repeated. This is something that has emerged in the story about the KM8 and the PM2 project: problems in the KM8 project again repeated in the PM2 project. However, to be able to transfer knowledge and experience between projects, an awareness of the non uniqueness of the project is required. Since the projects were seen as extraordinarily events by most of the participants from the mills' project organisations neither awareness nor incentives existed regarding gaining from earlier project experience. The awareness or incentives necessarily to facilitate the transfer of knowledge and experience to future projects was also absent. When the projects were completed the mills instead turned their attention to learning how to run the new machine and how to transfer product- and process-related knowledge to the permanent organisation.

To sum up, to perceive something as 'unique' can as argued above shut out possibilities for knowledge transfer and organisational learning (see also Roth, Florén & Ingelgård 1999). Inasmuch as a unique event is something that has not happened earlier and will not happen again, no knowledge and routines from earlier projects can be used in the new and no knowledge or routines developed in the project can be used in later projects.

> *Unique! That is just an excuse for doing things your way.*
>
> Consultant in the KM8 project, my translation

The limits of language and the lack of previous experience

> *I think that there is very little that can't be transferred. However, you cannot transfer it all by putting it on paper. You cannot document it like that and say, here is how to run the project. You've got to sit down with the people. […] You not only transfer knowledge, I think you transfer people as well.*
>
> Project participant in the PM2 project

The notion that you cannot transfer all your experience by putting it on paper has long been acknowledged by academics. Since there is always a tacit dimension of knowledge we cannot put words to all of our experience (Polanyi 1958; Polanyi 1966). This means that experience cannot be transferred between individuals hundredfold. At the same time, however, while there are limits of our language, language is also the process where the private is made public (Furberg 1981), i.e. the process throughout which personal experience is transformed so as to be shared with other people.

Although one of the participants from the KM8 project reported after he had examined at the maintenance and the document control system that the routines were insufficient and that the project had to put in more resources to solve these problems, in other words had pointed out the problems, little happened. Since few of the participants in the PM2's project organisation had any previous experience of maintenance supply or document control the experience that had been written down in the memo was not put to use. If you have never participated in a project of this size it is difficult to imagine the magnitude of all the drawings and documents that will be produced and how routines should be build up to handle these. Here we could rightly say that the experience was poorly transferred. To be able to understand what has been written down in a memo we have to be able to refer this in some way or another to our previous experience (Polanyi 1966). To return to the citation from Nietzche in Chapter Two: '*A man has no ears for that to which experience has given him no access.*'

In line with Huber (1991), Stein (1996) discusses the importance of understanding the knowledge that is transferred and to be able to relate it to previous experience. If the knowledge can be related to previous experience, Stein (ibid.) argues that this knowledge is experience-based not what he calls 'clinical' knowledge or 'to know that' in Ryle's terms (1949). Also Hammerén (1999) makes this point when she argues that how much you can learn from examples depends on your previous experience. People who have participated in similar projects can therefore more easily understand and gain knowledge from written project reports than those who have no experience at all. Cohen and Levinthal (1990) use the expression 'absorptive capacity' when emphasising a similar implication.

To sum up, since this type of investment projects is rare at the mill level there is very little previous experience of organising and managing investment projects. A mill that has not been engaged in any investment project during recent years (as in the case of the mill in Skoghall and at the mill in Port Hawkesbury) might not be able to grasp the complexity, that is, formalised routines may not say much as the tacit dimension of 'knowing how' is lacking. To send documents may thus not be adequate when knowledge is to be transferred between projects.

Organisational structure

There are at least two features in the way in which STORA organised the two projects that are of interest when analysing the challenge of knowledge transfer between projects. The first concerns the role of the mill as the 'owner' of the project and the second concerns the mill's ability to organise a project.

While the decision to invest in a new machine, as well as its financing, is made at the level of the board, the responsibility for carrying out the project rests upon the 'owner' of the project, i.e. the mill that is later going to run the new product line. Inasmuch as it is the mill that is the owner of the project it could be argued that the objective of the project was exclusively to build a new product line in order to enhance the mill's production capacity for a specific product. From a mill perspective, the objective of the project was thus not to enhance the corporation's experience in organising and managing major investment projects, i.e. the actual learning within the corporation. It can thus be argued that the mills have exclusively a traditional view on project management (Chapter Two), i.e. an internal focus on the projects *per se* and their objectives.

A traditional view of project management implies that when there are no bridging structures that can absorb the experience gained within a project and transfer it to the next, there is a risk that the organisation's learning effects are lost (c.f. Blomberg 1998):

> *The resources of the organisation are gradually watered down if there is no form of "function", "unit" or "mechanism" that facilitates continuity, stability and farsightedness. One such "mechanism" are structures that*

> *extend over several projects, occurring simultaneously or over time. "The bureaucracy" is one example of such a structure. If such structures are dismantled without being replaced by new ones, the organisation will not only become more flexible or borderless but risks becoming totally disintegrated.*
>
> Blomberg 1998: 66, my translation

There is also a risk that when bureaucratic organisations are replaced by project-based organisations no natural structure extends beyond the projects and that the learning effects therefore might be lost (cf. Packendorff 1993). This is also in line with Brown and Eisenhart (1997), who discuss the need for some kind of structure overarching the projects within a project-based organisation. In their study on project-based organisations within the computer industry, Brown and Eisenhart (ibid.) found that the organisations that were successful in managing their projects were those which had some kind of formal structure to link together the projects. It can also be argued that this applies in a nonproject-based organisation like STORA Corporation, where projects are seen exclusively as complements to the normal operations performed in line organisations.

Instead of providing some kind of bridging structure, it can be argued that the mills were almost free to organise the investment project as they saw fit (except for project procurements) as long as the project was kept within time and budget limits. Organising, the projects without any bridging structure for knowledge transfer between the projects means that the knowledge that is developed in a project stays local (see also Söderlund 1998). This is also in line with Saari (1997), who argues that the learning effects most often stays on a local level, i.e. does not spread throughout the organisation. This is also something that can be seen in the studied case, where learning about managing and organising projects remains if not any actions are made on a local level.

Huber (1991: 106) states that a consequence of specialisation, differentiation, and departmentalisation is that organisations do not know what they know, which is something that can be seen in the studied case. Duncan and Weiss (1979: 103) write that '*One of the important problems many decentralised organizations face is the lack of integration. There tend to be growing interdependencies between different parts of the organization and*

no way to coordinate these units'. Since the mill in Skoghall during the initiation of the PM2 projects belonged to the division of Stora Paper Board while Port Hawkesbury belonged to Stora Publication Paper, the mill in Skoghall was not a natural speaking partner for the mill in Port Hawkesbury. Thus the people from the mills did not know each other when this initial phase of the projects was started.

> *I did not really feel any affinity with the mill in Port Hawkesbury before, but I do so now. I knew that STORA had a paper machine there, but that's all. Now when I have been there and worked there for 13 months I feel this closeness. You are closer to your own mill of course, but then you are a part of a division and also a part of STORA, and you think that it is fine when things are working out well for them. But, I suppose it is the same for everyone working within a large corporation. It is so big that it is difficult to feel real close.*
>
> Project participant in the KM8 and in the PM2 project, my translation

To be endowed with an investment of this size means a lot for the mill. Not just for its long-term survival, i.e. for getting a new machine, but also that the board believes in the mill. A project can hence be seen as a mission based on confidence and the project members from the mills talk about the project with pride. Since the mill 'owns' the project: they also feel responsibility for its success, since this is a way for the mill to show that they have deserved the project and that they are able to handle a project of this size on their own. Asking other mills within STORA for help might therefore not be the first way to go, especially when the mills do not feel closeness with the other mills. If you do not know each other, why should you share scare resources? Further, since the mills are used to managing smaller projects while at the same time running their normal operations they feel that they are able to also handle this project on their own.

Thus in the beginning of the PM2 projects there was no communication between the KM8's and the PM2's project organisations. The mill in Port Hawkesbury, before the PM2 project started up, had only heard and read about the project in Skoghall. The participants in the PM2 project did not think that the KM8 project could be of any interest since it meant a completely different product and manufacturing process, i.e. the product- and process-related knowledge was of no

interest in this case. Looking back at the different mills that Port Hawkesbury worked together with during the project, the product- and process-related knowledge can be said to have been a driving force when the contacts were established during the first part of the project.

One way to facilitate for people to get to know each other within an organisation is to apply rotation (Allen 1999). It can be argued that mature technologies, as in the case of the pulp and paper industry, favour rotation of people among the mills without risking losing their attractive technical knowledge (see, for example, Allen 1999). That is, in a mature industry it would be no problem for the project participants to go back to their normal duties within the operations since the overall technology does not change that fast. However, the mills do not have an excess of employees from which they can send people to other projects; all are needed on their own site. It is also not certain that these people want to move. In the studied case participants from the second prestudy group at the mill in Skoghall did some attempt to enlist the project manager for STORA's lastest project, the PM11 project in Kvarnsveden, to manage also the KM8 project in Skoghall. This was, however, not possible.

To summarise, if people do not know each other within the organisation, this might lead to the fact that even if there are experienced people, with regard to project organising within STORA, their knowledge might not either be known and therefore not used. The decentralised organisational structure and the lack of an overarching structure that extends over the projects can in this way be a barrier for knowledge transfer. This is also a point made by Allen (1999)[42], who argues that organisational structure is the major barrier to knowledge transfer within a large organisation.

[42] This is based on a seminar with Tom Allen from 1999-01-19 at Linköping University.

The rhythm of time

> *…because major projects of this size generally only come around every 10, 15, or even 20 years, it is very difficult to maintain or carry that experience, say from one project to another within a mill.*
>
> Project participant in the PM2 project

Since these kinds of investment projects occur very seldom at a mill level it is difficult for a mill to maintain and transfer project-related knowledge from one project to another within one and the same mill. The KM7 and the KM8 project were timewise too far away from each other for participants from the former projects to still be on site when the KM8 project was under the way. Product- and-process related knowledge can, as argued above, be transferred from the normal operations within a mill in the form of running competencies (the case of the KM8 project) or in the form of working groups within the division (the case of the PM2 project).

A challenge to the transfer of project-related knowledge between projects is thus time. Brown and Eisenhardt (1997) discuss the importance of rhythm within the organisation. A set rhythm can bring some continuity and also an exception that after this more projects will come. If we look at the continuity of investment projects *from above* we can say that there is a rhythm in the organisation and that a new investment project occurs approximately every second year. If we on the other hand look *from below* it is difficult to find a rhythm at all, since you cannot know if the next project at the mill will be in 10, 15, or even 20 years.

Another way in which time can be a barrier is that pulp and paper projects today are run as fast-track projects. Both of the projects focused here were already from their project start-up focused on the deadline (see also Roth, Florén & Ingelgård 1999) and the participants now proudly to state that they managed to keep the project on time. The greatest problem for a mill targeted for an investment project lies not in how to organise and manage the project but in how to get the new machine running as fast as possible. The projects are thus seen as a product- and process-related problem rather than project-related, hence the focus is on technology rather than organisational.

Since the projects are seen as being fast-track there was little time before the project started up to gain from others' experiences. During the project had you '*hardly time to think*', as one of the participants expressed it. When the project has reached its goal people in the mill are still busy learning how to operate and to maintain the machine. According to Laestadius (1996a; 1996b) the production of a machine can increase as much as 50 percent after the start up, and since the mill is under pressure to give returns on invested capital the 'running competencies' of the mill are of importance. To write project reports and to have discussions about project experiences is therefore of less importance to the mill: the mill is not thinking of conducting a new project within a foreseeable time.

To sum up, from a mill perspective the learning between the project and the operations is experienced as more important than the learning between projects. If you only have a limited amount of time you have to make choices and since the mills are valued after how much they produce it is more important for them to use their resources in the operations.

Summary

As argued by Penrose (1959), when knowledge is of no use in one part of the organisation, the management should try to make use of it in other parts of the organisation. One way to make use of knowledge developed in a project, i.e. the project-related knowledge as well as product- and process-related knowledge, is then to utilise it in the next project or within the organisation in which the projects are performed. The discussion of knowledge transfer between projects is as we have seen in the analysis more complex than what has been illustrated in the theoretical discussion. In the analysis the discussion focused how knowledge transfer can be hindered and how it can be facilitated, using the concepts of knowledge barriers and knowledge bearers (Figure 18).

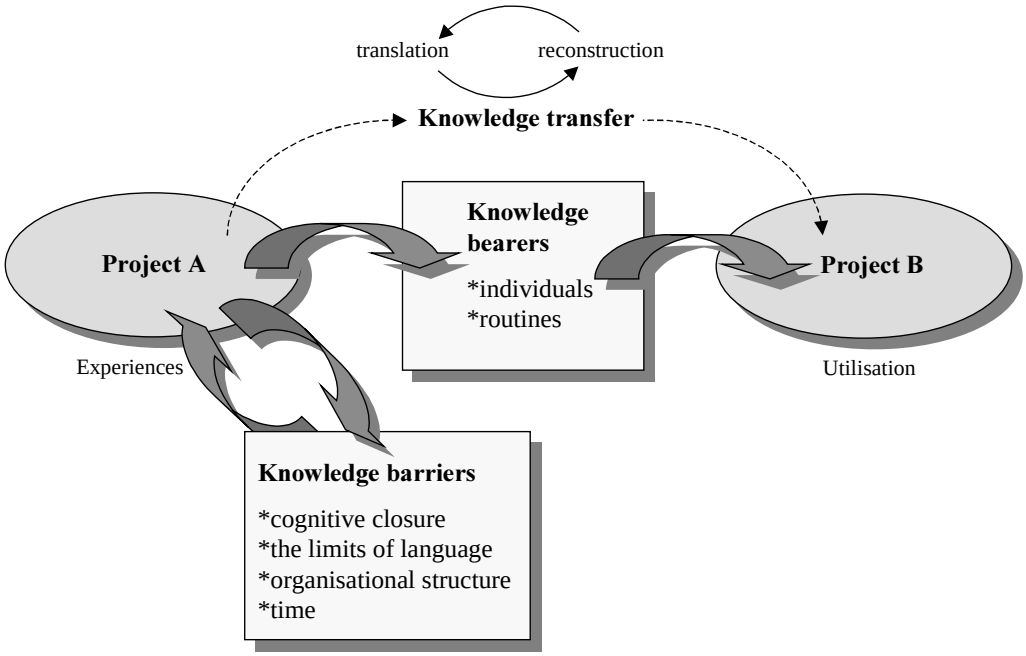

Figure 18: Bearers and barriers in knowledge transfer between projects.

Throughout the empirical story the picture of individuals and routines as bearers for knowledge transfer which emerged uniqueness, language, structure, and time as barriers for knowledge transfer.

As we have seen in the analysis, similarities can be found between the phenomenon of knowledge transfer among business units within a multinational organisation and the phenomenon of knowledge transfer between major investment project within a large-scale production organisation, as in the studied case (cf. Hedlund 1994). Also similarities in knowledge among different organisations can be found (cf. Cohen & Levinthal 1990). These studies, however, most often focus the transfer of technology (see for example Clark & Fujimoto 1991; Clark & Wheelwright 1992). The main reason for any similarities can be found in the fact that the studied investment projects were owned and managed by two different production units within the Corporation. In short organisational factors that influence knowledge transfer within an organisation overall will here also influence the transfer of knowledge between internal projects.

- CHAPTER EIGHT -

Reflections and Contributions

In the previous chapter a theoretical framework for knowledge transfer within an organisation was developed. In this chapter the concept of exploitation and exploration will be elaborated in a discussion concerning the strategic implications of the transfer of knowledge between projects. Further, a dual approach to project management will be proposed, and finally, implications for management and future research deliberated.

Strategic implications of knowledge transfer between projects

As argued in the introduction, a firm needs to exploit its knowledge in order to make short-term profits, such as reducing costs and being more efficient in its existing operations. However, a firm also needs to explore new knowledge in order to find ways of gaining future, long-term profits (see e.g. March 1991; Weick & Westley 1996). In this section the concepts of exploitation and exploration will be elaborated in a discussion covering the strategic implications of knowledge transfer between projects.

Exploitation and exploration

From a knowledge-management point of view a project can be seen as an occasion for the generation of new knowledge, both with regard to product- and process-related knowledge and project-related knowledge. By transferring knowledge explored in one project, this knowledge can be utilised and exploited in later projects or in other parts of the corporation. In the case of the PM2 project new product- and process-related knowledge was explored in, among others, the area of calender technology; in the case of the KM8 project new project-related knowledge was explored in the area of document control. Knowledge developed in the area of maintenance supply could, as we have seen above, be exploited in the later project.

As illuminated in Chapter Seven knowledge transfer does not mean knowledge copying, i.e. as proposed by the conduit metaphor for knowledge transfer, but that knowledge is translated and reconstructed by the actors involved. Routines developed e.g. for maintenance supply were thus not directly copied into the PM2 project. However, when one of the participants from the KM8 project went over to the PM2 project to organise this part of the project, the routines earlier developed in the KM8 project were transferred and further developed within the PM2 project. As argued by some of the participants from the KM8 project, the spare-part routine is better organised in Port Hawkesbury than in Skoghall. This can also be said concerning routines developed in the area of project procurements. In this way the KM8 project can be seen as a learning experiment where knowledge developed in the KM8 project was transferred and further developed in the PM2 project.

To transfer knowledge from one project to another can, however, be problematic. As discussed in the previous chapter, knowledge barriers appear in the form of cognitive closure, the limits of language, organisational structure, and time.

Learning myopia

Levinthal and March (1993) argue that there is a risk for 'learning myopia' within the organisations. That is, because of the possibilities of increasing short-term profits through a concentrated exploitation

of the firm's knowledge, there is a risk that this shortsightedness will diminish or even take over the need for exploration when a company intensifies its ambitions to be more effective in its operations. Volume-producing or large-scale-production organisations can be seen as illustrations of this. Since STORA competes with large volumes and low costs the company cannot afford to experiment too much with its operations. One example of this is that the KM8 project was not supposed to be some kind of 'play ground'. Instead of being on the front line in the development of new technology the participants argue that it is better to be number two or three, i.e. it is better to exploit other pulp and paper companies' product- and process-related knowledge than to be the one who makes the mistakes. In the PM2 project the participants have much the same arguments, the exception being that in the case of calender technology a large step did occur and that instead of letting other manufacturing companies take the first step, STORA did.

In an organisation where projects are seen only as complements to the normal operations and are performed in different parts or divisions of the organisation, there is a risk for partiality toward inventing own solutions and hence, exploring instead of exploiting corporate experiences. To not take advantage of any earlier project experiences within the corporation is also a 'learning myopia' if they, on a corporate level, are of a repetitive character. The projects within STORA Corporation were, however, to a large extent managed from a portfolio perspective, where both projects were managed separately without any consciousness about gaining from knowledge synergies (see Porter 1987) that could have been created through the integration and communication between the project organisations. To not take advantage of earlier project experience is to have an internal focus on the projects and to view them as completely separate entities, in other words, to have a traditional view on the projects.

The possibility of taking advantage of earlier experience is however always dependent on the characteristics of the project. Thus it should be remembered that this study is about knowledge transfer between major investment projects within a volume-producing organisation and not innovative change projects or product-development projects within a project-based organisation. Even if projects per definition are seen as unique, knowledge can be useful to transfer. In the case of

product- and process-related knowledge the need for knowledge transfer from other sectors within the Corporation, which had this experience this was a more obvious option for the participants than in the case of project-related knowledge. In the PM2 project the participants were very clear about not having enough knowledge about the technology for the development of a new SC-A+ machine and that this knowledge was available in other sections of the division. Although at least some of the participants both in the KM8's and the PM2's project organisation had earlier managed smaller projects, they were not aware of the need for transferring knowledge from earlier projects, similar regarding project-related knowledge, within the corporation. After the completion of the project the participants expressed an awareness of the importance of gaining from earlier project experiences. Especially these who participated in both projects argue that because of the similarities between these projects more knowledge could have been gained from experience made in the KM8.

To learn from history

'*We learn from history*', as argued by Hesselstedt and Lunnemar (1991: 7) in their book '*The Skoghall's thought*' which was given to me during one of my visits to the Skoghall mill, and '*getting your thoughts on paper*', as you can read in one of the advertising brochures from the mill in Port Hawkesbury, can serve as a summary of what this is all about. I would argue that these two statements are of importance also in the area of project management, i.e. to learn from earlier projects, to take time to reflect on the actual project, and to write down thoughts that could be used in later projects. Project evaluations should thus not be based only exclusively on the project organisation's need but also from organisation's (see also Christensen & Kreiner 1997):

> *…the termination period makes it possible for the participants to summarise experiences and learn for the future. Individual learning is thus a 'bridge' to future temporary organizations [project organisations] and learning the glue in a world of temporary organizations and individuals moving around in temporary and permanent settings.*
>
> Lundin & Söderholm 1994: 204

This demands, however, an awareness that learning is not solely for the actual project but also for the next. That the same people might not be involved in the next project to learn from the history can, as argued in the discussion about knowledge bearers and knowledge barriers, be problematic.

A conscious exploitation of organising and technical knowledge developed in earlier projects can be a way to reduce both time and cost by exploiting project organising by taking advantage of the knowledge bearers. On the one hand exploring new knowledge is seen as necessary for long-term survival. The technological developments made in the PM2 project can therefore be seen as an important step toward gaining competitive advantage on the long run. On the other hand, in the area of project organising, long-sightedness is provided by some kind of overarching structure (see also Brown & Eisenhardt 1997; Blomberg 1998) that absorbs the knowledge gained in one project and transfers it to the next. Long-sightedness is thus about consciously looking beyond the contemporary project, about to closely examine the other projects within the organisation. That is, from the view of the board, to acknowledge that lean mills have neither the resources nor the knowledge to manage major investment projects on their own and that therefore the engagement of the whole corporation is needed to bring the experience into the project organisation. Since this type of project occurs very seldom within a specific mill there are few persons with experience of how to manage such projects, which means that to exploit knowledge developed in earlier project can be a way of facilitating the running of the other projects.

To sum up and as argued by March (1991), the long-term survival is provided by exploration of new knowledge. Therefore, to transfer project-related knowledge from one project to another also provides a long-term competitive advantage. There is thus a tension between the short-term focus within the project organisation (these projects on a mill level 'occur once in a lifetime') and the long-term focus that is needed to ensure that the importance of knowledge transfer between projects becomes conscious within the organisation.

Incentives and disincentives for knowledge transfer between projects on an individual level, on a mill level, and on a corporate level are summarised in Table 7.

Table 7: Incentives and disincentives for knowledge transfer on different levels within an organisational.

Different levels	Incentives (+) and disincentives (-) for knowledge transfer between projects
Individual	+ get some kind of structure and routines for how to organise and manage the project, get someone with experience to talk and work together with - the fun of inventing
Mill	+ time, cost, efficiency, not to fail - to not get the whole honor if the projects succeeds, difficult to find people with experience within the organisation, difficult to judge the quality of earlier experience, the mills are measured after how much they produce and not how much they help other mills to manage their projects
Corporation	+ time, cost, efficiency, a productive use of the firms resources - the mills independence, the importance of decentralization

A dual approach to project management

What has been argued in this study is that since this kind of project occurs once in a lifetime, the mills have neither experience nor knowledge necessarily to manage a project of this size. Instead of exploring *project-related knowledge* in every new project, there should be incentives for adopting a proactive approach to managing knowledge transfer between projects inasmuch as knowledge, as argued in Chapter Seven, can be useful if transferred between projects within the Corporation. What is being proposed in this thesis is therefore an alternative approach to project management, i.e. to focus not only on the project *per se*, e.g. the new product line that is to be built, but also on the learning possibilities that a particular project provides. In short, to have *a dual approach to project management*. Such an approach brings forth a focus on both the traditional view and the knowledge-management view regarding project management (Figure 19). As is made explicit through the analogy of projects as 'experiments', not only the traditional dimensions of time, cost, and quality but also learning are of importance. This approach signifies the importance of applying a strategic perspective on project organising where both the short- and the long-term are taken into account and where projects are seen as learning 'experiments' for the company as a whole.

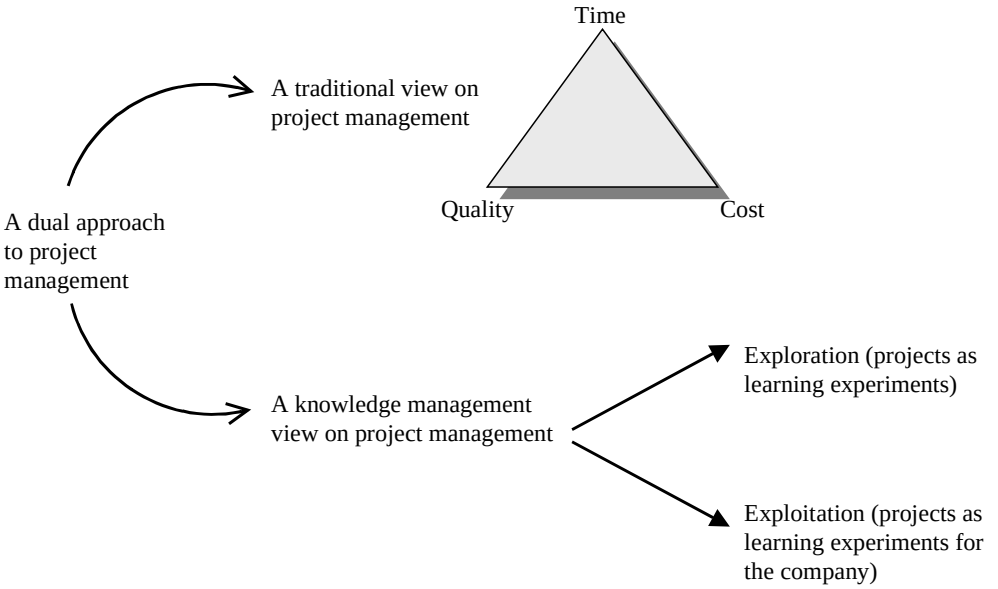

Figure 19: A dual approach to project management.

Viewing projects as learning 'experiments' provides incentives for the company to consciously create knowledge (exploration) and facilitates an awareness of the overall importance of knowledge synergies (exploitation) for the company as a whole, and for the productive use of a firm's resources. To have a dual approach to project management is not solely a matter of learning for the ongoing project but also of *learning for the next project*.

Implications for management

With this thesis I hope not only to contribute to the research area that seeks to create understanding concerning the organisation of projects within organisations but also to contribute to managers' understanding of the phenomenon of knowledge transfer within an organisation as well as the strategic implications of such transfer. Through the development of a conceptual framework for different types of knowledge developed within a project and of knowledge bearers and knowledge barriers, I hope to create conditions for an understanding of the difficulties and possibilities inherent to knowledge transfer between projects in order to create conditions for future actions. As we have seen in Chapter Seven, while the concepts created are not on a specific level they are simple and easy to understand and therefore meaningful for the understanding of the phenomenon.

Hansen et al. (1995) discuss two different strategies for knowledge transfer within organisations, personalisation strategy and codification, where personalisation is knowledge transfer through personal contacts and codification is knowledge transfer through documents and databases. Further, while a personalisation strategy makes both explicit- and tacit-knowledge transfer possible, codification strategy allows only explicit knowledge, i.e. knowledge that is possible to express in words, to be transferred. When transferring knowledge through codification, some kind of shared knowledge and experience are vital. Since very few of the project participants had any previous experience of managing and organising this kind of projects, the knowledge that was transferred was, as we have seen in the studied case, mainly transferred via personal contacts.

However, independent of whether the organisation adopts a personalisation strategy or a codification strategy, an awareness is needed of the implications apparent in how the projects within an organisation are organised. As argued in the introduction there is a tension between the transfer of knowledge from project to project and the transfer of knowledge from a project to the line organisation, or, in other words, there is a tension between the perspectives of a project, from above and from below. Project management is thus both about managing projects as effectively as possible, by exploiting knowledge developed in earlier projects, but it is also about starting up the new product line as smoothly as possible. To have people who will only participate in one project in their lifetime come from the mill might from a mill perspective provide the best way of organising the projects. This would, however, imply that if the projects within the corporation are managed from a portfolio perspective there are no bridging structures that can provide the longsightedness needed; knowledge is to be transferred between projects. There would thus be a very limited awareness concerning the transferring of knowledge from one project to another.

To engage people who participate in the corporation's entire project and who travel in the corporation might provide the bridging structure needed for the transfer of routines between the projects. However, since '*a pulp and paper project is not like buying a truck*', as argued by one of the project participants, centrally organised projects might be problematic. Instead, both experienced people within the

corporation who can carry experience from one project to another and people from the mill itself with product- and process-related experience must be engaged. The argument in this study is thus not to have centrally organised projects but to nurture an awareness of the value of experience.

To acknowledge the importance of knowledge management and knowledge transfer different types forums where people can meet need to be created, not only within divisions but also overarching divisions, to discuss questions related to project management. Most important is however a dual approach to project organising, i.e. to not solely focus on the project that is to be conducted but also on the learning possibilities within and between projects. That is, deeper awareness of how projects can provide occasions for both exploration and exploitation and that both are needed when managing by projects.

Future research

This study has provided a base for how knowledge transfer between projects and between the project- and the permanent organisation can be understood and from which further research can be developed. One example of the latter would be to look at a completely different type of organisation, i.e. an organisation where all operations are organised in project form, in order to study bearers and barriers for knowledge transfer within a multiproject environment.

Another interesting area would be to more deeply study the role of the consultants as knowledge bearers of project-related knowledge. To penetrate deeper into the theoretical field of strategy or to further investigate different strategies for managing projects within an organisation so as to facilitate the knowledge transfer between projects would also be interesting. Further studies into the role of information technology in transferring knowledge between projects could also make valuable contributions. Finally it would be of value to study knowledge on a more operational level, perhaps even measure it.

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Learning for the next project

Bearers and barriers in knowledge transfer within an organisation

by

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ABSTRACT

This study concerns knowledge transfer within an organisation. More specifically this encompasses knowledge transfer between projects and the organisation in which the projects are performed. The study has been conducted at STORA Corporation, a large Swedish industrial organisation within the pulp and paper industry, where two major investment projects at two different mills, divisions, and countries have been carried out. Through visits to the mills and by conducting interviews with participants from the projects a thematically structured story illuminating events related to knowledge transfer has emerged.

The thesis concludes that different types of knowledge are developed within a project: process- and product-related knowledge, project-organising knowledge and technical knowledge, meaning that even though the end product differs between two following projects, experiences and knowledge from previous projects can be utilised in projects with similar procedures. Since there is no natural transfer mechanism between projects, because of their temporary nature, knowledge transfer becomes problematic. Through the concepts of knowledge bearers and knowledge barriers, this problem is addressed.

The study actualises the importance of having a dual approach to project management, i.e. to not only focus on the traditional dimensions of time, cost and quality, but also take into consideration what the experience gained

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in one project can mean for the efficiency of the next project. From the view of the company as a whole, therefore, the metaphor of projects as learning experiments is introduced emphasising the explorative character of projects, i.e. gaining knowledge that can be exploited in the next.

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